The Wireless Constructor

6D MONTHLY

EDITED BY
PERCY W. HARRIS

Vol. 1. No. 8 JUNE 1925

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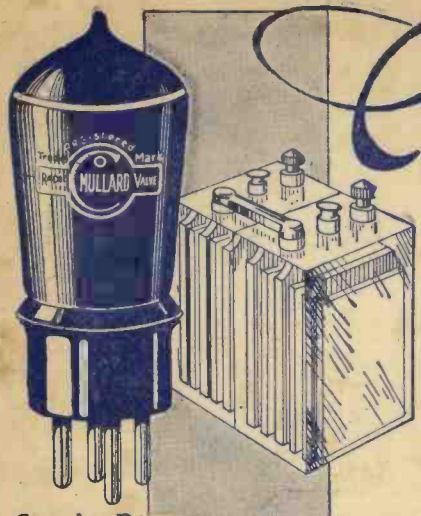
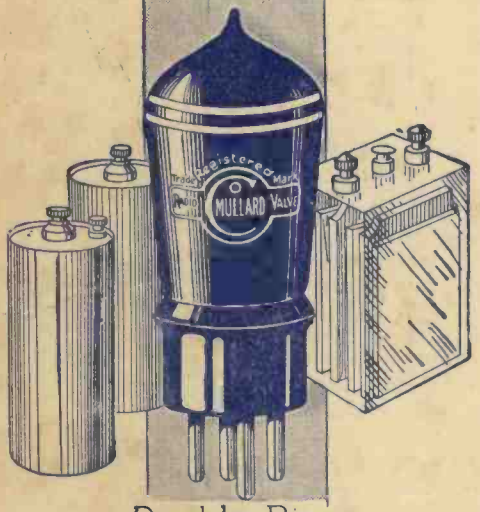
FREE BLUEPRINT INSIDE



Single Ring
Bright Filament Type Valve



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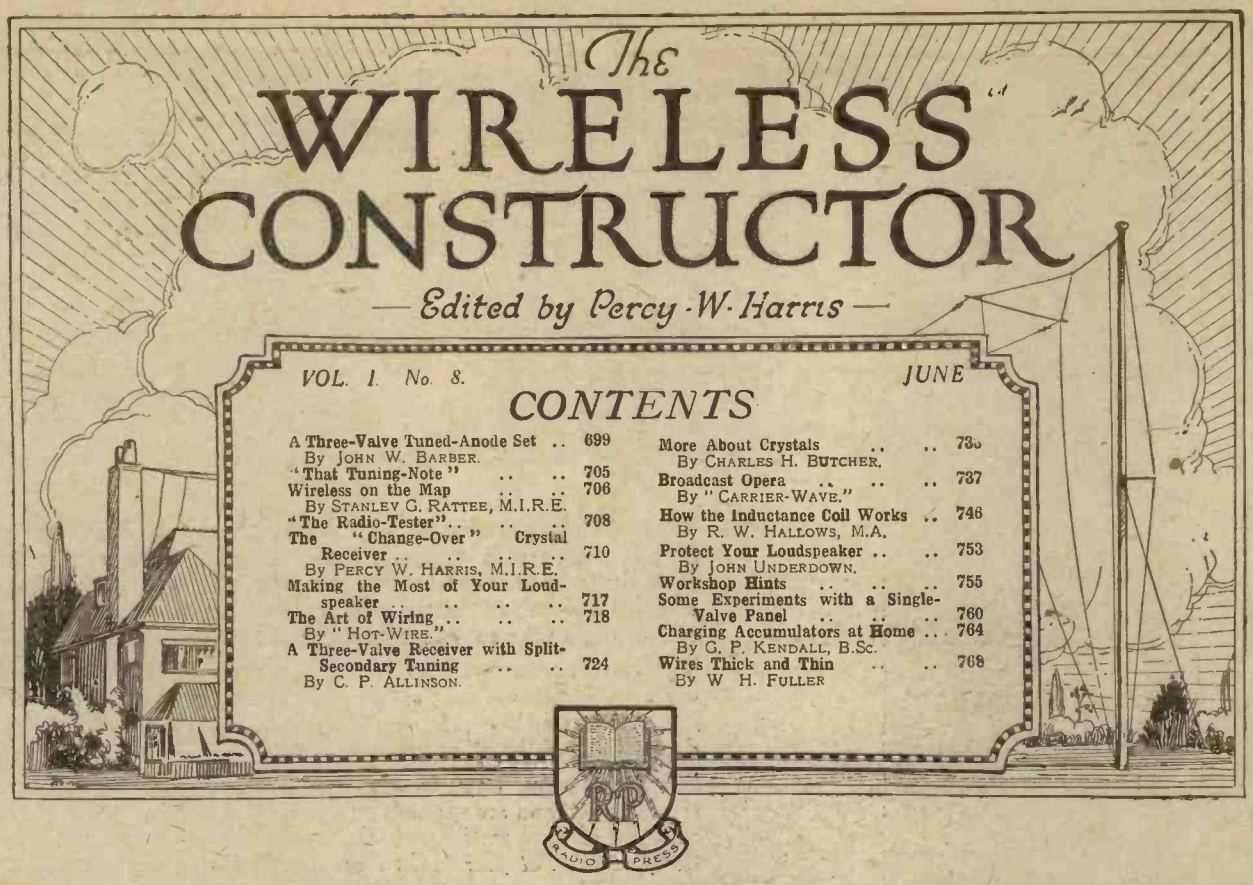

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Scientific Adviser; Prof. G. W. O. Howe, D.Sc., M.I.E.E.
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The WIRELESS CONSTRUCTOR

Staff Editors; E. H. Chapman, M.A., D.Sc. A. D. Cowper, M.Sc R. W. Hallows, M.A G. P. Kendall, B.Sc S. G. Rattee, Member I.R.E.

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A Three-Valve Tuned-Anode Set

By JOHN W. BARBER

Probably the most popular receiving circuit of to-day employs three valves, and the present receiver will therefore appeal. It has several interesting features, and will be found easy to control

A CONSENSUS of opinion of many people interested in wireless seems to indicate that by far the most popular receiver employs three valves in the respective functions of high-frequency amplifier, detector and note magnifier, and in the writer's opinion this combination is, for all general purposes, the most desirable.

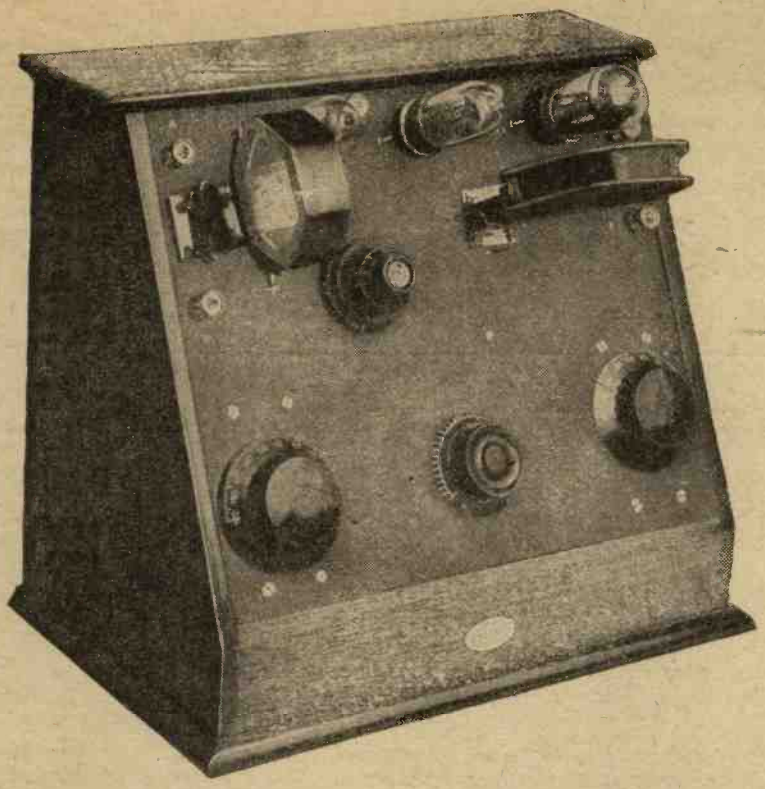
Several alternatives in design immediately confront the would-be constructor, and it is therefore a matter for some thought when the various possibilities are surveyed. For example, shall we use tuned-anode or tuned-transformer coupling for the high-frequency amplifier? If the latter, shall we tune primary or secondary, or both? What coupling shall we employ for the note magnifier? These and many similar questions have to be answered before constructional work can be commenced, and the constructor would, in most cases, prefer to copy some standard design, rather than attempt the work himself.

Several very good forms of receiver employing three valves in the manner indicated have been put forward by other Radio Press constructional authors, but, as the present set incorporates several interesting features, no excuse is offered for another design along similar lines.

Reaction is easily adjusted by means of the potentiometer.

Aerial Coupling

Firstly, let us consider the aerial circuit. At the present time, with so many broadcasting stations working in the 300 to 500 metre band of wavelengths, quite apart from the problem of spark interference, selectivity is a vital question. With a direct-coupled circuit it is in many cases impossible to get rid of interference from unwanted stations, and some form of loose coupling is essential. For the benefit of the novice, let me explain that a direct-coupled circuit is one which contains, say, a coil and condenser in parallel, the ends of the circuit being connected to aerial and earth, and also to the grid and filament respectively of the first valve. A loose-coupled circuit is one which has a separate aerial circuit, coupled to the coil in the grid circuit of the first valve. The latter circuit necessitates a complication of the tuning controls, and, as this is not desired, some other means for obtaining the necessary selectivity must be devised. A useful method consists in employing the Lissen "X" coil, which gives the circuit shown in Fig. 1. Here L_1 is the plug-in



This view of the receiver complete with coils and valves, makes evident the simplicity of the instrument.

"X" coil which is tuned by the condenser C_1, the circuit L_1C_1 forming the grid circuit of the H.F. valve. On the "X" coil there are two tappings, one at the sixth and one at the tenth turn, brought out to terminals on ebonite lugs on the side of the coil. By joining the aerial to one of these tappings and the lower end of the coil to earth we obtain what is known as "auto-coupling," which gives us greatly increased selectivity over the direct-coupled circuit, without any complication of the tuning controls.

Types of Coupling Employed

Coming now to the actual design adopted, we see, on reference to the circuit diagram, that the tuned-anode system is employed. In practice the anode coil is placed in such a position that little coupling exists between it and the aerial coil, the two being held in separate sockets which are placed at right angles. In order to obtain minimum coupling, the sockets should be so placed that, in addition to being at right angles, the coils are disposed in the form of a T, one coil pointing toward the centre of the other. In this case, however, no undue tendency toward self-oscillation was found to exist with the coils as placed, the potentiometer giving adequate control of reaction effect.

In a receiver employing high-frequency amplification, given a good design, with low-loss coils, some form of stabilisation must be provided, or the set will oscillate freely whenever the grid and anode circuits of the H.F. valve are brought anywhere near tune with each other, and in consequence the receiver becomes unmanageable. In this case a potentiometer has been used to control this tendency, hence we can dispense with the usual variable reaction coil.

Low Frequency Coupling

Turning to the note-magnifying portion of the receiver, we have three methods at our disposal. Firstly, the low-frequency transformer, which is probably the most used form; secondly, the resistance-capacity coupled amplifier, which is gaining favour among those who wish to obtain purer reproduction with less experimenting; and, lastly, the reactance-capacity, or choke, system. This latter system, which was described by the present writer in "A Unit Choke Amplifier" in the April issue of this magazine, gives greater amplification than the resistance method, and has the added advantage of not requiring so high a value of high-tension voltage, at the same time giving equal purity. In many cases purity is better with choke coupling, as the annoying "background" of crackles which one hears so often with resistance amplification is entirely absent.

Compared with transformer amplification, the choke gives less volume, but, in my opinion, the greater ease with which good reproduction may be obtained, (compared with some makes of transformer) warrants its use, as, again in my opinion, if good quality is present one does not require exceptional volume. The present receiver operates a loud speaker in a large room, off a long, low aerial, and gives very pure

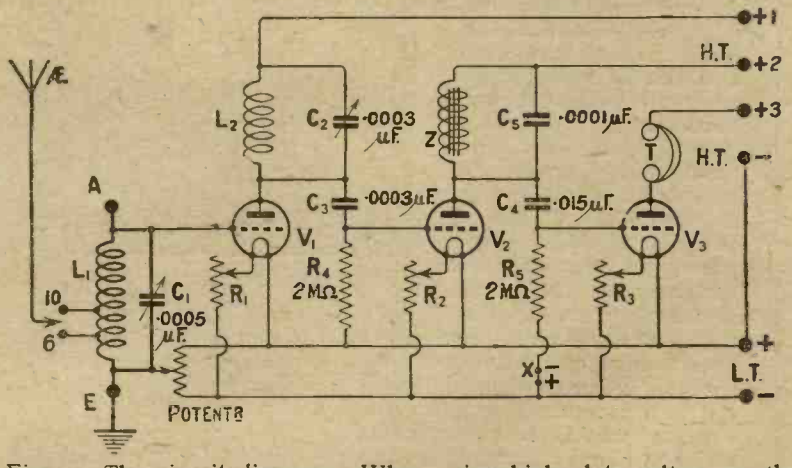
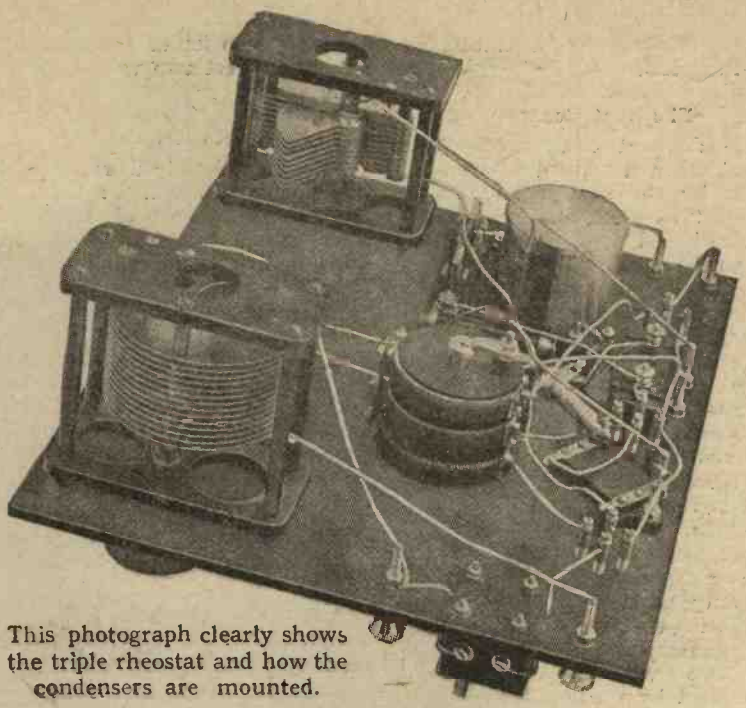


Fig. 1.—The circuit diagram. When using high plate voltage on the last valve, or with dull emitter valves, it may be necessary to provide grid-bias by inserting a small battery as shown at the point X.

signals, the result being very pleasing indeed.

Constructional Details

Considering the form which the receiver is to take, we have several possibilities. Firstly, we may use the American type, in which the controls only are mounted on the panel, the other parts being on a false bottom to the cabinet, at right angles to the main panel, which is vertical. Many prefer this type of receiver, but it requires a little more care and patience to construct neatly, and the novice will probably be more happy with either the "tray" or "desk" type of cabinet. Personally, I favour the desk type of cabinet, as being of neat appearance and easy to handle, as the variable condensers and potentiometer are mounted at the bottom of the panel, thus permitting of their adjustment without the hands covering the receiver. A further point of usefulness is that one can effect careful tuning with the



This photograph clearly shows the triple rheostat and how the condensers are mounted.

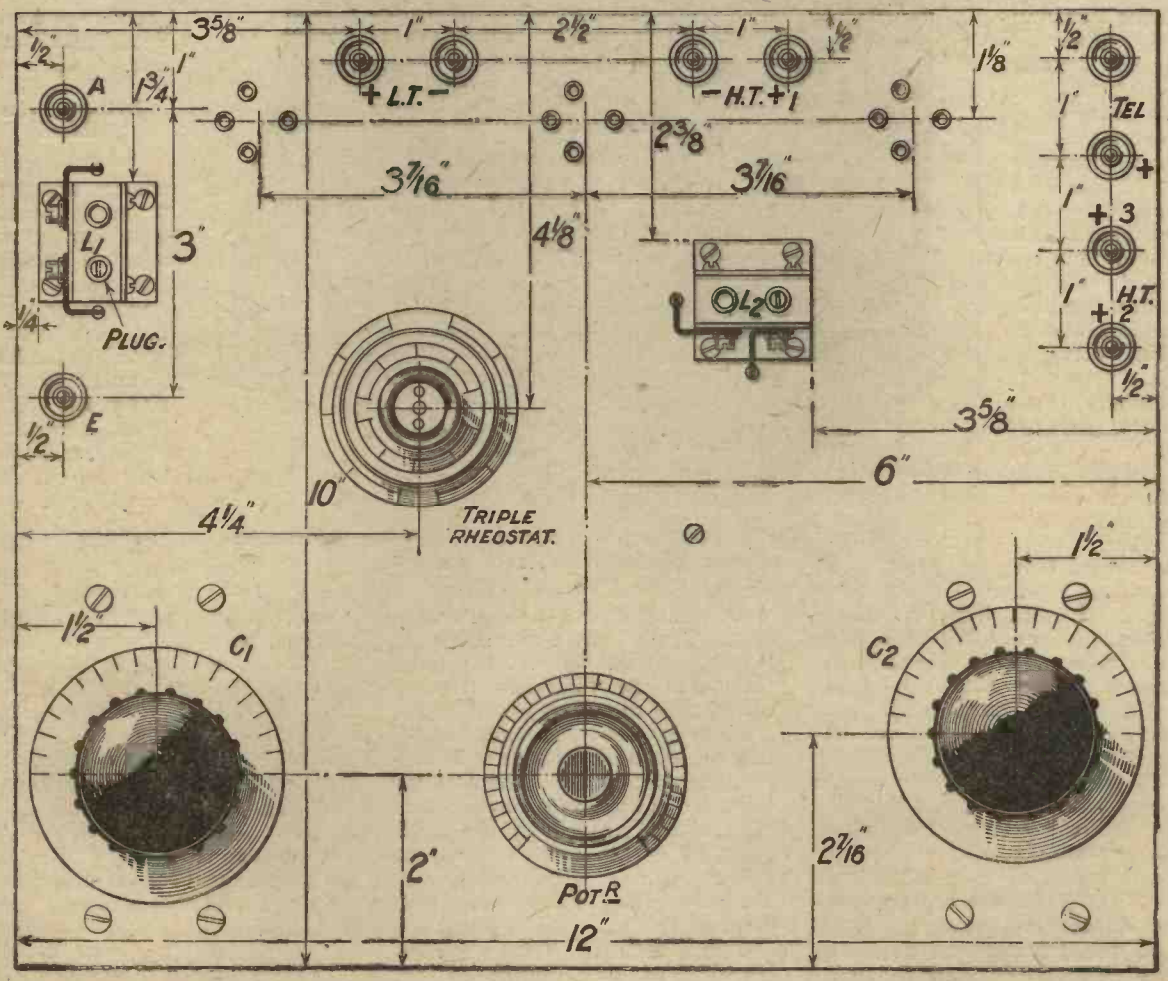


Fig. 2.—This large size drawing gives all the necessary dimensions for drilling the panel. For those who prefer it, full size blueprint No. C1014A may be obtained, price 1/6 post free.

elbows resting on the table—a great advantage when tuning in weak signals.

Filament Control

The filament control has been considerably simplified in this receiver by the incorporation of a "Triple" rheostat, made by Messrs. L. McMichael, Ltd. This consists of three formers, mounted on one spindle and arranged to be controlled on two concentric knobs. In a three-valve set, therefore, each valve has its own separate resistance coil, two of them being, however, simultaneously controlled by means of the top knob, the lower one controlling the third resistance. The rheostat is of the "dual" type, that is, it is suitable for either bright or dull emitter valves, the only stipulation being that it is necessary for the two valves controlled by the one knob to be of similar consumption. For example, one may use two bright emitters *or* two dull emitters in the stages controlled by the one knob, while the other resistance, which is separately controlled, may be used for regulating the filament of the third valve, of either type. Incidentally, it may be mentioned here that the rheostat is eminently suitable for controlling a four-valve receiver, two of the valves being controlled together off the single resistance, which is wound with sufficiently heavy wire to carry the necessary current, while the other two valves each have their own resistance, but are simultaneously controlled from the upper knob.

The provision of this rheostat in the present receiver has considerably simplified the constructional work, as there is only one resistance to mount instead of the usual three. The high frequency valve is controlled from the separate resistance, while the detector and note magnifier are simultaneously controlled from the other two windings. This arrangement was found to answer best in practice, and no loss in efficiency was found to result from having the last two valves so controlled.

Parts Required

In order to build this receiver the following parts will be required. Similar components of other reliable makes may be employed without loss of efficiency, but in regard to values, these should be adhered to.

One panel, 12 in. by 10 in. by ¼ in. or ⅜ in. (Radion, Black).

Suitable cabinet of a type to suit your own requirements. That used in this case was made by the Carrington Manufacturing Co.

Two variable condensers, one of ·0005 μF and one of ·0003 μF capacity. Those shown are made by Messrs. Beard & Fitch, Ltd., makers of the "Success" components, and are of a geared type, giving very fine control and ease of tuning on weak signals. Hand-capacity effects are minimised by the use of a fibre gear, thus keeping the dial well away from any metal parts in actual contact with the moving vanes. The condenser is known as the "Success No-loss" condenser.

Three sets of valve sockets. Those used are known as the Radiohm Anti-Capacity Sockets, sold by Sparks Radio Supplies. Drilling template and the necessary drill are also included with the sockets.

Two coil sockets for panel mounting (Magnum).

One triple rheostat (McMichael).

One potentiometer (McMichael).

One Lissenagon "X" Coil (Lissen, Ltd.).

One ·0003 μF condenser, type 600 (Dubilier) and one extra clip.

One ·015 μF condenser, type 610 (Dubilier).

One 2 megohm grid leak (Dubilier).

One 2 megohm (or less) grid leak and clips (McMichael).

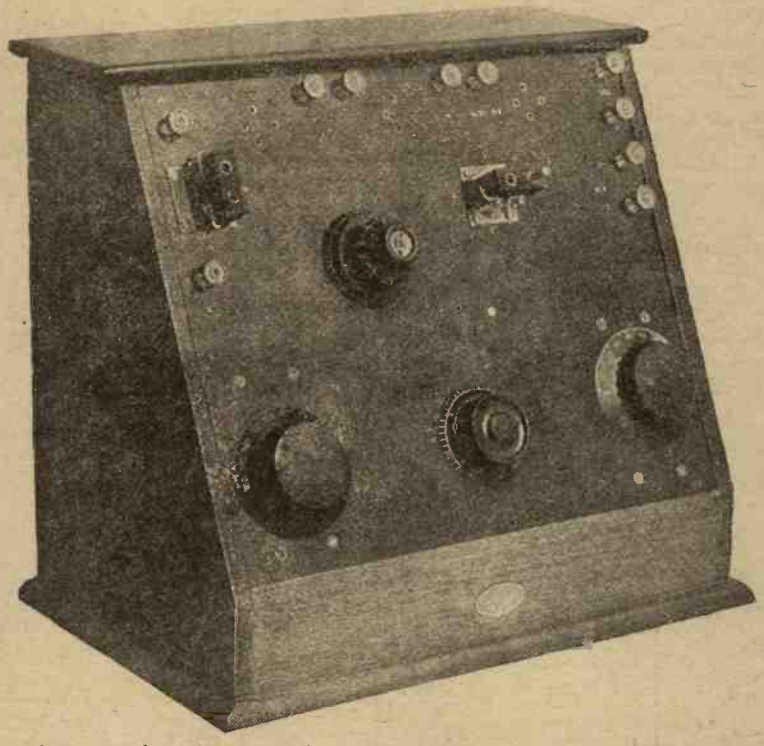
One "Success" iron-core choke coil (Beard & Fitch, Ltd.).

One ·0001 μF clip-in condenser and base (McMichael).

Ten W.O. type nickel-plated terminals (Magnum).

Sufficient wire for connections, No. 16 gauge round or square section.

One set Radio Press Panel Transfers.



A view of the set showing the layout. Note the accessible position of the variable condensers.

Drilling the Panel

Use good ebonite, and mark it out in accordance with the drawing showing the layout. Use a scriber for marking, and not a pencil, as the lines formed by the latter will constitute a network of high resistance leaks all over the panel, with a consequent loss of efficiency. Most makers of components other than the one-hole fixing variety, supply drilling templates, and these should be used when drilling is commenced. You will not, I think, have any difficulty in this part of the work if you follow the design carefully, but should you use components other than those specified (and you may certainly do so without loss of efficiency), be certain that they will fit into the spaces provided for them, and also that you drill the necessary holes correctly.

Mounting the Components

When you have finished drilling all the holes, you can commence

to secure the parts in their various places. If you use the valve sockets mentioned and drill the holes with the drill supplied, you will find it an easy matter to screw the sockets straight into their holes, as the drill size is such that the sockets make their own thread in the ebonite as they are screwed home, and they are perfectly rigid when so fitted. Do not, however, screw the sockets right home so that their ends are flush with the top surface of the panel, but leave a small distance, afterwards countersinking the top to give a neat appearance. If you do not possess a countersink, use a ¼ in. drill, and give a few turns in the *reverse* direction.

The terminal arrangement is somewhat unusual, but fits in with the wiring, which is thereby kept short.

It will be noticed on the drilling diagram that the knobs of the variable condensers are not in line, and this may not seem desirable on the score of appearance. The reason for this is that the spindle of the condenser is not centrally disposed in the framework, but is nearer to one end; thus, if the condensers are mounted on a level, as in this case, the knobs will be one above the other. In order that the knobs may be in line, it is necessary to raise the aerial condenser a matter of half an inch.

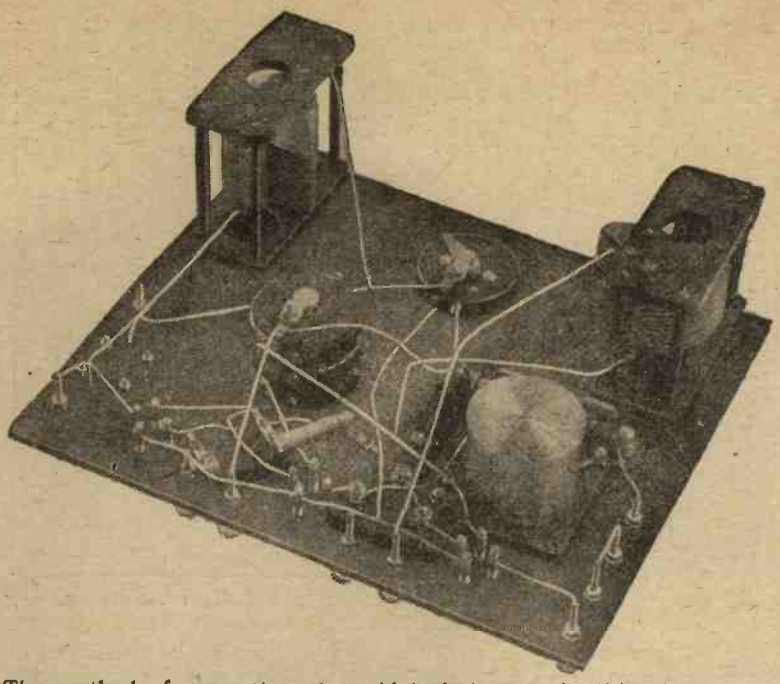
Wiring Up

You will have no difficulty in making the necessary connections if you follow carefully the free blueprint which is given with every copy, while the photographs of the back of the panel will make clear which wires are run above the others, and will help you to make a good copy of the actual set. You will notice that the moving plates of the variable condensers are marked with the word "moving," and you should certainly adhere strictly to these connections, in order that the presence of your hand shall not affect the tuning. The design of variable condensers used, as previously explained, also helps to reduce this trouble.

When wiring up from the blueprint, it is a good plan to cross out every line on the paper as you make the connection on the set that the line represents. This method helps to eliminate errors and prevents a superfluous wire from being put in.

Aerial Coil Connections

It is essential to follow exactly the connections to the aerial coil socket, as if these become reversed we shall have the tappings on the grid end of the coil instead of the filament or earth end.



The method of mounting the grid leak is seen in this photograph.

Having completed the wiring, the set may be mounted up in its cabinet, which is then placed in a suitable spot for the initial test.

Join up the accumulator and plug in the valves. Turn the rheostat knobs toward the "on" position and note whether the valves light up correctly. If this is so, turn the rheostats off, join up H.T., telephones, earth, and plug in the aerial coil, joining the aerial lead to the 6th turn tapping.

It may be found that louder signals are obtained by joining the aerial to the 10th turn tapping, but selectivity will, in general, be greater with the connection made to the sixth.

A No. 50 or 75, or an equivalent coil, should be plugged into the anode coil socket.

As an initial test, the three terminals marked H.T.+1, 2 and 3 may be joined together by a piece of wire, and a single lead taken to the high-tension positive. The best results will be obtained, however, with separate voltages on the valves, this being possible by means of the three high-tension positive terminals.

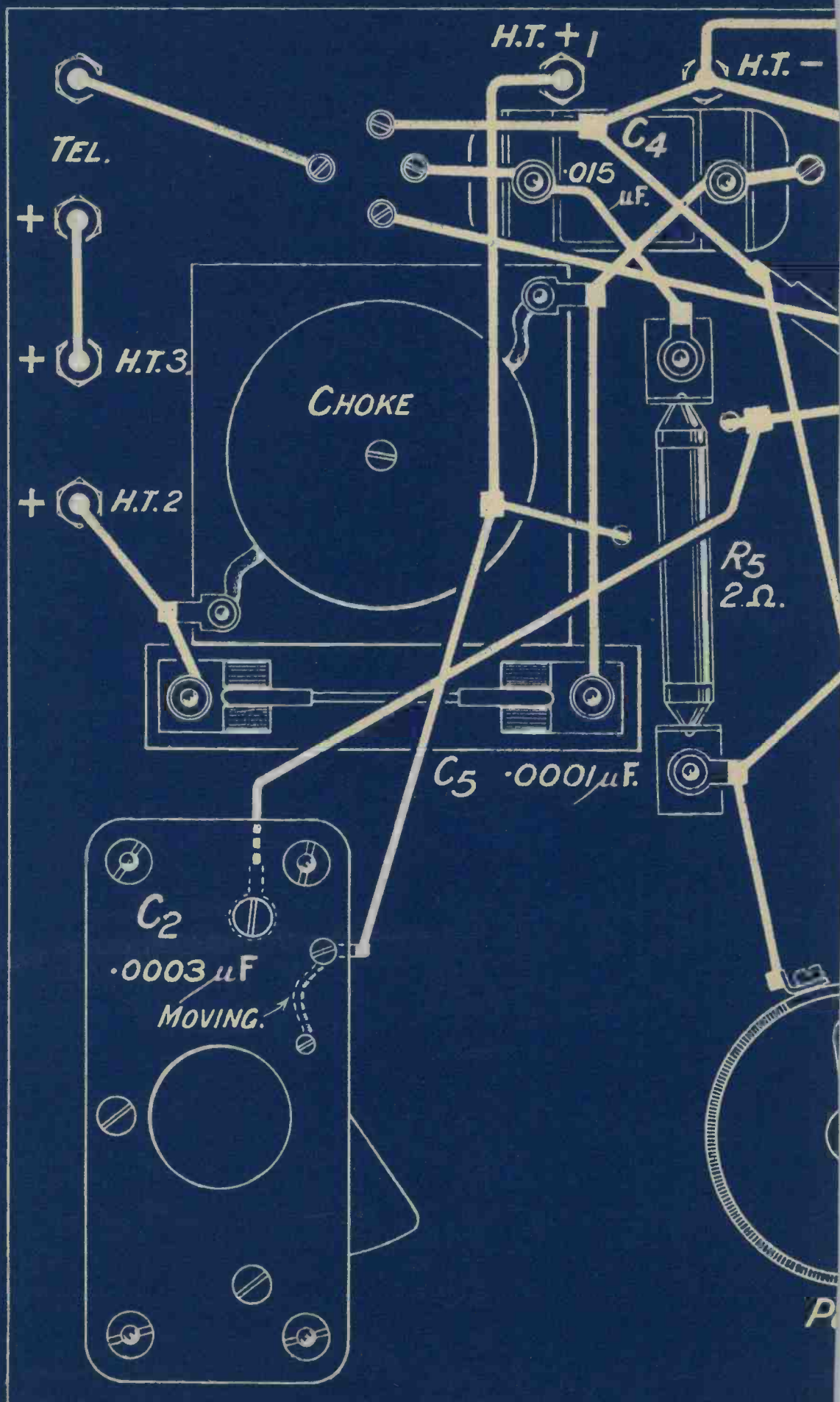
Turn on the filament current, and vary the two condensers simultaneously and you will soon hear your local station. Now adjust the potentiometer until signals are loudest. To make the set oscillate, the potentiometer is turned toward the negative end, but as this will cause interference to the neighbours, do not allow the set to get into this condition. To pick up distant stations it is not necessary to oscillate, but put the potentiometer toward the negative, and adjust the condensers. A little practice will soon enable you to pick up stations, and when you have one tuned in, try turning the potentiometer away from the negative end in order to stabilise the set still more effectively. The control of reaction by this means is very simple, and you will very soon become accustomed to it.

As previously stated, sufficient volume for a large room is obtained on a low aerial (12 ft. high) when tuned to London at 4½ miles roughly (the "old" station is here referred to).

Volume

On the large aerial, 40 ft. high, London gives sufficient volume to be heard two floors away, the announcer's voice being clearly discernible. Birmingham and Glasgow are clearly audible in a small room on a standard C.A.V. speaker, while Bournemouth is received with slight interference from London. Other stations have also been received, including two of the relays and several foreign stations, and considering the screening which exists, I am thoroughly satisfied with the performance of this receiver.

I shall be pleased to hear of the results obtained by any reader who makes this set, as I am sure that any who do so will be completely satisfied.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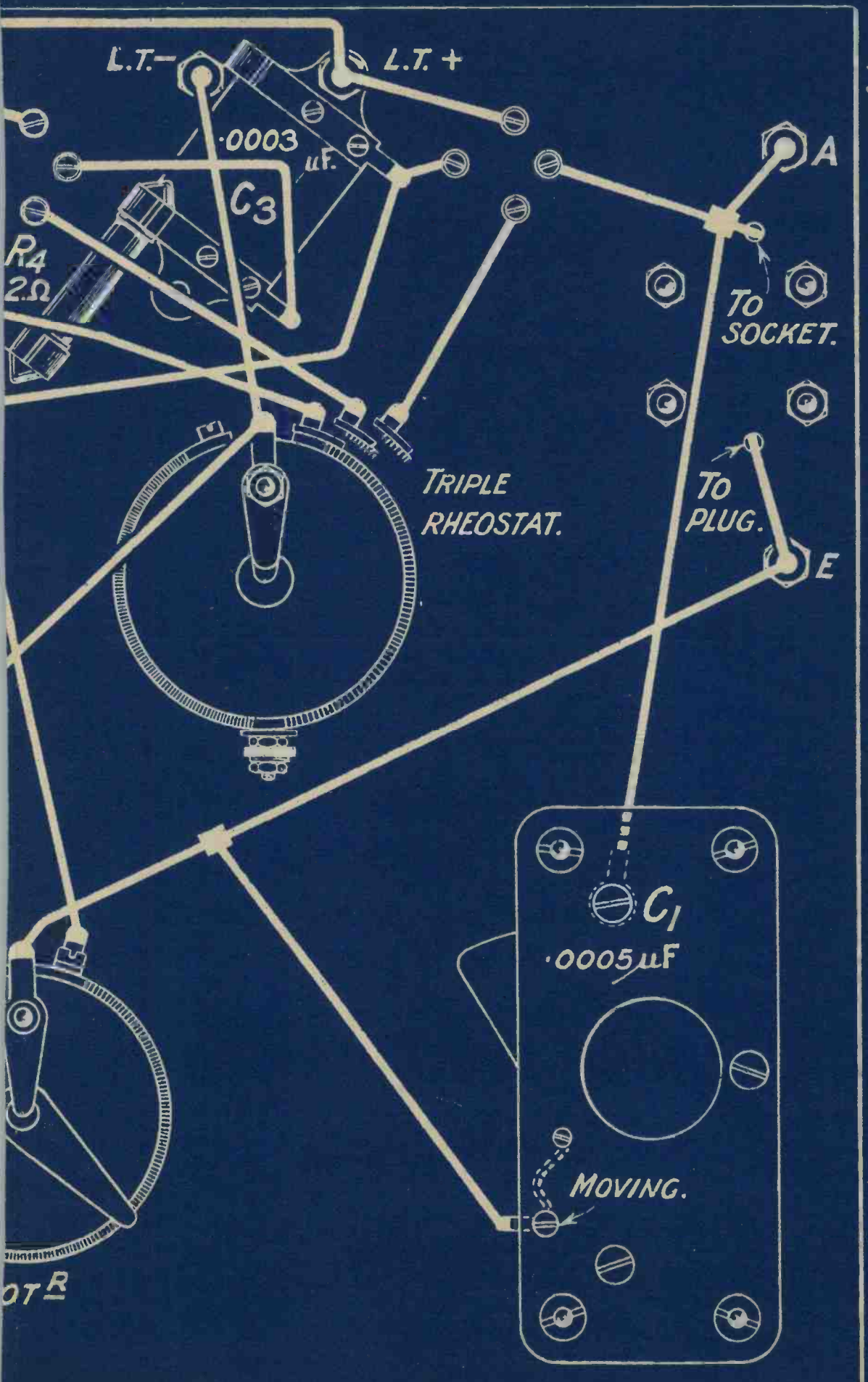
TEL.
+
+
H.T.3.
+
H.T.2
C4
·015 µF.
CHOKE
R5
2 Ω.
C5 ·0001µF.
C2
·0003µF
MOVING.



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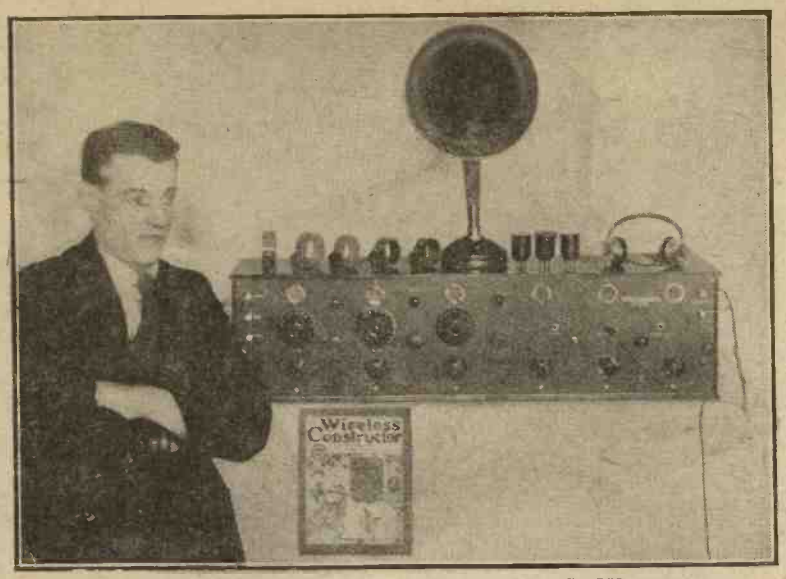


The "Anglo-American Six" made by Mr. C. W. Newson.

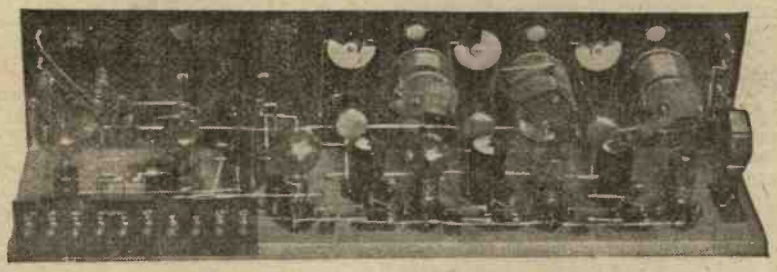
Some Readers' Appreciations of the "Anglo-American Six"

SIR,—I am writing to you to give you a report on the "Anglo-American" Six, which I have constructed according to your instructions in THE WIRELESS CONSTRUCTOR. I am enclosing some photographs, which I hope will be of interest to you and your readers. This receiver is one of the best, and can be highly commended for its simplicity and reliability. Components used, Rheostats Peerless 6 ohm, condensers, ·0005 and ·0003 square law, and ·0003 double, all of my own design and construction; Colvern verniers, neutrodyne condenser (own design and construction), plugs and jack of my own construction; also all the valve holders. Silvertown transformer, Peto Scott neutroformers, aerial coil Airmax or Igranic, Dubilier 80,000 ohms resistance, fixed condensers and leaks, Dubilier, Bretwood var. leak, Mansbridge ·25 condenser. Valves used are of various makers, but the best combination of valves I am using now are three "P2" Cossors for H.F., Ediswan "A.R." for detector, Ediswan "R." first note mag., B.T.H. "B4" second note mag. These make a splendid combination.

All B.B.C. stations can be tuned in and out with the greatest of ease, with Peto Scott's 250-550 m. transformers can get anything up to 700 metres. The amateurs are most amusing to get. The volume and audibility through a Sterling Baby or Ultra loud speaker, three working, would fill a large hall. Continental stations come in with great magnitude, and I have logged stations in the States in early mornings regularly, with all six valves working on telephones. I do not know how to thank you and the Radio Press for the splendid circuit. I may mention that I use a frame aerial and also a 15 ft. indoor aerial. The receiver makes a splendid piece of furniture, it improves the appearance of anyone's home, and is a set that would give any person the "Radio Fever."

Again congratulating you,
Yours faithfully,
C. W. NEWSON.

Finsbury.



The interior of Mr. Newson's receiver.

THE "A.A. SIX" IN SOUTH AFRICA

SIR,—Since seeing the articles on your Anglo-American Six in the January and February issues I was tempted to build this set up, completing the work just as the February issue of your admirable paper arrived.

I have, however, been compelled to make many of the parts for it myself, as they were unobtainable in South Africa.

Up to the present I have had little opportunity of testing the receiver, but last night, February 18, 1925, at about 12 o'clock, I tuned in either London or Bournemouth for the first time on it.

The items in rotation were as follows:—

Selections from Gilbert and Sullivan particularly clearly, "The Mikado."

Song, "Carry me back to old Virginia."

Soprano, "Home, sweet home."

I shall be pleased if you can confirm these items for me, since I am unable to judge the wavelength, having used series aerial tuning for the first time on this receiver last night.

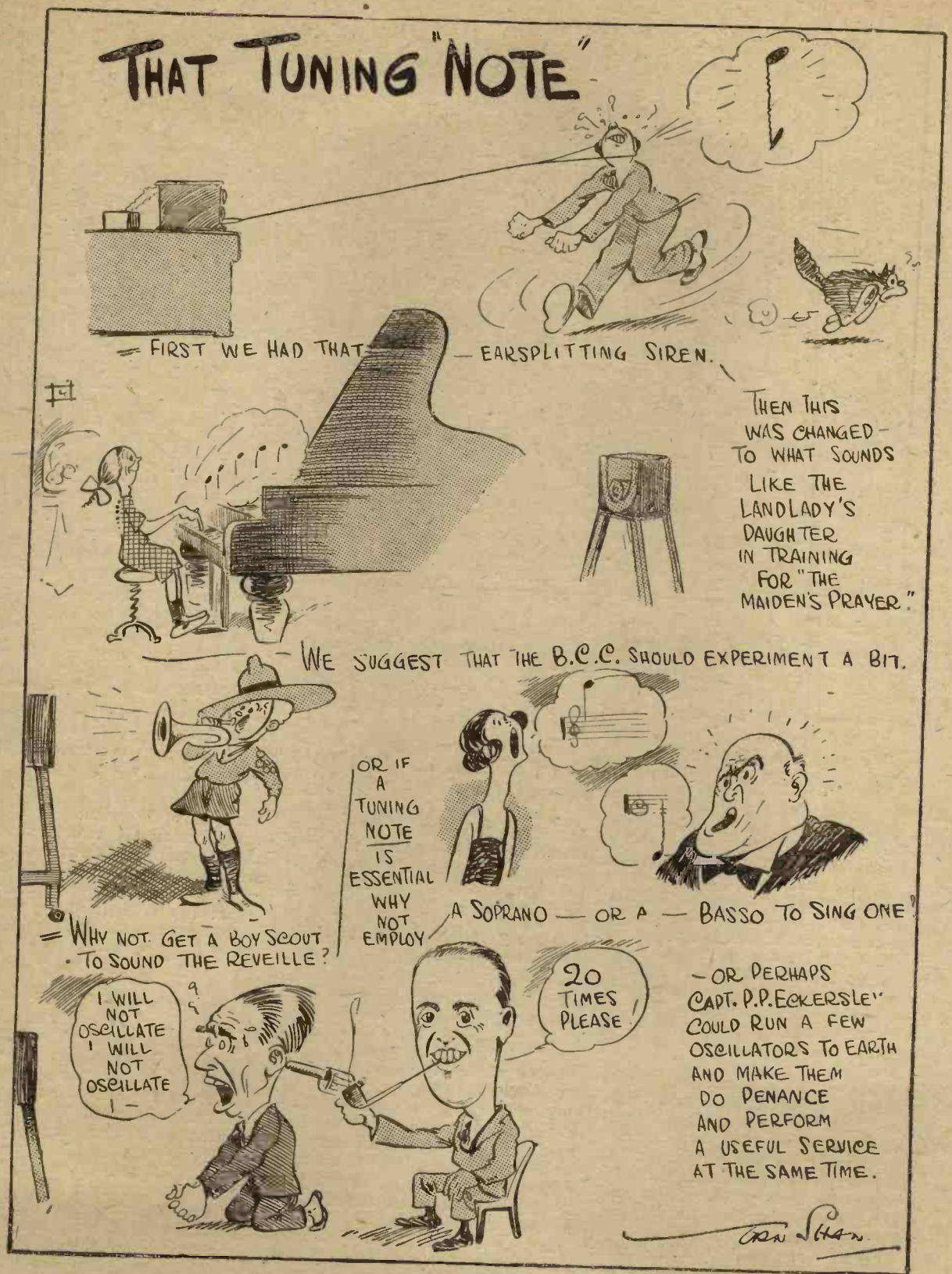
If I am able to have a photograph taken of the set this coming week I will forward a print so that you may see how we sons of the old country are carrying out your instructions to the best of our ability.

Time does not permit me to give you further detail by this mail, as I have an early start this morning and wish to lose no time in confirming the above-mentioned items.

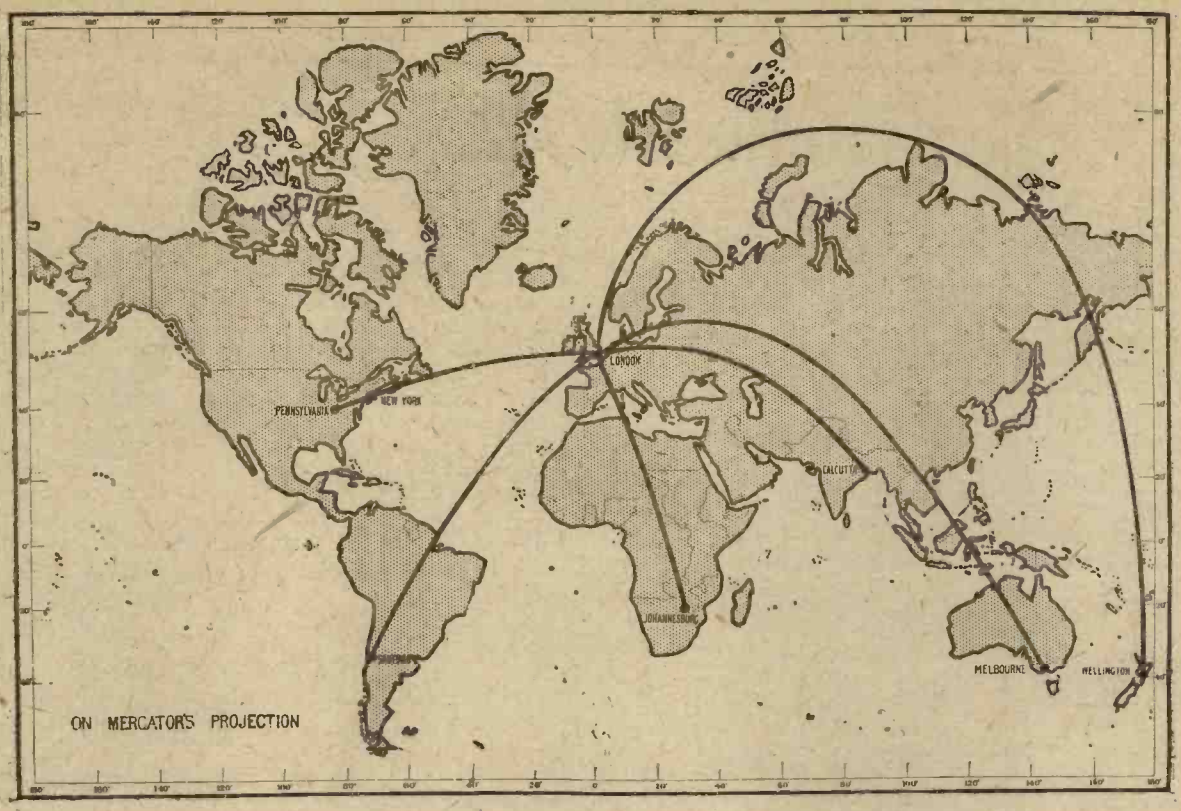
Thanking you for a most excellent receiver, and wishing THE WIRELESS CONSTRUCTOR every success,

Yours faithfully,
H. ATKINSON.

Cape Town, S.A.



What do *you* think about it?



Wireless on the Map

By STANLEY G. RATTEE, M.I.R.E., Staff Editor

Few people realise how misleading an ordinary map of the world can be. Look at the map above. The black line from England to New Zealand is actually the shortest distance between those places. The other lines all mark the shortest ways between points joined.

I WONDER how many listeners to long distance transmissions have considered the shortest possible route by which the signals could come? We are so used to visualising our distances upon maps remembered from our school days that once we are interested enough to refer to a globe it comes as somewhat of a shock to find that the shortest route to New Zealand from London is in a north-easterly direction!

One of the illustrations of this article is a map of the world drawn on Mercator's projection, upon which are shown the shortest routes to several well-known places as revealed by the globe. It is highly probable that many readers will have at some time or other received the popular concerts transmitted by KDKA and WGY, little thinking at the time that the shortest routes to these two stations are identical in direction. Pennsylvania (KDKA) merely being a continuation of the line from London to New York. Again, how many readers know that the New Brunswick corner of Canada is between this country and New York?

New Zealand via the Arctic

In the autumn of last year when the first amateur two-way radio communication with New Zealand was established, we were all inclined to believe that New Zealand would be soonest found along a south-easterly course, and for a long time this belief prevailed.

Remembering our sense of direction from school maps, if we consider the relative positions of London and New Zealand without consulting a globe it seems perfectly reasonable that the shortest route would be across France, Austria, Persia, Borneo, North Australia, and so on, but a glance at the globe shown in the photograph, with London and New Zealand represented by flags, will soon show how hopelessly wrong is our sense of direction. The straight line between the two flags shows the shortest possible route, and is redrawn on the map of the world, passing over the same countries as on the globe, namely, skirting Norway, over Siberia, and across the Pacific Ocean.

To the Antipodes

Another optical delusion, if one may call it so, is the shortest route to Australia, where the amateur station 3BQ Melbourne is situated. This station is frequently heard in this country. In this case our sense of direction again tells us that the shortest route would be somewhere south-east, whereas it is actually, so far as Melbourne is concerned, an east-north-easterly direction, and is once more drawn upon the map to show the peculiar line which results.

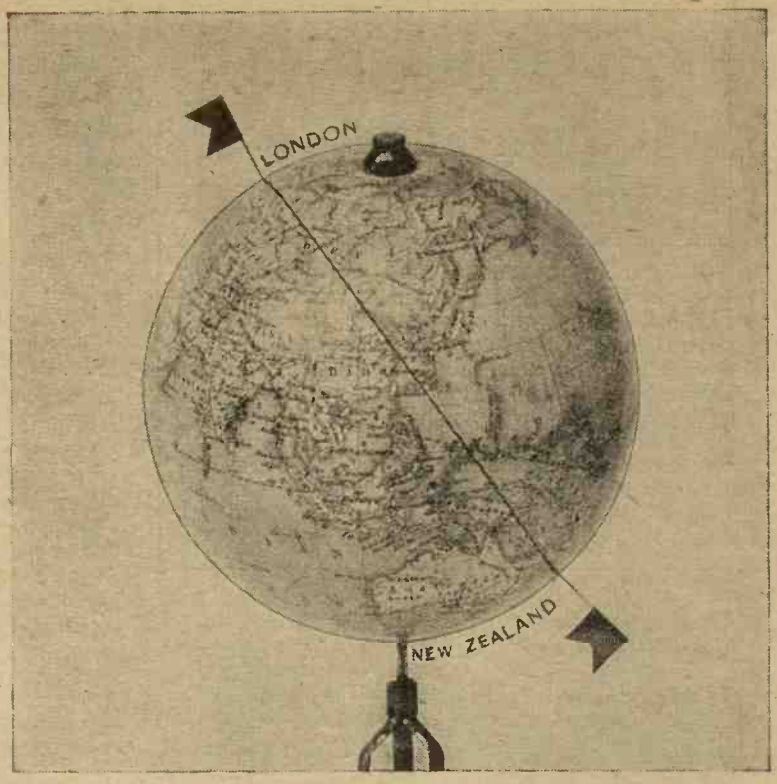
In considering these short routes no attention has been paid to hours of light and darkness, which, as every reader knows, will have some bearing upon the actual route

taken by the signals, and in this connection a particularly interesting article by Mr. Philip R. Coursey was published in *Wireless Weekly*, dated March 25, 1925.

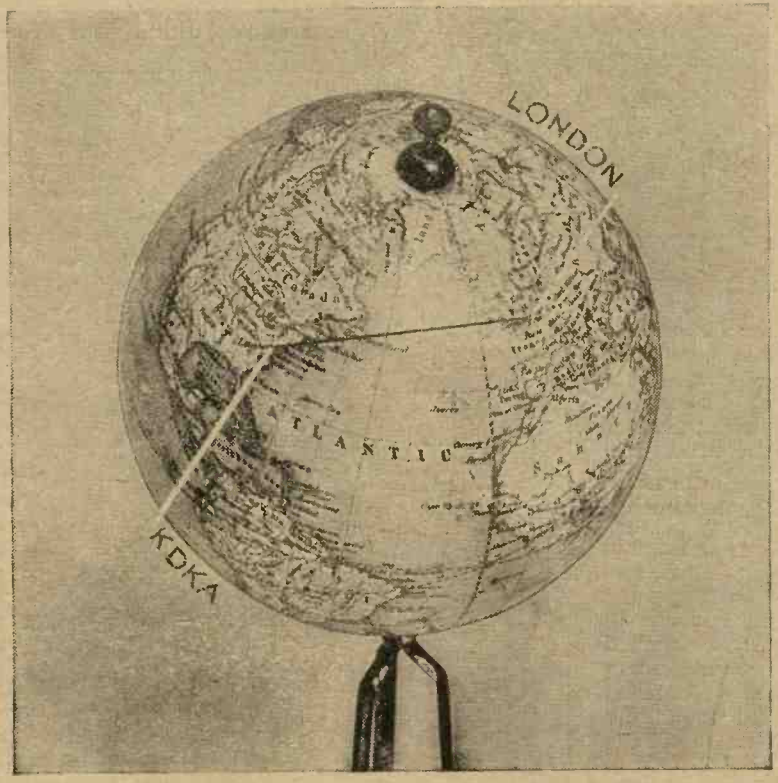
During the winter months the London station of the B.B.C. was heard both in Calcutta and Johannesburg, and in connection with the first-named place it is interesting to add that the shortest route extends a considerable way across Russia, departing very widely from the usual sea-route associated with India.

In the days before the war, when the crystal detector was the vogue, and Poldhu was in the habit of sending press messages for publication upon ships at sea, it was not altogether unusual when homebound to first hear Poldhu at Aden, and to receive press each night until the Gulf of Suez was reached, when signals faded out. An inspection of a globe or even a map will show that Aden is considerably more distant from England than Suez, yet Poldhu was rarely heard again until the ship was south of Malta.

Though these last remarks would seem to have no bearing upon 2LO and Calcutta, they indicate firstly, that the average crystal user of to-day may with careful operation



Indicating the most direct route from London to New Zealand as shown upon a globe.



The black line drawn across the Atlantic indicates the position of KDKA in relation to London.

receive over longer distances than modern practice has led him to believe, and, secondly, though it is possible to sometimes hear 2LO in Calcutta it may not be possible to hear that station along every point of the line stretching between London and Calcutta. Another illustration of this latter point is that though before the war Poldhu was still audible in an east-bound ship at Aden, reception would be lost between Aden and Bombay, and again picked up between Bombay and Karachi at a strength even better than when at Aden. Another inspection of the globe will show that Karachi is considerably more east than Aden, and for signals from Poldhu, more overland, the countries being Persia, Russia, Austria, Germany and Belgium.

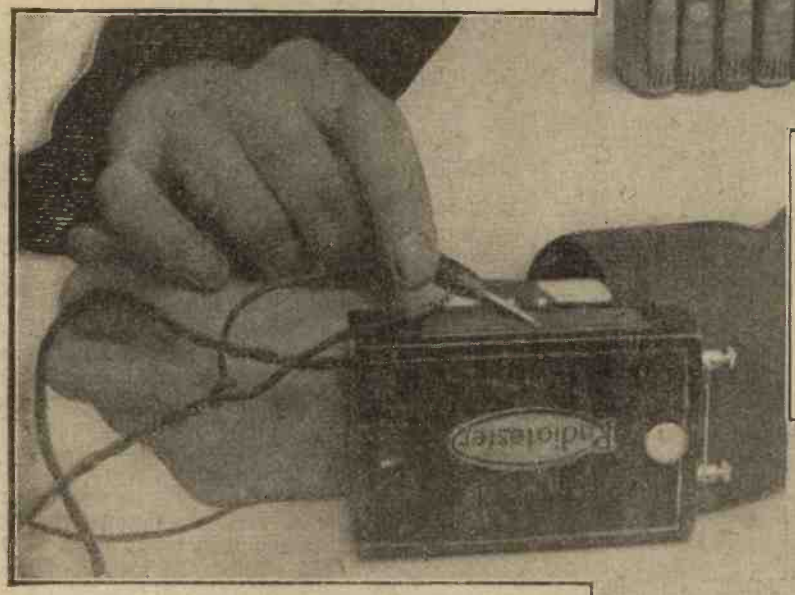
In regard to the reception of 2LO in Johannesburg, here again our conception of direction is liable to go astray, in so far as that we may think that the route is a southerly one mainly overseas. In direct contradiction of this an inspection of the globe will show that the route is overland for the most part, crossing France and through the centre of Africa, the only overseas portion being the English Channel and the Mediterranean Sea.

A Useful Testing Instrument

A RAPID AID IN FINDING FAULTS

FEW things are more annoying on finishing the wiring up of a set than to find that it will not work properly, although you know that the wiring is correct and that the design is a good one. In such places as Radio Press Testing Department, elaborate and expensive testing apparatus is immediately available, and the discovery of what is wrong proves a fairly simple matter. Most home constructors, however, have not access to such apparatus, and will, I am sure, welcome the small device illustrated in these pages and now available on the market.

Testing H.T. battery units.



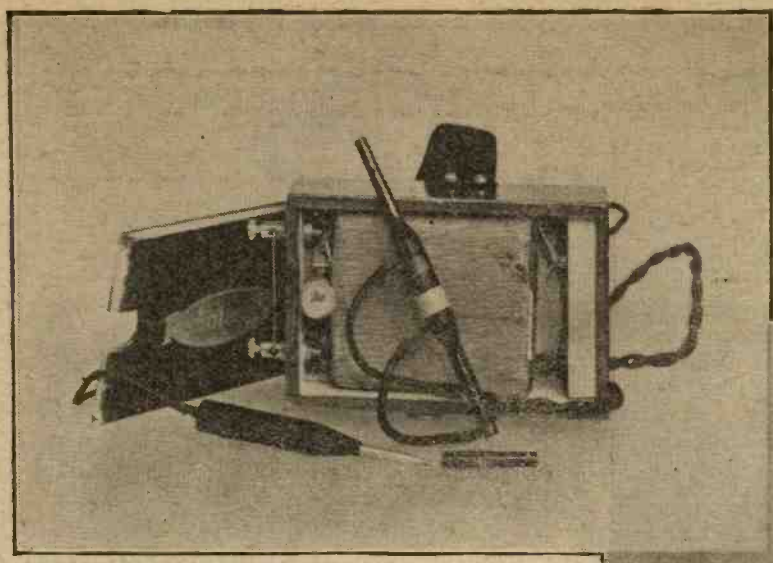
Sharpening the points on the side of the box.

The tester consists of a small box to which is fixed an elastic band, so that it may be slipped over the wrist as shown in the photograph. Attached to this box are two flexible leads, one terminating in a double-ended pin and the other in a single ending. These pins are fitted with insulated handles, and are provided with protective devices to prevent short-circuiting when not in use.

On the back of the box is a small peanut lamp, such as is used in pocket flash lamp outfits, and within the box is a small dry cell to supply the current for this. At one end of the box will be seen a pair of terminals normally short-circuited by a wire. The uses of this testing instrument are so numerous that they cannot all be detailed in a short description such as this, but we indicate just a few to show how helpful it can be in the hands of the home constructor.

Let us imagine, for example, that you have made your set and there appears to be some break which does not make itself visible. Slip the band on the back of your hand, remove the protecting cover from two of the points, and place these points in contact with the two sides of the conductor which you think may be broken. There may, for example, be a disconnection within the coil

Testing transformer windings.



Details of the testing set.

socket. To discover this it is merely necessary to place the points of one pin on, say, the projecting pin of the coil socket, and the other on the terminal which is supposed to be connected to it. If there is proper contact between the two parts, then the lamp will light up, owing to the passage of the current from the dry cell to the lamp and to the circuit being tested. It only takes a few moments to run over the connections to the set for continuity, and, even where you are using flexible insulated wires, the points are sharp enough to pierce the insulating covering so as to make contact to the wire within.

We have already mentioned that one of these pins carries two points. One of these points is used as just described, and the other enables a circuit to be completed through the lamp without the use of the battery. This means that you can test the individual units of an accumulator to see whether they are giving current, and a brief touch on the units of a high-tension battery (say between 3 volt tappings to show whether current is passing here). We do not recommend the tester for general use in the testing of high-tension batteries, for the resistance of the lamp is so low as to form practically a short-circuit. A quick test, however, may be given in emergencies to identify a "dud" unit. By removing the short-circuiting link between the two terminals on the end of the box and inserting in them the leads of a pair of 'phones, the battery in the box, and the 'phones can be placed in series. This means that you will get a loud click to show continuity in such circuits where there would not be enough current passing to light the lamp. Disconnections within telephones and the windings of intervalve transformers can be discovered in this way. Furthermore, you

Telephone windings are easily tested.

Finding a fault in a variable condenser.

may have a short-circuit between the windings of a transformer and the frame; the tester will show this by a loud click.

A further most valuable use of this instrument is to discover whether there is a disconnection within fixed condensers. For example, you may have a small ·0003 condenser which appears to you to be good. Instructions supplied with the tester will show you how you can find whether the insulation is bad or not. We recently had the opportunity of discovering a faulty condenser used for shunting a high-tension battery with this instrument.

Movement of the switch will change from your local station to Chelmsford, slight retuning only being necessary in addition.

The Change-Over Crystal Receiver

CHELMSFORD OR THE LOCAL STATION IN A MOMENT

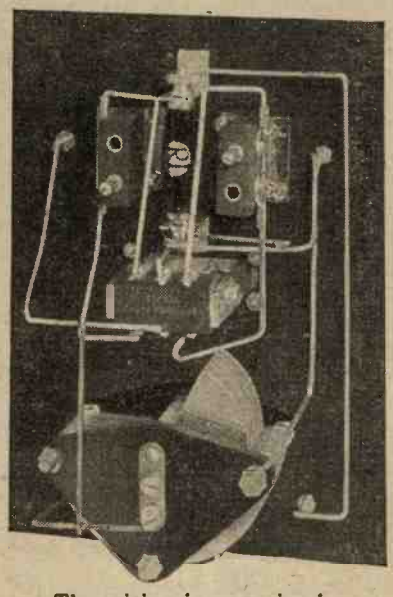
By PERCY W. HARRIS, M.I.R.E., Editor

Already famous for its crystal set designs, "The Wireless Constructor" this month gives you a further addition to a remarkable series. Even if you already possess a crystal set, you will want to make this instrument

THANKS to the organisation and activities of the British Broadcasting Company, many millions of listeners have a choice of two stations to which they can listen on a crystal set. All commercial crystal receivers, save the cheapest, have a socket into which a Chelmsford coil can be plugged, this socket being short-circuited when you are listening to the local station. This extra coil must be kept somewhere, and few sets have any provision for it in the box. Furthermore, it is very annoying to find that the coil is missing just at the moment you discover that there is something worth listening to from the high-power station, and quite likely the vibration of the box, due to withdrawing the short-circuiting plug and inserting the long wave coil may upset your crystal adjustment. Why not build yourself a set in which both short- and long-wave coils are kept permanently in the instrument, with a switch to change from one to another in a moment? This idea is the basis of the design I am about to give you, and which I find of great use in other circumstances as well.

Correct Panel Size

Even if you have never made any kind of set before, the building of the "Change-over Crystal Receiver" will present no difficulty. For it you require an ebonite panel measuring 8in. by 6in. by ¼in. thick, which may be of any make, provided it is of good quality and guaranteed free from surface leakage. Such a panel may be obtained ready cut



The wiring is very simple

to size from a number of the advertisers in this journal, if when writing you ask for the panel for THE WIRELESS CONSTRUCTOR Change-over Crystal Receiver. On this panel you will need to mount a variable condenser of ·0005 microfarad capacity, two sockets for the conventional plug-in coils, a change-over switch, crystal detector, and the necessary terminals. The more advanced reader will see from the circuit diagram on page 713 that the switch completely disconnects one coil and substitutes for it the other, both coils being kept permanently in their appropriate sockets. To change from one station to the other is but the work of a moment, the change-over switch being moved from one side to the other, and slight retuning made upon the dial of the variable condenser. There is no plug to pull out, no hunting for the long-wave coil, and no shaking of the instrument by the withdrawal and insertion of plugs and coils. These advantages are of great value to people young and old who desire to use a crystal set merely for listening to broadcasting, and not for experimental work. By adopting one of the latest crystal detectors, which make a feature of their semi-permanent adjustment, practically all of the troubles which have been thought inseparable from crystal receivers are eliminated.

List of Components

The components can be of any good make, but for the convenience of readers who are not fully acquainted with the market I am detailing those actually used in the set described. No mention is made of the make of plug-in coil, for there are so many designs available, all excellent, that there is no need to specify any individual maker. Some readers may desire to use a different size of panel to fit some box or cabinet they already have in their possession.

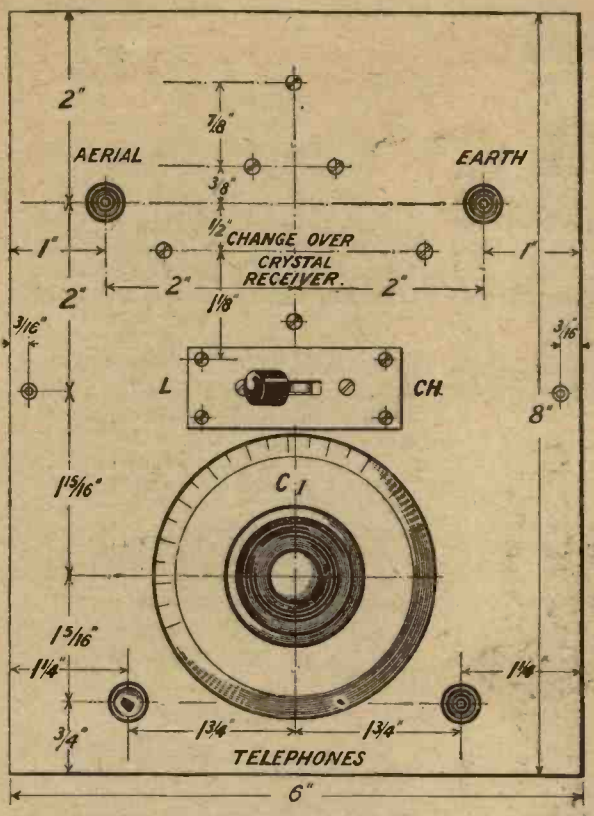


Fig. 1.—This shows how the panel must be drilled.

There is no objection to their doing so, provided the wiring is kept short and approximate to that illustrated.

One ebonite panel of good quality, guaranteed free from surface leakage, measuring 8 in. by 6 in. by ¼in.

One suitable cabinet which can conveniently be of the upright type, with a lift-up lid for gaining access to the coils and crystal detector ("Camco" cabinet).

Two coil sockets for panel mounting (Magnum).

One crystal detector (Radio Instruments P.M.).

Four terminals.

One variable condenser, square law pattern, ·0005 microfarad (Bowyer Lowe).

One double-pole change-over switch (Efesca).

One or more pairs of telephones (high-resistance type), according to the requirements of the user.

As soon as you have obtained the various component parts, lay them on the table conveniently to hand and stand them on the back of the panel to see that they will dispose themselves as you require. If you use the actual components described, you can, of course, follow in detail the practical wiring diagram given with this article. If you use different makes of components, they will vary somewhat in size, and may need to be disposed a little differently. If you should have to make a slightly different lay-out, be careful to keep your parts symmetrically placed, or the finished set will have an amateurish appearance.

The Change-Over Switch

The only component which may give you a little difficulty in mounting is the change-over switch, for this will require a hole to be cut in the panel larger than that obtainable with an ordinary drill. Before attempting to cut the hole for the Efesca switch, unscrew the knob and remove the two brass screws which hold the top brass plate to the framework. When you have done this, you can measure the frame and scratch on the panel an oblong which will need to be cut out before the switch can be mounted. To cut this piece of ebonite, drill four holes at the corners of the oblong and saw out the ebonite with a fret-saw, if you have such available. If not, a good plan is to drill a number of holes touching one another all along the line you have scratched on the panel, until the piece drops out. Do not worry if the hole has rather rough, jagged edges; these can be smoothed down with a file quite easily, and in any case the shape of the hole is covered by the brass plate which you will subsequently replace on the framework. When you have cut this hole to fit the frame, replace the top brass plate and the knob, whereupon you will see that there are four holes at the corners of the top brass plate still requiring to be drilled. These can be drilled quite accurately by passing the drill through the hole in the plate and drilling with the plate *in situ*. Small brass screws can then be passed through from the front and held in place with nuts.

Variable condensers nowadays are either supplied with templates to drill the holes or else are of the one-hole fixing type. The clips for the crystal detector and the coil socket mountings are secured to the panel by passing 6 B.A.

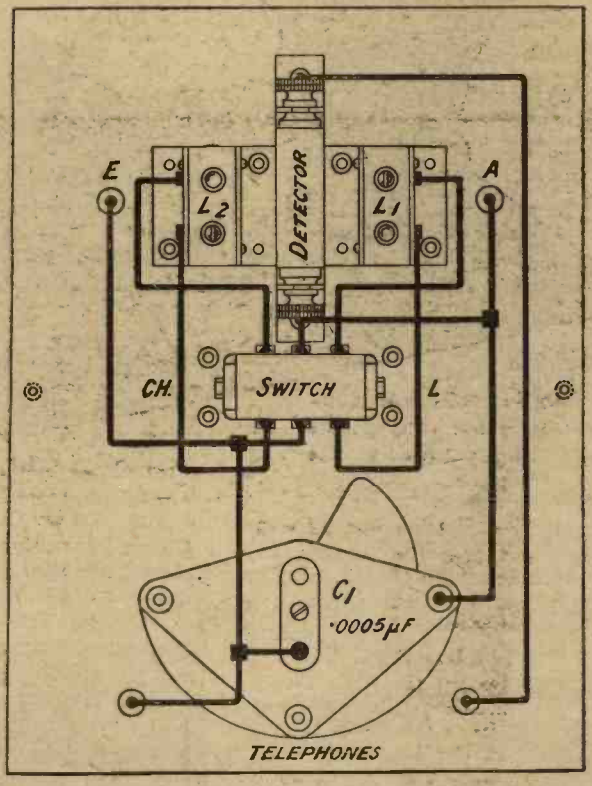


Fig. 2.—The connections necessary.

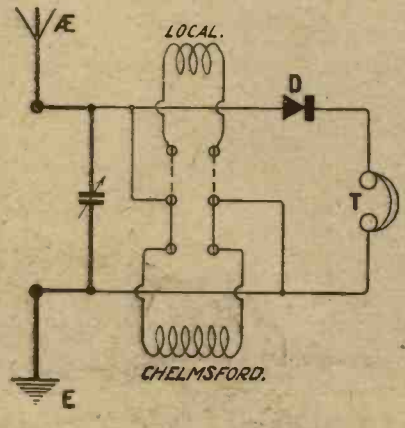
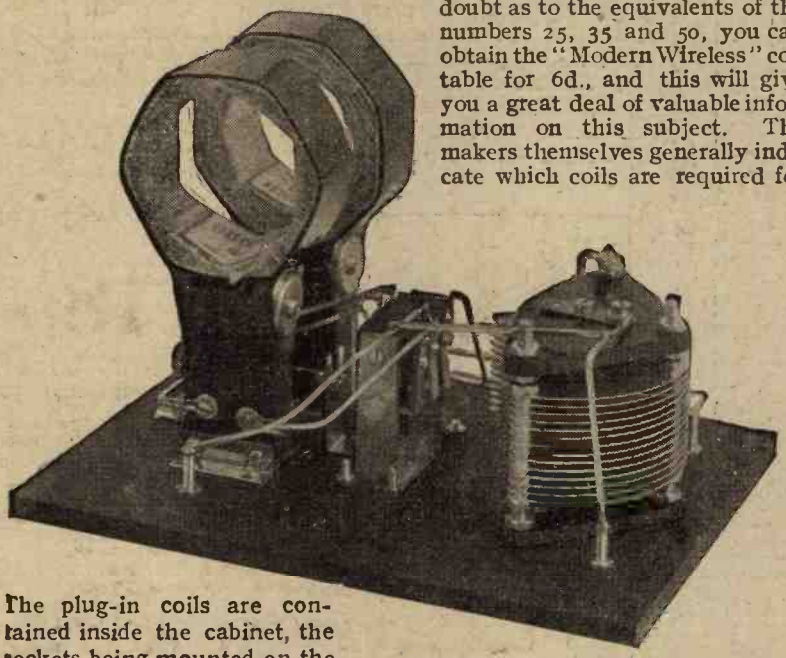


Fig. 3.—Circuit diagram, showing the connections to the switch.

countersunk head metal screws through the panel, and holding components to the back with nuts. The wiring you will be able to do either with the square section tinned copper wire, which is so popular, or with thinner wire covered with Sistoflex, or with the handy Glazite wiring advertised in this journal. It is just as well to solder all possible connections, and, of course, the fixing of the panel in the box will present no difficulty whatever.



The plug-in coils are contained inside the cabinet, the sockets being mounted on the panel.

How to Use the Set

If you wire up the set exactly as described, then the left-hand coil looking from the front of the panel will be the long-wave coil, and the right-hand the short-wave coil on the local station. To listen to the Chelmsford station the switch knob should be pushed over to the right, and on turning the dial (provided, of course, you are within crystal range of Chelmsford) you will soon pick up this station. The crystal detector, if of the type illustrated, will be found to be in a sensitive state when purchased, but sometimes a slightly better setting may be obtained by lifting up the small knob and gently lowering it again after giving it a slight turn when lifted. Never twist this knob while the two crystals within are in contact with one another.

The Local Station

Now push the switch knob to the other side and readjust, when you will soon hear the local station. The coil for the local station will be either a 25, 35 or 50, depending on the wavelength of this station and the dimensions of your aerial. Most makes of coils are given numbers, such as 25, 35 or 50, but other makes are differently described, and may be called A, B, C, 1, 2, 3, or whatever marking the maker thinks fit. If you have any doubt as to the equivalents of the numbers 25, 35 and 50, you can obtain the "Modern Wireless" coil table for 6d., and this will give you a great deal of valuable information on this subject. The makers themselves generally indicate which coils are required for the broadcast band. For Chelmsford, a No. 150 coil will be required.

Using the Set for Comparing Coils

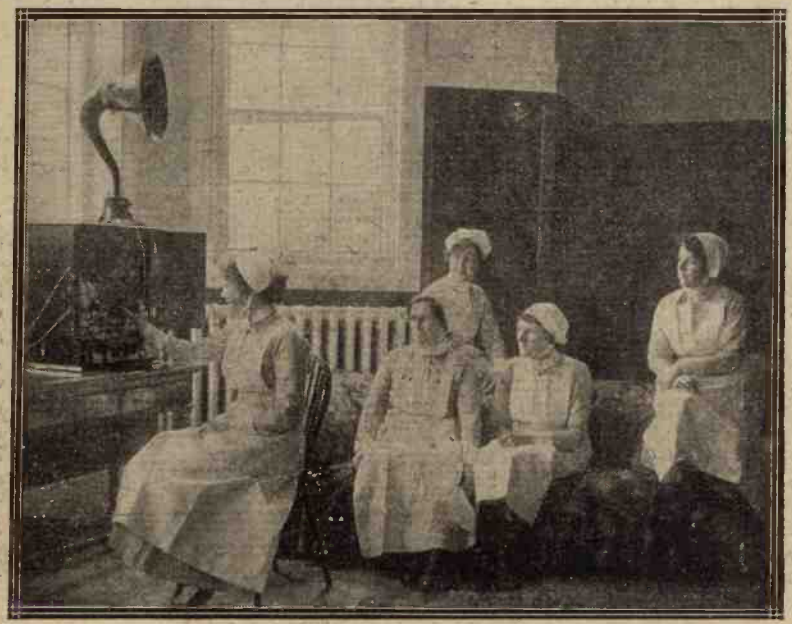
A very interesting use of this set is to compare the merits of different plug-in coils which you may have in your possession. You may, for example, find that your local station comes in on a No. 35 coil, and possibly you have three or four certified coils of different makes. Withdraw the Chelmsford coil and place a No. 35 in each socket. Tune to the local station on one of these coils, and then throw the switch on to the other, retuning, of course, when doing this. You will soon find whether one coil is better than the other, and in a few moments you can compare several makes. You will also be able to demonstrate whether or not home made coils are superior to the bought types, and whether your friend's coil, of which he makes such a fuss, is as good as yours!

In short, this crystal receiver can well be used as a standard set for family use, and is as near foolproof as any crystal receiver can be, while it will also give you valuable information, when required, on such matters as coils and sharpness of tuning. Make it, and let me know how you like it!

Greasy Crystals

If you use the galena and catwhisker type of crystal detector, guard against touching the surface of the crystal with your fingers. This almost always causes a slight greasy deposit on the crystal which will decrease, if not entirely remove its sensitivity. The catwhisker should be treated just as carefully.

It is often an improvement, when using an old catwhisker, to clip off the end, in this way exposing a surface of bright metal.



The recreation room at the Alfred Langton Home for Nurses has been provided with a four-valve receiver, presented by the Chairman of the Royal Free Hospital. Above are seen some of the nurses listening-in.

Making the Most of Your Loud Speaker

SOME HINTS ON GOOD REPRODUCTION

By an "OLD STAGER"

This article will help you to get the purity and quality you have so often desired

HAVE you ever visited the homes of your friends and listened to their loud speakers? Have you noticed the big difference in the results obtained? Jones' loud speaker perhaps possesses that pleasant mellowness so pleasing to the ear, whereas Smith's, on the other hand, reproduces some instruments exceedingly well and others extremely badly. You have, I expect, compared these results with yours, and you have, perhaps, envied the good reproduction which Jones obtains, while you have condemned Smith's owing to its bad rendering of certain musical passages. You probably put it all down to a matter of luck, and you immediately make up your mind to borrow Jones' loud speaker in order to try it out on your own set. You do this, and, surprisingly enough, you find that the very points you admired so much have disappeared; in fact, the reproduction is no better than that which you obtain with your own instrument.

Many Good Instruments

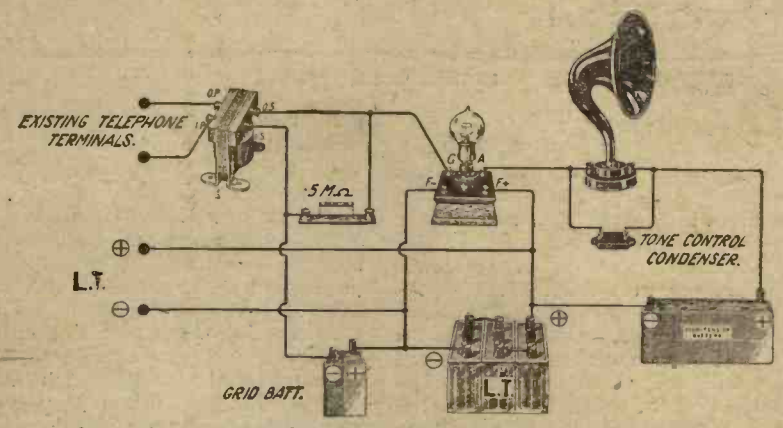
Now, let me tell you that every loud speaker of reputable make is capable of giving good results if properly handled. Some, it is true, have a slightly different tone to others; one will give a deep rich tone, while another will be a little higher pitched. This is due to the design of the instrument itself, and the choice is largely a matter of individual taste. To get purity, which I am sure you will agree should be the sole aim of the true broadcast listener, you must handle your loud speaker intelligently. The chief factor is your set; does it give undistorted reproduction? I am afraid that in very many cases the answer is No!

Let me give you a few hints on obtaining better reproduction.

Reaction

If your receiver employs a valve detector, I expect you have a method by which the strength of signals can be increased, called reaction. This is one of the primary causes of distortion, so please keep the reaction coil well away from the aerial or anode coil as the case may be. Most sets amplify the signals after detection by means of low-frequency transformers.

Assuming this to be the case, try connecting a resistance of about half a megohm or less across the two secondary terminals of the transformer, or, if two transformers are used, across the last one. It is quite an easy matter to do this, and it very often effects a wonderful improvement in quality, although there will be, unfortunately, a slight reduction in volume; but, after all, it is quality we require before volume. The lower the value of the resistance the greater the reduction in signal strength, and the greater the increase in purity up to a point. Try a resistance of half a megohm first. Next, are your low-frequency valves operated in the correct manner for distortionless amplification? If you look at the wiring of your set you will find that one end of the secondary winding, probably that marked I.S., is connected to the low-tension negative lead. Try connecting a small six volt grid battery (obtainable from any wireless dealer), variable in steps of one and a half volts between this secondary connection and the negative L.T. lead. The positive terminal of the grid battery should be joined to the L.T. negative, and a short length of flex with a wander-plug attached to it should be connected to the secondary terminal of the transformer. Increase your high-tension voltage to about a hundred volts, and try various values of grid bias by means of the wander-plug until the best results are obtained.



A guide to wiring up for good quality reproductions.

Much can be done by what is sometimes called a tone control condenser. This is simply a fixed condenser connected across the loud speaker terminals, and often known as the telephone condenser. Some loud speakers require quite a large one for the best results, and

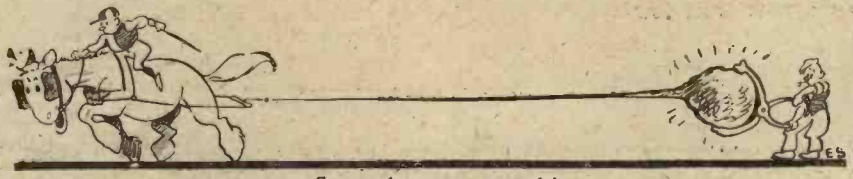
(*Concluded on page 739.*)

The Art of Wiring

FRESH HOPE FOR THE DESPERATE!

By "HOT-WIRE"

WIRELESS is so called because any receiving set contains several miles of wire. As you become more and more versed in the mysteries of science you do not worry about this kind of thing. It has already been pointed out that condensers get their name from the fact that they do not condense, and who ever heard of a battery battering? I could give you lots more instances like these but I refrain, for space is limited, and I am sure you are burning to hear all about the art of wiring a set.



Samuel went grand!

What is Wire?

First let us discover what wire is. You will perhaps understand most readily if I use a simple analogy, and call it copper in the vermicelli form. Wire is produced from metal in the lump state by being drawn. Though you may be unable to draw metal you can do a little experiment with a teaspoon and a pot of treacle, which will give you an insight into the process. The more you draw out the treacle the thinner it becomes. It is just the same with wires. Some of them are fatter than others; others again are thinner. But all are made by the same ingenious process. Wire drawing is done in the following beautiful way. A hundredweight of copper is made so hot that it is in a treacly condition. The drawer then starts pulling from one corner, and when he has got a yard or two of slack he attaches the end to the harness of a willing horse bestridden by a skilled jockey, who forthwith gets under way. The original horse, whose skeleton is preserved in a glass case in the hall of the Worshipful Company of Wyre Drawers, was named Samuel. In early days his rider was in the habit of saying upon finishing his allotted course, "Samuel Went Grand." This phrase has now become abbreviated into the letters S.W.G. The number prefixed to them signifies the mileage covered by the steed. As Samuel always jibbed at the end of forty-four miles, No. 44 S.W.G. is the finest wire usually listed by makers.

How to Use your Wire

And now that we know all about wire let us see how it should be used in making the connections of the receiving set. We are not concerned in the present article with that which is used in making the tuning coils. This subject has already been dealt with by my colleague, Mr. G. P. Bendall, in his little book, which, all things considered, shows that he has grasped at any rate the elements of the subject in a gratifying way. This being so, I will not poach upon his preserves. I will confine myself entirely to the wires which, discreetly hidden beneath panels, connect terminal to terminal, thingmejig to thingmebob and whatsitsname to valve leg.

Many Systems

It cannot be too clearly understood that there are many systems of wiring a set. There is, first of all, the system used by the Very Great in which connections are made with square rod. This is a most difficult method, for it is essential that all angles should be right angles. Euclid demonstrated some time ago that when one straight line stands upon another so as to make the adjacent angles equal, these angles are right angles. Euclid, however, has been completely put in the shade by Einstein, who has proved that there is no such thing as a straight line. It follows, then, that there is no such thing as a right angle, and that wiring with square rod is impossible. I expect that you have already discovered this, but that you did not quite grasp why. You will now be able to explain convincingly to your friends why you have not wired up your new set in this way.

Parallel Lines are Impossible!

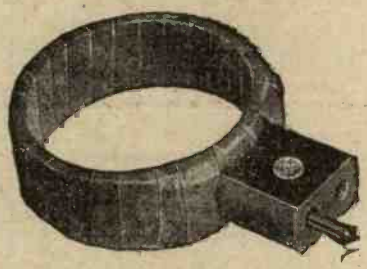
Einstein is a splendid fellow really if you make proper use of him. For example, you will find it stated over and over again in wireless articles that every care must be taken to avoid having leads at different potentials running parallel. As I have already mentioned, this indefatigable scientist has proved that there ain't no sich thing as a straight line, and that even if there were no two of them could be parallel. If therefore, when your set refuses to work, an expert points an accusing forefinger at two of your wires and says, "There you are, what can you expect with parallel leads like that?" you should reply crushingly "To speak of parallel straight lines is to expose the grossest form

Samuel jibbed!

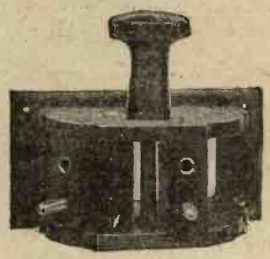
of ignorance." At the present moment I understand that an American man of science is endeavouring to overthrow the whole of Einstein's theory. To show my disapproval I have decided to give up listening to KDKA. I must, however, admit that I am rather glad of an excuse to do this, since though I have performed prodigies of tuning and have run up appalling

Coil No.	True Inductance — Microhenries	Distributed Capacity — Micro-Microfds	Primary Tuning on Average P.M.G. Aerial with ·001 Condenser or Burndept Tuner: Condenser in Series min.	Condenser in Series max.	Condenser in Parallel min.	Condenser in Parallel max.	Condenser in Parallel with Coil: Secondary Circuits (Burndept Tuner = ·0005 mfds.) min.	max. ·0005	max. ·00075	max. ·001	Tuned Anode Circuits min.	Tuned Anode Circuits max. ·0002	Price (Mounted) A	
A	1·6	7	80	150	—	—	—	—	—	—	—	—	4/3	Extra Short Wave Coils Set of 4 16/-
B	13	8	110	190	—	—	75	170	210	240	45	110	4/3	
C	22	10	130	220	235	325	90	215	270	305	60	140	4/3	
S1	36	10	150	260	300	415	120	280	330	375	80	175	4/3	Concert Coils Set of 4 16/- A
S2	64	10	175	300	360	550	160	375	440	500	105	230	4/3	
S3	110	9·5	200	360	420	700	210	490	580	655	130	305	4/3	
S4	200	9·5	250	450	560	940	285	660	780	885	190	405	4/3	
S5	350	10·5	330	600	740	1250	380	865	1035	1175	255	535	4/6	Set of 9 Coils S5 to 1000 £3 16 6 A
100	583	27	450	750	950	1600	525	1150	1350	1530	375	730	5/-	
150	1193	22	650	1050	1300	2300	730	1625	1930	2180	520	1035	6/-	
200	2300	21	900	1450	1900	3300	1010	2260	2670	3020	710	1420	7/-	
300	4770	17	1250	2000	2600	4500	1430	3250	3850	4350	1000	2050	8/-	
400	9600	17	1750	2900	3700	6500	2030	4600	5450	6200	1420	2900	9/-	
500	23550	20·5	2600	4300	5500	10000	3235	7250	8600	9750	2320	4550	10/-	
750	53250	19	4000	6600	8500	15000	4840	11000	13000	14600	3400	6900	12/-	
1000	104650	17·5	—	—	12500	23000	6750	15300	18200	20500	4700	9650	15/-	
1500	182000	22	—	—	16500	30000	9040	20200	23800	27000	6400	12800	24/-	

A handy table about Burndept Coils



A Burndept single-layer Coil. Notice how neatly the coil is wrapped and how clearly its number is marked on the plug. The windings are well protected.



REDUCED PRICES.

No. 133. Two-Coil Holder, unmounted. **15/-**

No. 135. Three-Coil Holder, unmounted. **20/-**

The backs of Burndept Coil Holders are open so that all wiring may be kept out of sight. The handsome appearance of these Coil Holders, therefore, need not be spoilt by untidy wires.

IN the above table, prepared in the Burndept Research Laboratories, there is useful information which should be of assistance to you in choosing Burndept Coils. As the figures show, Burndept Coils have extremely low distributed capacity and high-frequency resistance. They cover all wavelengths from 80 metres upwards. Purchasers may definitely rely upon each Coil covering the range indicated with a margin to spare both up and down. Each Coil is mounted on a non-reversible plug with spring contact pins.

Burndept Coil Holders are moulded in solid black bakelite, highly polished and beautifully finished. The moving holders are operated by means of 5 to 1 gears, the action being particularly smooth. Fine adjustments are made with ease. ***Note the price reductions.***

Write for Publication No. 44, which gives full particulars of Burndept Coils, Coil Holders and Standard Variable Condensers.

Purchase Burndept by its name—substitutes are not the same

BURNDEPT

WIRELESS LIMITED

Aldine House, Bedford Street, Strand, London, W.C.2

BRANCHES *at Leeds, Birmingham, Cardiff, Northampton and Newcastle.*

bills for midnight therms this winter I cannot honestly say that I have been successful in obtaining satisfactory reception from this station.

Two more Methods

Counting out square rod then we are left with two systems of set wiring. The first and most simple of these is that which is known as the Go-As-You-Please, or Clapham Junction method. In this we make use of wire either decently clad in a double cotton covering or provided with a chest protector of Systoflex. And here I think I must utter a word of warning. There are many who believe that the American wireless publications are full of bright ideas which are vastly ahead of our own. I admit that they are full of bright ideas, though many of them shine mainly on paper. If you are one of those who insist upon reading the American papers in order to be three months ahead of the latest

Spaghetti!

fashion in wireless, do be quite sure that you understand the language before setting to work to follow out the directions given for making up the latest super set. It is customary upon the far side of the Herring Pond to refer to what we call Systoflex as spaghetti. You are instructed to obtain so many yards of this material and to use it for insulating your wires. One unfortunate friend of mine who had failed to take the world-famous Transatlantic Course, which guarantees to enable any Englishman to understand American in three months by simple postal lessons, purchased his insulating material from the grocer and never obtained really good results with the set which he constructed.

The Shortest Route?

The main idea of the Clapham Junction method is that leads should be taken by the shortest and easiest route from any one point in the set to any other. This is all very well in theory, but in practice one has to be careful or horrible tangles may result. If, for example, you ask my friend Bloggsopp to raise the panel of his set so as to expose its hidden side you will be confronted by what looks like a macaroni pudding that has been struck by lightning. Bloggsopp's set never works really well, in fact I have seldom heard anything from it but squeaks and howls which he puts down to the activities of the fellow next door. It used to be held that genius was an infinite capacity for taking pains; in the light of later knowledge we know that real genius consists in taking infinite pains to eliminate capacity. If, therefore, you must adopt the Clapham Junction method, let me give you one word of advice. Tell your better half that the dish which you desire above all others to see upon your table is macaroni. Bid her serve it up *au naturel*, *au gratin*, in puddings and in soup for a solid week at every meal. By the end of this time you will have conceived so firm a loathing for the mazy coils of this indigestible substance that you will avoid any resemblance to it in the wiring of your set.

Pliers

There remains the third or cat's cradle system, which is carried out with stiff bare wire. You have always been taught that leads should be kept as short as possible. That is why when using stiff bare wire to make a junction from, say, the aerial terminal to the fixed plates of the condenser you proceed in the following simple way. Snipping off about two yards of wire, you solder one end—it does not really matter which—to the aerial terminal. The wire now stands up straight on the point of soldering. Seizing a pair of pliers, you bend it sharply downwards about 4 in. above the terminal. Next, armed with any number of flat-nosed pliers that you can manage to hold in your hands and teeth, you take the first turning to the left and go down a bit, then the second to the right, and go up for a short distance, and so on and so on, until, after a jolly little series of right and left-hand bends, combined with ups and downs, you have used up the whole of the wire. The free end is now soldered to the contact point of the condenser. All other leads beneath the panel are fitted by the same engaging process. When you have finished the job you will have a set with wiring that is really worth looking at. Lots of fellows are so proud of their wiring when carried out in this way that they do not want to cover it up in a cabinet. That is why the American type of set, which can be used with its viscera fully exposed to the eye, is now so popular with bare wirers.

I have now described the best methods of wiring a set in such a simple way that even you can understand them. Always remember that careful neat wiring is *the* thing which makes for efficiency. When I wired up my set first of all I was most careless about it. I did not solder a single connection; I did not even use connections made of the same kind of wire. The filament circuits were done with odds and ends from the tops of gingerbeer bottles, whilst fencing wire flex, barbed wire and even hairpins were to be seen in other parts of the set. The thing worked well enough, bringing in all the broadcasting stations at full loud-speaker strength on one valve. But no real expert—and I think that I can claim without undue immodesty to be such—could be satisfied with its appearance. I therefore entirely re-wired it, soldering all the joints and using nothing but the fattest

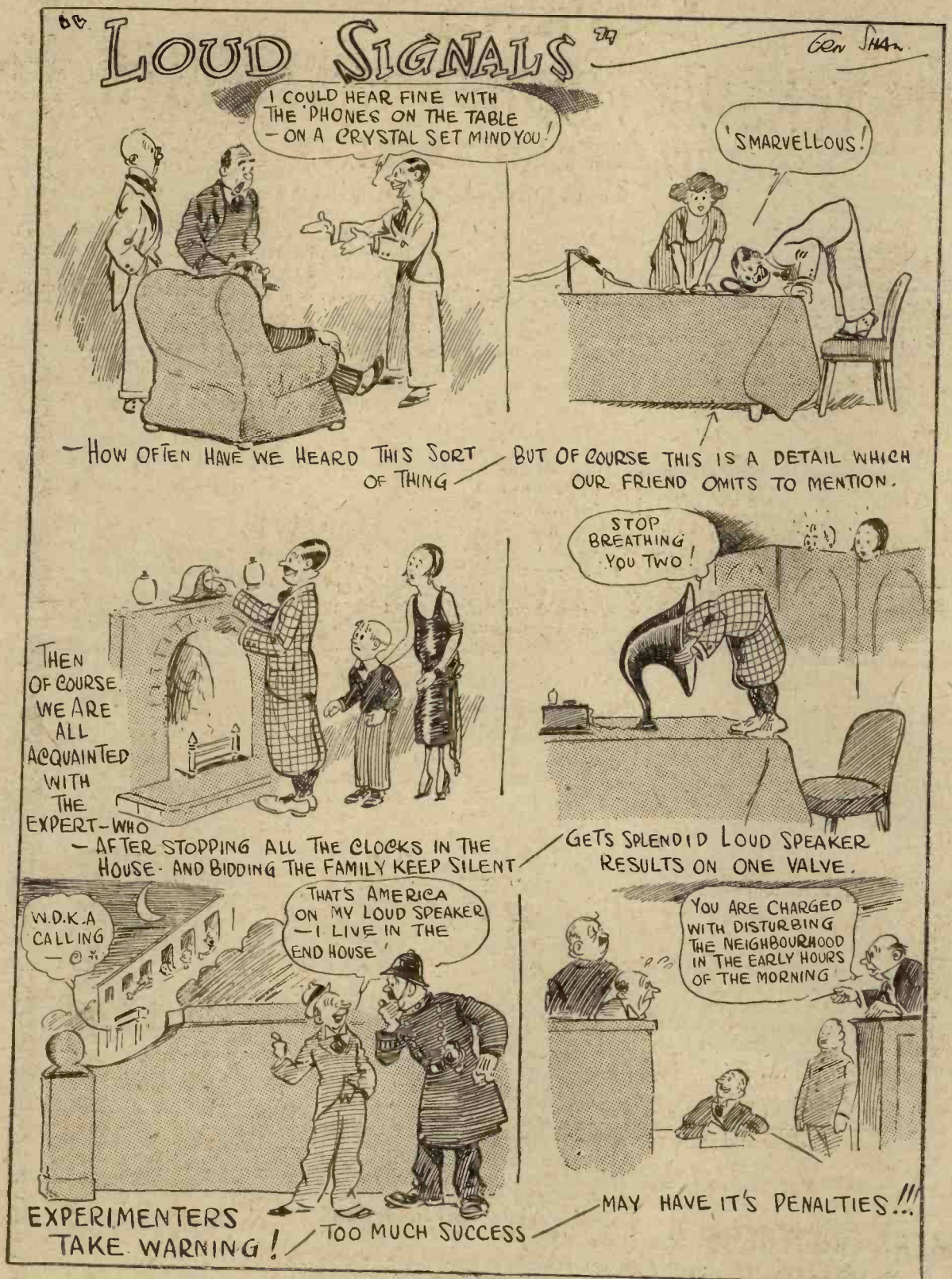
Any number of pliers.

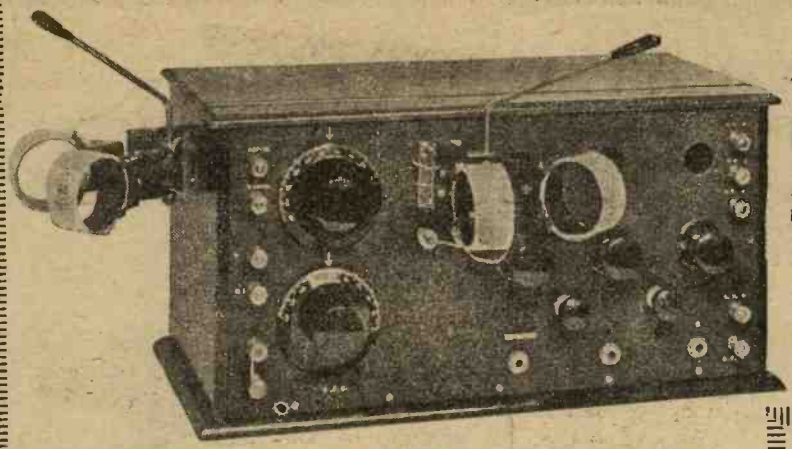
and stiffest of bare wire. I have not since been able to hear even London, but that does not matter in the least since I am fully satisfied that my wiring is now efficient, and I know that the underside of my panel is a perfect picture. Let me beg of you never to be satisfied with mere practical results, which anybody can obtain, but rather to strive ever after theoretical efficiency, which it is given only to the select few to achieve.

SPECIAL NOTICE

Query Department

Readers are advised that the Query Department is now re-opened, and queries, which should be accompanied by a fee of 2s. 6d. per question, can be dealt with. A stamped, addressed envelope should also be enclosed.


LOUD SIGNALS
I COULD HEAR FINE WITH THE 'PHONES ON THE TABLE — ON A CRYSTAL SET MIND YOU!
'SMARVELLOUS!
— HOW OFTEN HAVE WE HEARD THIS SORT OF THING
BUT OF COURSE THIS IS A DETAIL WHICH OUR FRIEND OMITS TO MENTION.
THEN OF COURSE WE ARE ALL ACQUAINTED WITH THE EXPERT — WHO — AFTER STOPPING ALL THE CLOCKS IN THE HOUSE AND BIDDING THE FAMILY KEEP SILENT
STOP BREATHING YOU TWO!
GETS SPLENDID LOUD SPEAKER RESULTS ON ONE VALVE.
W.D.K.A CALLING — @ *
THAT'S AMERICA ON MY LOUD SPEAKER — I LIVE IN THE END HOUSE
YOU ARE CHARGED WITH DISTURBING THE NEIGHBOURHOOD IN THE EARLY HOURS OF THE MORNING
EXPERIMENTERS TAKE WARNING!
TOO MUCH SUCCESS
MAY HAVE IT'S PENALTIES!!!



This photograph shows how the aerial and reaction coils are coupled to the two secondary coils.

A Three-Valve Receiver with Split-Secondary Tuning

By C. P. ALLINSON

THERE are many experimenters who favour the "detector and two note-mag." combination of valves. If, however, such a receiver is used within 10 to 15 miles of a main broadcasting station considerable difficulty may be experienced in eliminating its transmissions, even though a loose-coupled circuit be employed. Further, when reaction is used, as is of course necessary to receive distant stations, every variation of reaction coupling necessitates a readjustment of the closed circuit tuning condenser, and the alteration of the aerial coupling means an alteration of the reaction coupling.

By the use of "split-secondary" tuning this difficulty is almost entirely overcome. As the name implies, the secondary or closed circuit coil is divided into two portions in series with each other, one of which is coupled to the aerial coil, and the other to the reaction coil. With this arrangement, not only is there a very large increase in selectivity, but the aerial and reaction couplings do not interact on each other to a very appreciable extent, nor on the tuning of the closed circuit.

Plugs and Jacks

In order to allow of the number of valves in use being varied at will, jacks have been used. These are employed in preference to switches, as not only do they simplify the lay-out and wiring, but their use also ensures that when using the detector valve only the value of high-tension voltage being applied to the L.F. valves is not transferred to the detector, as usually occurs when a two-way switch is used. In the latter case, if the low-frequency amplifying valves are switched off a hasty readjustment of reaction is usually necessary, as the higher plate voltage then applied to the detector may result in the set breaking into oscillation. Filament control jacks have been used, so that when the plug is withdrawn the set is switched off and the valves are not so liable to be accidentally damaged. In order to simplify the wiring, only two of the filament contacts on each jack have been used, and these are all wired in parallel, so that placing the plug in any one jack switches on the L.T. Valves not in use can be turned out by means of the filament resistances.

The Circuit

On consulting Fig. 1 it will be seen that three valves are used—

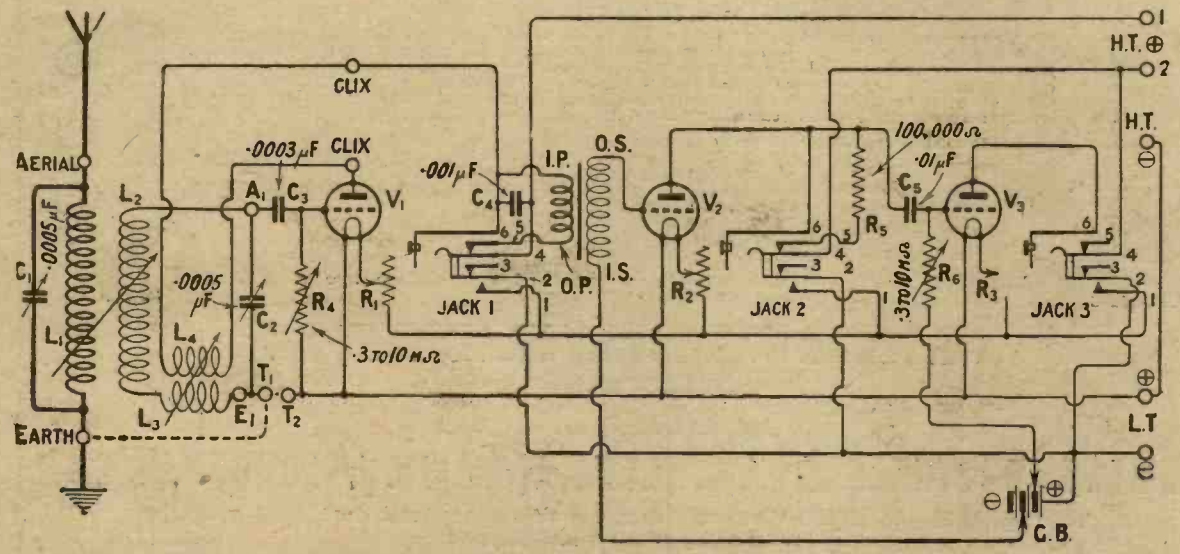
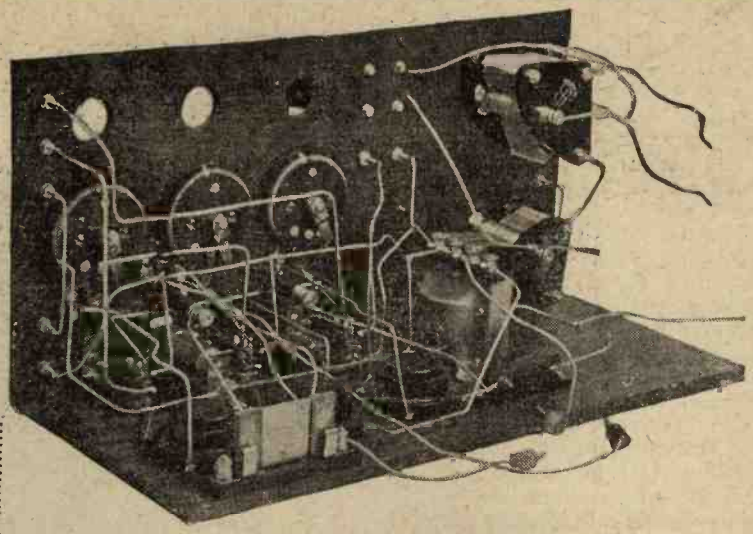


Fig. 1.—The theoretical circuit of the receiver shows how the jacks are wired to provide a handy L. T. switch.

The "split-secondary" arrangement of tuning not only makes this receiver very selective, but simplifies the use of loose coupling, as the alteration of reaction coupling has only a slight effect on the tuning. Pure reproduction is also obtained by the use of a stage of resistance capacity coupling



A back view of the receiver which will assist in following the wiring.

namely, a detector followed by two stages of low-frequency amplification. One stage makes use of resistance capacity coupling in order that pure reproduction may be obtained. This has been made the second stage, as any distortion that may possibly occur in the inter-valve transformer is less at low load. Also there is no appreciable change in the voltage applied to the plate of the detector valve when the phones are substituted for the primary of the L.F. transformer, as there would be if they were put in circuit instead of the usual coupling resistance employed in resistance capacity coupling, owing to the large voltage drop that may occur across this.

Four coils are needed for tuning and reaction; one for the aerial circuit, L_1, will be of the usual size—namely a 35 or 50, according as to whether it is desired to receive the lower or higher broadcast wave lengths—two, L_2 and L_3, for the secondary circuit, which may both be of the same size (two 35's or two 50's will do very well), and one for reaction L_4, which may be a 35 or 50. It will be found that two 50 coils for L_2 and L_3, though appearing to be equivalent to one 100, nevertheless allow Brussels on 265 metres to be tuned in, while the highest wavelength that can be received is in the neighbourhood of 700 metres. Two 35's in that position will just tune up to Aberdeen, and allow of amateur transmissions on 200 metres being received. The above results were obtained using a ·0005 μF tuning condenser which has a very low minimum. The actual make will be found in the list of components, though of course many others are quite suitable.

Some Values

The other components used have the usual values, but for the benefit

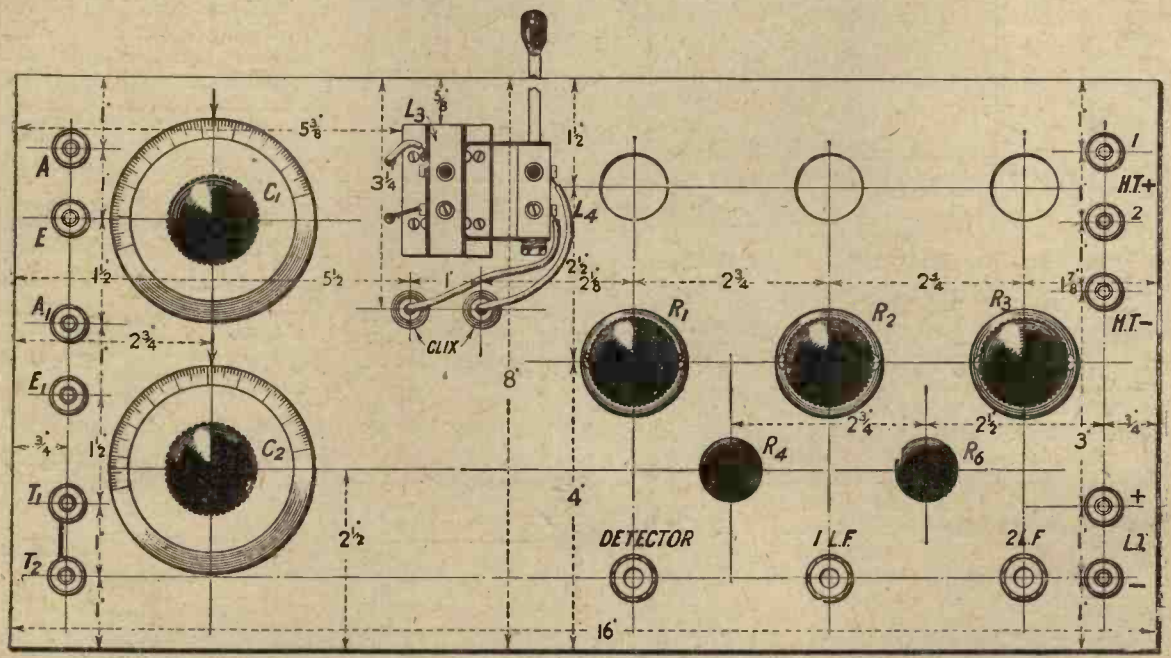


Fig. 2.—The symmetrical layout of the panel will be appreciated. Blue print No. C1015A (full size) may be obtained, price 1/6 post free.

of those who may make their "debut" in wireless set making with this receiver, these values will be briefly given. The aerial tuning condenser C_1, and the secondary tuning condenser C_2, are each ·0005 μF. The grid condenser may be a ·0002 or ·0003 μF, the latter value being used in this receiver. C_4, which is connected across the primary of the L.F. transformer, is ·001 μF, while the coupling condenser C_5 is a ·01 μF. No condenser has been shown across the output of the last valve, as its value depends largely on the make of loud-speaker in use. Useful sizes to try are ·004, ·006 and ·01 μF. The two grid leaks shown at R_4 and R_6 are variable, but if fixed ones are used they may be 2 megohms and ½ megohm respectively. R_5, the anode resistance, is one of 100,000 ohms. The three filament resistances, R_1, R_2 and R_3, should be suited to the valves it is intended to use. If bright emitters, they should be 6 or 7 ohms each, while for dull emitters a useful value is 30 ohms, so that an accumulator may be used. In the receiver here described dual type resistances have been used, so that either bright or dull emitter valves can be employed.

Adding H.F.

The two terminals T_1 and T_2 shown in the theoretical diagram have been included so that a stage of H.F. may be used in front of this receiver if desired. In normal use they are strapped across, but if it is desired to employ tuned anode this connection is broken, the terminal A_1 being connected to the anode of the H.F. valve and E_1 going to H.T.+. The connections to be employed are shown in Fig. 3, and this scheme allows of high-frequency amplification being added with a minimum of extra components.

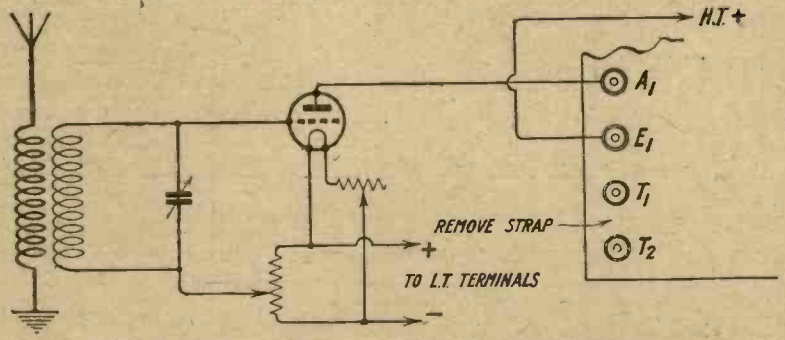
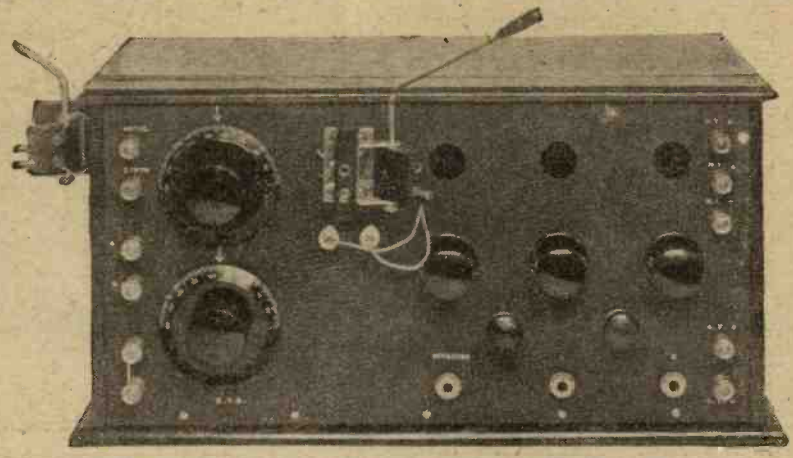


Fig. 3.—The addition of H.F. is a simple matter.

The Receiver's Appearance

As will be seen from the photographs, the finished receiver has a distinctive appearance, while the American type of cabinet with the valves enclosed (yet accessible through the lid) protects these from injury. The symmetrical lay-out is also most pleasing, and the bright nickel fittings are in striking contrast to the dead matt black of the panel. The cabinet is of the "All Concert" type, and, of course, may be in any wood that the constructor likes best. The front of panel lay-out is shown in Fig. 2, and is exactly to scale, while a full-size blue print No.C1015A may be obtained from our Sales Department. This blue print will be found of great use in marking out the panel, as it may be placed directly over it, and the various points at which holes are to be drilled can be pricked through with a scriber or sharp instrument on to the panel.



A photograph of the set with coils removed. No valve windows have been used, but may be fitted if desired.

Components

We here append a list of the components required, while for the information of those who wish exactly to duplicate this receiver, the actual makers' names have been given.

One ebonite panel, 16 in. by 8 in. by ¼ in. (Paragon, Curtis).

One "All Concert" cabinet with loose base board (Camco).

Two 2-coil holders, Type L (Burne Jones).

Two .0005 μF square law variable condensers (Jackson Bros.).

Two Collet dials.

One .0003 μF and one .001 μF fixed condenser (Peter Curtis).

One .01 μF clip-in condenser and mounting (McMichael).

One intervalve transformer (Formo).

One anode resistance, 100,000 ohms (Dubilier).

Two variable grid leaks (Bretwood).

Three "Antiphonic" valve holders (Burndept).

Three dual filament resistances (Burndept).

Three double-contact filament control jacks, and

One plug (G.R.C.).

Eleven nickel W.O. type terminals (Burne Jones).

Four Clix.

One tapped grid battery (Ever-Ready).

Square tinned copper wire, and a short length of rubber flex.

Other components may, of course, be used, but if good results are to be obtained these should be by makers of known repute.

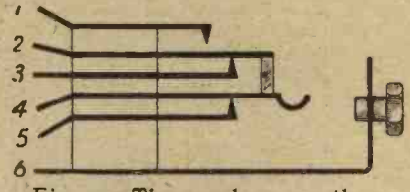


Fig. 4.—The numbers on the jack contacts correspond with those in Fig. 1.

Construction

The constructional work necessary is quite straightforward, and should present no difficulty. The

first thing is to prepare the panel. If this is of ebonite which is guaranteed free from surface leakage it may be marked out and drilled at once. Otherwise it should be carefully rubbed down on both sides with No. 0 glass paper till all traces of the original surface have been removed. Having drilled the panel (maker's templates will be found of use here), the transfers should be affixed next, and after this, if the panel has been rubbed down or sand-blasted, it should be wiped over with a slightly oily rag, so as to restore the black finish of the ebonite. Next mount all the components that go on the panel, and these may be wired up before affixing the panel to the base board. These connections will be most easily made in the following order :—

Flexible lead to grid leak R6, L.T.— to contacts No. 2 of all three jacks, filament resistances to contacts No. 1 of the jacks, aerial and earth terminals, terminals A_1, E_1, and T_1 to their respective points on the tuning condensers, contact No. 4 on jack 1 to H.T.+ 1, and contacts No. 4 on jacks 2 and 3 together and to H.T.+ 2, L.T.+ to H.T.—, and a lead to the variable grid leak R_4, which will go to the L.T.+ bus bar.

The Base Board

The components that go on the base board may now be mounted, making sure that the lay-out in Fig. 5 is carefully followed. The following connections can be made before the panel is fixed to the base board, in the order given.

Anode resistance to anode of V_2 and to one side of C_5, other side of C_5 to grid of V_3, fix a lead on to the terminal of the anode resistance which is nearest the edge of the base board (this goes later to contact 5 of jack 2), grid condenser to grid of V_1, grid of V_2 to O.S. of L.F. transformer, bus bar to three filament contacts which go to L.T.+.

Completing the Connections

The panel may now be fixed to the baseboard by means of five ½-in. No. 3 wood screws, and the remaining connections completed. The chief connections that might present any difficulty should be made in the following order, and the various connections not mentioned can be made afterwards, as is most convenient.

Lead from anode resistance to contact 5 of jack 2, one side of C_4 to the H.T.+ 1 lead from jack 1, I.P. of transformer to Clix and contact 6 of jack 1 and other side of C_4 to same point, contact 5 jack 1 to O.P., anode of V_1 to Clix, grid leak R_4 to grid of V_1, filament resistance R_1 to filament lug of V_1, anode of V_2 to contact 6 of jack 2, filament resistance R_2 to V_2, anode of V_3 to contact 6 of jack 3, filament resistance R_3 to V_3, L.T.+ to bus bar. Pieces of flex which go to the moving coil holder which is fixed on the side of the cabinet, are fixed to their respective points, and before fixing the panel into the cabinet the grid battery may be mounted on the back of this in a convenient position. Three small brass

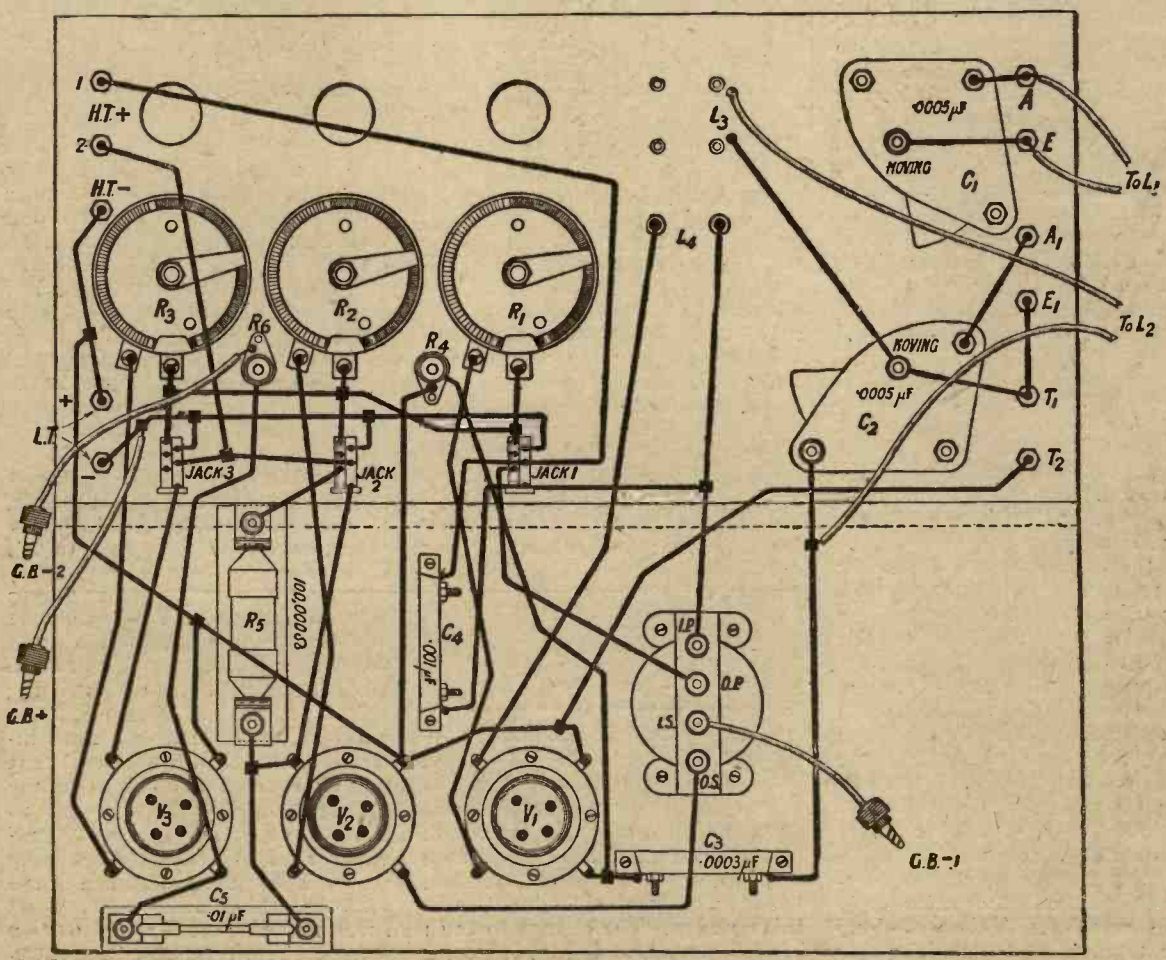


Fig. 5.—This drawing shows the positions of the components on the baseboard, together with the actual wiring of the receiver. Blue Print No. C1015B.

clips are required, one for the battery to rest on and the other two to hold it against the cabinet. The panel can now be placed inside the cabinet, and the connections to the coil holder on its side completed. The leads from A and E go to the moving coil holder (L_1), the leads for L_2 going to the fixed socket. Two short leads ending in Clix are attached to the moving coil holder on the panel, and provide a handy means of reversing reaction when coils with dissimilar connections are employed.

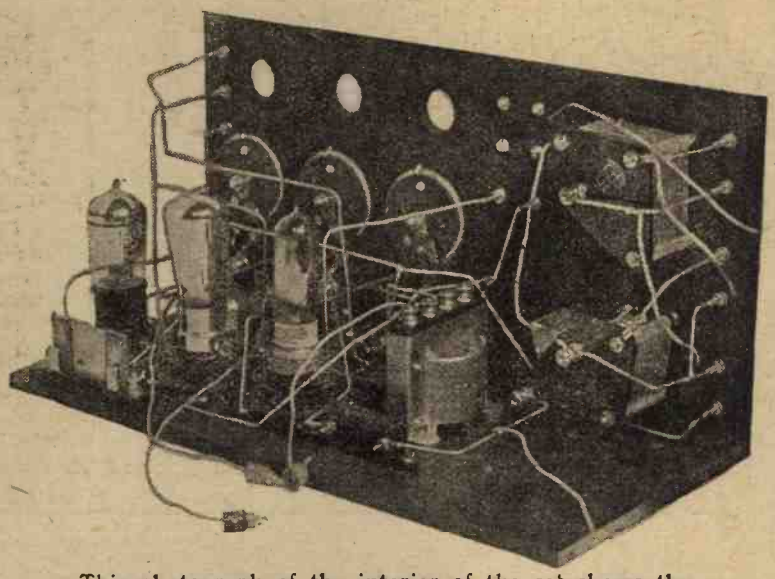
Testing Out

Having made sure that all the wiring has been completed we may now connect up. Place the required coils in the coil holders, remembering that the two fixed holders are the two halves of the secondary—that is, L_2 and L_3—connect aerial and earth to the top two terminals, and the two L.T. leads to their respective terminals. Place the plug in one of the jacks, insert the valves, and switch each one on in turn by means of the filament resistances. If all is well turn out the valves and connect the H.T. leads, suitable values being 40 to 60 volts for H.T. + 1, and 80 to 100 volts for H.T. + 2. Swing the reaction coil away from the secondary coil to which it is coupled, and place the phone plug in the jack according to the number of valves you wish to use and tune in the local station. Now tighten the reaction coupling, and notice if the signals get louder; if not, reverse the connections to the reaction coil by means of the Clix.

Tuning

When searching for distant stations, only the secondary condenser need be used, the aerial tuning condenser being employed to get the transmission up to maximum strength after it has been found. The secondary condenser should be turned very slowly as the tuning is exceedingly sharp with this receiver, even when square law condensers are used with their even spacing of wave lengths. A little practice will soon show you the best method to adopt when tuning, and experience having been gained, the effect of varying the aerial coupling may be tried. Using this receiver the writer has been able to receive Manchester on his aerial, which is only 6 miles from 2LO, with practically no interference from the latter station while it was working. This was done without loosening the aerial coupling more than 10 or 20 degrees.

Single circuit tuning may be employed by connecting the aerial and earth leads to terminals A_1 and E_1 respectively, and placing a shorting plug in the coil holder in which L_2 is usually placed. Particular care must be taken when using this form of tuning not to interfere with near-by listeners. With this form of tuning the aerial coil may be a 35 or 50 for the lower and higher broadcast wavelengths respectively.



This photograph of the interior of the set shows the valves in position.

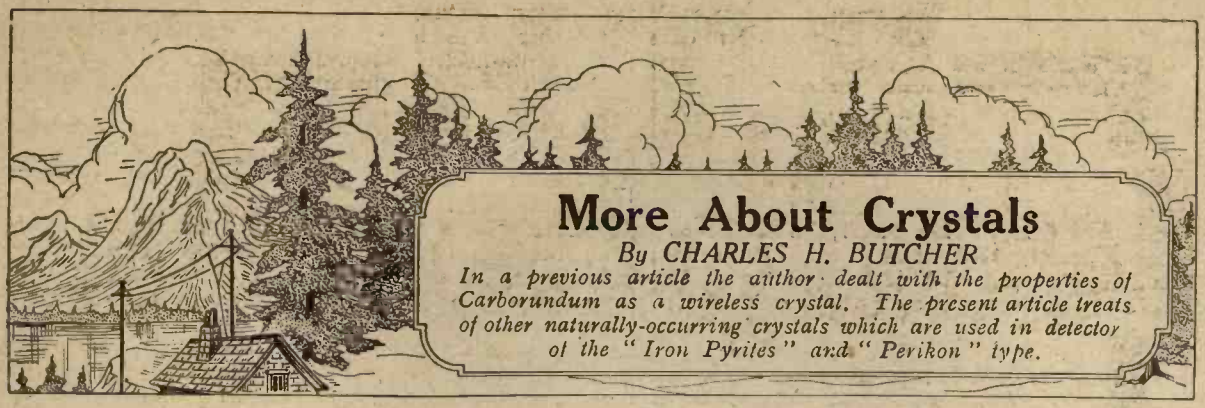
Results Obtained

On 2LO's transmissions, full loud-speaking was obtained, and after the necessary adjustments as regards grid-bias, &c., had been made the purity of reproduction was really excellent. In order to get the maximum amount of amplification from the resistance capacity coupled stage the second valve in the anode circuit of which the high resistance is connected was a D.E.5B type valve, while for the last stage a small power valve was employed. Excellent results are, however, obtainable with general purpose valves.

Although it was only reckoned that the set would work a loud-speaker on 2LO, some half-dozen other stations were tuned in on the loud-speaker at varying strengths, some of these being Continental transmissions, while on the headphones, even under very average conditions, no difficulty was experienced in going the round of the B.B.C. stations, these being received at good strength. Dozens of foreign stations were heard, but with the exception of the better known ones, such as FPTT, SBR, Voxhaus, Zurich, Madrid and one or two others, were not identified. These results were obtained in a locality that is not too good for reception, so the writer would be glad to hear of results obtained by readers constructing this receiver, as such information is always of value, and is also a guide to the designing of other receivers.

ANOTHER STEP AHEAD

LAST summer Radio Press, Limited, took the bold step of transferring its offices from the quiet, old-world premises previously occupied in Devereux Court, Strand, to spacious and up-to-date apartments in Bush House, the finest office building in this country. The change to Bush House seemed, as indeed it was, a bold step, and many people questioned the wisdom of taking premises which at the time seemed unnecessarily large. Those who have watched the growth of this great wireless publishing house will learn with interest that the existing offices occupied by Radio Press at Bush House have now proved inadequate for their needs, and that additional accommodation on the second floor has been taken to house the steadily increasing editorial staff, leaving the existing premises for the sales branch of the business, which, owing to the great success of *Wireless Weekly*, *Modern Wireless*, THE WIRELESS CONSTRUCTOR, and the Radio Press Books, envelopes, and other publications, requires very large premises.



More About Crystals

By CHARLES H. BUTCHER

In a previous article the author dealt with the properties of Carborundum as a wireless crystal. The present article treats of other naturally-occurring crystals which are used in detector of the "Iron Pyrites" and "Perikon" type.

GALENA, either as the naturally occurring mineral or in some treated form, is now generally used in conjunction with a metallic "catswhisker" in crystal detectors for the reception of wireless signals from the broadcasting stations. There are, however, several other types of detectors in which natural mineral crystals are used for rectification, which give equally good if not better results.

In the "Iron Pyrites" detector, a gold point makes contact with a selected crystal of iron pyrites, the natural disulphide of iron. In general, this detector is very reliable, and when the pyrites is carefully selected the highest sensitivity is readily obtained. The crystal is usually fixed in a metal cup by means of Wood's metal, and the gold point, carried on a silver U-shaped spring, is pressed into sensitive contact and adjusted by means of a screw. Metallic antimony is sometimes used in place of the gold point, with increased sensitivity.

A Common Mineral

Pyrites is a common vein mineral, very widely distributed and often found associated with other minerals which have found application in wireless, such as copper pyrites and galena. It is pale brass-yellow in colour, and has a splendent metallic lustre. It is readily distinguished from copper pyrites (chalcopyrite) by its paler colour and by its hardness, being scratched by the steel blade of a pocket knife only with great difficulty. The massive material is usually met with, but definite cubic crystals and pyritohedrons are not uncommon. The faces of the cubic crystals are usually striated in a characteristic manner, the lines on adjacent faces being perpendicular to each other. The majority of iron pyrites is sensitive at almost any point on the surface, although, of course, the relative sensitivity of a number of specimens varies somewhat. The smooth natural faces of the crystals are usually found to be much more sensitive than surfaces exposed by fracture.

"Perikon"

The "Perikon" detector consists of a crystal of one of the double sulphides of iron and copper, chalcopyrite or bornite, pressing in contact with a crystal of zincite, the natural oxide of zinc. This type of detector is exceedingly sensitive, and is easy to adjust. The crystals are mounted separately in metal cups either by clamping screws or with Wood's metal, and the two are brought into contact by means of spring and screw adjustments. Sensitiveness depends to a large extent upon the pressure at the point of contact. Small pieces of crystal, slightly blunted rather than too sharply pointed, will be found to give the best results, and crystals of varying degrees of bluntness should be tried.

Zincite is a mineral of characteristic reddish-brown colour, found in unique deposits at Franklin Furnace, New Jersey, U.S.A., intimately associated with a number of rare minerals, including the black

Tom Mix, the famous film star, is here seen with his horse Tony. Tom Mix spoke recently from 2LO, when millions of listeners-in heard his impressions of England.

franklinite and the yellow-green willemite, and occasionally embedded in calcite of a slightly pink colour. It is generally massive or granular, with sometimes a laminated structure showing distinct cleavage. The quality of the zincite usually found in Perikon detectors is very inferior. Some crystals, apparently, have no really sensitive points, but there are specimens to be obtained which will make sensitive contact at practically any point. Crystals found to give poor results should be fractured to expose a new surface. The most sensitive points are to be found at right angles to the cleavage, and not on the actual cleavage planes. Such points must be carefully sought out by systematically examining the whole surface of a crystal. Unfortunately, zincite is not a very hard mineral, and is liable to crumble away at the point of contact. It is also liable to become insensitive by the close proximity of transmission discharges, and if therefore used on a receiver near transmission apparatus, the detector should be short-circuited while transmission is in progress.

Bornite

Bornite, or purple copper ore, which is mostly used in conjunction with zincite in the perikon detector, is easily recognised by the characteristic purple and blue tarnish acquired by freshly exposed surfaces. It is a massive mineral, brownish-bronze in colour when untarnished, and is an important and widely occurring ore of copper, found as a primary constituent in igneous rocks and as a secondary deposit in enriched copper veins. The best specimens for wireless purposes come from Chili and Peru.

Copper pyrites, or chalcopyrite, is brass-yellow in colour and often tarnished to bronze, or iridescent. It is the most common ore of copper, and occurs widely distributed in the form of metallic veins throughout the world. The freshly exposed surface of the massive mineral is preferable as a contact point when used with zincite. The natural faces of the tetragonal or sphenoidal crystals, which are by no means rare, do not appear to be generally sensitive to the same extent as fractures.

Many Theories

Many theories have been advanced from time to time to explain the rectifying properties of crystals, and it would appear that their action depends principally upon variation of resistance with temperature, and the production of an increase or decrease in temperature (Peltier effect) together with a certain amount of thermo-electromotive force. All crystals certainly exhibit unilateral conductivity, that is, they show predominating current transmission in one of two possible directions, but the true mechanism of this phenomenon is still surrounded by considerable mystery.

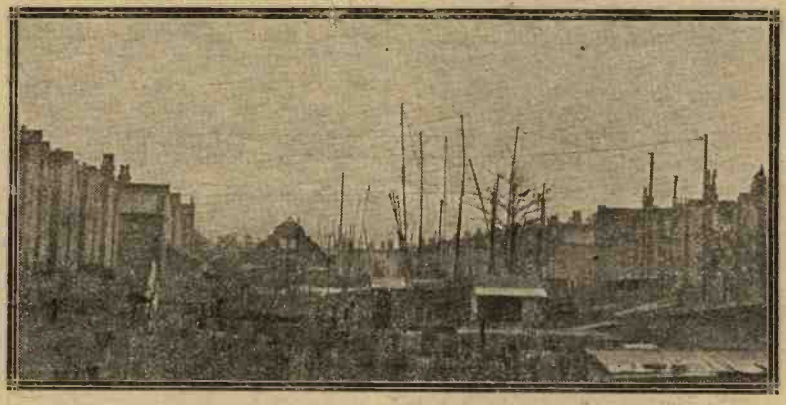
Unquestionably the internal structure of crystals determines their relative sensitiveness towards wireless signals. Crystals are polyhedral solid bodies bounded by plane faces mutually arranged in accordance with some definite plan of symmetry. This external symmetry is really a natural expression of the internal structure, or of the arrangement of the crystal molecules. The act of crystallisation is probably due to the operation of definite attractive and repulsive forces among these molecules, and results in the formation of a solid assemblage in which molecules arrange themselves in some definite and regular manner. Under the influence of wireless waves the molecular forces within the crystal are probably put under a certain amount of strain in one direction or another.

Different Efficiencies

Crystals of the same material show wide variation in their efficiency as rectifiers or detectors. It will always be found that certain parts of a particular crystal act better than others. This is more especially noticed when the natural faces of the crystals are tested. The direction of the current within the crystal and the position of the contact point largely determines the effectiveness in a perfect and symmetrical crystal. Many of the crystals used in detectors of the perikon type, such as zincite, bornite, or copper pyrites, will be found quite insensitive if casually examined. In many cases this insensitivity is merely due to the nature of the contact area, since fresh fractures may be found quite sensitive immediately they are tested. In other cases, the surface of the crystal may only be sensitive at particular spots.

Crystal Faces

In a perfect crystal, where the natural faces are clearly defined, the point where several interfacial edges meet to form a solid angle is generally found to give the best results, with clearness and maximum strength of signals. Of course, in a crystal fragment, it is not an easy matter to discover such a spot by mere observation. In testing, therefore, a large number of points all round the crystal should be carefully examined in turn, working systematically over the surface in accordance with some plan based upon the shape of the fragment. Never discard a piece of zincite, or iron pyrites, until all the possible points on the surface have been thoroughly tested. In the end your labours will be rewarded by the discovery of some sensitive spot which far exceeds your expectations.



They call it "Wireless!" How radio has captured the Fulham Road, London.

Broadcast Opera

THE ARTISTS IN THEIR RÔLES

By "CARRIER-WAVE"

Opera has become one of the most popular broadcast programmes, and in this article our contributor tells us some very interesting things about the well-known operatic stars and their rôles

Mr. William Michael as "Marcel" in "La Bohème."

Miss Gertrude Johnson, a well-known operatic star.

IT is not so many years since a well-known opera producer announced that he had had a most successful season, and had only lost £200!

Since then a battle has been waged every season to redeem this most important section of music from its position as the "Cinderella" of the Muse, but it has remained for the British Broadcasting Company to take opera willy-nilly into the homes of people unable or, in many cases, unwilling to hear it under its normal conditions.

The First Broadcast of Opera

Very early in its career the company made the experiment, as far back, indeed, as January 8, 1923, when, with the co-operation of the British National Opera Company at Covent Garden, "The Magic Flute" was broadcast, this being the first occasion in which opera was transmitted by wireless. According to Mr. J. C. W. Reith, there were surprisingly few hitches in the subsequent experiments, though occasionally errors would be caused in time, one being the occasion of a character continuing to sing his aria after he had been announced as killed. Of course, at the first proposal to broadcast opera, a storm of disapproval was evoked; I fancy that when a vote was taken a little later in the year, the percentage of operatic listeners-in was found to be only 4 per cent. To-day, owing to the continued co-operation of the B.N.O.C. and the "Old Vic." Company, the percentage would be a very high one. Previous to this, the high price of seats and all the accompanying expenses entailed precluded the support of the great bulk of the public, that very public which to-day would gladly dispense with all the high-brow classics foisted upon them in place of the melodies and stories found in opera.

William Anderson as the King in "Aida."

The Power of Imagination

Naturally, imagination must play a strong part, for no matter how familiar be the story or even the music itself, the loss of actual vision detracts from realism, and perhaps for this reason alone the broadcasting from the studio is not enjoyed so much as when heard from the stage itself. The preliminary hum of the audience, yes, even to the coughs in winter time, the tuning of the orchestra, and, most of all, the applause of the unseen audience, all add to the illusion and enjoyment of opera at home. We are not likely to forget when the above companies gave us a chance of hearing Melba herself, and most of us will always remember the thrill caused when "La Bohème" was being performed, and the announcer said "Mimi now enters." The applause which greeted Melba at the close of that act lasted for five minutes in Covent Garden, and was probably echoed by the still vaster audience which extended as far as Madrid and Christiania. To-day it would be picked up all over the world.

Clothes and the Audience

There is another factor about opera that appeals both to the ear and to the eye, and that is its standard dress. One can feel more in sympathy with the "Hunding" of Mr. Norman Allin in Wagner's "Valkyrie" when we know that he is really fighting Siegmund in helmet, armour and spear-armed, instead of being clad in conventional attire singing before the microphone.

Mr. Allin has, indeed, one of the finest of bass voices, and whether as Hunding, Arkel (in "Pelleas

A well-known operatic star, Miss Beatrice Miranda, is here seen as Santuzza in "Cavalleria Rusticana."

and Melisande"), Guinemanes in "Parsifal," or Mephistopheles in "Faust," he is for the time being literally living the part. He is rightly included in "The Big Four" of the bass contingent, the other members being William Anderson, Frederick Collier and Robert Radford.

Mr. Radford, besides being a director of the B.N.O.C., has made equally famous his rôles in "Faust," "Tannhäuser," "Marriage of Figaro," as Pognor in "The Meistersingers," and his favourite comedy part, Osmin in "Il Seraglio."

In some early recollections, Mr. Radford admits that he was by no means a second child Handel to practise by stealth, indeed, his own earliest remembrance is at nine years old, putting the clock forward when sentenced to a daily half-hour of scales. But in later years, when he took up a musical career in real earnest at the Royal Academy, his bass voice developed, and his first operatic performance was as the Commendatore in Mozart's "Don Giovanni," at Covent Garden, with Hans Richter conducting. To-day there is not a principal bass rôle in which he has not achieved a triumph.

The Wagnerian Operas

Considering that not fifty years ago Wagner's music was held up to scorn by the admirers of the Italian school—indeed, Signor Tito Mattei used to call "Tannhäuser" "cat's drama"—it would surprise many that a recent plebiscite resulted in the list being headed by "The Meistersingers."

Mr. Robert Parker is perhaps best known for his interpretation of "Hans Sach" in this opera, though his rôles range from Wotan, a

Miss Edna Thornton as "Delilah."

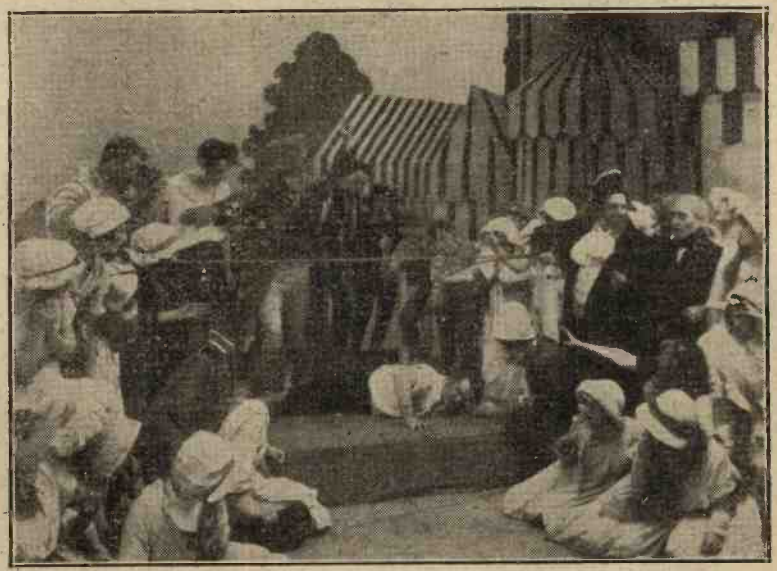
veritable god of wrath, to Amfortas, Wolfram, Tonio, the Wizard ("The Perfect Fool"), to Kurwenal, and all of them magnificent character studies and marvels of detail. He has had ideal support from Miss Miriam Licette, one of the most beautiful of "Evas," Constance Willis as Maddalena, as well as Robert Radford for Pognor, and Tudor Davies as the Walther for the famous Prize Song, and also Walter Widdup.

Miss Marguerite Davis, who played the part of Polly in "The Beggar's Opera."

The Lighter Operas

When we turn to the lighter operas we find some fine feminine stars, including Miss Beatrice Miranda, who, like Florence Austral, Elsie Treweeke, and Gertrude Johnson, is an Australian, and a most versatile singer, her parts ranging from "Santuzza," in "Cavalleria Rusticana," to the great Wagnerian rôles, and particularly in "Aïda" (Verdi).

Miss Edna Thornton is best known to us for her "Delilah," though very close in favour are her "Freia" and "Azucena." In the ever popular "Tannhäuser," we have Miss Elsie Treweeke, as the temptress "Venus," though she can become an equally effective Witch in "Hansel and Gretel." Miss May Blythe is one of the most popular of



A scene from "Hugh the Drover." John the Butcher (Frederic Collier) is "knocked out" by Hugh (Tudor Davies).

Mr. Norman Allin, who is here seen as Hunding in "Valkyrie," has one of the finest bass voices in Opera.

broadcast artists, and she has been heard in every rôle, from the Mother in Humperdinck's opera to Siebel, in "Faust."

As the "Perfect Fool," with a one-word part, Mr. Raymond Ellis acts admirably, but from a vocal standpoint, he is best in such plays as the Mozart operas, "Marriage of Figaro" or "The Magic Flute."

Andrew Shanks, too, is known for his parts in these operas, his Count Almaviva and Shapless have been heard again and again.

Othello

Perhaps the most famous part of Frank Mullings is that of Othello. He is supposed to be the counterpart of Tamagno, for whom Verdi wrote his opera. Certainly to hear Mullings run the gamut from tender love, to suspicion, anger and frenzy, to that last terrible climax can be as well enjoyed by ear as by eye. Few artists reach greater dramatic heights. His Rhadames is a person of human thought, Parsifal the "simple youth taught by pity," and his parts in "Phoebus and Pan," "Pagliacci," "Apollo," in the modern "Alkestis," are all masterpieces of dramatic art.

Mr. William Michael

Mr. William Michael is another fine character actor. He is able to go from Beckmesser, in "The Meistersingers," to Marcel, in "La Bohème," with equal smoothness and power, while his Alberich is always acclaimed.

Mr Sydney Russell has been responsible not only for his own singing, especially in the modern "Gianni Schicchi," of Puccini, but for his production of operas for studio purposes for the B.B.C.

William Anderson plays all bass rôles with equal facility, but is especially successful in "Aida," while another popular figure is Joseph Farrington, who is, perhaps, best known as the King in Dame Smyth's opera "Fête Galante."

"The Beggar's Opera"

Turning further afield, we have Miss Marguerite Davis, the charming heroine of "The Beggar's Opera," which was also broadcast from the Lyric, Hammersmith, with such success, and Miss Mary Lewis, as the dainty Mary, in "Hugh, the Drover."

All these parts have been taken

Frank Mullings as Othello.

by various artists of the opera companies, but one thing is certain, the dresses remain practically the same, so that no matter to whom

Doris Lemon and Raymond Ellis in their "bird duet" in "The Magic Flute."

we listen "over the aether," we can picture them in such dresses as are worn here.

Making the Most of Your Loud Speaker

(*Concluded from page* 717.)

it is wise to try values between ·001 μF and ·01 μF. You will easily notice the difference as the size of this condenser is increased, and when it is too large speech becomes muffled and the higher musical notes are lost. Nearly every make of loud speaker requires a different value, and those who neglect to experiment a little in this direction are not giving the instrument a fair chance. The makers, I find, are always pleased to give advice in this matter, and one well-known maker actually supplies condensers of approximately the correct value for the different types of instruments they manufacture. Lastly, don't forget that most loud speakers have a means of adjusting the distance between the diaphragm and the magnets. The diaphragm should be adjusted so that it does not touch the magnets when the loudest musical passages are being received. Be kind to your loud speaker and it will be kind to you.

THE CHOKE AMPLIFIER UNIT.

SIR,—I have made up the choke amplifier described by Mr. J. W. Barber in THE WIRELESS CONSTRUCTOR of April. I have tacked it on as a second stage of L.F., the first being reflex (Scott Taggart, No. 74). The combination is excellent, and the choke unit gives the extra volume and purity to make Chelmsford quite a pleasure on the speaker. In the choke unit I have used the Success coil—a ·01 condenser, and a Lissen variable grid leak. It is curious, if not rather significant, that the amount of leak in operation appears to make but little difference!

The combination is far superior to two transformers. I have used two square law condensers—R.I., P.M. detector—separate H.T. to the two valves, and grid-bias on the second. Valves 2 B.T.H., B6., Ideal voltage reflex valve 39, choke 96, with 4½ Neg grid-bias. I am much obliged to you for the article. By the way, the first unit has a Success transformer. I am nearing the end of a long illness, and am still in bed, where I have done most of the work.

Yours faithfully,
G. BOUSFIELD,
M.B., B.S. Lond.
Denmark Hill, S.E.5.

THE MARCH SINGLE-VALVE RECEIVER.

SIR,—As you request readers to write about their results, I am writing to let you know the success I am having with the "sharp-tuning" single-valve set described by Mr. Rattee in the March number of THE WIRELESS CONSTRUCTOR.

It is really a wonderful little set, and gives results equal to many two-valve circuits I have tried.

A great point in favour of it is its appetite for distant stations.

One night between 7 p.m. and midnight I tuned in thirty-two British and Continental stations all at good strength, without the aid of any note magnifiers.

Glasgow, 45 miles away, can be heard quite plainly on an Amplion loud speaker, all over a small room, and by adding a single-valve amplifier perfect loud speaking can be obtained.

Brussels, 500 miles, and Madrid, 1,100 miles, both come in at good 'phone strength on the straight circuit.

This morning, between 2 a.m. and 3 a.m., I tuned in KDKA on 326 metres, and WGY on 380 metres, speech and music being quite strong and clear at times. Then, later, I hooked on the one-valve amplifier, and heard four other stations, but was unable to get their call signs, as the conditions were not good and signals faded badly.

I have added a Watmel variable grid leak of ·5-5MΩ., and I think it helps in tuning distant stations.

I may say that I have received American broadcasting on every one of the Radio Press circuits that I have tried.

Wishing your papers every success.

Yours faithfully,
R. G. MURRAY.
Biggar, Lanarkshire.

"A SIMPLY-MADE SINGLE VALVE RECEIVER."

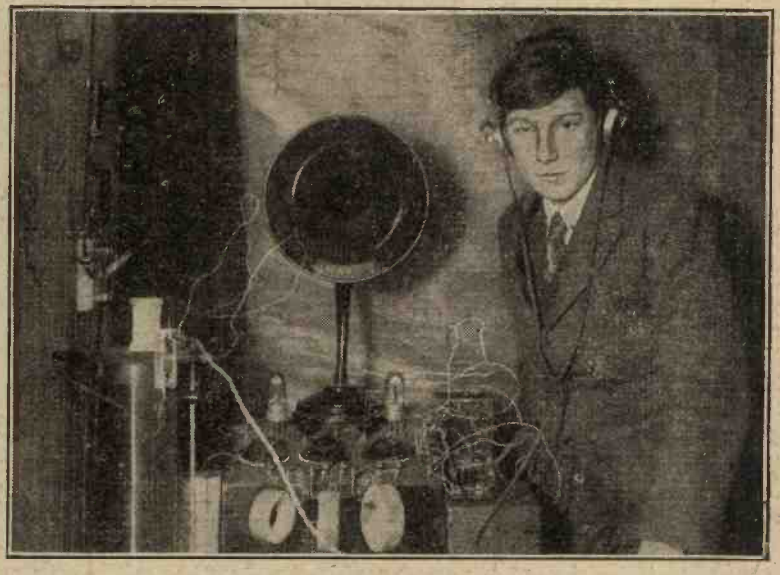
SIR,—I thought it might interest you to know that I have made the "Simply-made Single Valve Receiver" as described by Mr. Percy W. Harris in the December number of THE WIRELESS CONSTRUCTOR.

It is far the best single valve set I have heard, extraordinarily clear and pure in tone.

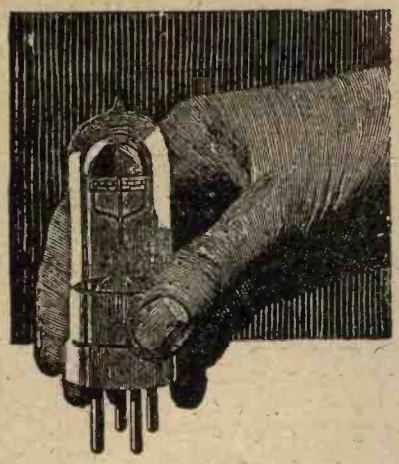
I live 20 miles north of London, and get 2LO too loud on four pairs of phones. Chelmsford, too, needs a lot of toning down. Birmingham, Belfast and Radio-Paris come through quite well.

I have also had Petit Parisien and Madrid.

Yours faithfully,
St. Albans. J. H. KITTO.



Master Robert Brittain, son of Sir Harry Brittain, M.P., who has been elected wireless adviser to his school at Harpenden. He is seen here with some of his apparatus.



Wuncell exclusive advantages featured:

IF you own a multi-valve Set using Bright Valves you will naturally decline to discard all your present valves in order to try out Dull Emitters. There's a better way than that with Wuncells. You can choose Wuncell W.R.1 or W.R.2 (see below) and use it at once alongside your other Valves. It has a special resistance within its base which enables it to function from a 4- or 6-volt accumulator. When all your bright Valves have been replaced by Wuncells you can short-circuit these resistances by means of the screws provided and alter your accumulator to give 2 volts with a greatly increased capacity. This advantage is found on no other Dull Emitter.

Technical Data:
Filament voltage, 1·2 to 1·8
Fil. consumption, ·3 amps.
Plate voltage, 20 to 80

Prices:

W.1 For Detector or L.F. Amplifier

W.2 (With red top) for long distance reception

18/- each

*W.R.1 Corresponding to W.1

*W.R.2 Corresponding to W.2

20/- each

*Fitted with internal resistance so that Valve can be used with 2-, 4-, or 6-volt Accumulator without alteration to Set.

That low filament consumption fetish!

TWELVE months' experience with Dull Emitter Valves working from Dry Batteries has proved to most wireless enthusiasts two things; first, that the low current consumption necessary for a Dry Battery means a whittling down of the filament to the point of fragility. Secondly, that if a multi-valve Set is used, large and expensive dry cells must be purchased to cope with the heavy current demands. It is not surprising, therefore, to find that prominent wireless engineers and experts attached to the various wireless magazines are wondering whether the price they are paying for the convenience of Dry Batteries is not out of all proportion to their advantages.

Obviously there are three distinct factors to be considered when choosing a Dull Emitter. They are (*a*) first cost, (*b*) upkeep cost, and (*c*) length of life.

No sensible man ever spent ninepence to save sixpence, yet that is exactly what you are doing if you choose your Dull Emitter on filament consumption alone. Current consumption, generally speaking, is influenced by the diameter of the wire used in the filament. The thinner the wire the less current it will consume. But obviously there is a very decided safety-limit, and a Valve that will give a tolerably long life in the hands of a careful laboratory worker would certainly not last long in the rough-and-tumble of everyday Broadcast reception.

The Cossor Wuncell Valve has been designed with a true realisation of the part it has to play in the hands of the average wireless enthusiast. In view of the immense popularity of the Cossor Bright Emitter we should not be doing our duty if the Wuncell carried the risk of fragility or lack of efficiency in the hands of the inexpert.

The Wuncell Valve is a long-life valve for two reasons—(*a*) because its filament glows only at 800 degrees (a dull red heat almost invisible in daylight), and (*b*) because its filament is essentially as robust and as stout as in any standard bright Valve.

Naturally this special filament is not an ordinary type of coated filament. It is manufactured under a process which is exclusive to the Wuncell.

That the Cossor policy of placing long life before current consumption is right is proved by the wave of popularity the Wuncell is enjoying. On every hand there is unmistakable evidence of public appreciation of its sterling qualities of greater sensitiveness, absolute reliability, and exceptional purity of tone coupled with an entire absence of microphonic noises. You'll end your search for an ideal Dull Emitter when you try the Wuncell.

Cossor Wuncell Valves

THE ONLY DULL-EMITTER VALVES SOLD IN SEALED BOXES

Advertisement of A. C. Cossor Ltd., Highbury Grove, N.5. *Gilbert Ad 2539*

Radio Press News

The latest of the Radio Press Book Series deals with "Wireless Faults and How to Find Them." Some details will be found below

THE inauguration of the Radio Press Test Department went far to remove the natural hesitation experienced by the average constructor when about to embark upon a new set, that hesitation being the result of a feeling that perhaps he might make a mistake in the wiring, incorporate a defective component, or experience some other misfortune which would completely nullify his time and trouble.

The constructor has always had the sense of confidence given by the absolute guarantee of soundness and dependability which accompanies every Radio Press design, and the Test Department completed that confidence with the assurance which its existence provides that if the finished set fails to function for any of the reasons enumerated the instrument can be taken to the Test Department, and there the trouble will be located. To many constructors, however, the Test Department always seems rather a last resource, since to invoke its aid involves parting with the set for some days, and, moreover, many people like to clear their difficulties for themselves. It is not surprising, therefore, that the latest Radio Press publication, "Wireless Faults and How to Find Them" (R.P. Series, No. 24, price 1s. 6d., or 1s. 8d. post free), by R. W. Hallows, M.A., Staff Editor, is meeting with a really extraordinary reception, in view of the short time which has elapsed since its publication.

Everywhere immediate appreciation is being given of the clear and lucid manner in which the author has treated the subject of fault-finding in general, it being quickly realised that his method of dealing first with the testing of separate components and accessories before passing on to the treatment of complete sets reduces the whole procedure of fault-finding to a process which can be followed quite easily by even the relative beginner.

The method given by the author for the use of a complete series of tests for each type of set designed to narrow down gradually the possible area of the trouble until it is tracked down in a particular circuit and finally in a particular component seems to be a specially time-saving one, and is probably the best method which could be designed for use under the average home constructor's conditions.

Complete separate chapters are provided explaining the testing of crystal sets, single valve sets, multi-valve sets and reflex receivers, which latter, of course, demand somewhat special treatment, since the symptoms they display when even the common faults are present are often somewhat peculiar. As a final aid to quick and easy location of faults, at the end of each chapter there is provided a summarised table which can be used as an aid to memory in running through the tests for any particular type of set, it being understood that the preceding chapters have previously been read and grasped.

Altogether, it is a book which no one should miss.

How It Works

THE INDUCTANCE

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

IN our April issue we discussed the way in which the condenser works. This time I want to talk about the inductance coil which is used in conjunction with a variable condenser for making up what we call in wireless a tuned circuit.

To understand properly what a coil does and how it does it we must see first of all something of the way in which an electric current travels along a conductor. All substances, as you know, are made up of countless numbers of those tiny bodies which are known as atoms. Each atom consists of a nucleus containing a positive electrical charge and a varying number of electrons—the tiniest bodies that we know of—which are nothing more or less than minute negative charges of electricity. Upon the number and arrangement of the electrons in the atom depends the nature of the atom itself and therefore also the nature of the substance which the atoms go to make up. In metals

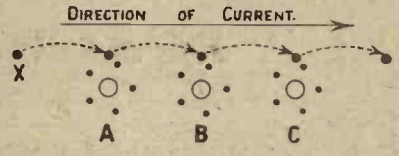


Fig. 1.—Illustrating the passage of current through atoms in a wire.

there is always one electron in each atom which is more loosely held than the others. These are known as the *detachable electrons*, and it is by means of them that currents are able to pass along a wire.

How Current Flows

Fig. 1 shows diagrammatically how current travels. In it we see what happens when one electron, X, leaves the negative pole of a battery in an endeavour to travel round a circuit and to get back to the positive pole. Electrons repel each other very violently. X, on leaving the battery at great speed, cannons into the first atom which lies in its path. This is represented by A in the drawing. The force of the collision is such that the detachable electron of this atom is driven out whilst X takes its place. The electron released from A collides with the next atom B, driving out and replacing its detachable electron. And the same process continues from end to end of the wire, the result being that a single

The "DRAGON" SHAPE
An Explanation of interest

IN Loud Speaker design it is important to secure the utmost efficiency in every essential detail, but at the same time the desirability of an attractive ensemble must not be lost sight of.

Without sacrificing one iota in the way of appearance, the AMPLION has the technical advantage of an extended and correctly developing sound conduit terminating in a radiating or amplifying trumpet occupying, together, a comparatively restricted space owing to the origination of the unique and now well-known "Dragon" shape.

Let the electro-magnetic element be of the most effective type, as that of the AMPLION certainly is, it is necessary to employ a lengthy acoustic duct of appropriate contour to enable the Loud Speaker to reproduce in full volume and tone.

To illustrate the outstanding feature of AMPLION "Dragon" design the "New" Junior-de-Luxe, Model AR 114, is shown as an example. With a back-to-front measurement of 11¼ inches only, there is afforded the equivalent of a "straight horn" Loud Speaker having an overall length of 21⅜ inches.

No other style of Loud Speaker possesses or even approaches the AMPLION in the qualities which, in association with a suitable Wireless Receiving Set, ensure "Better Radio Reproduction."

Obtainable from AMPLION Stockists and Wireless Dealers everywhere

electron entering at one end causes a single electron to be driven out at the other. Instead of one electron imagine millions upon millions entering the wire and the same number leaving it and you have some idea of what happens during the passage of an electric current. When you think of the countless collisions, expulsions and replacements that must occur you have some idea of the tremendous activity which takes place. If the current is heavy enough the agitation will be sufficient to make the wire white hot—this is what happens in the filament of a valve.

Now when electron activity of this kind takes place either in the body of a wire, as happens when

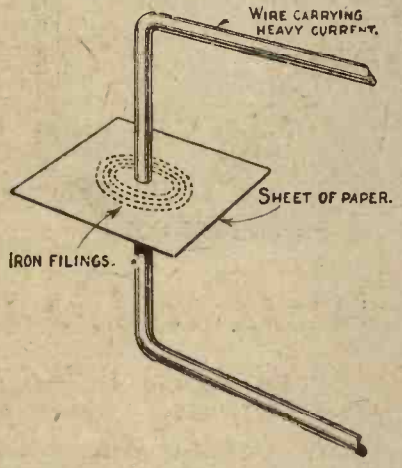


Fig. 2.—Iron filings are affected by the proximity of a conductor carrying heavy current.

direct current is flowing, or upon its surface only, as happens during the passage of high-frequency currents, the ether in and surrounding the conductor is affected. The motions of the electrons set up waves in the ether and a rather curious effect takes place. In Fig. 2 a simple experiment is shown which demonstrates the effect of the agitation of the ether by electron movements in a conductor. A wire carrying a fairly heavy current is passed through a hole in a sheet of paper which is so arranged that it lies horizontally. Fine iron filings are sprinkled gently on to the paper from a pepper pot. It will be found that they arrange themselves in concentric circles around the wire. The number and sizes of the circles formed will depend upon the magnitude of the current carried by the wire. To put it in other words we may say that round any conductor which is carrying a current there is a magnetic field. We must regard this field as a kind of invisible sleeve which surrounds the wire throughout its length.

Growth of Field

The "sleeve," or magnetic field, does not come into being *instantly*

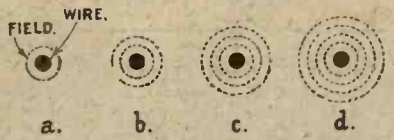


Fig. 3.—The manner of growth of a magnetic field around a wire.

when a current starts to flow. It seems to begin within the wire itself and then to form more and more rings outside it, these rings continually growing. Fig. 3 shows this process diagrammatically. The black portion in the middle of each of the little drawings represents a section of the wire, and the dotted circles round it represent the field of force. At *a* current has just been switched on. The field here is quite small. In *b* and *c* it grows in size until at *d* it reaches considerable dimensions. Now the field is built up by energy taken from the wire. This means that when we switch on, the flow of current round a circuit does not *immediately* reach its full value. Part of its energy is utilised in building up the magnetic field, and until this reaches its proper size the maximum rate of current cannot pass. To put it in another way, we may say that at the moment of switching on the building up of the magnetic field opposes the rise of current to its full value. As soon as the field is

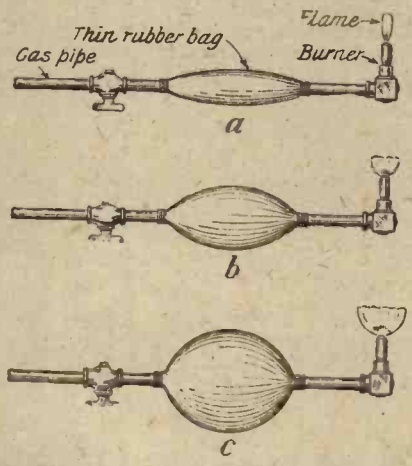


Fig. 4.—A simple analogy which explains the previous figure.

properly formed it offers no further opposition to the flow of current.

Opposition

But when we switch off, precisely the opposite effect takes place. Current does not immediately fall to zero. The magnetic field falls in, so to speak, in the same gradual way that it was built up, giving back the stored-up energy as it does so. Until it has collapsed entirely current will flow in the wire.

A Gas-pipe Analogy

We can obtain a clear idea of the effects of the magnetic field upon the flow of current by means of an experiment with a gas burner such as that shown in Fig. 4. Between the burner and the supply pipe we fix up a bag of thin rubber. We now turn on the gas and apply a light to the burner. The bag begins to fill, thus absorbing the energy from the pressure of the gas, and the flame at the burner is at first a very tiny one,

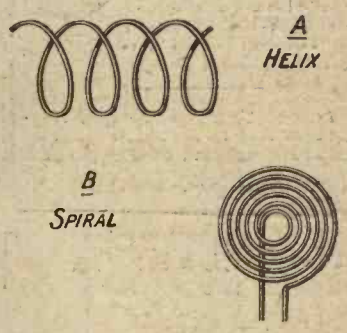
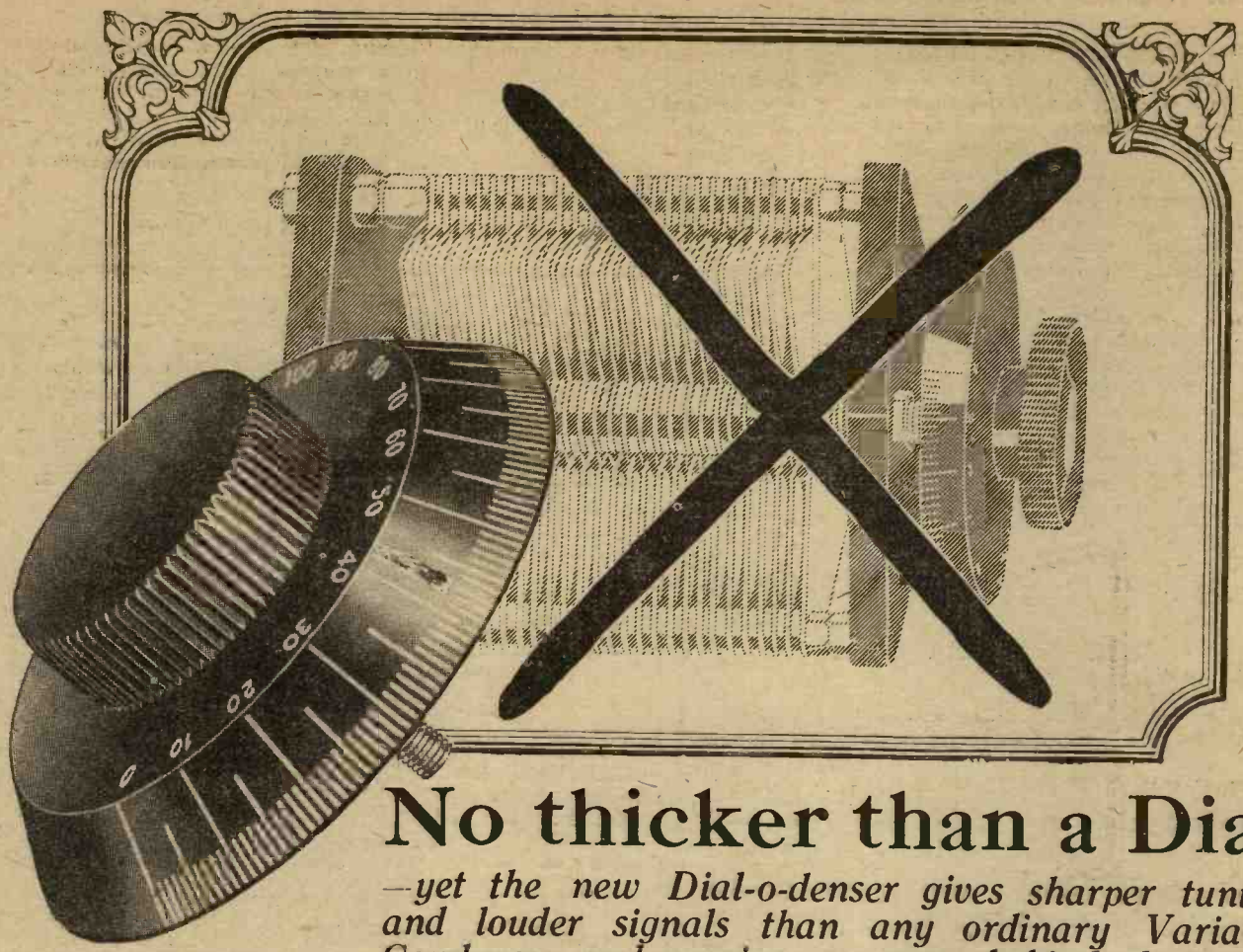


Fig. 5.—When a wire is wound as shown, its inductance is greatly increased.

as at *a*. A few moments later the position will be that shown at *b*. Here the bag has expanded considerably and the flame has grown in size. At *c* the bag is fully inflated and there is a large flame at the burner. The flame will now continue to burn quite steadily. When we turn off the gas tap the process shown in Fig. 4 will be reversed. The bag will fall in under atmospheric pressure, giving up the gas stored in it, and the flame at the burner will not be extinguished until it has collapsed entirely. If we look upon the whole length of an electrical conductor and its magnetic field as a collapsible tube through which current must be forced, we obtain a good idea of the effects of the "sleeve" upon a flow of current. We may say that, owing to the presence of the magnetic field, there is opposition to both the starting and the stopping of a flow of current in a circuit. Further than this, there is opposition to any change in the rate of flow. If, for example, by means of a rheostat we reduce the amount of current, the reduction does not immediately take place in the



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2. *All vanes—moving and fixed—totally enclosed and protected against dirt and dust.*
3. *A genuine low-loss condenser through the elimination of oxydisation losses.*
4. *Standard 2½-inch Dial no thicker than an ordinary Condenser Dial.*
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EVERYONE who has examined this revolutionary Variable Condenser declares that its possibilities are enormous. No thicker than ordinary Dial with simple one hole fixing, it can be used anywhere in the Set in place of the ordinary type of Variable Condenser. And because it is a true low-loss Condenser it will give better results—louder signals and more accurate tuning.

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A condenser that is fully guaranteed —that is accurate and cannot alter —that cannot be damaged in use— that is fully protected against dust and dampness—a condenser that costs no more, and in some cases even less, than a standard variable condenser with thick aluminium plates.

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"THE CONDENSER WITHIN THE DIAL"

circuit; it cannot do so until the field has collapsed to the appropriate dimensions. In the same way an increase in the current cannot be fully established until the field has completed the necessary enlargement.

Inductance

This property of conductors which opposes the starting and stopping of current as well as any change in the rate of flow is known as inductance. The electrical unit of inductance is the henry. When a raising or lowering by 1 volt of the potential takes one second to produce a change of 1 ampere in the current, the inductance of the circuit is 1 henry. In wireless we generally use the microhenry, that is, a millionth part of a henry, as the unit of inductance for measuring tuning coils; but an iron-cored low-frequency transformer may have an inductance value of several henries.

Inertia and Momentum

We found, if you remember, a mechanical analogy for capacity which we compared with springiness; can we find one for inductance? There is in all bodies at rest a property which makes them resist any effort to set them in motion. Think of a heavy rock resting upon the side of a hill. It has been there probably for thousands of years defying all efforts of wind and storms to move it. You place your shoulder against it and push. It gives a little, perhaps, but you can feel that it opposes your attempt to move it. To set it in motion a very great deal of strength may be required. This property which causes heavy bodies to oppose any effort to move them is known as *inertia*. Now, imagine that by putting out all your strength you overcome the inertia of the rock and set it rolling down the hill. What happens? It gathers speed as it goes, and if you tried to stop it you could not do so. It has now acquired another property which makes it resist any effort to deprive it of movement. This property is known as *momentum*. We see then that the rock resists both the beginning and the ending of all motion just as the inductance of a wire opposes the beginning and ending of a flow of current.

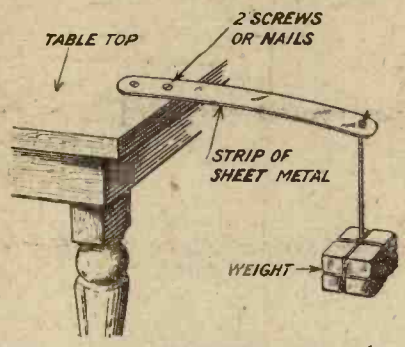


Fig. 6. — Inductance may be likened to weight in that it will control frequency of vibration.

A Further Analogy

We may see another excellent illustration of this property any day in a railway goods yard. Standing upon the rail is a loaded truck. Half a dozen men are endeavouring to set it in motion. After great efforts they succeed in doing so, and once it is going a single man can keep it moving without exerting any great strength. He could not, however, stop it by himself. To do so he must make use of the greater power of the brakes. Now the quality upon which both inertia and momentum are founded is *weight*, and if we think of inductance as being the electrical equivalent of weight we shall find it quite easy to understand how the coil plays its part

in a tuned circuit. We must regard the tuned circuit as containing the electrical equivalents of springiness and weight. Any wire has inductance, but this quality is enormously increased if we wind it into a helix (Fig. 5A) or a spiral (Fig. 5B). Every tuning coil must, when you come to think of it, be either a helix or a spiral or a combination of the two.

Weight and Inductance

Fig. 6 shows a simple experiment to demonstrate the effect of weight upon springiness. We take a strip of thin metal 12 or 15 inches in length, and fasten one end of it to the top of the workshop table by means of a couple of screws or nails. Next we depress and release the free end of the strip. It swings up and down fairly rapidly before coming to rest. We now tak a small weight, and fasten it to the free end of the strip. When it is depressed and released as before we shall find that it vibrates more slowly than it did in its original unweighted condition. The heavier we make the weight the slower will the rate of vibrations be. Thus we see that by adding weight to a spring we decrease the frequency of its swings. Now in wireless, as you know, the wavelength depends upon the frequency of the oscillations. The greater the frequency the shorter is the wavelength, and *vice versâ*. By means of the simple formula wavelength in metres = 300,000,000, divided by frequency, we see that a wavelength of 300 metres will have a frequency of

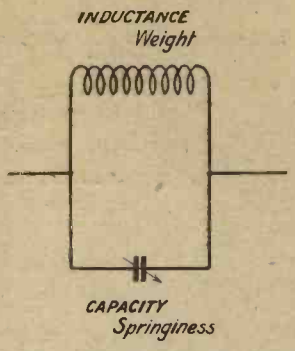
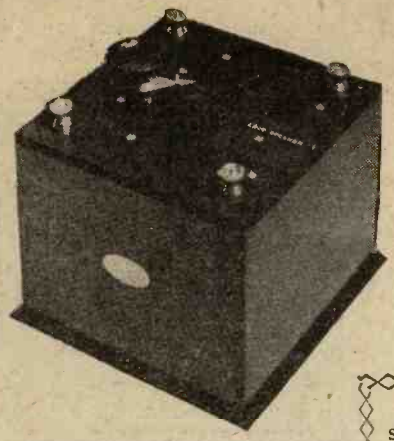


Fig. 7.—An oscillatory circuit containing inductance and capacity.

1,000,000 cycles a second, whilst a wavelength of 100 metres will have a frequency of 3,000,000 cycles. Thus the more we slow down the frequency of a circuit the higher is the wavelength to which it is tuned. Any increase of inductance in a tuned circuit such as that seen in Fig. 7, will have precisely the same effect upon the frequency as the addition of weight to the spring, seen in Fig. 6. The larger the coil is the greater will be the wavelength of the circuit.

Wavelength and Frequency

We see now exactly what we are doing when on changing over from 2LO to 5XX, we remove one inductance and replace it with a larger one. We are adding weight to the circuit, thus decreasing its frequency and increasing its wavelength. We tune the circuit to the precise wavelength that we want, within the limits of the coil in use, by means of the variable condenser. We can see exactly what the use of the condenser accomplishes by referring again to Fig. 6. In the drawing the extreme end of the metal strip is shown fixed to the table. In this position it will have its greatest springiness, and therefore its lowest frequency, or highest wavelength. If we reduce the projecting portion of the strip to half its length by fixing it to the table at about its middle point, we shall lessen its springiness and increase the rate of vibrations. By turning the knob of the variable condenser we increase or reduce the springiness and therefore tune the circuit exactly.



The instrument is compact and of symmetrical design.

Protecting Your Loud-Speaker

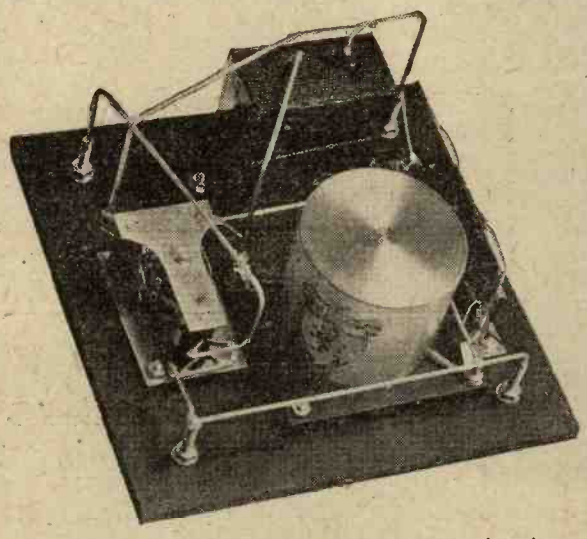
By JOHN UNDERDOWN

Loud-speakers and telephones are expensive instruments and it is well worth while to safeguard their delicate windings by means of the compact instrument described below

THE average amateur seldom realises that the windings of telephones and loud-speakers are very delicate in nature, and time upon time these are inserted directly into the anode circuit of low-frequency valves, and often when power amplifiers are used. In this position not only does the loud-speaker carry the necessary fluctuating current representing the signals received, but also the plate current of the last valve. Using some types of power valve this steady anode current is of considerably high value and will often cause a breakdown of the delicate windings to take place. To overcome this trouble, it is desirable that the windings of the loud-speaker should be isolated so as merely to carry the necessary signal current fluctuations, and not the heavy direct anode current of the last valve. To overcome this difficulty a simple type of filter circuit, such as that about to be described, may be used.

The arrangement used

Referring to the circuit diagram of Fig. 2, you will see a transformer coupled stage of low-frequency amplification which may be taken to represent the last stage in any set. Even if resistance capacity or choke coupled, the essential part to which we wish to refer will remain unaltered, namely, the arrangement shown in the plate circuit of the valve V. Within the dotted lines on this diagram is what is known as a filter circuit. This consists essentially of the choke Z and the condenser C1. The passage of direct current through the loud-speaker L.S. is completely stopped by this condenser, but the fluctuating currents representing signals are communicated through it and actuate the loud-speaker. The direct anode current supply to the plate of the valve is, however, carried by the choke Z, and does not pass through the loud-speaker windings. Thus, by this device, the loud-speaker windings merely carry signal impulses, and the danger of breakdown is considerably reduced. The condenser C2 is that normally connected across the loud-speaker for "tone" control purposes. C1 is of fairly large value since it has to pass frequencies of the audible range, and must have a low impedance to them. In practice, a value of 1 to 2μF is used in this position, and in the unit to be described is actually of 2μF capacity. The value of C2 will, of course, depend upon the type of loud-speaker used, and will generally vary from ·001 to ·01. If the value of this condenser is too low, the tone will tend to be shrill and somewhat tinny, whilst if too high the stage of "mellowness" can be passed and the resulting signals become "woolly" or "fluffy" in nature.



A photograph of the back of the panel, showing the simple construction and wiring.

To allow interesting comparisons to be made as to the effect of using the loud-speaker with the choke in circuit and without, a two-pole double-throw switch has been incorporated, and the necessary connections are shown in the diagram of Fig. 1. In this diagram the components are given the same letters as in Fig. 2, but it will be seen that the connections allow, with the switch in the left-hand position, the loud-speaker to be tried without the filter circuit, whilst with the switch to the right the filter arrangement is brought into use. The direct current in the plate circuit of the last valve now goes through choke Z, and the loud-speaker is isolated as far as this current is concerned. In practice, when heavy output is to be dealt with, the latter arrangement usually gives more satisfactory results than when no filter is used.

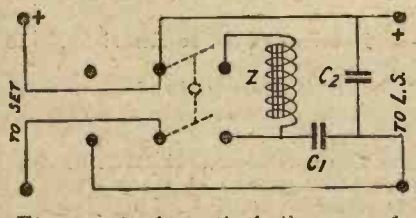


Fig. 1.—A theoretical diagram of the connections.

Components Required

In the construction of the unit the following components were used; advertisers' names are given

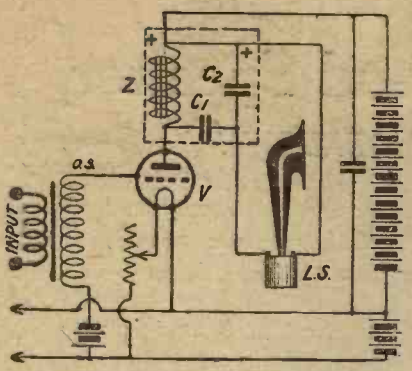


Fig. 2.—The last stage of a low-frequency amplifier, with the filter circuit incorporated.

so that if desired an exact copy can be made:—

One ebonite panel matt finish, 6 in. by 6 in. by ¼ in. thick (Paragon, Peter Curtis).

One suitable case to take above panel, 6 in. by 6 in. and any suitable depth to take the components on the panel. That shown in the photograph was made by the Carrington Manufacturing Co.

One "Success" choke (Beard & Fitch, Ltd.).

One 2 μF fixed condenser (T.C.C.).

One double-pole change-over switch. That used is the Gambrell anti-capacity type.

One McMichael clip-in condenser with clips. The value of this condenser will depend upon the type of loud-speaker to be used.

Four W.O. type terminals.

Quantity of 16 gauge tinned copper wire for wiring.

Seven 6 B.A. ½ in. screws and nuts.

2 ¾ in. 6 B.A. screws and nuts.

Drilling and Mounting

No difficulty will be experienced in mounting the components on the panel, as these are all held in position simply by screws through the panel, and nuts. Ample room is left inside to carry out the wiring, and to permit of the condenser across the telephones being readily changed. Wiring is carried out with 16 tinned copper wire, and from the diagram no trouble should be experienced in this part of the construction. The change-over switch is simply mounted by means of three screws, whilst a further two have been used as stop-pins to allow the switch contact to make correctly.

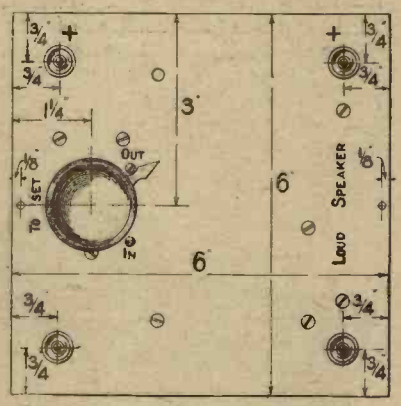


Fig. 3.—The drilling diagram.

Connections

To connect the unit to the set, the two terminals on the left-hand side of the panel are connected to

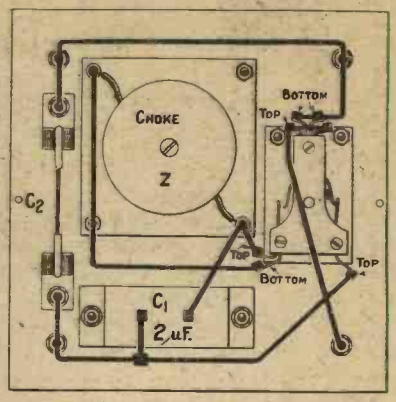


Fig. 4.—The practical wiring diagram. Follow the switch connections with care.

the telephone terminals of the set, that marked plus going to the plus telephone terminal. This latter is always identified by the fact that it goes directly to the high-tension supply. The loud-speaker is connected to the two left-hand terminals on the panel marked "loud-speaker," the plus of this latter being connected to the terminal marked plus on the right-hand side.

With the switch in the position marked "out" the loud-speaker is correctly connected to the set, whilst with the switch in the "in" position the filter circuit is brought into operation.

Our Minor Poet

"IF"

With all apologies to our National Poet

If you can tune your set when all around you
Are oscillating, and blaming it on you;
If you can trust your circuit when all friends doubt it,
But make excuses for the sceptics, too;
If you can wait (two minutes) and not tire of waiting,
Or, being jammed, don't deal in heterodynes,
Or, being baited, don't give way to baiting,
And yet don't look too sad or deal in whines;

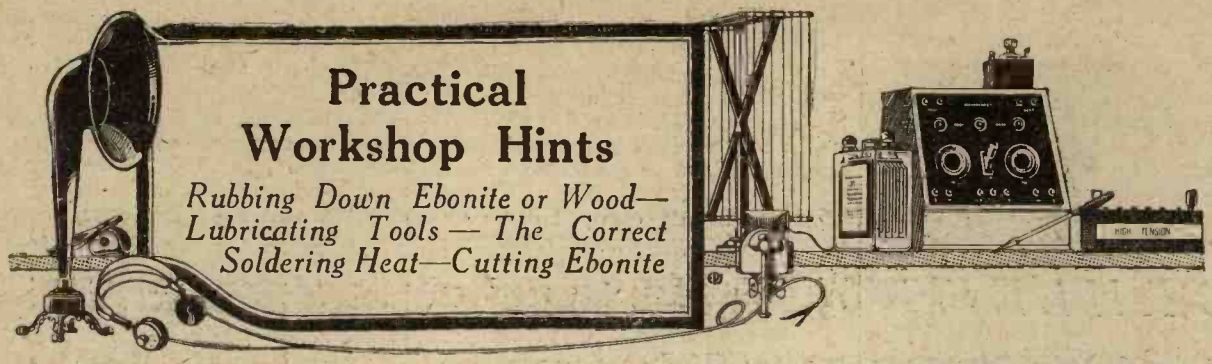
If you can build, and not make "prints" your master;
If you can hear—and not make sound your aim;
If you can cope with microphone and "blaster,"
And treat these two catastrophes the same;
If you can bear to see the valves bespoken,
Purchased by others to make a set for fools;
Or watch the set you gave your notes for broken,
And start to build another with new-found rules;

If you can make one test of a new wiring,
And risk it on one turn of switch and knob,
And "bust" the lot, but work without inquiring,
And never breathe a word about your job;

If you can force your valves and set and batt'ry
To serve their turn long after they are gone,
And so transmit, when there is nothing in them,
Except your cheek which says to them, "Go on!"

If you can bear the "talks" and keep your temper,
Or walk with experts, nor use the common stuff;
If neither plays nor lecturers can bore you,
If all pros count the same, but none enough
To fill the unforgiving minute with ninety seconds' waste of current run;
Yours is the wireless earth and all that's in it,
And—what is more—you'll be a "fan," my son.

L. B.



Practical Workshop Hints

Rubbing Down Ebonite or Wood—Lubricating Tools — The Correct Soldering Heat—Cutting Ebonite

Rubbing Down

THE business of rubbing down the ebonite of panels or the wood of cabinets is not really a very difficult one, though it is apt to be rather tedious and may take a considerable time unless you set about it in the right way. Let us take, first of all, the case of ebonite panels. Some constructors tear off a strip of emery cloth about 4 in. wide and fold it into a pad. This is simply pressed by the fingers upon the surface of the material and worked to and fro. I am not going to say that you cannot obtain a good preliminary surface in this way; you can, but it takes a long time, and it is very uneconomical in the matter of emery cloth. As regards wood for cabinets, some wireless men do their rubbing down in the way just described, using glass paper

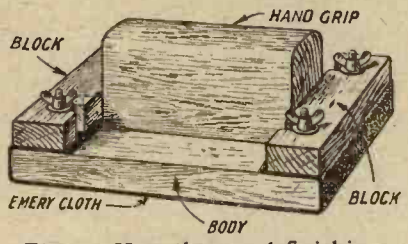
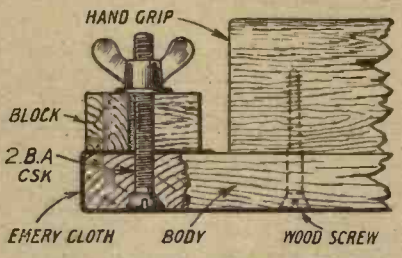


Fig 1.—How the panel-finishing tool is made.

instead of emery cloth, whilst others wrap the abrasive round a cork, holding it in place with the palm of the hand and the fingers. Of the two methods the latter is the better, though it is by no means ideal. I have found that a much better tip for finishing wood or ebonite is to use a special little tool for the purpose, which is very easy to construct in the home workshop. Its cost is almost nothing at all, and it takes perhaps half-an-hour to make. Not only does it render the work easier and quicker to do, but it also makes for a better surface, and last, but by no means least, it enables you to get more than twice as much useful service from a piece of emery cloth or sand paper, as you can obtain either from a folded pad or by the use of a cork.

Constructional Details

Fig. 1 shows the finished panel-rubber, which consists of a body made of 1 in. thick wood 3 in. wide and from 4½ in. to 6 in. in length to which is fixed, by means of a couple of screws, a hand grip with rounded edges. Two blocks of ½ in. hardwood, ¾ in. wide and 3 in. in length, clamped down by means of wing nuts, serve to hold tightly the ends of a strip of emery cloth or glass paper, as seen in the drawing. In Fig. 2 is



F g. 2.—Details of the clamping device.

shown the detail of the clamping arrangements. Two 2 B.A. screws with their heads well countersunk are inserted into the body of the tool at each end from its underside. The heads of each pair should be placed about 2 in. apart. In the blocks slots are cut, as seen in Fig. 1, to take the clamping screws. A washer is placed under each wing nut.

The tool is prepared for use in the following way, supposing, for example, that we are going to use fine emery cloth:—Cut out half-a-dozen strips of the cloth, each 3 in. wide and 3 in. longer than the body of the rubber. Lay them on the table, one on top of another, with their business sides downwards. Half-an-inch from one end pierce or punch two holes, which will allow the clamping screws to pass through them. At the other end make a pair of slits 2 in. apart, as shown in Fig. 3. Now lay the rubber upon the pile of sheets. Turn up the ends in which the holes have been made and pass them over the screws. Put on the block and the washers and turn the clamping nuts hard down. Stretch the sheets of emery cloth tightly, folding them round the edges of the body, and draw them up over the other end, so that the clamping screws here pass through the slits. Now slide the block into place and clamp down tightly. All this takes much longer to describe than to do. Actually one can "charge" the rubber very quickly indeed with either emery cloth or glass paper. When the top sheet has become so worn that it is of no further use, it is simply torn away, leaving a fresh one exposed and ready for work. You will be surprised to find how long a piece of either kind of abrasive lasts when used in this little tool. The other day I rubbed down one side of a piece of mahogany measuring 24 in. by 10 in., using only two strips of glass paper, one fine and the other of the finest grade obtainable. If I had been using glass paper simply folded into pads, I should have worn out two or three whole sheets in the process. It is best to make up a set of four of these handy little rubbing tools, filling one pair with two grades of emery cloth and the other with two of glass paper. In this way one can do one's surfacing work easily and quickly, for the required tool for the work is always at hand.

Lubricating Tools

Many constructors spoil their tools far too quickly by failing to lubricate them properly when they are in use. This applies particularly to work done in ebonite, which is a most deceptive material. It looks and feels soft, "cheesy" kind of stuff, which seems as if it ought to have little or no effect upon the cutting edge of a steel tool. As a matter of fact, ebonite dulls the edges of tools more rapidly than do many metals unless precautions are taken to use lubricants whilst work is in progress. The best lubricant of all, I believe, for tools that are cutting ebonite is turpentine. A good tip is to keep in the workshop a small bottle of turpentine (Fig. 4),

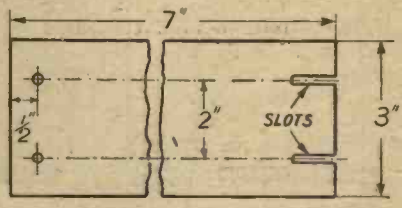


Fig. 3.—How the emery cloth or glass-paper is prepared for the panel rubbing tool.

through a hole in whose cork is inserted a little brush pushed down far enough to allow its bristles to be immersed in the liquid. With this brush one can apply a little drop of turpentine to cutting tools, which makes all the difference to the length of their useful life. When drilling, the best way is to put the drill dry into the punch mark where the hole is to be made and give it a few turns so as to enlarge the mark into a hollow about the same diameter as the

drill. Now remove the drill for a moment and put a drop of turpentine into this hollow before continuing the work.

The other material that wireless constructors mainly use for their work besides ebonite is brass. This is a peculiar metal in that it requires no lubrication at all. This fact makes matters rather difficult sometimes when one is making deep holes with a small drill, owing to the way in which the tool heats up when it is being worked dry. To prevent heating up in these cases I generally use a drop or two of water. Drills should never be allowed to heat up, for if you do so you are very liable to spoil the delicate tempering of the metal. By applying a few drops of water, refraining from feeding too fast, and taking care that the drill is not binding one can avoid overheating and its evil effects.

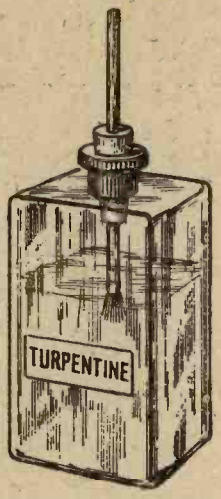


Fig. 4.—A handy lubricant bottle.

The Right Soldering Heat

The advice to use a *hot* soldering iron has been given frequently in these columns and elsewhere in THE WIRELESS CONSTRUCTOR; but many constructors, beginners especially, find themselves rather at a loss to know just when the proper heat has been reached. A tip frequently given is that the flames of the fire or the gas ring in which the iron is being heated should be watched carefully. As soon as they show a greenish tinge or a change in their natural blue colour, the iron is ready for work. This hint is an excellent one if the iron is clean, but if the bit is dirty or corroded and the tinning upon its point has lost its first freshness, these coloured flames may not appear until the iron is much too hot. A method which I have found to answer very well indeed is this. On the table beside me when I am engaged in doing a soldering job, I put a folded newspaper. I try the iron from time to time by placing the bit upon the paper. When the paper is browned after about a second's contact with the iron, you may feel sure that you have reached the right heat for good work. The paper also serves another useful purpose. I use a gas ring for heating my iron, but even the cleanest gas and a properly adjusted bunsen flame make the point rather dirty. By giving each face of the tinned point a rub on the paper one obtains a perfectly clean iron, which enables soldering to be done without the least difficulty. When the iron is heated to the right temperature, solder flows evenly on to the face to which it is applied and runs into a joint immediately. If, however, the iron is too hot, solder generally forms little blobs on it, which fall off in the most exasperating way when one tries to bring the bit to the place at which it is needed. With an iron that is too cool solder does not melt freely on to the point, and when you try to make a joint you find that it simply will not stick. It is *possible* to make joints with an iron below the right temperature, but each one takes too long, and the shanks of terminals, valve legs and so on become so hot, owing to their long contact with the iron, that the ebonite round them begins to melt, with the result that they are loosened and will require to be tightened up again. This may be a difficult matter when the shank has a wire soldered to it.

Ebonite Cutting Made Easy

One of the most difficult jobs that occurs in the workshop is to cut reasonably straight the edges of a panel which has to be made to size. If we use the hacksaw for the purpose its blade is almost sure to run in or out a little instead of following the scribed guide line exactly. Matters are rather better if we use a tenon saw, but here it is by no means easy to keep the saw perfectly upright, so that the edge, instead of being at right angles to the surface, may slope a little in one direction or the other after the cut has been made. The appliance which I use myself for cutting ebonite, and find most useful, is seen in Fig. 5. This is what is called a cutting table. It

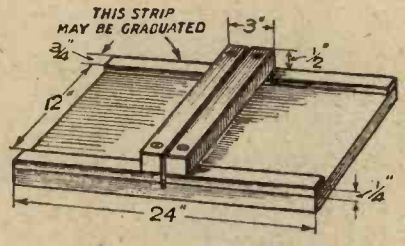


Fig. 5.—A useful cutting table with saw guide.

consists of a bed made of softwood 1 in. or 1½ in. in thickness, upon the long edges of which are mounted strips of hardwood ¾ in. wide and ¼ in. thick. In the middle of the board is secured a block of hardwood ½ in. in depth and 3 in. wide. Owing to the presence of the edge-strips or "fences" below it, its underside is ¼ in. above the upper surface of the bed. In the block a slit is cut, which must be exactly at right angles to the edge-strips. If you cannot be sure of making this cut accurately, you had better get it done for you by a joiner. It should be just wide enough to allow the stiff-backed saw which you purchase to use for the purpose to work easily in it and without any side play. One of the edge strips is graduated into inches, subdivided into quarters and eighths. This is very handy when a good many lengths have to be cut roughly to size, for one can do the work without marking at all. The graduations, by the way, start from 0 at the slit and go up to 12 in. to right and left of it. With a table of this kind the work of cutting out panels of any size is immensely simplified. The work is laid upon the table, and either clamped or held with the hand against the strip on the side away from you. It is then moved until the scribed line coincides exactly with the slot in the guide block. The saw is now inserted, and since it is prevented by the slot in which it works from straying out of its proper path, a perfectly clean-cut edge can be made, which requires only to be finished up with a very fine file and the rubbing-down tool described in an earlier paragraph.

A Drilling Difficulty

It is very seldom that one wants to drill a hole in wireless constructional work which is more than ½ in. to ¾ in. in depth. Quite short drills will, therefore, suffice, even in the largest sizes, for all the jobs that have to be undertaken. It happens sometimes, when the bench drill is in use, that there is not sufficient room between the drilling table and the chuck to allow a standard drill of large size to be used. The kind of job I mean is the making of a special plug and socket fitting in which holes ¼ in. in diameter have to be drilled in a piece of ½ in. ebonite which may be 2 in. or 3 in. in length. When this is mounted in the vice the space left is too small for the drill. It is not generally known that special short drills are obtainable in inch-fraction sizes up to a diameter of ¼ in. These are most useful, and as a set of them can be bought very cheaply, constructors will be well advised to invest in them rather than in drills of the standard length. Unfortunately, there appears to be no short drill made in the ⅜ in. size. The standard one is far too long for wireless work, and in many kinds of bench drill the table cannot be separated far enough from the chuck to take it properly, even though the jaws of the latter have a sufficient gap to hold its shank. Here is a tip that I have found useful when I have wanted to make a ⅜ in. hole in a piece of work which was too bulky to allow a drill of the standard length to be used. First of all run a short ¼ in. drill through the panel at the proper place. Then remove the drill and in its stead place a countersink with a body ⅜ in. in diameter in the chuck. Run this right through and you have a ⅜ in. hole. Meanwhile, if some enterprising manufacturer will turn out a ⅜ in. drill no more than 3 in. in length, I am quite sure that he will find a ready sale for it.

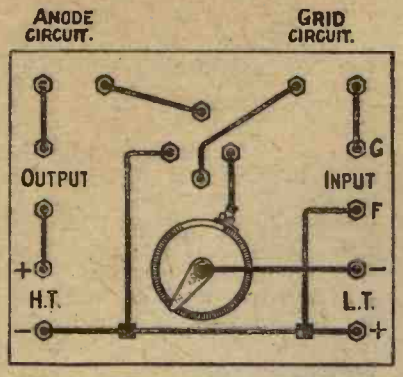


Fig. 1.—The wiring of the panel used in the experiments.

Some Experiments with a Single-Valve Panel

By HAROLD H. WARWICK

Many interesting and instructive hours may be spent with a single-valve panel. This article will show upon what lines the experiments may be conducted.

IN this country it is probable that single-valve sets are used as much as the most popular combination of any two or more valves, and this is no doubt due to the fact that erstwhile crystal users generally graduate to the one valve stage and then often go no further. This is most likely due to the fact that the vast field of experiment opened up by the acquisition of one valve is so great as to be almost unlimited.

It is not my intention to resuscitate the many varieties of circuit arrangements that have been evolved for the use of a single valve, but to show how certain useful experiments may be performed in

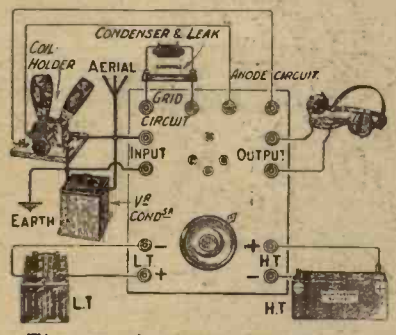


Fig. 2.—A simple circuit in pictorial form.

order to determine approximately certain values, and at the same time to point out as simply as possible the effect of some of these values.

A Suitable Valve Panel

To do this it is suggested that a small panel be built upon the lines of that illustrated. It consists essentially of a valve holder, a filament rheostat, and some terminals mounted upon a suitable piece of ebonite, the whole being mounted, if desired, within a box. Certain terminals are connected together as shown in Fig. 1, these connections being for the great majority of experiments permanently required. It should be mentioned that no extra expense need be involved by anyone contemplating building a single-valve receiver in doing it this way, since it may be used as a receiver pure and simple in a score of different ways, and several circuits will be given for the benefit of anyone doing this.

A Simple Circuit

Fig. 2 shows how the unit may be converted to a receiver whose circuit is that most commonly employed for a single valve. It will be noted that the aerial connection is made to the upper input terminal, and the earth to the lower, whilst a coil is connected between the two. A further coil is connected to the two terminals in the anode circuit, and is arranged in a movable holder so that the distances between the two coils may be varied. A grid condenser and leak are placed in the grid circuit, accumulator to the L.T. terminals, high-tension battery to the H.T. terminals, and 'phones to the output terminals. The aerial coil, that is, the one connected between aerial and earth, has a variable condenser connected across its ends; the resulting arrangement is that shown theoretically in Fig. 3.

Tuning

Let us first consider the effect of varying in size the various tuning components. These consist of the two coils and the variable condenser. Now it will hardly be necessary for even a beginner to plug in various-sized coils in order to find out that different signals will be received according to the size used. The reason as simply as possible is this: Stations work on different wavelengths, so that their signals are of different frequency, the higher the wavelength the lower the frequency. Now when energy is absorbed by a circuit the wire helping to constitute that circuit exercises a certain "resistance" or impedance to the high-frequency oscillations received, and this rises sharply to a maximum when a certain amount of wire is used for a certain frequency. This constitutes tuning.

The other factor in an electric circuit is capacity, and this, in unscientific terms, depends upon the distance apart of the respective portions of the metallic or conducting parts in the circuit, such as the wire of a coil or the plates of a condenser. If we have a coil of, say, 100 turns of wire, this may respond to a frequency equivalent to a wavelength of 950 metres; at the same time a much smaller coil might be used, provided an additional capacity be added to that actually present in the coil itself, so that it might at

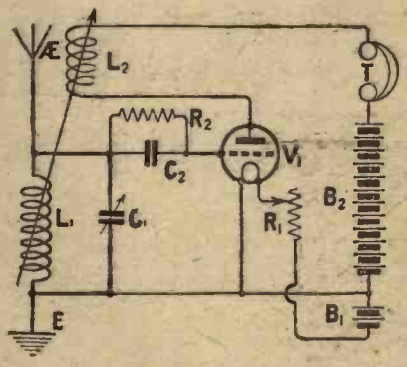


Fig. 3.—The connections of Fig. 2 in theoretical form. A condenser may be joined across the telephones if necessary.

first sight appear to be possible to use a coil of perhaps only one turn if the required amount of capacity were available.

Increasing the Capacity

An experiment on this can be tried as follows: First tune in the local broadcasting station by placing the largest coil in the aerial circuit that will receive the station with the smallest amount of con-

denser in use possible; the coil will be a No. 35, 40, 50 or 60 in all probability. Now place in the next size smaller coil and tune in again with the variable condenser. The strength aurally may still be the same. Repeat this with a smaller coil still and retune: if the condenser be not large enough, place across its terminals a fixed

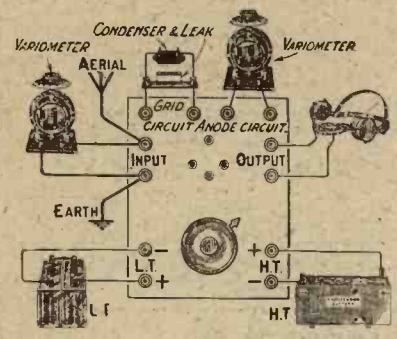


Fig. 4.—A circuit in which variometers are used for tuning.

condenser whose capacity is not greater than that of the variable, when it will be found possible to retune. This may be repeated until a coil of quite a few turns only, comparatively, is used, but the signals will have dropped in strength and may be only just audible. What, then, is the reason for this? It is due to too little wire that goes to make inductance and too much capacity. In practice variable condensers having a higher capacity than ·001 μF are rarely used in parallel with tuning coils, since losses are too pronounced when using high values.

Home-made Coil Equivalent

When home made tuning coils are constructed a somewhat similar difficulty occurs in not knowing what wavelengths they will cover or what is their equivalent in some standard well-known make. A simple solution suggests itself at once. First obtain signals by tuning in with the coil whose equivalent is required, and then replace it by coils of known wavelength until the same signals are heard upon approximately the same condenser setting. The coil found will be the equivalent size required, and the wavelength range of the unknown coil will be much the same as this if condenser tuning is reasonably close.

So much for the aerial tuning. A further fruitful source of experiment other than with different types of tuning coils is the determination of the best values of grid leak and condenser for use with different valves. Little definite may be said about this except that trial and error play the greater part in the experiments, but, as a guide, the limiting values of grid condenser may be taken as being ·00005 and ·001 μF, and the limiting values of grid leak being ·5 and 5 megohms using receiving valves in common use.

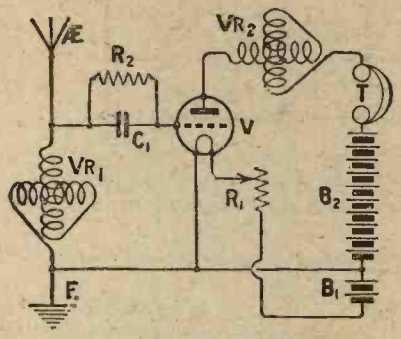


Fig. 5.—The theoretical form of Fig. 4.

The more usual values used are ·0003 μF and 2 megohms, and signals will nearly always be received at good strength if these are used.

Suppose we now turn to the coil in the anode circuit of the valve—the reaction coil. It is the most abused accessory, but

we could do very little without it. Its function in a receiving set is simply this:—Incoming oscillations from the aerial are damped considerably owing to certain unwanted high-frequency resistance that is bound to be present in the oscillatory circuit. To overcome this, energy from the H.T. battery is utilised and applied

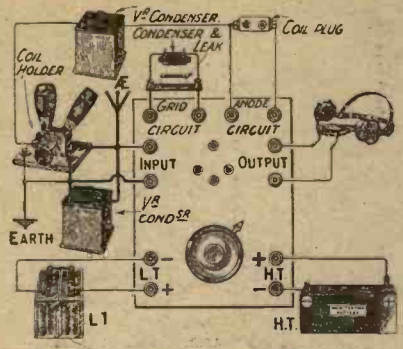


Fig. 6.—The connections for a Reinartz circuit.

with the aid of the reaction coil, which supplies energy from the output of the valve to the input by coupling to the aerial coil.

Experiments may be carried out with a view to determining the right reaction coil to use when certain coils are inserted in the aerial circuit. The reaction coil is generally semi-aperiodic, that is, it is effective over a large band of wavelengths without using a tuning condenser, but some experiments may be made with tuned reaction.

Fig. 5 shows an extremely convenient circuit for demonstrating this effect. It is quite a popular American circuit, but it has not been particularly well received in this country for several reasons, among which are differences in valves and limitation in wavelength range due to the variometer tuning employed in place of the coil and condenser in the more usual circuit.

Fig. 4 shows the connections to the panel described.

Keep the two variometers a long way apart, so that there can be no coupling directly between them, and tune that one in the aerial circuit until signals are heard. On tuning the anode circuit to the same wavelength as the grid circuit energy is passed back through the valve itself thus providing reaction.

A Reinartz Circuit

While experimenting with reaction you can try out the Reinartz reaction system. It is one of the simplest forms of reaction to use, it is quite as powerful as the usual method, and it deserves a much greater popularity than it has in this country at the present time, although it is very rapidly growing. The theoretical circuit is shown in Fig. 7, and the practical layout in Fig. 6. The great advantage of the arrangement is that there is a fixed magnetic coupling between the aerial and reaction

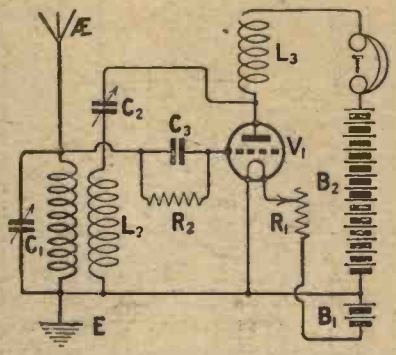
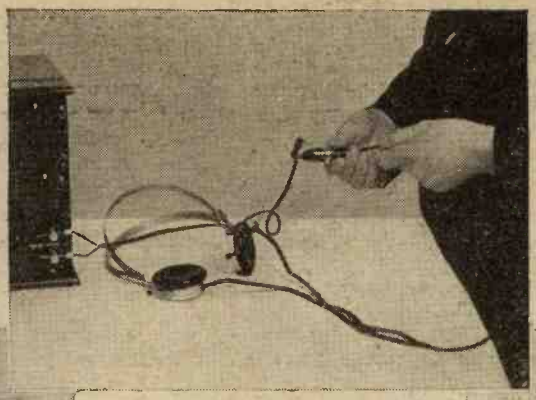


Fig. 7.—A theoretical diagram of the Fig. 6. circuit.

coils, and the aerial tuning alters but very slightly when the reaction is varied by means of the small variable condenser. The third coil is in reality a high-frequency choke, while the variable condenser C2 controls the reaction effect.

Those Twisted Cords!

A new invention to save wear



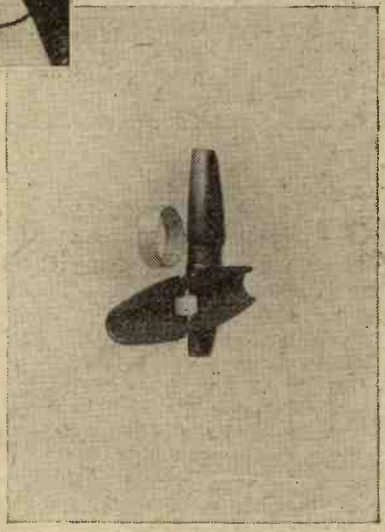
transverse wire. To use the device the two pieces of wood are placed over the cord and held together with a spring clip provided, whereupon the whole may be slid backwards and forwards, the passage of the cord over the roller and through the orifice immediately smoothing out the twists as if by magic.

The Bead is quite unobtrusive.

Using the Radio Bead.

EVERY user of headphones has been worried at some time or other by the twisting and knotting of the telephone cords. Not only is such twisting highly inconvenient, but it also imposes undue strains upon the fine wires which go to make up the cords.

A very clever little device, known as the "Radio Bead," has just been placed on the market, with the object of quickly removing the twists. It consists of two pieces of turned wood which fit together over the cord and a tiny roller running on a



The Radio Bead dissected.

Charging Accumulators at Home

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

The accumulator is the most neglected part of the wireless equipment, and can soon be ruined by incorrect charging. This article tells you how to charge your own accumulators, and gives some hints on looking after them

THE financial problem involved in keeping the "juice pot" well filled is no mean one, as I expect most of my readers will have discovered by now. I suppose that something like 90 per cent. of us use accumulators to light the filaments of our valves, and that means that we are paying anything up to 2s. 6d. or 3s. 6d. for recharging at intervals which depend upon the number and type of valves which we are using. Those who run multi-valve sets with bright emitters have only to work out what they spend upon recharging in the course of a year to realise that this represents one of the most serious expenses connected with their hobby. To all such, therefore, I would strongly advise the desirability of considering some means of charging their batteries at home, so long as they have any sort of electric supply in the house.

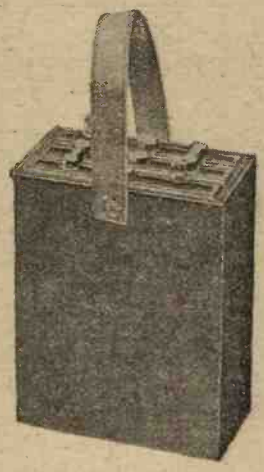
The Financial Side

When costs are compared over a considerable period, such as one or two years, there is usually a considerable balance in favour of home-charging methods, and one has, in addition, the satisfaction of knowing that one's batteries will keep in much better health, provided reasonable care is taken. This latter is a most important point, because the attention given at the average garage to small batteries such as are used for wireless purposes is usually extremely scanty, and they are almost always charged at a most excessive rate, being placed in series with large car starting and lighting batteries, which may be given anything up to 8 amperes, whereas the correct charging rate for the smaller type of battery may be only 2 or 3 amperes.

A Bad Test

There is, furthermore, always the horrid possibility that one may innocently take one's battery to one of those places where they test them to see whether they are properly charged by shorting them with a piece of wire, noting whether a nice, fat spark is produced, or where they are in the habit of making up for any deficiency in the level of the acid by filling with acid, regardless of whether the said deficiency of level was a result of evaporation or spilling.

It being granted, then, that it is most desirable that accumulators



should be charged at home, from the point of view both of their own welfare and that of their owner's pocket, let us proceed to consider some of the available methods, with a view to deciding upon the most suitable one for any given state of conditions.

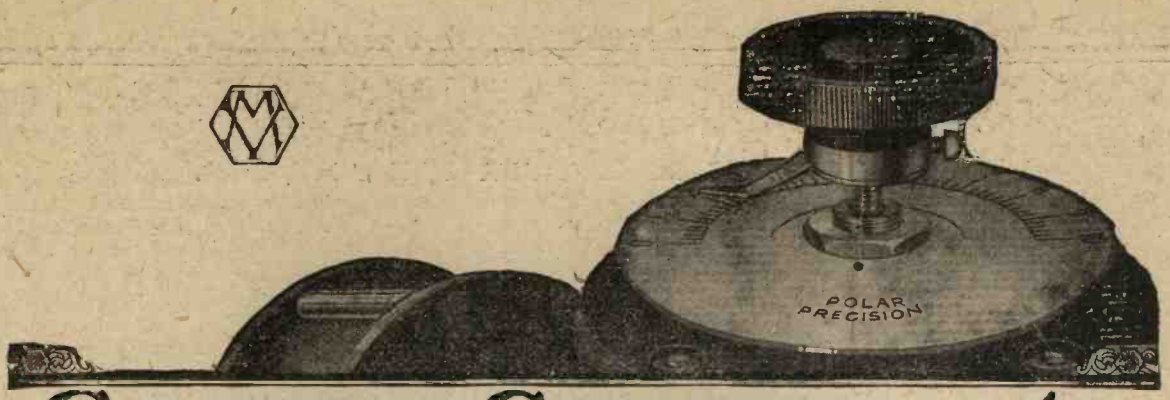
D.C. or A.C. ?

First, we must ascertain whether the house supply is alternating or direct current, and this can be obtained, as a rule, by looking at the meter. If the supply is alternating, a space will be found in which is marked the frequency, or periodicity of the supply, this being usually 50 per second in this country. If you are unable to decide this point yourself, application to your local electricity authorities will supply you with the desired information. Assuming that it is found that the supply is direct, and not alternating, the methods of charging are relatively simple and few in number, since it is possible to achieve the desired end simply by connecting the accumulator across the mains in series with a suitable resistance which will permit just the desired value of current to flow for charging the battery. (It is assumed that the reader understands that the charging of an accumulator consists merely in the passing of an electric current of suitable volume through the battery for a given number of hours in the opposite direction to that in which current flows when the battery is supplying the valves.)

In general, such methods are extremely wasteful, when considered from the point of view of the units of current used, but they are so simple and convenient that many people are prepared to use them, bearing in mind the fact that no expensive apparatus is needed, so that the waste of current is, to some extent, offset.

A Simple Appliance

To carry out charging conveniently in this way, it is necessary to possess a simple appliance known as a charging board, which may be purchased complete with the necessary measuring instrument and regulating resistance for a quite reasonable sum. Such a board usually carries an instrument known as an ammeter, which



Cosmos Components
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The Foundations—
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"Cosmos" Strip Inductance Coils

are constructed on a new principle which results in Low Resistance, Low H.F. Resistance, Robust Constructions, and Low Self Capacity. With regard to the last feature, a report on an independent test conducted by "The Wireless Trader" (issue March 4th) reads as follows:—

"Our tests proved satisfactory, for the coil (tested on 377 metres) was found to have quite exceptionally low self-capacity. It was tested at the same time as a well known and favourite type of plug-in coil, and the decrease in self-capacity was phenomenal, the other coil having approximately thirteen times the amount of self-capacity found in the 'Cosmos.'"

"COSMOS" STRIP PLUG-IN INDUCTANCE COILS are made in the following sizes:—

Coil No.	Inductance Microhenries.	Price. s. d.
20	12.5	4 9
25	25	4 9
35	50	4 6
40	100	4 9
50	150	4 9
75	300	5 0
100	700	6 0
150	1,000	6 6
175	1,400	7 0
200	2,500	7 6
300	5,000	8 9
400	9,000	9 9

"POLAR" PRECISION VARIABLE CONDENSERS are made in the following capacities, all having the same outside dimensions:—

Max. Capacity.	Price.
·001 mfd.	12/6 unmounted
·0005 mfd.	12/6 "
·0003 mfd.	12/6 "

Mounted 5/6 extra.
SEPARATE VERNIER ATTACHMENT 3/6.

The "Polar" Precision Variable Condenser

is a remarkably Compact Robust Dustproof Component with low minimum capacity, low losses, high insulation and a smooth movement. The last named feature is so effective that a Vernier plate is really unnecessary, but to provide for those amateurs who require exceptionally fine tuning, a separate Vernier attachment can be obtained. The "Polar" Precision Condenser is conveniently mounted by means of one hole in the panel.

YOU CAN OBTAIN THESE COMPONENTS FROM YOUR LOCAL WIRELESS DEALER ALSO "COSMOS" RHEOSTATS, POTENTIOMETERS, FIXED CONDENSERS, GRID LEAKS, VARIOMETERS, REACTANCE COILS AND ALL DETAIL ACCESSORIES.

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SUMMER SEASON REDUCTION IN PRICES OF "COSMOS" VALVES

To assist Wireless Retailers to maintain their turnover during the summer months, "COSMOS" Valves have been REDUCED as follows:—

DE 11 to 17/6 || A 45 to 9/6 || SP 18 to 15/-

measures the actual flow of current into the battery, and some sort of variable resistance for altering the value of that current. Such a resistance may be either wire wound, with tappings to a stud switch, or it may be of the lamp variety. This latter is much the cheaper arrangement, and gives quite reasonably good results. It consists of a number of ordinary lamp sockets mounted upon the board, and connected in parallel, so that one can add lamps to increase the charging current as desired. Thus, for example, if one wants to charge a battery at 1 ampere, one would insert, perhaps, four lamps in the sockets, leaving the other sockets empty. To charge a battery at 1½ amperes, two more lamps might be inserted, or larger lamps might be substituted for those already in use.

Carbon Lamps

It is customary to employ carbon filament lamps for this purpose, since they are very cheap, and pass a considerably larger current than the more modern metal filament type. The connection from the board to the mains is usually a flexible lead terminating in an adaptor which can be inserted in any of the house lighting sockets, while at the lower edge of the board will usually be found a pair of terminals, marked positive and negative, from which leads are taken to the battery.

Points to Observe

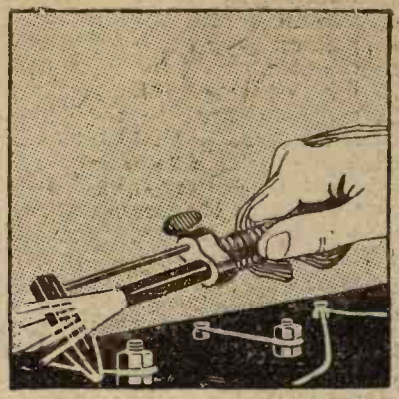
There are two important points to be observed in using such a charging board, and the first of these concerns the polarity of the output terminals. One must, of course, see that the current passes in the correct direction through the accumulator, and therefore on first connecting up the board to the mains one must see that it has been done in such a way that the terminals for connection to the battery marked positive and negative are actually giving a voltage whose polarity is in that direction. To do this, insert a few lamps in the sockets, take two bare wires from the terminals which are intended to be connected to the battery, and dip their ends into a glass of water to which a few drops of vinegar have been added. Now insert the adaptor into the lamp holder from which you propose to run the charging board, and watch the two bare ends of wire dipping into the vinegar and water. Care should be taken that these two wires do not touch, and it will be found that after a few seconds bubbles are rising from the two wires, a much larger quantity rising from the negative lead. If this wire is not that which comes from the terminal marked negative, reverse the adaptor in the lamp socket. Having made sure that the polarity is correct in this way, mark both the lamp socket and the adaptor in such a way that it can always be inserted in the same way, if it should at any time happen to be removed.

The Charging Rate

The next point to be attended to is the adjustment of the charging rate to suit the particular battery, and to do this the procedure is as follows:—Remove all the lamps except one, and switch off the supply from the charging board. Now take two wires from the output terminals of the board to the battery, connecting the one from the terminal of the board which is indicated as positive, to the positive terminal (the red one) of the accumulator, after which the supply can be switched on again, and the reading of the ammeter noted. It may be, perhaps, in the neighbourhood of a ¼ or ⅓ of an ampere. Now proceed to insert lamps until the charging rate rises to the value marked upon the label of the battery. The accumulator is now charging, and is to be left until it begins to "gas" freely. In this condition it will be observed that loads of small bubbles are rising through the acid solution with which the battery is filled, so that the liquid becomes quite milky with them, and almost seems to be boiling. When this has gone on for perhaps half-an-hour, the battery is fully charged, and it should then be examined to see what attention it needs before being put into use again. Examine the level of the acid solution, and if it is less than a ½ in. above the tops of the plates, fill up to that level with distilled water (obtainable from any chemist) and put the battery on charge again for another quarter of an hour: At the end of this period the battery can be taken off, the terminals carefully rubbed over with a rag and a little vaseline, and put into use once more.

(To be continued.)

Albert Knowland, a partially blind hawker, was knocked down in the Strand and severely injured. His plight being brought to the notice of Messrs. Burndept Wireless Ltd., the company installed the apparatus seen above, and in this way the sick man's mind was taken off his sufferings.



Wires Thick and Thin

How to Join Them

By W. H. FULLER

A chat about the methods in general use for joining various types of wires and cables

THERE is a lot more in joining wires and cables than appears at first sight. Three things are essential: (1) Mechanical strength; (2) Low resistance; (3) Freedom from atmospheric influences.

Taking the first. The joint should be as strong as a piece of the wire from which the joint was made.

The second proviso demands that, if anything, a lower resistance shall be found in the joint than in a piece of wire of the same length as the joint. This ensures that no additional resistance shall be included in the circuit.

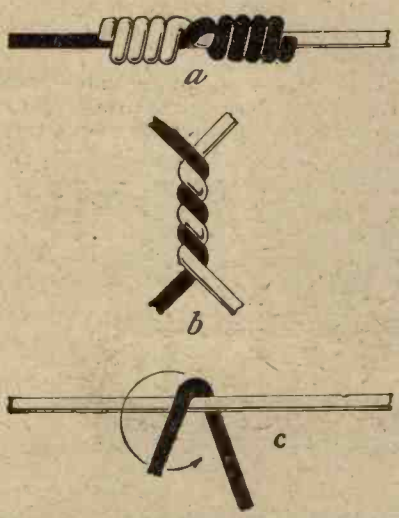


Fig. 1.—Two types of joints in single-strand wires.

The third demands that the joint shall be free from such troubles as oxidation of the internal parts of the joint, thus introducing resistance. Also damp should be excluded as far as possible.

Types of Joints

Naturally there are different types of joints for different types of wires and cables. The joint suitable for a single wire will not do for a stranded cable. If a single-wire type of joint were used for a stranded cable, the joint would be very poor and the wires would be easily pulled apart.

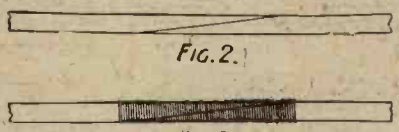


FIG. 2.

FIG. 2a

How thicker wires are joined.

Single Wires

Fig. 1 shows two methods of joining single wires. There is not much to choose between these two joints from an electrical point of view, as there is approximately the same amount of metal facing, but from the point of view of neatness, the first is best. However, some electrical institutions favour the second. Of the two soldered joints the first is much stronger than the second. The first joint is made in the following manner: Scrape or clean both wires for about two to three inches, and lay them together as shown in Fig. 1, *c*. The black wire is wound round and round the other wire until it is used up. The other wire is then wound round the first so that the joint is as shown in Fig. 1, *a*.

Soldering

The joint is then soldered, or rather sweated, by placing in a hot flame, some flux is applied and a stick of solder touched on the joint. The joint is withdrawn from the flame and slightly tapped to knock off any excess solder, or it may be wiped with a dry rag.

The second joint is made by simply putting the two ends together and twisting with a pair of pliers. Soldering is carried out as before.

Very Thick Wires

When dealing with very thick wires another method is employed. The ends of the two wires are filed to a taper as shown in Fig. 2. These two ends are then bound together with a wire of much smaller diameter, as shown in Fig. 2, *a*, after which the whole joint is sweated as previously described.

Stranded Wires

Wire is stranded so that greater flexibility may be obtained, and

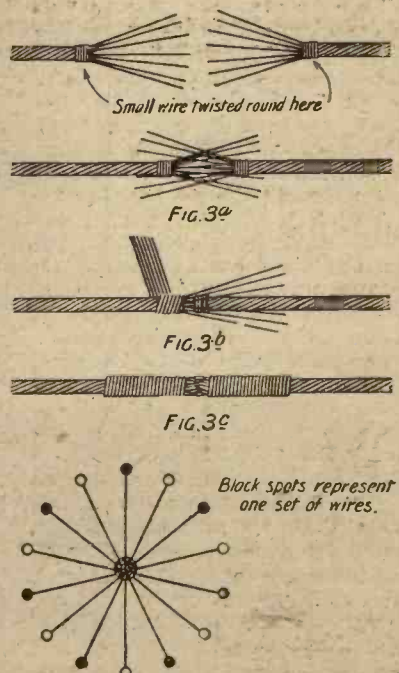


Fig. 3.—How to join stranded wires, such as are used for aerials.

if two ends of the wire were just twisted together as in the case of single wires, a very slight pull would break the joint.

The wires should be separated, in the case of 7/22's, for about 4 in. or 5 in., and well cleaned.

A small piece of thin wire is twisted round the main cable to prevent it from untwisting further as seen in Fig. 3.

Binding Round

The wires in each piece are spaced apart so that they may

Fig. 4.—Preparing a braided cable for jointing.

interleave one with the other, as in Fig. 3, *a*. The ends are pushed together as close as possible. One set of wires are temporarily laid down along the core while the others are bound round the core as in Fig. 3, *b*. The wires, if started in correct order, will follow one another round the core in perfect order. These should then be tightened up with a pair of pliers. The other wires are then bound round in a similar manner. The finished joint should appear as in Fig. 3, *c*. This joint if properly made, and without being soldered, should bear the weight of a full-grown man, but if it is intended to put the wire into the open it should certainly be soldered in the manner described previously.

Small Flexible Wire

Small flexible wire, such as is used for telephone leads, &c., should be stripped of the insulating material and thoroughly cleaned as the sulphur from the rubber oxidises the copper very quickly. The two ends are tied together and the ends twisted round the joint with the fingers. A piece of rubber tape, obtainable at any electrical shop, should be very tightly bound round the joint to exclude damp, and finally bound with black adhesive tape.

Braided Cables

When cleaning and stripping covered cables, it will be found that a layer of tape exists between the rubber covering and the outer braid, the braid being usually impregnated with wax. This tape should be cleaned away from the rubber, as in Fig. 4. This is done to ensure that no leakage takes place across it. This tape unfortunately picks up the damp very easily. Sometimes the tape may be unrolled from the rubber, but often it adheres, so that scraping with a knife is necessary.

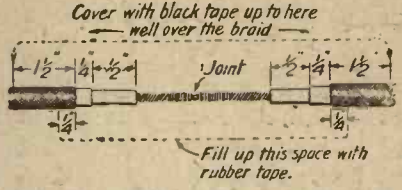


Fig. 5.—The joint ready for covering

If cable of this description requires to be jointed, any of the methods described may be employed, according to whether it is stranded or single cable.

The joint should be well wrapped with rubber tape and two layers of black tape laid well over the outside braiding, as shown in Fig. 5.

A supposed seaman was picked up in the sea near Norfolk, Va., and the authorities were unsuccessful in learning his identity, owing to the language problem. They persuaded him to speak from the WTAR station, and a young Finn identified the man as Cxekula, a writer and naturalist of North Finland.

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Munich,	Breslau,	
Glasgow,	Belfast.	

The set requires a little handling to begin with, but after a night or two it becomes perfectly simple. One other point of interest is that I can receive London at good loudspeaker strength without any aerial or earth.

STENSON COOKE, Jnr.
Earl's Court.

P.S.—I have since received:

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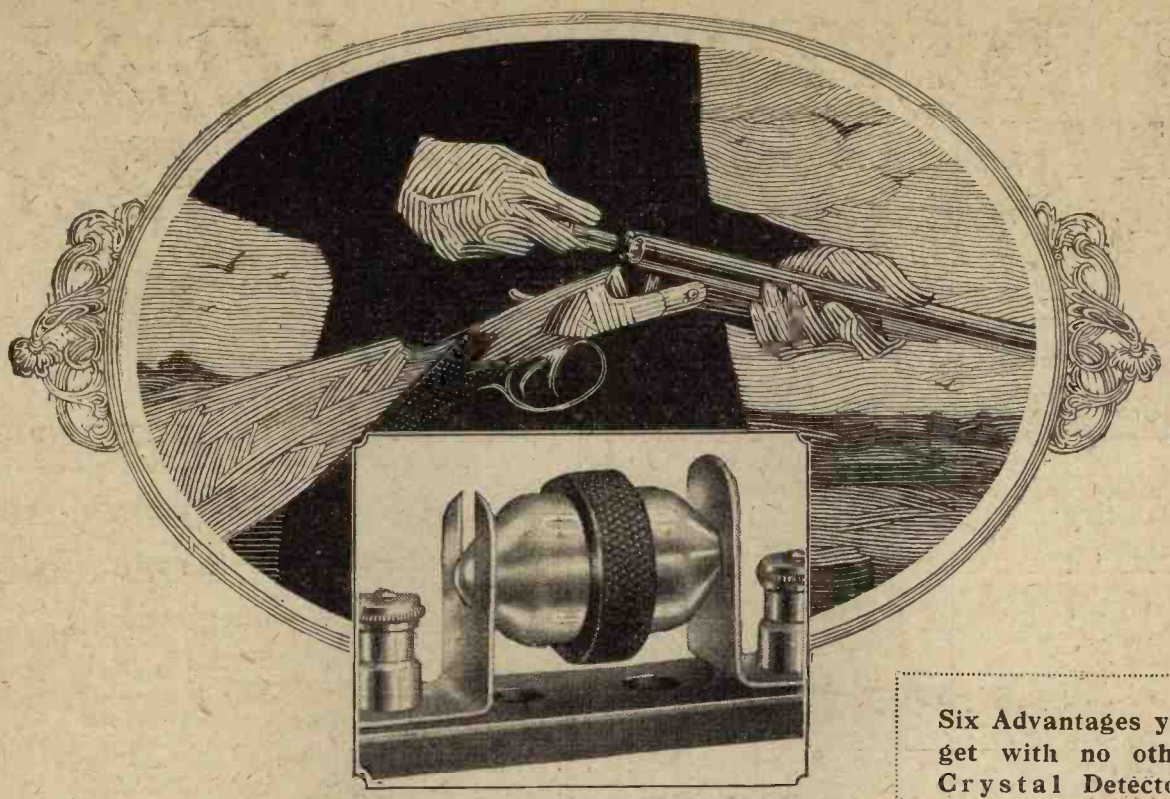

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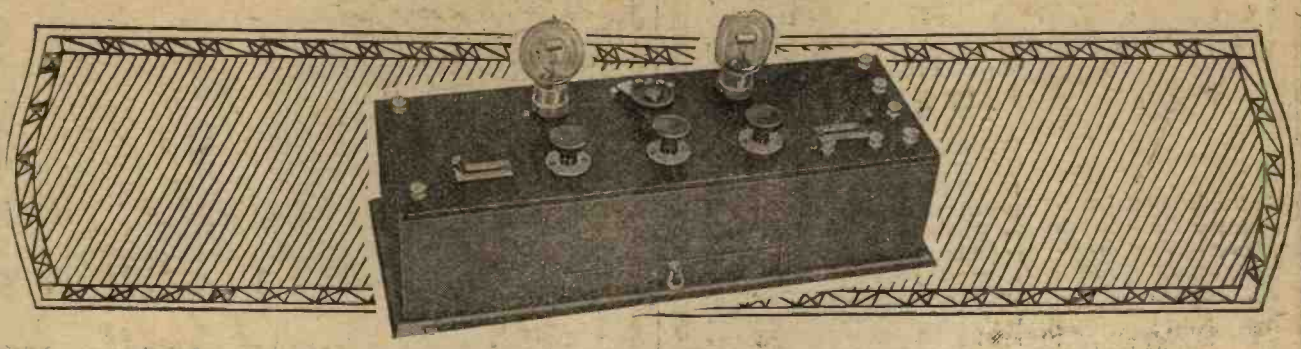
A Two-Valve Amplifier de-Luxe

BY

HERBERT K. SIMPSON



IT is not always that one wishes to wear head-phones. Sometimes they become a trifle irksome when listening for any length of time. Of course a loud-speaker would give you relief, the pleasure of sitting back comfortably in the armchair and enable not only you, but also your friends to enjoy the programmes. Maybe your set is of the crystal or one-valve variety, incapable of giving adequate loud-speaker results.

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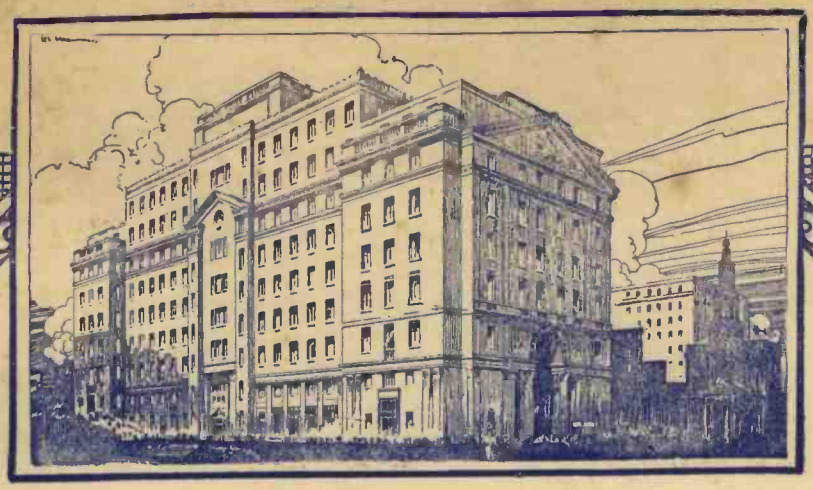

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