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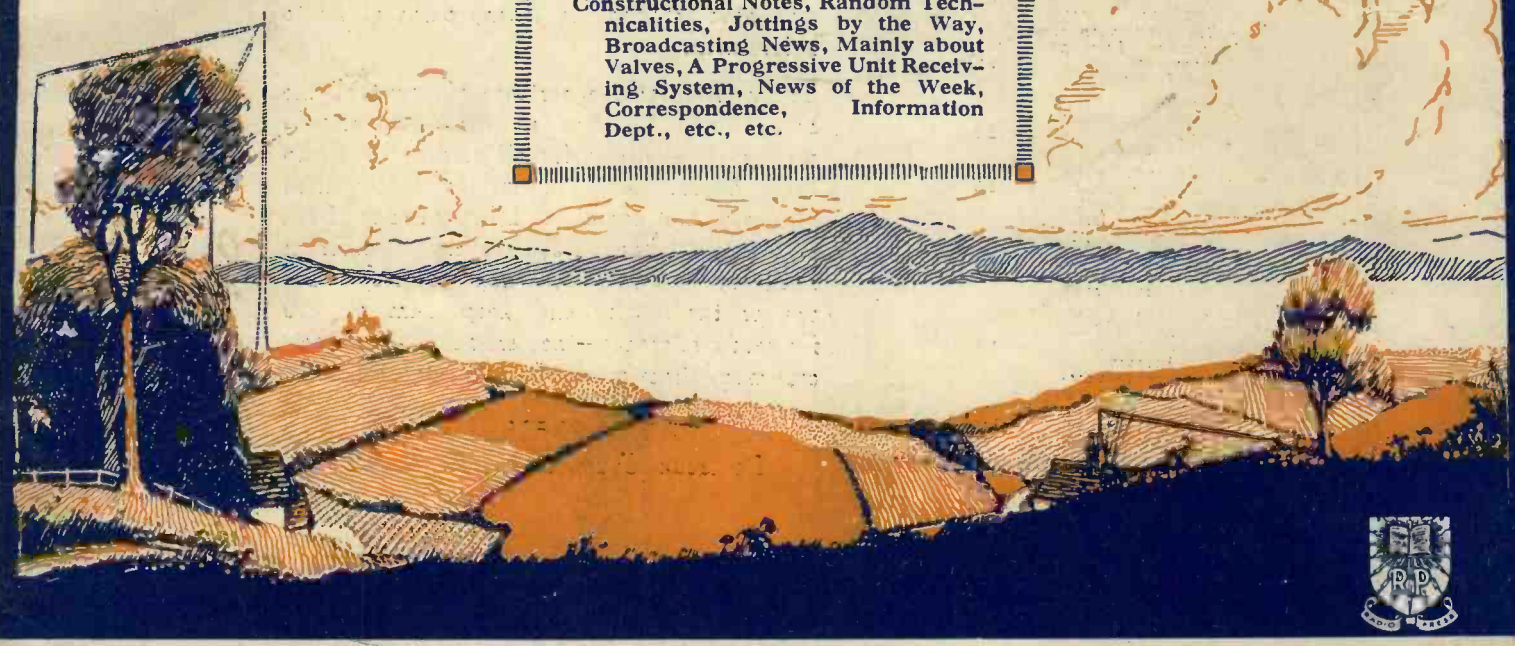
Wireless Weekly

and The Wireless Constructor

No. 14

CONTENTS



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¶ Those printed in heavy type have been published recently.

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Wireless Weekly

Vol. 1. No. 14
July 11, 1923

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Editorial

YOU have no doubt heard the story of the man who was implored: "Hurry! there's a house on fire," and who replied, "Why should I? It isn't *my* house."

In the application of this story to the present broadcasting situation the moral is, of course, that speed or any real effort is best stimulated by interest. It is remarkable how difficulties can be overcome and complex problems can be solved when the conduct of affairs is in the hands of those who have a real and active interest in them.

Interest-energy is one of the greatest driving forces in the world, and if only the present Broadcasting Committee were imbued with a little of it, we are confident that a settlement of the broadcasting difficulty would have been arrived at ere this.

The never open door.

As a result of the investigations still proceeding, the Committee doubtless knows a great deal by now about broadcasting, but, in the light of the most unreasonable delay, we are forced to conclude that something is missing. Perhaps the missing "something" is interest-energy.

It is certainly very unfortunate for both the wireless industry and the public that the Committee is not more representative of real wireless interests. Nevertheless, by agreeing to conduct the investigations at the request of the Postmaster-General, the Committee undertook to perform an important public duty, and it is time that its full responsibility in this matter was realised and some definite action taken to relieve a situation which is daily becoming more serious.

Up to the time of going to press there is no news whatever from the Committee—no interim report—no recommendation with regard to the issue of constructional licences, not even a statement that matters are progressing and that an announcement may be expected shortly. Even the last-named would be welcome after the long and unbroken silence during which the Committee has deliberated behind closed doors.

THE CONSTRUCTION OF A 5-VALVE AMPLIFIER

By Alan L. M. DOUGLAS, Staff Editor.

The following description should prove of interest to experimenters who wish to have an amplifier which can readily be controlled so as to receive from a nearby broadcasting station, or extended to enable the most distant telephony to be clearly heard.

THE most useful feature of this amplifier lies in the fact that by simply bridging or disconnecting various sets of terminals, it is possible to introduce various experimental arrangements into the circuit without disturbing the general functioning of the instrument. For instance, one stage of high-frequency amplification employing tuned anode intervalve coupling can be employed, which may be changed in a second to two stages using the same method of coupling. In an equally short space of time, high-frequency transformers of the plug-in type may be put into circuit, or resistance coupling may be used for the higher wavelengths.

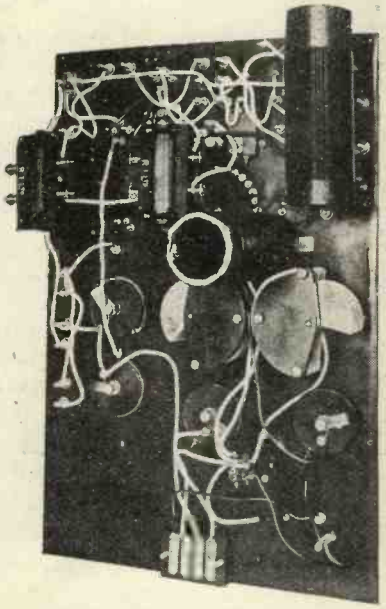


Fig. 1.—Rear view of amplifier panel, showing wiring.

A variable gridleak may be employed or the ordinary method of connection can be introduced by means of an appropriate switch. Reaction can be effected on to either of the high-frequency inter-valve couplings or on to the aerial or secondary circuit coil if desired by means of moveable plugs.

The high-frequency amplifier may be separated from the rectifier and low-frequency unit, or alternatively the detector and low-frequency valve may be used in conjunction with any existing tuner. Potentiometer control may be readily effected to either the tuned anode intervalve coupling or the high-frequency transformers, and a plug arrangement ensures that the potentiometer when used shall either work with the customary central zero position or with a more pronounced negative or positive potential.

Separate high-tension feeds may be applied to each group of valves if desired, or a common H.T. battery can be used and the direction of the plate current through the telephones may be reversed at will. Grid cells may be introduced into either of the low-frequency stages, or both, and telephones or a loud-speaker may be instantaneously connected in circuit either together or separately.

These constitute the chief advantages possessed by this instrument from an experimenter's point of view, but for general reception purposes it forms a very useful adjunct to any other receiver which might normally be used for, let us say, broadcasting purposes.

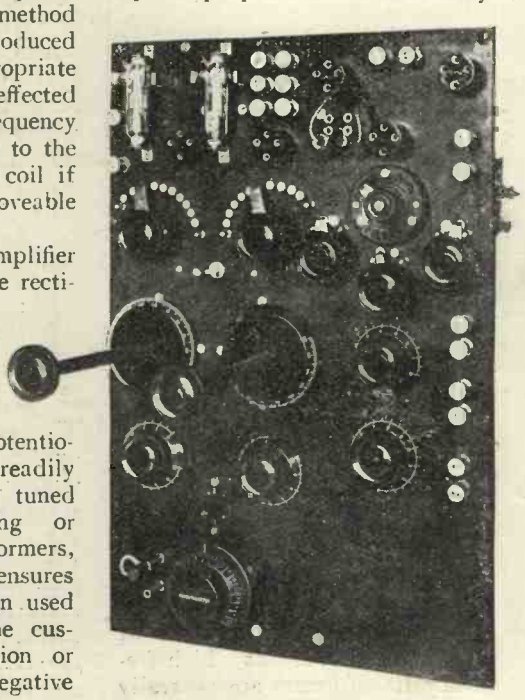


Fig. 2.—The complete instrument.

In its simplest form a direct and irreversible connection is made by means of a four-pin plug to the high- and low-tension batteries, which are common to all parts of the receiver. Thus, for the reception of broadcasting, it is only necessary to insert this plug, attach the telephones and tuner to the appropriate terminals, and

place the high-frequency control switch in the position marked 1. This lights the necessary filaments

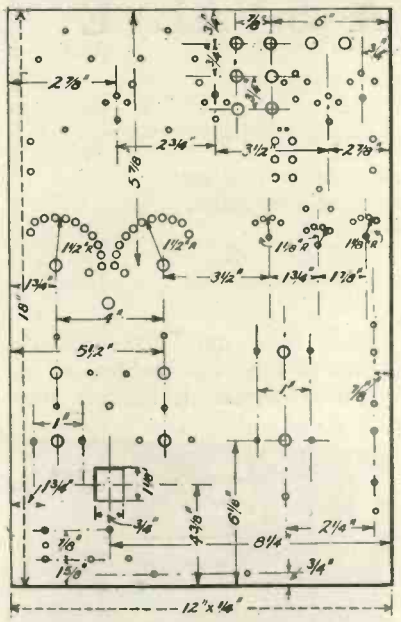


Fig. 3.—Drilling plan of panel.

and connects the other necessary circuits in such a manner that one high-frequency valve and two stages of note magnification are immediately functioning.

The tuned anode intervalve coupling arrangements are very efficient up to about 1,100 metres, above which it is advisable to use plug-in high-frequency transformers. By a very simple alteration it would be possible to introduce resistance coupling to function over the higher bands of wavelengths, but as high-frequency transformers are generally easy to stabilise above 1,000 or 1,500 metres there is no reason why these should not be used. It will be noted that the anode condensers are fitted with long extension handles, which considerably simplifies the tuning on short wavelengths. The actual coils effecting the high-frequency couplings are so disposed that interaction is practically nil, and therefore the shortest waves may be received with the minimum of capacity effect.

It will be noted that no tuner of any description is fitted to this amplifier, as it is more convenient in many instances to have an amplifier which can be used with any of the arrangements for tuning the aerial circuit which may be in the possession of the experimenter. In any case, it is always advisable to have the tuner at some distance from the amplifier, particularly when high-frequency amplification is being carried out.

Before describing the actual construction of the apparatus it will be convenient to make a list of the material required for the construction of the instrument. This is a procedure which will save the experimenter a great deal of trouble at various stages during the construction of the receiver, and will also enable him to estimate accurately the total cost of the various parts. The construction has been simplified to a certain extent, insomuch as only four sizes of drills are required for the assembly of the panel, and these are as follows :—

1 $\frac{3}{8}$in. Whitworth.
1 2 B.A. Clearing.
1 4 B.A. Clearing.
1 6 B.A. Clearing.

The ebonite panel, 12in. by 18in. by $\frac{1}{4}$in. thick, should be of good quality. High - frequency leakage giving rise to irritating sounds is often due to the use of inferior ebonite, which may have impurities in it. Two complete sets of clips for V.24 valves, five valve-holders of the ordinary pattern, 8 valve sockets in addition, and 3 " Wander " plugs are also required, together with the following :—

Five filament rheostats.
Two variable condensers, having a value of about 0.00025 µF.
One variable gridleak.
One gridleak of the usual pattern, 2 megohms resistance.
Eighteen terminals of any suitable type.
One potentiometer, preferably having a resistance of not less than 300 ohms.
One Dewar switch, which must have 4 contacts on each side.
Two cardboard tubes, 6$\frac{1}{2}$in. long by 1$\frac{3}{4}$in. external diameter, and one piece of cardboard tube 1$\frac{1}{2}$in. long by 1$\frac{1}{2}$in. external diameter. Two small turned ebonite end pieces will be required to fit into this latter tube.
Two low-frequency intervalve transformers, which should be of reputable make, such as those shown in the photograph.
Two small fixed condensers 0.0003 µF, and one of 0.002 µF.
Twenty-six switch studs and 10 stops.
Three short switch arms for the small switches shown in the photograph (Fig. 2), and 2 longer switch arms for the anode tuning inductance.
Ebonite tube for making the extension handles for the variable condensers, together with suitable knobs.

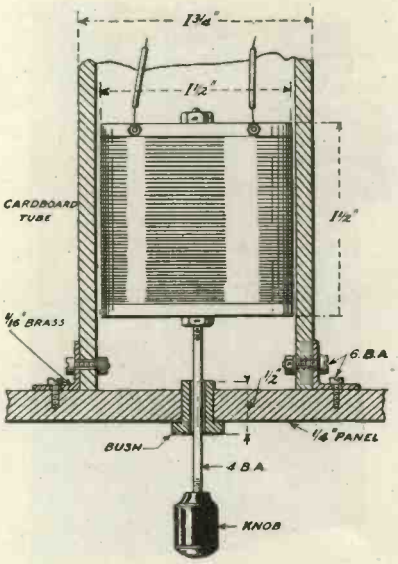


Fig. 4.—Illustrating the sliding reaction coil.

This tube might be about 10in. long for each condenser.

About ¼ of a pound of No. 26 s.w.g. enamelled copper wire will also be required, together with about ½ a pound of No. 18 s.w.g. tinned copper wire with appropriate Systoflex tubing for wiring up.

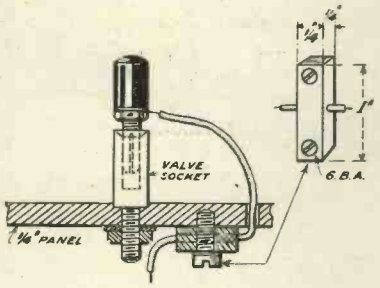


Fig. 5.—Selector plug and socket.

Various screws and nuts will be required of course, for attaching the components to the panel, but the average experimenter has a number of these in his possession so that no definite details will be given.

The panel should first of all be smoothed by rubbing it with fine emery, and, if a brilliant finish is desired, rotten-stone carefully applied with a soapy cloth will ensure a brilliant surface. In the original scheme, it was intended that this amplifier should fit into a vertical cabinet, but the details of a suitable case are best left to the constructor, who usually has his own ideas on this point. After the surface of the panel has been prepared, both back and front, it may be suitably drilled in accordance with Fig. 3. The positions of the various holes may be marked on the back of the panel, but if pencil lines are employed care should be taken to entirely remove these afterwards. This can be done by means of a wet cloth.

The most convenient point at which to start the construction of this instrument is to insert all the terminals into their respective holes and to complete the basic wiring, consisting of the low tension negative and positive feed wires, and the high tension positive connections. This will ensure the filament rheostat and other essential portions of the circuit being wired in such a manner that there will be no necessity for the parts of the apparatus working at a low potential to interfere with either high potential or high-frequency circuits. It also reduces the chance of high-frequency leakage across the panel, which is very important where short wave amplification is concerned.

Having attached the rheostats and terminals in their respective positions, inserted the valve-holders and fitted the clips for the V.24 valves, the panel may be laid on one side while the construction of the two anode reactance coils is taken in hand.

These consist of two identical cardboard tubes, each being 6½ in. in length by 1¾ in. external diameter, and should be perfectly dry. A thin coat of shellac varnish may be applied, and the whole baked in a warm oven. Care should be taken not to overheat the shellac. On each of these tubes, 120 turns of the No. 26 s.w.g. enamelled copper wire should be wound, with tappings taken at every tenth turn commencing from the fortieth. These tappings, which may simply consist of twisted loops of the copper wire, should be brought back, bared, and connected to the switch studs at the rear of the panel in an appropriate manner. The method of attaching the two coils to the panel should be noted, and can be readily grasped from an examination of the various illustrations showing this part of the amplifier. The first anode coil is mounted vertically, being kept at some little distance from the back of the panel by means of nuts attached to a 4 B.A. screwed brass rod. The second anode coil, which contains the reaction coil, is placed at right angles to the panel and secured by means of small brass brackets, as shown in Fig. 4. Care should be taken that the anode coil is so attached that the hole through which the reaction coil spindle passes is exactly in the centre.

Fig. 6 shows the plug-block for the common L.T. and H.T. feed for use where single batteries are being used to operate the amplifier. The dimensions of this

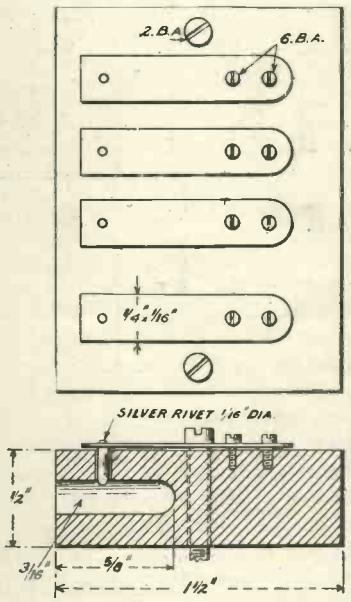


Fig. 6.—Plug block for H.T. and L.T. connections.

are clearly given in the figure, from which the brass spring contacts can be constructed; these should have small silver rivets inserted into one end so as to bear on the spring plungers of the plug itself; this latter will be described later on.

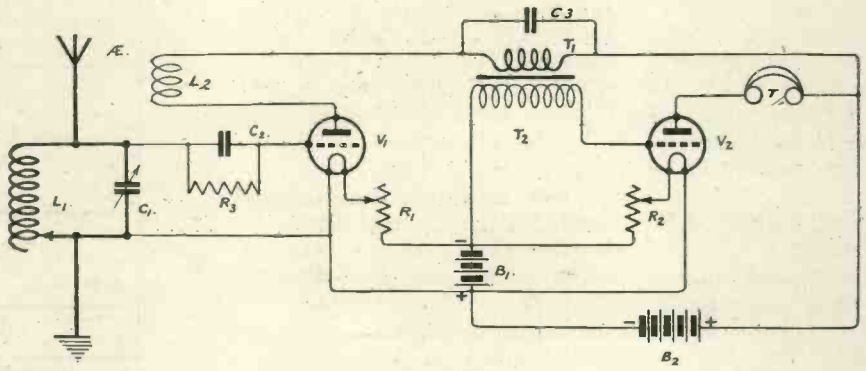
(*To be continued.*)

ERRATUM.—Owing to an Editorial oversight a paragraph at the end of the article "A New Interference Eliminator" stated that "the Hinton System of reception produced equivalent results, but with distortion of the signals." This, of course, should have read "*without* distortion."

Wireless Weekly Circuits

No. 14.

A Reaction or Continuous Wave Receiver



COMPONENTS REQUIRED.

L_1 : A variable inductance.
C_1 : A variable condenser having a capacity of preferably 0.001 μF.
C_2 : A grid condenser having a capacity of about 0.0003 μF.
R_3 : A gridleak having a resistance of about 2 megohms.
R_1, R_2 : Standard rotary filament rheostats.
T : High-resistance telephone receivers.
B_2 : 60-volt high-tension battery.
B_1 : 6-volt accumulator.
L_2 : A reaction coil.
C_3 : A fixed condenser of 0.002 μF capacity.

GENERAL NOTES.

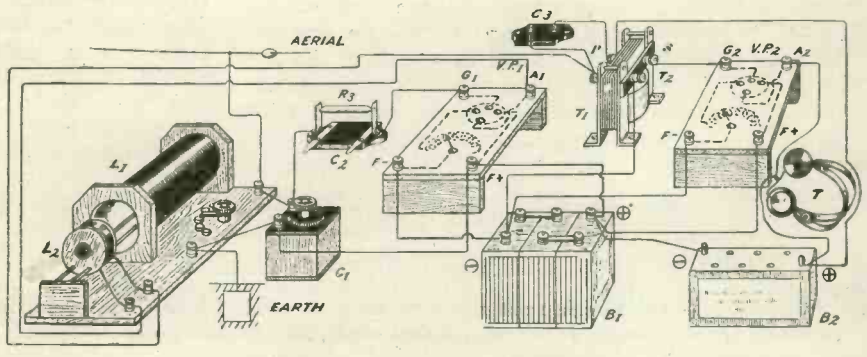
This circuit is a reaction circuit which may not be used for the reception of British broadcasting, but is useful for other reception. By coupling L_2 sufficiently tightly to L_1, the first valve may be caused to oscillate, when continuous waves may be received.

VALUES OF COMPONENTS.

In view of the fact that this circuit may not be used for the reception of British broadcasting, it is not possible here to give the details of the inductances L_1 and L_2 for other wavelengths.

NOTES ON OPERATION.

When L_2 is brought closer to L_1 signal strength should increase. If it does not try reversing the leads to L_2. Any variation of the coupling between L_2 and L_1 should be accompanied by readjustment of the condenser C_1.



THE RECEPTION OF CONTINUOUS WAVES

By E. REDPATH, Assistant Editor.

A complete article—the second of a series—dealing with the theoretical principles of reception.

IN the reception of continuous waves (a term usually abbreviated to CW), entirely different methods have to be employed to those used for the reception of damped or spark waves.

Whereas the latter are radiated in groups or "trains," with separating intervals, the groups themselves occurring at an audible frequency, continuous waves consist of an unbroken stream of waves of constant amplitude, the duration of which is determined only by the length of time the transmitting key is depressed.

The Transmitting Station

At a continuous wave transmitting station the essentials are, firstly, an aerial system in which high-frequency or oscillatory currents can be made to flow, with consequent radiation of electromagnetic waves, and, secondly, apparatus capable of applying electrical impulses to this aerial system with sufficient rapidity to maintain continuous oscillations of constant strength or amplitude.

As in the case of a spark station, the wavelength and radio frequency of the aerial system depend only upon its electrical length, or, in other words, upon the values of inductance and capacity associated in the circuit.

In the case of a spark transmitting station, however, the rate of impulsing the aerial depends upon the rate at which sparks can be made to occur at the spark gap, and this in turn depends upon the frequency of the alternator supplying current to the primary of the step-up transformer.

For the radiation of continuous waves 300 metres in length, the aerial circuit, suitably tuned to that wavelength, will require to be impulsed one million times per second, so that the great difficulty of doing this by any electro-mechanical method will be appreciated. Another point in connection with the spark method is that a certain time must elapse between successive spark discharges, during which the condenser in the closed oscillatory circuit is being re-

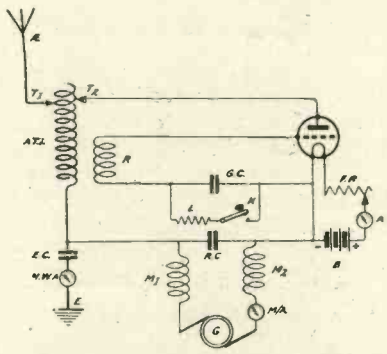


Fig. 1.—Circuit diagram of typical CW transmitter.

charged, and this, of course, operates against the production of continuous oscillations as, in the comparatively long time occupied in recharging the condenser, the energy in the aerial circuit, due to previous discharge, is all dissipated.

The Valve as a Generator

The modern three-electrode valve affords a very convenient means of generating continuous oscillations at the necessary high frequencies, as, owing to the entire absence of any inertia due to mechanical moving parts, oscillatory currents at a frequency of ten million or more per second can easily be obtained

Also, as the energy is given to the aerial continuously as long as the transmitting key is depressed and the aerial is radiating in a corresponding manner (without any idle periods), each individual impulse need only be small and can be applied direct to the aerial circuit, thus dispensing with the necessity for a closed oscillatory circuit as in a spark transmitting set.

In Fig. 1 is shown the circuit arrangement of a typical continuous wave transmitting set. The set may be considered as consisting of five circuits: *The aerial circuit*, comprising the aerial itself Æ, the aerial tuning inductance ATI, the earth condenser EC, hot wire ammeter HWA, to register the current flowing in the aerial circuit, and the earth E. *The anode circuit*, comprising the anode of the valve, a portion of the ATI, namely, the turns included between the anode tapping T_2 and the bottom of the coil, the condenser RC and the valve filament. *The grid circuit* includes the grid of the valve, the reaction coil R, the grid condenser GC and the valve filament, whilst across the condenser GC are connected the grid leak L and the transmitting key K. *The filament lighting circuit* comprises the accumulator battery B, ammeter A, the filament rheostat FR, and the filament itself. *The high-tension circuit* includes the direct-current generator G, capable of supplying current at a voltage of 1,000 to 1,500 volts, a milliammeter M/A to indicate the rate of current supply to the anode, two iron core choke coils M_1, M_2 and the reservoir condenser RC. The purpose

of these coils and the condenser is to smooth out any slight fluctuations in the supply current.

It will be noted that the necessary positive potential is applied to the anode of the valve *via* the ATI and the anode tapping T_2, whilst the rather dangerous high potential is effectively insulated from earth by the earth condenser EC.

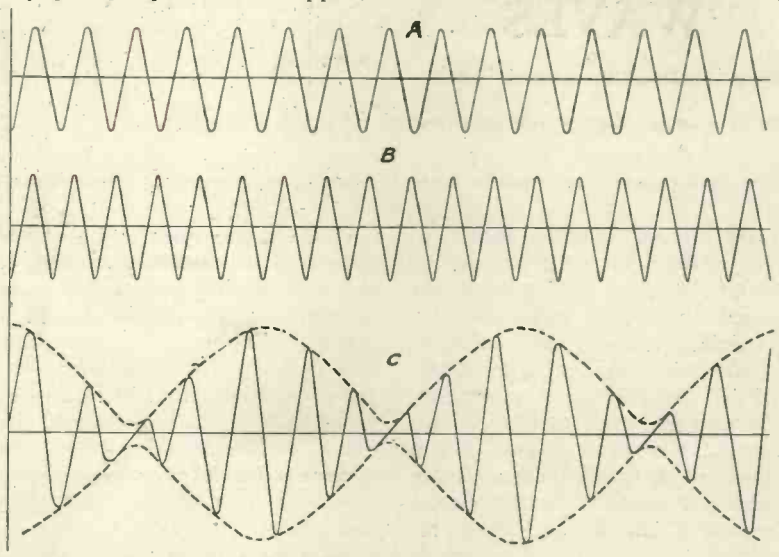


Fig. 2.—Showing "beats" produced by interference between waves of slightly different frequencies.

The Action of the Transmitter

Suppose the apparatus to be connected up as shown in Fig. 1, the filament to be glowing, but the high-tension circuit to be incomplete. Upon completing this circuit, momentary oscillations take place in the valve circuits, and the grid acquires a highly negative potential, sufficient, in fact, to entirely prevent electrons reaching the anode.

When the transmitting key K is depressed, however, the grid leak L, having a value of, say, 50,000 ohms, is shunted across the condenser EC, and a considerable portion of the charge upon the grid leaks away to the filament, thus raising the grid potential to a correct average value, according to the type of valve and the high-tension voltage employed. The grid potential will still be negative, but not nearly so negative as before the key was depressed. With the grid at its correct potential, a flow of electrons to the anode takes place, a difference of potential is set up between opposite ends of the ATI—the aerial end being negative, and the earth end positive, and a current commences to grow in the coil.

This *growing* current induces an EMF in the reaction coil R, and the respective windings of the coils ATI and R must be in such a direction that this induced EMF lowers the grid potential, thus cutting off the flow of electrons to the anode.

The current, which is, as it were, trapped in the ATI, reaches a maximum value, and, because the aerial circuit is an oscillatory circuit, it commences to swing in the reverse direction, and in doing so induces an EMF in the reaction coil in such a direction as to raise the grid potential and turn on again the anode current.

This cycle of events continues as long as the transmitting key K is depressed, and, as the aerial circuit is the only oscillatory circuit in the set, all oscillations must take place at its natural frequency.

It will thus be seen that there is only one frequency and that one a radio frequency, there being no equivalent to the *group* or *audio* frequency of a spark transmitter.

The Receiving Apparatus

From the foregoing it will be understood that the ordinary type of receiving apparatus, employing, for instance, a crystal detector, is of no use for the reception of continuous waves, unless special means are provided whereby the incoming oscillations are mechanically interrupted at frequencies within the audible limits, or other additional apparatus is employed, as will be described presently.

All the results that would be produced in the telephone receivers of an ordinary receiving set would be a click when the continuous waves commence to arrive upon the receiving aerial, and another click when they cease, even though the transmitting key had been depressed for a full minute or more. A breathing sound might be heard, due to slight unavoidable irregularities in the radiated wave, as in the case of the carrier wave received from any broadcasting station when no speech is actually being transmitted.

It is obvious that an audible

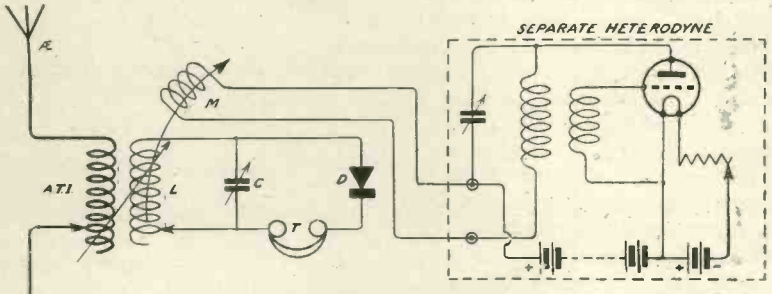


Fig. 3.—Circuit diagram of crystal receiver with independent heteroayne for production of "beats."

frequency of some kind is necessary, and it is in the means adopted to provide this that the modern continuous wave receiving set is particularly interesting. Incidentally the reader will also see why the principles and action of a continuous-wave transmitting set have been dealt with at such length.

The Heterodyne Method of Reception

The present-day continuous-wave valve receiving set makes use of a well-known physical law relating to superimposed waves. The law states that if any two waves, of air, water, or anything else, differing slightly in frequency and not differing too greatly in amplitude, are superimposed, they give rise to "beats."

This is illustrated in Fig. 2, in which the original two waves are shown at *A* and *B*, and the resultant "beats" at *C*. Note the peculiar variation in amplitude of the beat waves, which occurs at a rate corresponding to the difference between the frequency of the original waves.

Examples of this phenomenon occur in several instances, *e.g.*, two violin or mandoline strings, *very slightly* out of tune, give rise, when bowed or struck together, to noticeable "beating," the frequency of the "beat-note" increasing as the distuning is made greater.

In the application of this principle to waves at radio frequency, the received continuous waves (or the oscillations caused by them in the receiving circuit and represented at *A* in Fig. 2) would, in the case of a 300-metre wave, have a frequency of one million per second.

If the second set of waves or oscillations, shown at *B* in Fig. 2, had a frequency of either 999,500 or 1,000,500, the variation in amplitude of the beat wave would occur at the rate of 500 per second. This is shown at C in Fig. 2.

Thus if two separate sets of oscillations are occurring in one circuit, although the frequency of either is much too high to give audible impressions, if the frequency of *one* can be varied slightly from that of the other, the resulting beat oscillations may be made slow enough to actuate the diaphragm of a telephone receiver. This method is known as the "heterodyne" or "interference beat" method of CW reception and is extremely effective.

In practice, of course, one set of oscillations is due to the waves emitted by the distant transmitting aerial, the frequency of which is definitely fixed as far as the receiving station is concerned.

The second set may be provided in one of two ways, namely:—

(1) The oscillations may be produced by means of a valve at the receiving station, acting as a small power generator and known as an "independent heterodyne."

(2) They may be generated in the receiving set itself, in which case such set is known as a "self-heterodyning" receiver.

In Fig. 3 is shown a typical inductively coupled receiving set, which by itself is of no use for the reception of continuous waves. By means of the coupling coil M, which forms part of the oscillatory circuit of a very low-power continuous-wave generator identical in principle to that shown in Fig. 1, locally generated oscillations may be induced in the closed oscillatory circuit of the crystal receiving set.

If the frequency of the locally-generated oscillations is made slightly different from that of the incoming wave, audio-frequency beats will be produced in the circuit LC, and, after rectification by the crystal detector D, will give rise to a pure musical note in the telephones T, the pitch of the note being determined only by the tuning of the separate heterodyne.

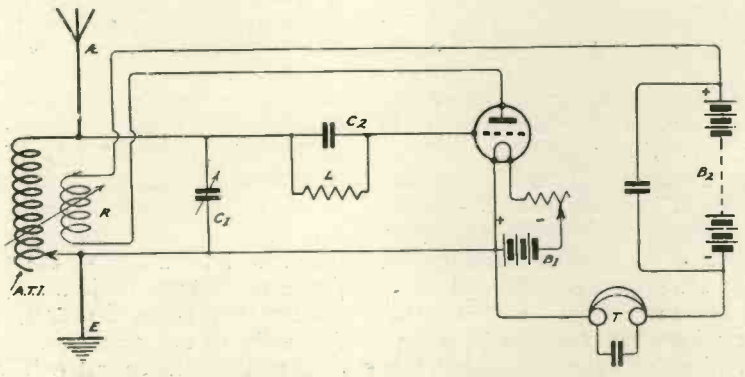


Fig. 4.—Circuit diagram of modern self-oscillating valve receiver.

If the frequencies of the two waves coincide exactly, no beats will be produced, and consequently no sound will be heard in the telephone receivers; but, as the tuning of the separate heterodyne is varied on either side of the exact "silent point," a note will be heard which, commencing very low in pitch, will rapidly rise until it passes beyond the upper limits of audibility.

The Self-heterodyning Receiver

Fig. 4 shows a typical circuit diagram of a single-valve self-heterodyning receiver. *The aerial circuit* comprises the aerial itself, the aerial tuning inductance ATI with parallel condenser C_1, and the earth E, the upper end of the ATI being connected to the grid of the valve *via* the small condenser C_2 and gridleak L, and the lower end to the positive side of the filament. *The filament circuit* includes the 6-volt filament lighting battery B_1, a variable resistance, and the filament itself, whilst *the anode circuit* includes an inductance coil R, termed the reaction coil, the high-tension or anode battery B_2 and the telephone receivers T.

If this arrangement is compared

with that of the continuous wave transmitter, Fig. 1, it will be observed that the essential circuits remain the same, but that the position of the ATI and reaction coils are reversed, the former now being in the grid circuit and the latter in the anode circuit.

Any slight change of grid potential causes a variation of anode current traversing the coil R, and if the coupling between this coil and the ATI is made sufficiently tight, and provided that the respective windings are in the correct "sense," the impulses inductively transferred to the aerial circuit are sufficient to maintain that circuit in a state of continuous oscillation.

In other words, the aerial is now impulsed *inductively* instead of directly, as in the case of the apparatus shown in Fig. 1. Incidentally, it will no doubt be understood that, under these circumstances, considerable radiation may take place from the receiving aerial, which, of course, accounts for its strict prohibition upon the broadcasting wavelengths during broadcasting hours. The frequency of the locally generated oscillations depends upon the adjustments of the ATI and the variable condenser C_1. Suppose these adjustments are such that the aerial circuit is accurately tuned to a wavelength of 300 metres, and that the transmitting station within range is radiating continuous waves of this length. In these circumstances the oscillations in the aerial circuit due to the incoming waves and the locally generated oscillations will have identical frequencies, and no beats will result. Consequently no sound will be heard in the telephone receivers. But if the aerial circuit is slightly distuned, the frequency of the locally generated oscillations will be altered, and the beats produced will, after rectification in the valve, give rise to a musical note in the telephones.

There is one disadvantage about this method, in that the distuning necessary to produce the beats prevents full advantage being taken of exact resonance between the transmitting and receiving stations. On short waves only very slight distuning is required to produce the desired effect, and the loss is not great. On long waves, however, the exact resonance point has to be departed from considerably, and the resulting loss in efficiency is a rather more serious matter.

The use of the separate heterodyne device, which, of course, may be applied to a valve receiver as readily as to a crystal, overcomes this difficulty, and allows of the aerial circuit remaining exactly in tune with the incoming wave.

The rectification mentioned above is effected by the action of the grid of the valve, which, under the influence of the applied oscillations, collects electrons and reduces the anode current. As each complete "beat" is practically equivalent to a group of damped waves, the anode current is varied at this group or "beat" frequency, and the excess negative charge on the grid is neutralised between the beats by the action of the gridleak.

Questions & Answers on the Valve

A COMPLETE COURSE ON THERMIONIC VALVES

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

PART XII

(Continued from No. 12, page 693.)

In Fig. 1, what sort of Telephone Receivers should be included in the Anode Circuit of the Valve?

In all valve circuits the telephone receivers, if connected directly in the anode circuit of the valve, should be of high resistance, preferably not less than 2,000 ohms.

Assuming that a Three-electrode Valve is used as a Detector, how is it Possible to Obtain Stronger Signals?

Another three-electrode valve may be used, either to amplify the high-frequency oscillations before they are applied to the detector valve, or another three-electrode valve may be used as a low-frequency amplifier of the currents flowing in the anode circuit of the detector valve.

Which of these Two Arrangements is to be Preferred?

When about ten miles from a broadcasting station there is little to choose between the two arrangements, but, generally speaking, the high-frequency amplifier arrangement is best if the original signals in the aerial are weak.

The low-frequency amplifier following the detector does not need any special adjustment, and therefore this latter arrangement is to be recommended when simplicity of operation is a consideration.

Draw a Theoretical Diagram in which the First Valve acts as a Detector and the Second as a Low-frequency Amplifier.

Fig. 1 shows such a diagram. It will be seen that the first valve has a leaky grid condenser in its grid circuit, and instead of telephone receivers in the anode circuit we have the primary T_1 of an intervalve step-up transformer T_1 T_2. The secondary T_2 of this transformer is connected between the grid and the negative side of the filament accumulator B_3. In the anode circuit of the second valve we have the telephones T and a second high-tension battery B_4. The incoming oscillations are rectified by the valve V_1, and pro-

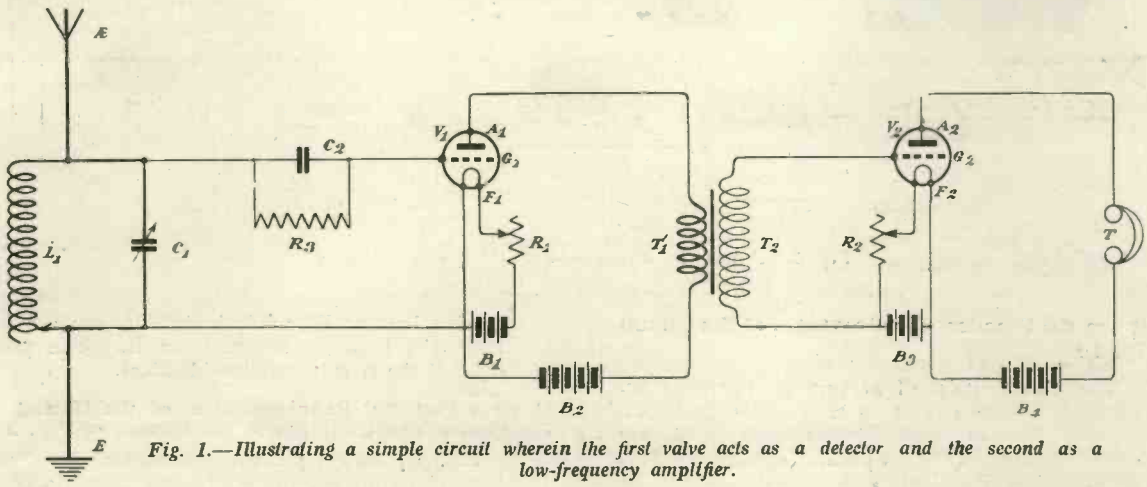


Fig. 1.—Illustrating a simple circuit wherein the first valve acts as a detector and the second as a low-frequency amplifier.

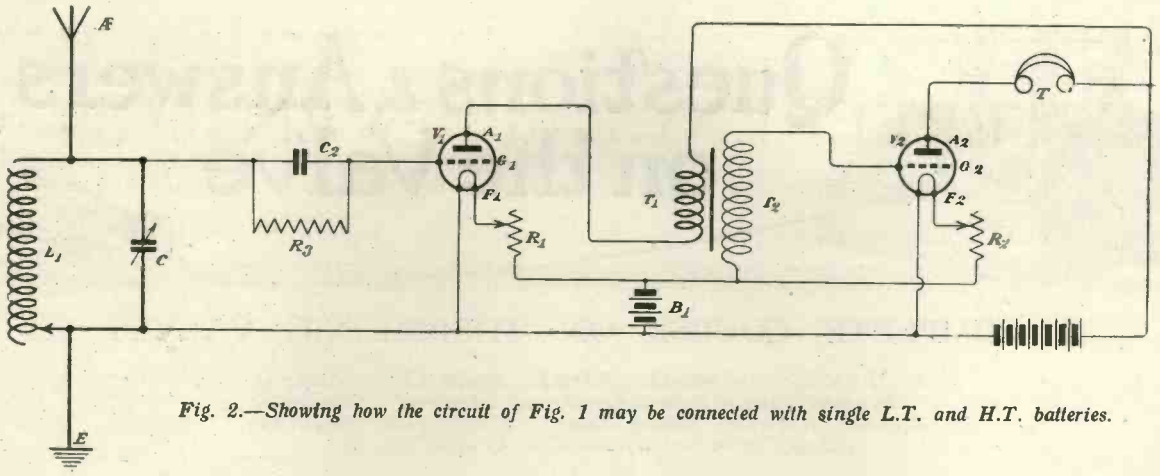


Fig. 2.—Showing how the circuit of Fig. 1 may be connected with single L.T. and H.T. batteries.

duce low-frequency current variations through T_1. These current variations are stepped-up by the transformer T_1 T_2, and variations of higher voltage are impressed on the grid of the second valve, which amplifies them, the magnified current flowing through the telephones T.

we therefore employ only one filament accumulator and one high-tension battery.

Draw a Practical Circuit to Use only One Filament Accumulator and One High-frequency battery.

Fig. 2 shows such a circuit. It will be seen that both anode circuits are fed from the high-

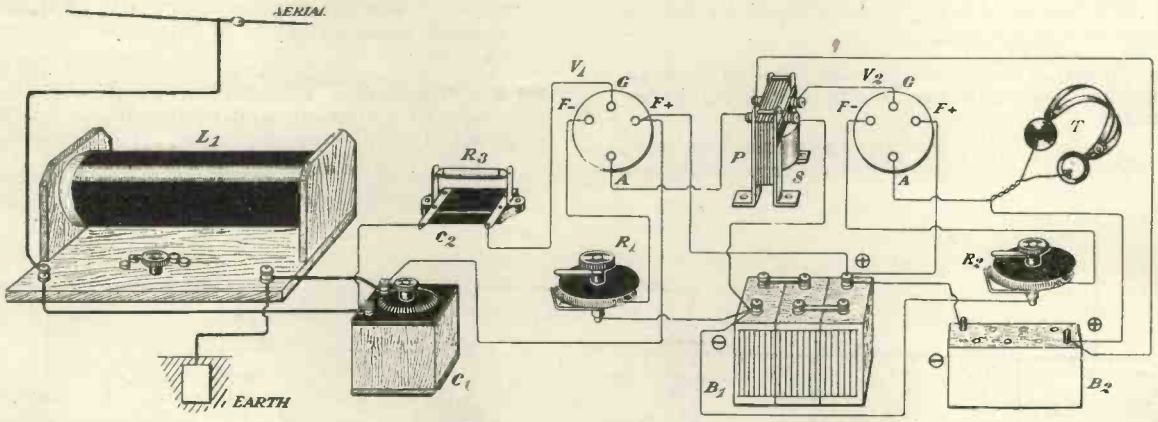


Fig. 3.—A pictorial arrangement of the circuit in Fig. 2.

What are the Practical Disadvantages of the Circuit of Fig. 1?

The disadvantage of arranging apparatus according to the circuit of Fig. 1 is that two separate filament accumulators, B_1 and B_3, are required, and also two separate high-tension batteries B_2 and B_4. This adds considerably to the expense and inconvenience of the receiver, and

tension battery B_2, while both filaments are fed from the filament accumulator B_1. The principle of the circuit remains identical.

Draw a Pictorial Representation of the Wiring of Components to Conform to the Circuit of Fig. 2.

Fig. 3 shows a pictorial representation of the Fig. 1 circuit, the different parts being labelled as in Fig. 2.

INTERFERENCE PREVENTION

By Prof. E. W. MARCHANT.

A paper read before the Radio Society of Great Britain on May 23rd, 1923.

DISTURBANCES may be classified into three groups :—

(1.) Interference due to what are commonly known as "atmospherics" or "strays" and other similar disturbances. Among these "similar disturbances," some of the most troublesome we have met with have been due to tramcars, and to tramcar points particularly. When an electrically-controlled tramcar point is altered, it is moved by an electro-magnet which gives a spark when the current through it is broken and causes a very strong "atmospheric." There are some places close to tram routes which are very badly disturbed from this cause, and the "wave shape" of the disturbance must be very much like the wave shapes that have recently been described by Dr. Appleton and Mr. Watt.*

(2.) Interference due to signals from other stations, and

(3.) Interference due to locally induced currents. Unfortunately, we are working in a laboratory with a large amount of machinery and a great many commutators and other sources of rapidly fluctuating currents; these give a great deal of trouble in receiving circuits, and the getting rid of them is one of the greatest, if not the greatest problem which has had to be dealt with.

[Prof. Marchant then described the work of Mr. Watt and Dr. Appleton, which was fully described in *Modern Wireless* No. 5.]

The time for which a wave lasts is of the order of 1-500th of a second; therefore, if one puts it in terms of wavelength for a complete oscillation, it means that the length of the waves produced are of the order of 600,000 metres.

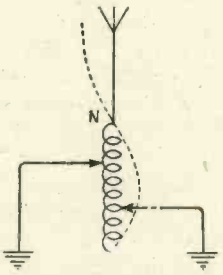


Fig. 1.—Potential nodes in aerial system.

When there are periodic disturbances the rate of oscillation is very much more rapid, and the wavelength is of the order of 10,000, 50,000 or 100,000 metres, which are comparable, of course, with the wavelengths that are used for long distance commercial transmission. These disturbances,

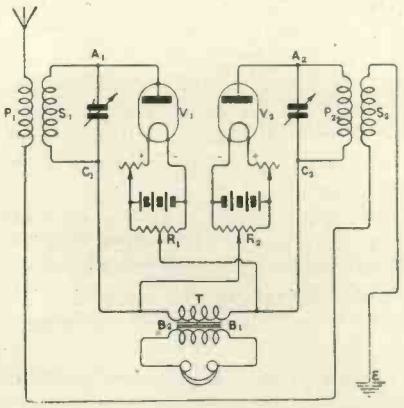


Fig. 2.—Circuit arranged to eliminate interference.

therefore, cause much more trouble on long distance long wave transmissions. Fortunately for those who are listening-in with broadcasting receiving sets, the trouble from atmospheric disturbances is nothing like so serious as it is when one is working on long waves. Short waves are so different in wavelength from these disturbances that the disturbances do not cause a great deal of interference in short wave sets. Dr. Eccles can tell you a great deal more about this subject than I can, because he has records of strays taken over a number of years. I should like to mention one rather interesting fact which is stated in one of his papers, and that is, that atmospherics appear to decrease just before sunrise. In one case he mentions they were rather strong during the night, but, just before sunrise, they completely disappeared and after sunrise they increased again. I do not know whether there is any explanation of this fact. I have never seen it, but it is a very curious record.

There are one or two other interesting facts about atmospherics which have been observed recently which, perhaps, might be mentioned. Stroye in Strasburg noted that when a particular condition of the sky occurs, viz., what he calls "curls" appear (I suppose he means those little wisps of clouds one sometimes sees in the sky), preceding a barometric depression, atmospherics are troublesome. Another observer has stated that atmospherics are greatest when the vapour pressure is a maximum. Atmospherics are a minimum during times of dry fog, low temperature, and high atmospheric pressure. I should think the weather here recently has been favourable as far as atmospherics are concerned; I mean the recent

* Proc. Royal Society A, vol. 103 (1923), p. 84.

weather seems to have corresponded fairly well with the conditions for fewer atmospherics. I have not specially observed atmospherics recently, but I should think they have not been so bad this year as in some previous years at this season

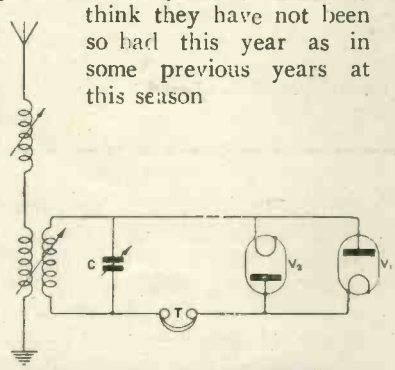


Fig. 3.—Balanced valve circuit.

Methods of Reducing Interference due to Atmospherics.

Now I come to methods of getting rid of the disturbance caused by atmospherics. A very large number of methods have been tried and I am only going to refer to some of those which appear to have been most successful. A method was suggested many years ago which consisted in connecting the aerial through a special form of crystal contact to earth, which was said to have the effect of diverting the atmospheric from the aerial and preventing it from going through the receiving coil of the antenna.

The principle which underlay the action of this contact was that it offered a low resistance to the heavy discharges produced by atmospherics and a high resistance to weaker signals, so that when a bad atmospheric struck the aerial, the atmospheric current was deflected through the crystal contact.

There was another suggestion made and, I believe, tried by Marconi, although I do not think it has been used to any great extent, and that was to tune the aerial, not to the fundamental wavelength, but so that it was set in harmonic oscillation by the received wave.

If we put an earth leak at the potential node N of the wave received on an aerial as shown in Fig. 1, the result is nil as far as the received wave is concerned; the earth connection will do nothing because it is at a node of potential, but when waves of other wavelength are received, the earth connection acts as a by-pass and the atmospheric or other wave goes to ground. I have had no practical experience with this arrangement.

Fig. 2 shows a diagram of a circuit which has been tried; which on paper looks well, for getting rid of atmospherics. There are two primary coils in series with the antenna, each having a secondary circuit coupled to it. These two secondary circuits are connected, as shown, with two valves, but they might be connected to any other kind of detector. One valve V_1 acts as receiver for the signal that is produced in the one circuit, and the connection to it is made between the points A_1 and B_1. The received current goes through the valve and through the transformer T to B_2 and thence to C_1. The other circuit produces a current in the opposite direction through T, so that the signals received by the two circuits balance each other if the currents that are produced in the two receiving circuits are the same. If both circuits are tuned to the frequency of the received signal, there will not be any signal at all, but if one of these circuits is detuned slightly, it will not have so strong a current induced in it as that in the circuit that is tuned for the signal it is desired to receive, and therefore there will be a current through the transformer, and a signal will be heard in the telephone. If, however, an atmospheric strikes the antenna, the effect that will be produced in both these circuits will be very nearly the same. The difference in tune will not make any difference in the strength of the signal, and therefore the atmospheric will not be heard at all. That looks very well on paper, but the trouble with the arrangement is that when a very powerful atmospheric strikes the antenna, the antenna starts in oscillation at its natural frequency, and when there is an oscillation of the natural frequency of the antenna, the arrangement is useless; and I do not think the method has been used to any great extent. I have described the arrangement, however, because, with a slight modification, it could, I believe, be used successfully. If a resistance were put in the antenna circuit, of such a value as to make the antenna aperiodic, the apparatus should work quite well. The trouble is that the amount of resistance that would be required for an ordinary P.M.G. aerial is large. The actual value comes out to about 800 ohms, and consequently the signal strength will be very much reduced. With strong signals, however, this arrangement should prove very useful.

Another circuit which has been used a great deal is the balanced valve or balanced crystal circuit. This is shown in Fig 3.

The two valves are run at different filament temperatures, one is bright and the other is dull. If a weak signal comes in, then valve V_2 rectifies the current and gives a signal on the telephone. When a strong signal comes in, it passes equally well through both valves, *i.e.*, there is as much positive as there is negative current through the two valves and the disturbance is eliminated to a certain extent and the effect produced by the atmospheric in the telephone is limited. I think the circuit, with balanced crystals, is probably the most successful of the anti-atmospheric devices in operation today; it is used largely in the tropics.

(*To be continued.*)

PECULIARITIES IN WIRELESS TRANSMISSION

By Dr. J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor (Physics).

The following article deals with the fundamental principles underlying wave propagation.

IT is well known that the energy-density of the field of waves from a Hertz radiator decreases with distance in accordance with the inverse-square law, but that considerable variations occur due to a variety of causes, depending partly upon the arrangements at the transmitting station and partly upon natural effects which are at present little understood, such as the configuration of land surfaces, the condition of the atmosphere, conditions due to night and day, and so on. A large amount of investigation has been carried out to ascertain the influence of these various effects. The inverse square law was early found to hold in the case of telegraphic waves over distances up to 50 miles. In 1902, it was discovered by Marconi, during the crossing of the Atlantic ocean, that this simple formula ceased to hold, and also that great differences occurred in the strength of signals by day and by night, at any rate at distances greater than 500 miles. He found that whereas at a distance of 800 miles certain signals were inaudible by day, similar signals at night were readable up to a distance of, perhaps, 1,000 miles. It has also been found by other observers that the fading of signals by day is much more rapid than that which would be given by the inverse square law, and that the night signals, although very much stronger than day signals, were also extremely variable, so that measurements of the intensity of night signals were too uncertain for any satisfactory conclusion, as to the law of fading, to be reached. Between about 1910 and 1915, a considerable number of experiments were made by the American Navy and an empirical relation was obtained, depending upon the current in the transmitting aerial, the effective heights of the transmitting and receiving aerials, and the wavelength. Other observations, notably by Eccles, have led to an expression which suggests a two-dimensional, rather than a three-dimensional, propagation of the energy.

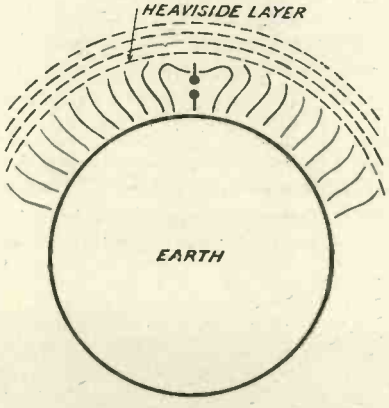


Fig. 1.—Illustrating the "Heaviside layer" theory, supported by Lodge and many other eminent scientists. The Fig. represents the "whispering gallery" referred to in the text.

The results of the work of the American Navy have shown that, at any rate for ocean transmission, there is a best wavelength for each range between transmitting and receiving stations, this wavelength varying as the square of the distance and being equal to 562 metres for a range of 1,000 kilometres. If the wavelength is adjusted for different ranges so as always to be the best, it is found that the current in the receiving aerial is inversely proportional to the cube of the distance, or, in other words, the energy-density in the field of waves falls off as the sixth power of the distance. In this respect the results obtained by the American Navy confirm what was already believed by wireless engineers before this work was carried out.

In trans-ocean communication it is found that any land intervening between the transmitting and receiving stations has a considerable influence upon the propagation of the waves, whilst mountains and valleys have also a marked influence on cross-country transmission. In some cases, stations which are located on opposite sides of a mountain chain are able to communicate with one another much better by night than by day, but this effect depends in addition upon a variety of other circumstances. On the contrary, some observations which were carried out in the Dutch East Indies showed that signals over a range of 200 kilometres were better by day than by night.

During the night hours signals, even in trans-ocean working, may vary considerably from hour to hour. For example, in the Arabian Sea, midway between Aden and Karachi, ships will sometimes receive one station so strongly that the other station is jammed, but the remarkable fact is that within an hour, or even

within a few minutes, the relative intensities of the two stations will be reversed, so that the station which was jammed becomes the louder, variations in signal strength having been recorded within an hour of the order of a hundredfold.

Not only does the intensity vary in this erratic way, but also the apparent direction of arrival of the waves; investigations upon these effects have recently been made by means of directional wireless apparatus. Discrepancies between the true and the apparent direction of arrival have been observed on very short ranges, even on twenty miles, and on ranges of a few hundred miles errors have amounted to as much as 90°.

On the other hand the error in determining the horizontal direction of a transmitting station by daytime is usually negligible, probably not greater than the experimental errors in the use of the directional apparatus. The vertical direction, however, even by day, is subject to considerable error (that is to say, the waves do not arrive in a horizontal direction), and it has been found by many observers that signals are received from a distant station more strongly upon an inclined aerial than upon a vertical one, the adjustment of the inclination of the aerial for best reception being such as to indicate that the received waves have followed an arched path through the air.

The nocturnal variations in the apparent direction of a distant station seem to commence shortly before sunset, perhaps half an hour, and to cease a short time after sunrise.

As to the explanation of these variations in the intensity and in the apparent direction of arrival of wireless waves, there are a variety of theories. Sommerfield has shown that even if the earth were flat, the electrical resistivity of the earth would cause the wave-front to fall forward as the wave travelled over the surface, thus increasing the intensity of the reception at certain distances. A good deal of success has also been obtained in the mathematical solution of the propagation of waves over the surface both of a perfectly conducting sphere and of

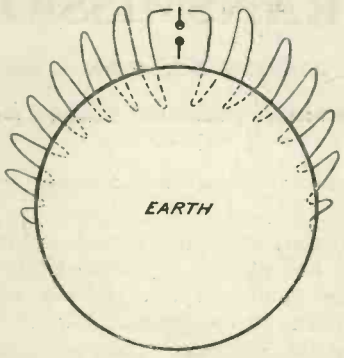


Fig. 2.—Illustrating the "gliding" theory, which supposes that the waves follow the curvature of the earth, without depending upon reflection.

a partially resisting sphere, and the results obtained are in some respects in agreement with those found in practice, but in regard to the signal strength indicated by the theory, very considerable divergencies have been found, the observed signal strength being in some cases thousands of times greater than that predicted by theory.

Influence of the Atmosphere

It seems probable that the atmosphere has an important in-

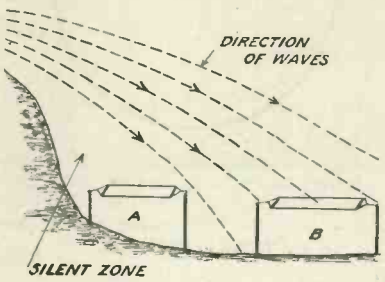


Fig. 3.—Shielding effect of high ground. Aerial A is in silent zone. Position B should be at distance from A equal to about 5 times the height of the mountain or hill.

fluence upon wireless transmission. Heaviside suggested, in 1900, that there may be at a considerable height above the surface of the earth a permanently conducting layer (the so-called "Heaviside layer"): such a conducting layer would have reflecting properties like a "ceiling," the surface of the earth and the Heaviside layer constituting an electrical "whispering gallery." It is easy to see that if such is the case, the practical two-dimensional propagation observed on certain nights in trans-ocean working can be explained. It is probable that if such a layer exists, it is at a height considerably above the region in which clouds are formed, as it has been observed that clouds have no influence upon the effect.

Again, it appears likely that during the daytime layers or strata are formed in the atmosphere which have a conductivity different from that which they possess at night, these conducting layers being at a much lower altitude than the Heaviside layer, and being very variable both in occurrence and properties.

It has been suggested that these conducting layers are produced by the ionisation of the air by the solar ultra-violet radiation, and since the production of such ionisation will be very erratic, it is easy to see, if it has an influence upon the propagation of wireless waves, how some of the variations which occur, particularly at sunset and sunrise, may be explained.

The bending of wireless waves round the curvature of the earth is also probably connected with ionisation in the air, for the presence of ions increases the velocity of electric waves, causing the vertical wave-front to fall forward, and adapts, to some extent, the direction of propagation of the waves to the convexity of the earth's surface. On the other hand, the presence of ions causes an *absorption* of energy; thus the advantage at a distant receiving station which would accrue from the bending of the waves (thereby utilising radiation which would otherwise be directed tangentially away from the earth), is to some extent neutralised by this absorption due to the ionisation. Ionised regions may drift about, and may persist for a consider-

able time after the solar radiation has ceased, whilst a large amount of the ionisation may be removed by recombination. In this way, all manner of electrical "patches," as it were, may be present in the atmosphere in irregular positions and may give rise to the erratic fading and strengthening effects which are observed, as well as to the deflection of waves and consequent errors in the apparent direction of reception.

Magnetic Effects

A theory to account for the presence of conducting layers in the atmosphere has recently been put forward which supposes them to be due to showers of electrified particles from the sun. It is already known, or at any rate generally accepted, that displays of aurora borealis are due to the arrival of such electrification from the sun, and magnetic storms have been supposed to be connected with the same cause. It is now thought that at a height of perhaps 20 to 30 miles above the earth's surface there is a region ionised by solar ultra-violet radiation, and that this ionisation is more or less permanent, even during the night. The region which is rendered conducting by the electrical showers from the sun is supposed to be at a much greater height, perhaps 50 or 60 miles, and probably the lower ionised region represents the base of the Heaviside layer. Investigations have been made by a British Association Committee into the connection between wireless transmission phenomena and magnetic storms and auroral displays, and the results of their investigations seem to support the above views.

Atmospherics

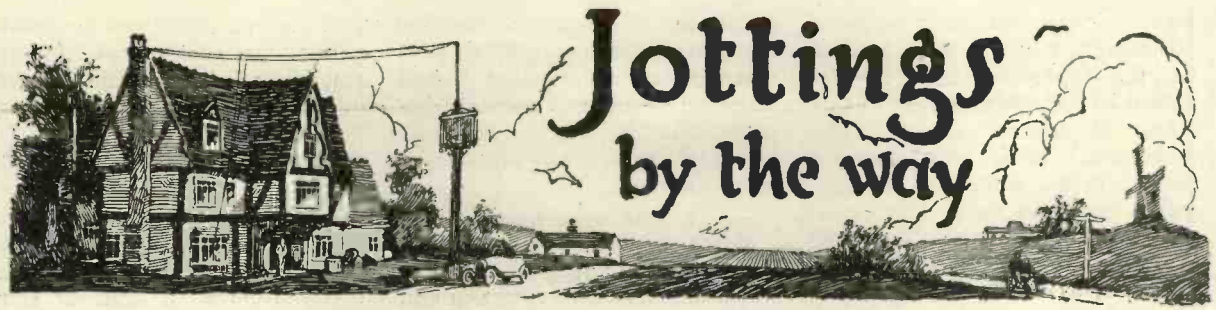
Every wireless experimenter is familiar with the disturbances which interfere with reception and which are variously known as "atmospherics," "static," "strays," etc. These may be described as natural electric waves, as they are produced by a variety of natural disturbances. Many of these disturbances give rise to electrical oscillations much more powerful than those which can be produced by artificial means, and a curious feature of some of the natural disturbances is that they appear to have the same natural period as the aerial. The explanation of the latter observation is probably that the disturbances are impulsive in character and consequently excite characteristic vibrations in an oscillatory system upon which they fall. Some of these interferences are due to electric discharges which may take place either on the earth or outside the earth's system. The effect on reception is to render signals either difficult to interpret or entirely unintelligible; in the case of tape-reception of wireless telegraphy, messages may be entirely obliterated.

A committee of the British Association, formed for the purpose of radiotelegraphic investigation, has dealt with a large amount of information on the question of strays, and has classified them into three types, (1) clicks, (2) grinders, and (3) hissing.

The hissing is found to be due to local meteorological action, or to the discharge of electricity from rain, hail, or snow passing the aerial. The other types are more difficult to explain completely; they are said to be louder at night in the tropics and to be louder in the daytime in polar regions, and also to be stronger and more numerous in the region of tropical mountain-ranges. It is probable that the clicks are due to lightning discharges and the grinders to "cosmic bombardment" of the upper atmosphere. With regard to the latter, it would seem that they arose vertically above the affected station, and on this theory a form of aerial has been devised which is insensitive to vertically-descending waves but is sensitive to horizontally-propagated waves. A considerable amount of more or less conflicting evidence has been adduced as to the region of origin of strays, but the consensus of opinion seems to be that they originate more plentifully in tropical regions. "X-storms" frequently occur in temperate climates, particularly during the summer, and may extend over considerable areas: these are thought to be due to lightning discharges.

A NEW USE FOR FIELD TELEPHONE CABLE

WE have recently received from The New London Electron Works, Ltd., samples of the three grades of heavily insulated stranded cable which they have placed upon the market. The largest cable is recommended for all purposes where great strength and durability is required, such, for example, as the construction of wire fences, the staying of aerial masts, and so on. A further application which is claimed to be a highly successful one is the use of the medium-sized cable for the aerial itself. The extremely heavy and durable vulcanised rubber insulation enables one to dispense altogether with aerial insulators, and simply throw the wire over any convenient natural supports. The cable consists of tinned steel and copper strands, rubber-covered, braided, and treated with a weatherproofing compound, and it can be obtained in three classes, of which the one of light weight seems suitable for making connections to receiving apparatus, such as connecting loud-speakers, etc.



A Super-circuit.

ONE cannot invoke the help of those home-made atmospherics too often, otherwise even the most credulous will begin to smell a rat. What is wanted is a set which can always be relied upon to perform the prodigies of reception of which one boasted at the club on the previous evening.

To meet the vast and growing demand for such an apparatus I have designed the accompanying circuit, which can be trusted never to let one down. The only factor that is at all critical is the alertness of the accomplice stationed in the next room. This circuit is guaranteed to bring in all British and European stations, provided that the assistant has his wits about him; and if a judicious supply of records containing ragtime, nigger melodies and the like has been laid in, a soft needle will make WJZ available.

Its method of operation is simplicity itself. Honest endeavours having failed, you press the stand-by button A. The tune—no tune switch, B, is then thrown over. Straightway a noise is heard: "Hello, Glasgie callin'; the next item will be a pibroch on the bagpipes," or something of that kind. It is only necessary to arrange a code of signals with the stand-by switch in order to have at will what you desire. If preferred, a buzzer may be substituted for a bell. By crafty manipulation of the switch you can then produce spark signals of splendid strength. The absence of C.W. is explained away by your pointing out that you have disconnected your reaction circuit in order to be sure of not causing pain and grief to others. Those who have installed the Wireless Wayfarer No. 1 forecast a great future for it.

On the Safe Side.

Don't use your set when atmospherics become really bad, or when thunder is about. You won't obtain results of any value if you are experimenting, for conditions are quite abnormal. When the weather is playing tricks of this kind the aerial, if not connected straight through to earth, is apt to become charged to a very high potential, and supposing that the set is used it may be damaged. You can minimise the danger of shocks, if you insist on working through a crackling roar of atmospherics, by using low-resistance telephones; but this, though it protects you to a great extent, does not safeguard your apparatus. Such a state of affairs very seldom occurs in this country, though it is a common event in warmer parts of the world. Still, everyone should provide his aerial with an earthing switch, which should always be turned over as a matter of routine when one closes down. It must not be simply a shunt across lead-in and earth wire; such an arrangement is of very little use at all. It should take the form of a genuine and complete cut-out, disconnecting the set altogether and leading currents from the aerial straight to earth with no alternative path.

A Sad Business.

I have just done the most finnicky, the most maddening, the most eye-trying job that ever came my way. It happened thus. A friend passed over to me a resistance-wound high-frequency transformer for which he had no further use. The reason which he alleged for discarding it was that he had become converted to the tuned anode and had sworn a mighty oath never again to sully the fair panels of his set with a transformer.

In the light of subsequent experiences I think that the reasons for his seeming generosity were quite different. Having spent a whole morning in making a seemly unit incorporating the said transformer, and having wired it well and truly with all connections soldered, I bore it triumphantly to the rest of the set, connected it up, switched on.

The smile resulting from pleasant thoughts of a good job well done faded; great expectations of noble performances with never a shiver of oscillation were suddenly stifled. For the set was mute, good reader; there was no ping, ping, ping, of spark, no cheery whistle of C.W. signals, no spoken word, no note of music. Not even a hiss or a grunt greeted my listening ears.

The Cause and the Cure.

The next move was, of course, to dismember that wretched unit in order to ascertain the precise nature of the complaint from which it was suffering. There was no fault to be found with the wiring; the valve was all that a valve should be. The transformer must be "vetted," though, of course, there could be nothing wrong with it.

The primary first of all: a portion of the high-tension battery drove three good milliamps. through its five thousand ohms; nothing wrong there. Then the secondary: not a flicker of the milliammeter's needle though 50 volts were brought into service. Something was "dis"; that became obvious. The naked eye showed nothing, but a magnifying glass disclosed that one end of the No. 50 gauge resistance wire had broken away from its moorings.

Even when sheathed in its silken covering this wire is no thicker than a hair. Have you ever seen it naked? Have you ever been faced with the task of soldering one tiny end of it no more than a quarter of an inch long to a little piece of thicker wire? Probably you have been mercifully spared

from such a business. But in case it should fall to your lot, as it fell to mine, to have to do so, here is how it was done.

A piece of fair white paper was placed below the joint that was to be, in order to show up the almost invisible wire. The insulation was singed with a red-hot knitting needle, then rubbed off with a stiff paint brush. Next a special soldering iron was made from a short piece of No. 14 copper wire inserted into the handle of a bradawl. This was heated as required in the flame of a spirit lamp. The thicker wire was tinned, then the fine stuff was coaxed into place and after several futile attempts to hit the mark a tiny blob of solder was deposited in the right spot.

If one had had a decent length of the resistance wire it would not have been so formidable a job; but a bare quarter-inch does not leave much to play with.

Mysterious Behaviour.

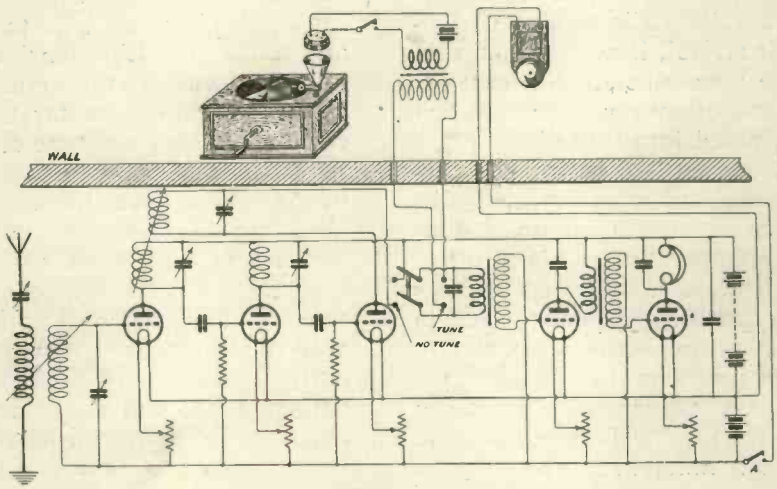
I wonder why it is that sets which normally are models of decorum should occasionally indulge in all kinds of strange pranks. Mine is usually exceedingly well behaved. When it is arranged for broadcast reception you may do your worst with its controls without evoking even the tiniest squeal. To-day it has been playing up in the most unmannerly way.

The trouble began this afternoon when I was working on 600 metres. Signals that are usually as clear as the proverbial bell became woolly and without their proper tone. On the higher wavelengths everything had to be damped with a heavy hand to prevent the wildest kind of oscillation. When 2LO switched on I tried him very gingerly, but was forced to close down almost at once on account of the set's misbehaviour.

Had I continued I would have rivalled the finest performances of Little Puddleton's most skilled "radiator," and that is saying a great deal. The curious thing is that yesterday all was well. Since then not a thing has been altered or even touched. Possibly something has come adrift, but I don't believe that this is the case. To-morrow all may be well again. It is probably the set's own little way of saying, "I'll just show you how little any of you really know about wireless."

American Transmissions in Summer.

We have not heard much about receptions from the United States recently. Is it that they have become too commonplace to be worth recording, or does the glad summer time make them next to impossible? Having burnt the midnight oil a few nights ago I resolved to sit up until 2 ack emma to see what was doing.



"Wireless Wayfarer," No. 1.

At that hour I switched on and searched round on the lower wavelengths, using 3 H.F., a rectifier, and a note-mag. American amateur C.W. signals were there in plenty. I picked up half a dozen different enthusiasts across the Herring Pond, all faint but readable. These were *not* harmonics of Leafield or Northholt, both of whom had obligingly closed down.

Telephony, however, was a different pair of shoes. Thrice I heard a few words, and on two occasions there were snatches of orchestral music, but nothing that I could do would tune them in "for keeps." They were there one moment and gone the next. Still, considering that this was done on almost the longest day in the year it was not unsatisfactory.

I expect I swanked about it, and that is why the set has now gone on temporary strike.

Some Aerial.

A friend who can justly claim to be called a wireless expert, for few know more than he of the ins and outs of the greatest of the newer sciences, invited me to his temporary abode a few evenings ago to see what could be done with a single valve. As he happened to be moving on the morrow into a permanent house his things were in rather a chaotic state.

His aerial proper had been dismantled, but for my benefit he had rigged up a makeshift that broke almost every one of the wireless commandments. The wire was a length of flimsy bare flex. No insulator graced the distant mast, the flex being tied directly on to the halyards. It was old stuff and had broken in three places. You and I would have rushed for the soldering iron; this heretic had simply tied reef knots in the wire. The lead-in, which was merely the spare end of the wire, came into the house through an open window. It was secured (bare wire, mark you) by being twisted two or three times round a handy nail in the window frame. Thence it passed to a room at the back, being tied to one of the banisters of the staircase to keep it from sagging on the way. Can you imagine a more utterly hopeless aerial, or a lead-in more indecent in its violation of every known law? And yet it *worked* and gave quite good results.

WIRELESS WAYFARER.

RANDOM TECHNICALITIES

By PERCY W. HARRIS (Staff Editor).

In these notes, which will appear regularly in "Wireless Weekly" from now forward, Mr. Harris discusses many points of interest to all Radio Experimenters.

JUST as soon as it became evident that England was to have a radio boom, a number of American business men with wireless interests set sail for our shores, hoping to find in this country a dumping-ground for their surplus radio products. Coincident with their arrival, it was decided that only British-made apparatus should be used, whereupon the Transatlantic visions of a rich harvest were dissipated into thin air.

But even if the market had been made perfectly free, it is doubtful whether any great business would have been done in selling standard American apparatus in this country, particularly among those wireless enthusiasts who had already had some experience in the art. These thoughts are borne upon me by an examination of the current advertisements in American wireless magazines, which show very clearly that the technique of the American amateur is different in many points from that adopted on this side of the Atlantic.

* * * *

First of all, let us consider the valves used in America and their accessories. I have discussed the matter with Paul Godley, M. B. Sleeper, and other well-known American wireless men during their visits to this country, and they all agree that the valves available to the British experimenter are superior to those used by amateurs in America. The patent situation in the United States has something to do with this, for only certain types of valve are licensed for amateur use in the U.S.A. For detecting purposes a soft valve is always used, these valves being particularly susceptible to slight variations in filament and plate voltages. For this reason every good wireless receiving set has fitted to it a vernier rheostat, whereas with the valves used in this country such a rheostat is a needless refinement. Again, who in this country has heard of the use of a potentiometer to control the *plate* voltage? Yet such potentiometers are frequently used in American receiving sets. The plate voltage used on the detector valve has usually a value of about 18 volts, whereas for amplifying valves 40 to 50 volts is generally used. The high-tension battery common to several valves is therefore tapped at about 18 volts for the detector tube. The British custom of using one type of valve for all purposes is practically unknown in America, owing to the fact that really good, reliable hard valves are not generally available. At the present time there is a boom in what are known as dry cell tubes, better known to readers of *Wireless Weekly* as dull emitter valves. Several are now available having a current consumption of about a quarter of an ampere each, and prove a great blessing to amateurs in country districts.

* * * *

These new dry cell tubes have brought into existence a very convenient little accessory which could be well made up and marketed in this country, although up to the present I have seen no equivalent here. This is an additional fixed resistance to place in series with the ordinary filament rheostat, so that the filament current can be suitably reduced. Many wireless enthusiasts are desirous of using dull emitter valves, and are accustomed to a 4- or 6-volt accumulator. If only one cell (two volts) of this battery is used for the dull emitter valve, the other cells are idle. Of course if we are careful we can use the two or three sections of the accumulator one after the other, thus equalising the discharge. This, however, is easier said than done, and the use of an additional series resistance for cutting down the filament current is perhaps the most practicable scheme. Whilst there is a waste of energy due to the

series resistance, yet all the cells are discharged uniformly, which is better for their general health. The average American valve rheostat has resistance of from 5 to 6 ohms (just as ours have), and in order that the current may be suitably reduced the series resistance (made to attach to any of the standard variable resistances) has a value of about 25 ohms. The idea of making and marketing such resistances is well worthy of the attention of British manufacturers.

* * * *

The valve pins and sockets used in America are also different from those used here. In place of four rather slender pins, which push into corresponding sockets, the Americans have four much shorter and thicker pins, differently spaced, which do not fit into sockets like ours, but make contact with four springs, the valves being held in firm contact with the springs by a form of bayonet holder, similar to that used here for electric lamps. The sockets themselves are frequently made of porcelain. Certain of the new American dull emitter valves have a special form of base, making an adaptor necessary if they are to be used with the standard American sockets.

* * * *

A valve accessory of some interest now being sold in several forms in America is a carbon resistance for filament control. Instead of the usual coil of resistance wire over which a contact rubs, a number of carbon discs are arranged in a suitable container so that pressure from a screw can be exerted upon them. When they are compressed to the maximum, the total resistance of the mass of carbon discs is low, and when the pressure is released the resistance is high. Between the two limits the resistance can be varied in a perfectly uniform manner. The manufacturers lay great emphasis upon the perfect uniformity of resistance variation, as of course, with the soft detector tubes to which I have referred in a previous paragraph, the slightest variation of filament voltage is of considerable importance in critical adjustment. Just recently a potentiometer operating on the same plan has been introduced, and both of these devices have been praised by those who are in a position to test them adequately.

FORTHCOMING EVENTS

JULY.

11th (WED.).—2LO. At 9 o'clock the Duke of Sutherland and Under-Secretary of the Air Ministry will speak on "Civil Aviation."

12th (THURS.).—2LO. At 9 p.m. Mr. J. Grant Ramsey, Principal of the Institute of Hygiene, will speak on "What to Drink."

Hackney and District Radio Society. Demonstration of a 5-valve power set operated at the National Cycling Union Rally.

Liverpool Wireless Society. At 7.30 p.m. a lecture entitled "Control of Intrinsic Reaction" will be given by Dr. S. S. Richardson at Liverpool Royal Institution, Colquitt Street, Liverpool.

13th (FRI.).—Leeds and District Amateur Wireless Society. Mr. W. G. Marshall will lecture at 8 p.m. on "The Propagation of Ether Waves" at Woodhouse Lane U.M. Church School.

13th (FRI.).—2LO. At 7.15 p.m. Mr. Ernest Esdaile will give the third of his "Elocution" series.

At 9 p.m. Mr. G. Tyrrwhitt-Drake, F.Z.S., M.A.S., on his "Private Zoo."

14th (SAT.).—2LO. At 7.15 p.m. Mrs. L. Russan, Joint Author of "Historic Streets of London," on "Old London."

Plymouth Wireless and Scientific Society will hold a Field Day at Galva, near Plympton, by kind invitation of Capt. Silverlock. Members will meet at Plympton station at 2.45 p.m.

Sydenham and Forest Hill Radio Society will visit 5D.T. transmitting station.

15th (SUN.).—Radio Society of Highgate. Direction-finding competition at 1919 Club, South Grove, Highgate, from 11 a.m. to 1 p.m.

16th (MON.).—Hornsey and District Wireless Society. Mr. J. A. Price will lecture on "Tuned Anode and other Methods."

2LO. At 7.15 p.m. an appeal on behalf of the National Library of the Blind.

At 9 p.m. Mr. R. Brook Little (of *Home Chat*) on "Royal Auction Bridge."

17th (TUES.).—2LO. At 9 p.m. Mr. Colin J. Cambell, Ph.D., on "Volcanoes."

18th (WED.).—2LO. At 7.15 p.m. Mr. G. C. Atkinson on "Cinema Matters."

At 9 p.m. Prof. A. J. Ireland on "History."

18th (WED.).—Radio Society of Great Britain. It is proposed to pay a visit to the transmitting station of Northolt and perhaps to the testing laboratories of the General Electric Co. This visit is reserved for members and associate members only, and special motors will leave from Kingsway at 2 p.m.

News of the Week

THE reception of 5SC, 300 feet down a Lanarkshire coalpit suggests interesting possibilities. Why should not the evening programmes and the daytime transmissions as well be received in all mines? It would tend to relieve the deadly monotony of the pit, and at the same time it would greatly increase the output by virtue of the fact that it would keep the miners interested and less likely to tire in their dreary surroundings. The idea of wireless in mines has far greater possibilities than the mere entertainment of the miners. It could be of great use in the event of a disaster in sending instructions down below.

At a Blackburn elementary school a four-valve wireless set has been installed for instructional purposes, and is used for listening-in by the students. Messages are received from all the stations in this country, as well as those on the Continent. The apparatus has been provided by Mr. J. W. Caithness, the headmaster, and some of the components have been made by the scholars in the manual instruction centre of the school.

When at last the Broadcasting Committee furnishes its report, it is to be hoped it will contain a provision for emergency broadcasting at any hour of the day or night. The recent call to the bedside of his little daughter, received by a father whilst on the Thames in a motor-boat, illustrates the efficiency of the method, which might prove of inestimable value in the event of a serious accident or any national calamity.

The Radio Society of Great Britain celebrated the tenth anniversary of its preliminary meeting on July 5th of this year, when the committee and officers were present at an informal luncheon. In 1913 Mr. R. H. Klein called the preliminary meeting of the "London Wireless Club," and within a month or two it became the Wireless Society of London. Under this title it became well known until last year, when its name was changed to the Radio Society of Great Britain, such title being considered more appropriate in view of the work done, not only on behalf of its own members but in representing other amateur societies.

By the time these notes appear in print both the sites for the Bournemouth and the Aberdeen stations will have been fixed. The B.B.C. are viewing the future on the South Coast with some anxiety, as it is anticipated that jamming from ships will seriously interfere with broadcast reception. The whole question of jamming is seriously affecting the wireless industry and it is high time that something was done towards making reception more satisfactory for the listener-in.

The Sheffield and District Wireless Society has just begun a series of experiments, in the deep caverns at Castleton (Derbyshire), on transmitting from one point to another underground. The first effort showed that messages were picked up at stations on the surface 12 miles distant, but subterranean communication was not established between the two parties. It is confidently calculated that this will be accomplished with a greater transmitting power, however, and the ten watts used will be considerably increased on the next expedition.

The French Minister of Commerce recently received, from the Members of the Industrial Group of the House of Commons, on the occasion of their visiting the Ongar and Brentwood wireless stations, a wireless telegram addressed to the Chamber of Deputies saying that they see in wireless a powerful bond between Great Britain and France. The Minister replied by wireless in similar terms.

Addressing the Members, Mr. Marconi made a statement as to the future of wireless telegraphy to which much importance was attached. He had just come back, he said, from a long journey on the West Coast of Africa, where he had been making experiments. The results were such as to convince him that, by means of radically new devices which he had tested between England and the tropics, long distance signals would become more rapid, more efficient, and more economical.

We understand from the *Westminster Gazette* that the Danish State telegraph administration has made arrangements whereby ships at sea will be able to obtain gratuitous medical advice by wireless through the Blaavand wireless station and the Copenhagen wireless station. The facility is extended to all ships, irrespective of nationality, and the captain of the ship on which occasion for medical advice has arisen

may send by wireless a description of the symptoms in Danish, Norwegian, Swedish, English, French or German, and the radio station receiving the message will submit it immediately to the medical staff either at the Esbjerg Municipal Hospital or the Naval Hospital at Copenhagen. The advice of the doctors will be retransmitted to the ship promptly and without cost.

Many retailers in the wireless trade have, for some time past, felt the necessity of an association solely representing their interests as retailers. As the depression in trade has increased, the opinion has been strongly expressed that only a body of this kind would effectively deal with the conditions creating it and with the questions of trade discounts, under-cutting and the status of the retailers. Such an organisation, the Wireless Retailers' Association, has now been formed, with a committee under the chairmanship of Mr. F. A. Bagley.

In America it has been experienced that the broadcasting of speeches by wireless, a method of propaganda that is likely to be largely used in the next year's Presidential campaign, gives distinct advantages to orators of the quieter and more conservative type. Wireless is more effective than the platform for candidates who can control their emotions and whose feelings do not flare up on any subject, because they view the human comedy dispassionately. On the other hand, a candidate whose voice burns with passion or whose liberal views inspire him to cry out in indignant tones against injustice, produces, in the receiving telephones, merely a series of muffled, choky, unintelligible snorts.

Mlle. Suzanne Lenglen speaking from the London Station on "The Wimbledon championships."

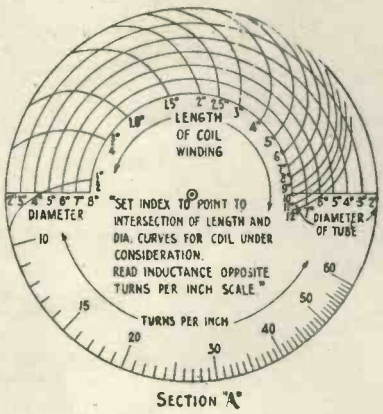
We learn from New York that an invention which makes possible privacy of conversation by wireless telephony has been perfected by engineers of the Bell Telephony system, and is already working successfully over a thirty-mile stretch of ocean between Los Angeles and Catalina Island.

A PRACTICAL RADIO SLIDE RULE

The following article gives some valuable hints on the calculation of various constants.

A SLIDE rule has long been the symbol of engineering science due to the fact that it is indispensable to the engineer. Practically every radio formula may be solved on a standard rule. However, to the novice who has only an occasional problem, the cost of such an instrument is unwarranted. Besides the first cost, considerable study and practice are necessary before the instrument is trustworthy and accurate. However, a slide rule designed to solve only one or two problems becomes very simple and easy to understand. It is with this in mind that the following scales have been designed, which may be cut out and pasted on a small card to produce one of the easiest types of slide rules to construct—the rotary type.

The charts take up the design and measurement of inductance of single, double and triple layer coils. This problem is found on one side of the card, and scales adapted to fit the reverse side of the same card will solve that ever-present problem which is always before every radio



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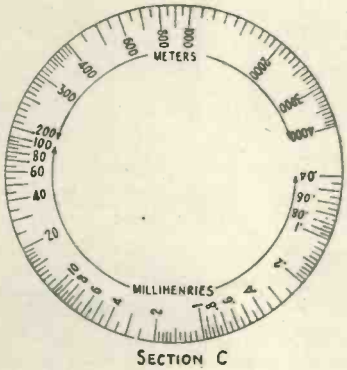

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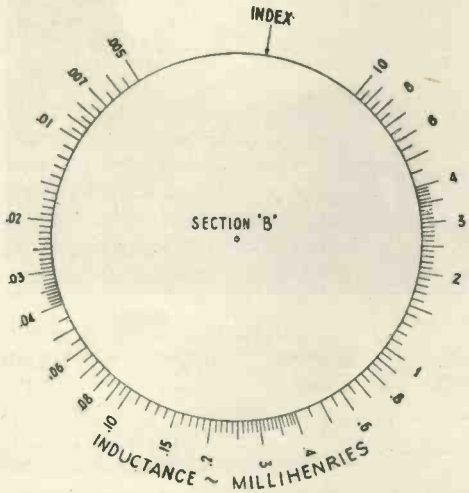
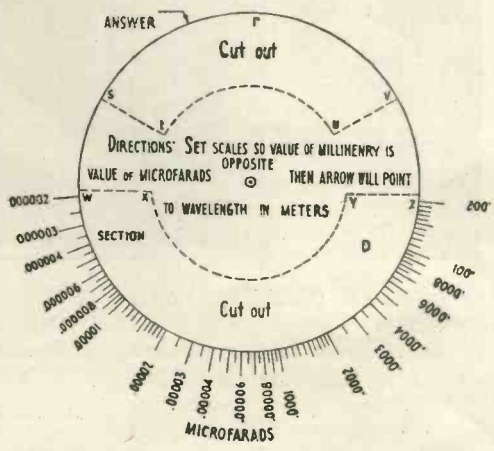


With these charts, which may be cut, pasted on cardboard and assembled, it becomes easy to find the dimensions of a coil for a given wavelength or inversely find up to what wavelength a coil and condenser will tune. Other operations are also possible.



experimenter: what wavelength will I obtain with a combination of this inductance and that capacity?

It may be mentioned that in either of these cases many variations of these problems may be solved as well. Thus if the diameter of the tube to be used in the construction of a coil is known, the inductance desired, and the size of wire to be used are also known, the chart may then be used to find out how long the winding should be.

Constructional Details

Procure two smooth flat cards having their smaller dimensions somewhat larger than the largest of the following scales. For convenience the four scales will be called Sections A, B, C, and D. First cut out Sections B and D, in the form of a square, being careful not to trim away any of the numbers. Paste these scales on opposite sides of one of the cards, taking care that the centres of the circles coincide. The best way of doing this is to punch small holes with a pin in the centre of each section B and D and another hole in the centre of the card. When these three holes are in line, the centres are together. A small dot in the centre of each section indicates where the hole should be punched. Dry the card after pasting, under pressure between flat surfaces to prevent warping.

Paste Sections A and C on opposite sides of the other card, getting the centres together in the same way, and dry flat. When dry, carefully trim off the edge around Section A outside of the circle, leaving no margin. This leaves a round disc with scales on each side. It will be found that Section C is a little smaller, but this is intentional.

Returning to the square card with Sections B and D, cut out the two circular slots on Section D indicated by the letters "s-t-u-v" and "w-x-y-z," cutting clear through the card. This operation is best done with a sharp knife. It is desirable to cut exactly on the lines and curves bounded by the above letters. The removal of these sections will not affect the scales on Section B on the other side, since the latter is somewhat larger.

Then lay the rectangular card on the table with Section B up. On top of this place the circular card with face A up, and fasten the two together with a small rivet or paper fastener eyelet inserted through the centre holes. The smaller disc should be free to turn about the centre. When this is done, the Computer is completed. If it is constructed according to these plans, the outer diameter of Section A should be even with the inner diameter of Section B; and the scales of Section C will show through the windows opposite the scales on Section D.

Method of Operation: Layer Type Inductance Coil Computations with Special Rule

To find the inductance of a single layer coil when dimensions (in inches) are known, rotate the disc until the index arrow points to *the intersection* of the Length and Diameter curves. Count the actual number of turns per inch of winding. The inductance of the coil will be found exactly opposite the location of this value on the turns per inch scale. It may be necessary to interpolate between the curves if the coil has an odd length or diameter. The Diameter curves are represented by concentric semi-circles, the length curves by oblique curves across these semi-circles.

For two-layer bank winding multiply inductance value so obtained by 4.

For three-layer bank winding multiply by 9.

For coils with more than three layers, the chart will give an approximate value only, when the value is multiplied by the square of the number of layers.

To find the dimensions of a coil for a pre-determined inductance, find out how many turns of the sized wire to be used can be wound in an inch. Set these values opposite on the scales. The index arrow will point directly to the various combinations of length and diameters that can be used.

Wavelength Determination using the Computer

On the reverse side of the inductance coil design card, scales will be found which may be used to determine resonance wavelength for a given inductance (in millihenries) and capacity (in microfarads). Set the disc so that the values for these quantities are opposite each other. The index arrow will then point directly to the wavelength in meters.

If the wavelength is known, and either the capacity or the inductance, the unknown value may be determined by reverse procedure.

DAYTIME TRANSMISSIONS.

The following letter, addressed to the B.B.C., has been forwarded to us for publication.

Captain Lewis, *2nd July, 1923.*

C/o The British Broadcasting Company Ltd., Savoy Hill, Strand, W.C.

Dear Captain Lewis.—I desire to confirm the opinion that from the business point of view the change in the afternoon programme has had a very adverse effect.

Before the change, when the children's hour commenced at 5 p.m. those who desired to get an impression of what "broadcasting" was really like were usually advised that "five o'clock was a good time."

Now, the programme does not commence until 5.30 p.m. and the microphone is occupied by voices which may or may not be suitable for broadcasting.

I fully understand that you have many opinions with which to contend, but both your good selves and those of us who are interested in the sale of wireless apparatus, must realise that unless the opportunity is available of giving really popular demonstrations during business hours we shall continue to suffer financially.

As you are no doubt aware, many hundreds of skilled men have recently been discharged owing to the slump in the sale of wireless apparatus, pending settlement of the licence question, etc.

I submit that the retailers, upon whom indirectly these men depend for their livelihood, are not being helped when a good demonstration is not possible until after business hours.

I therefore ask your company to seriously consider reverting to the original time of 5 p.m. and also please let us have the "Uncles" with their jolly talk to the kiddies.

Believe me, Yours very sincerely,
C. F. CLOSE, Manager, Wireless Department, Harrods, Ltd.

P.S.—In view of the suggestion that the general views of the retailers would be welcomed by your Company I propose to send copies of this letter to the Wireless Journals.

Explaining high- and low-frequency methods to an advanced class of students.

WIRELESS I

By R. J. HIB

The following article tells how wi of the pupils of the Grayswood Sch Hea

FOR some time past there has been a general neglect of practical science instruction in British public elementary schools; yet in America and Germany it takes its place as one of the fundamentals of education. The need of such instruction was never more justified than during the recent war. In my own special branch of service one found that an enormous amount of time had to be wasted in teaching such things as the meanings of a "circuit," "positive," and "negative," and other such simple matters which should have been taught at school, had educational bodies but kept pace with modern scientific developments.

As a schoolmaster, on my return to civilian life in 1919, I felt more strongly than ever that every boy and girl should have some knowledge of this branch of science, and I at once set to work to devise a scheme to introduce electricity and magnetism as a subject necessary in a child's education. This was not an easy task, and several objections were at once raised, amongst which were that the curriculum was already too crowded, that so-called school science never yet really interested children.

Not to be deterred, I decided to teach this science. Now no subject can successfully be taught in a school unless it gains the complete interest of the pupils. I was well aware that electricity and magnetism imparted in text-book style would prove distasteful; but, placed before the children in an attractive form, it would be certain to succeed. I found that this could be accomplished through the medium of wireless telegraphy, the theory and practice of which comprises the application of all the known principles of electricity and magnetism.

As I hope to show presently, its educational possibilities cannot be treated lightly, and if developed on proper lines and correlated with the various school subjects, is of enormous value in the school, and will, I feel sure, become a permanent section of the curriculum. This is no vague theory, but the conclusion at which I have arrived after carrying out careful experiments and tests extending over a period of more than three years.

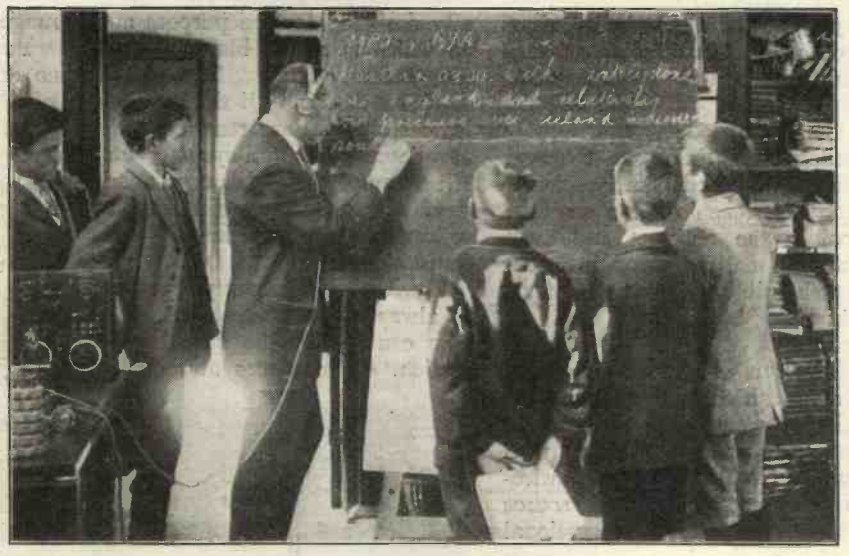
No highly technical institution was selected for the purpose, but a small public elementary school situated in a rural district; consequently the adverse conditions under which I had to work were enormous. Furthermore, the standard of intelligence and lack of scientific knowledge, due to environment, was naturally low, and as a result it necessitated imparting knowledge of the subject in a very non-technical manner. Nevertheless, these difficulties were over-

Employing a disused windmill as an aerial mast.

N SCHOOLS

BERD, M.I.R.E.

eless is included in the curriculum ol, Haslemere, of which the author is aster.



Receiving the weather report from Poldhu.

come, and the results obtained were beyond all expectations.

The upper classes—that is, boys and girls of eleven to fourteen years of age—were selected, and the course commenced by teaching the fundamental principles of electricity and magnetism, and as often as possible its relation to wireless was introduced and emphasised with regard to its functions in this respect. At the same time, the children were learning the Morse code as voluntary homework. In order to enable the pupils to understand fully the practical side of the subject, I allowed them to construct, under my guidance, as much of the apparatus as possible.

The directional effect of an aerial being explained.

For example, the insulators for the aerial were made from old bicycle tyres, the steel blades for the crystal detectors consisted of worn-out safety razor blades. At the woodwork class, boys made the stands for the inductance coil. Some boys went so far as to endeavour to construct their own telephones out of the lids of tins and toy magnets wound with fine wire. Naturally, they were unsuccessful in their efforts in this respect; nevertheless, it illustrates their interest in the subject and their attempt to master it.

The first receiving set constructed was very crude in appearance, but none the less efficient. However, improvements were continually being made, and at the present time the school possesses a very efficient three-valve set and loud-speaker.

In my spare time, I lectured on "The Educational Value of Wireless" to teachers in various parts of England. At the commencement I met with enormous opposition, and at one meeting the chairman, who, by the way, was a schoolmaster, very kindly stated that, in his opinion, radio had as much educational value as if he blacked his face and stood in front of his class. This happened in 1919, and you have only to note the large number of schools now equipped with radio to judge whether this gentleman's opinions were correct or not.

On another occasion I pointed out to several prominent educationists that it is possible for a number of schools, scattered over a wide area, to receive lectures on any subject from a professor speaking into a radio-telephonic transmitter at London University. As they appeared rather sceptical about such possibilities, I decided to carry out an actual test in support of my arguments. On June 4th, 1922, I travelled to The Hague, Holland, and from there delivered a lecture which was broadcast from PCGG. Even at that time it was estimated that at least ten thousand people in England alone heard the lecture. The actual speech was so clear that one experimenter in North Wales, at a distance of ap-

proximately five hundred miles from The Hague, was able to hear every word of the lecture when standing 6ft. from his instrument. Think what this means when broadcasting is fully developed; wisdom, knowledge, and understanding emanating from the best brains in the land, can be placed within the reach of the smallest school in the remotest and most isolated place, not through an incomprehensible, uninteresting text-book, but by actual word of mouth.

Now if a school is going to build or equip itself with a radio station for the sole purpose of listening to pretty music or a man speaking from an aeroplane, wireless will become merely a source of amusement and its educational value will disappear. I admit that listening to the works of some of the great composers should have its place in the music lessons, but there is no room for the ragtime or funny songs. The pupils must apply the radio knowledge imparted to them when and where possible solely for its educational value.

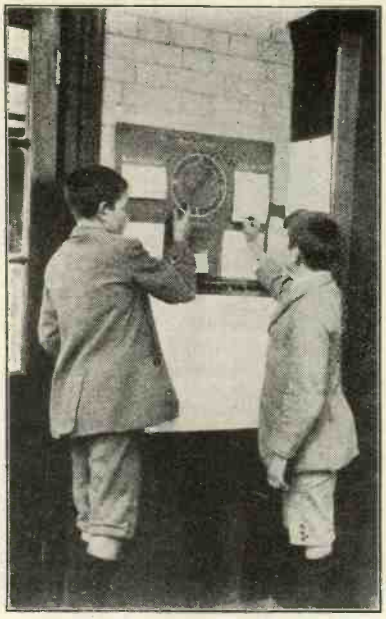
As for instance, after a few lessons on circuits a number of my boys were selected to fit up electric bells in each class-room to be controlled from the headmaster's desk. Working drawings explaining the principle of an electric bell were made by the boys, and the actual wiring was successfully accomplished without any assistance or advice whatever. Here we have an example of the knowledge gleaned from wireless being utilised in a drawing and manual instruction lesson. It does not end here, however; there is a place for radio in practically all lessons.

Picking up signals from stations throughout the world cultivates concentration of a very high order, besides training the memory and making the brain alert.

In the physical and political geography lessons I have found it has unlimited scope. In my own school two pupils, boys or girls, are detailed each week to take the wireless weather reports every morning.

These reports are fixed to a chart which the pupils have specially designed for the purpose and on which is also a blank map of the British Isles. The pupils mark on the map all the meteorological observations received, such as depression, anti-cyclone, etc. All the pupils read this report each day, and it is fully discussed as to cause and effect in the geography lessons.

During wireless reception there is always keen competition as to who can receive the most distant station. The places are, out of



Marking the weather report on a chart specially designed for the purpose.

curiosity, looked for on the atlas by the pupils. Their location and approximate distance from the British Isles thus become familiar to the children. The astronomical time signals are received each day, and these have greatly assisted me in explaining latitude and longitude.

There is a very wide field for the correlation of wireless with arithmetic and mathematics. The subject teems with simple and difficult mathematical problems, suitable for all grades of schools. A simple illustration will save a long explanation. A piece of apparatus termed an inductance was constructed by the pupils, and its range had to be calculated.

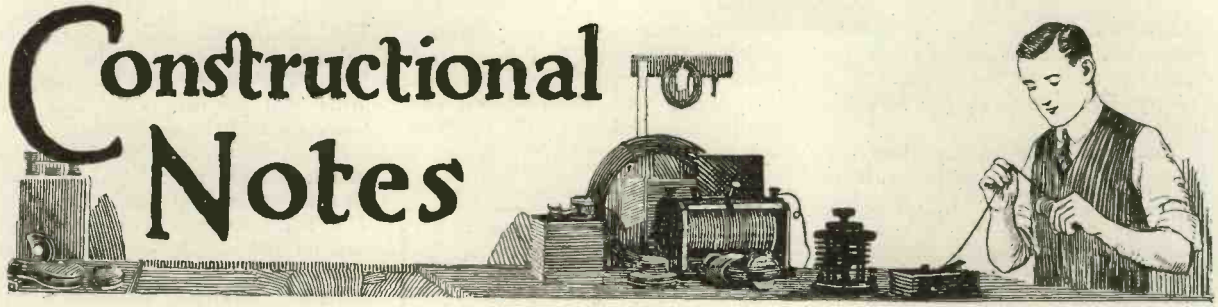
Pupils in the upper class found no difficulty in working out problems relating to the subject. The types and variations of such problems are unlimited. They have the advantage over text-books as being of real interest.

With reference to research work, I am of the opinion that pupils should be encouraged to construct their own apparatus, as by so doing they learn. At the same time, I have found by experience that it is advisable to have in a school a good ready-made receiver constructed by some reputable firm which should be used for special experiments and demonstrations. A good set encourages the pupils to make improvements in their own receivers with a view to making them equally efficient.

The application of radio to two other subjects is worthy of mention. They are manual training and language. In the former, pupils can be instructed to make such things as coils, condensers, etc., and eventually make their own complete sets. Its correlation with language lessons is perhaps novel, but nevertheless of great value. As an instance, up-to-date conversational French is received daily by wireless telephony, so that the dry-as-dust "French Conversation Book" can be dispensed with.

As I have already mentioned, my early efforts to introduce radio into schools met with disheartening opposition. Since then, however, that is, after a period of three years, a number of schools in England have acted on my suggestions and have introduced wireless in their schemes of work. From figures which I have collected, there are now over two hundred British schools equipped with wireless apparatus, whilst in America it has aroused considerable interest amongst educational bodies. Instead of two hundred, let us hope there will soon be two thousand English schools possessing wireless stations.

Constructional Notes



MOUNTING "TEST-TUBE" VALVES

MANY enthusiasts who use their sets largely on short waves desire to make trial of valves such as the Marconi V 24 or the Mullard S 3 or S 5, which

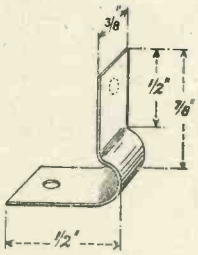


Fig. 1.—Dimensions for clips.

are particularly suitable for dealing with very high frequencies, since their design is such that capacity between grid, plate and filament leads is to a great extent eliminated within the valve itself.

To obtain the full benefit of their "anti-capacity" qualities the clips that support them should be mounted directly on the panel of

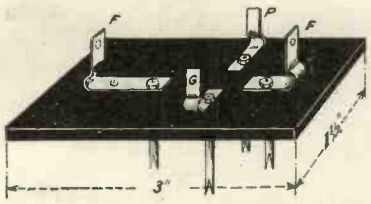


Fig. 2.—A horizontal adaptor.

the set, for then there are no valve pins or legs to introduce other capacity effects. For this purpose four clips of the size and shape shown in Fig. 1 are made from springy phosphor bronze. Those intended to take the pointed caps to which the filament leads are connected should have ¼in. holes drilled in them. The other pair, for grid and anode, are left plain. The filament clips are bolted to the panel so that their upright surfaces are 2⅜in. apart. The distance between those for plate and grid is ⅞in.

Those whose sets already contain holders for valves of the four-pin type can make adapters for these "test-tube" valves without great difficulty. The easiest to construct is the horizontal type shown in Fig. 2. A small ebonite base 3in. × 1½in. × ¼in. is cut out and trimmed up. Then four 4 B.A. clearance holes spaced in the same way as the legs of a valve (Fig. 3) are drilled near one end of it. Note that the fila-

Fig. 3.—Position of valve legs.

ment connections are on a line running lengthwise down the middle of the base.

Three of the clips, those for plate, grid and one of the filament connections will be of the pattern shown in Fig. 1. The other will have a tang 2in. in length. To fix them in place pass four valve pins up through the holes in the ebonite, slip the clips over their screwed ends and secure with nuts above and below. The clip with the long tang will require a screw as well as the valve pin to keep it firmly in position.

The only drawback to using a holder of this type is that with it the filament of the valve is horizontal, which is not the best position for it, since it tends to sag under the pull of gravity. Fig. 4 shows an easily made adaptor which provides a vertical mounting.

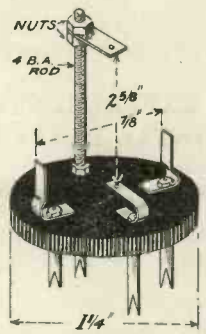


Fig. 4.—An adaptor for vertical mounting.

The ebonite base is either circular with a diameter of 1¼in, or 1¼in. square, it does not matter which. Grid and anode clips are of the standard pattern secured in the way previously described. The lower filament clip is simply a piece of phosphor bronze strip 1⅜in. long by ⅜in. wide. Its end having been secured to its valve pin, the strip is bent over as shown in the drawing.

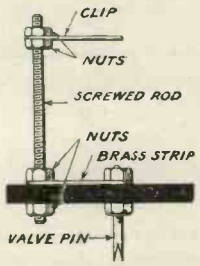


Fig. 5.—Details of vertical clip.

The upper filament clip is just a plain flat strip. It is mounted between nuts on a 3½in. length of 4 B.A. screwed rod, which is fixed to the base as shown in Fig. 5. A

short piece of brass strip makes connection between the rod and its valve pin. The height of the upper filament clip can be adjusted to a nicety by means of its securing nuts.

Adaptors made as described will take any of the following valves: V 24, Q, QX, DEV, DEQ, S 3, S 5. For the anti-capacity ORA, whose dimensions are slightly larger, as well as for the ex-R.A.F. C and D valves, rather different distances between clips will be necessary; but these can be determined readily by measuring up the particular valve that it is intended to use.

R. W. H.

AN EXPERIMENTER'S CRYSTAL DETECTOR

PROBABLY seventy-five per cent. of the receiving sets in use in this country to-day make use of the crystal as a rectifier either with or without the addition of amplifying valves. Quite apart from its simplicity, its cheapness and the ease with which it can be operated, the crystal detector has a fascination of its own. For telephonic transmissions there can be no doubt that the crystal is supreme as a rectifier owing to its almost perfect action which results in a complete absence

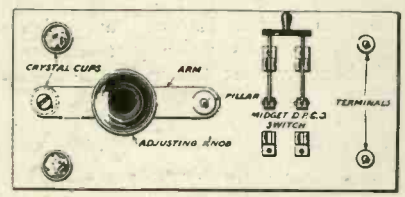


Fig. 6.—Showing plan of the finished detector

of distortion. It has therefore a particular attraction for the experimenter.

The worst of detectors of the ordinary type is that they provide only one combination of either crystal and crystal, or crystal with metal contact. If one wishes to try others quickly it becomes necessary to have a supply of ready-mounted detectors at hand; and to make a change, leads must be detached and reconnected. The detector now under consideration provides in its simplest form from three to six crystal cups, so that this number of different crystals can be mounted, any one of which can be brought into action in a

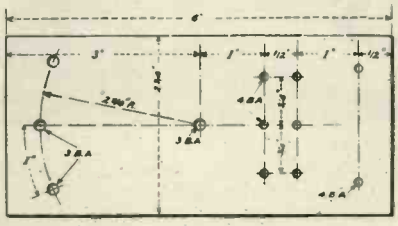


Fig. 7.—Layout of the panel.

moment. An elaboration of the arm, which presents little difficulty, enables one to have a variety of upper contacts always instantly available.

A further point to be noticed is the provision of a double-pole double-throw switch, by means of

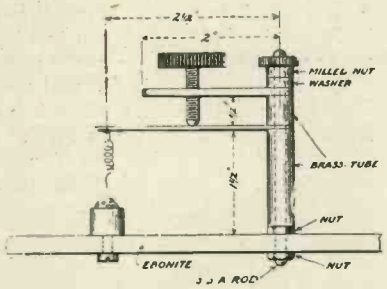


Fig. 8.—Details of the pillar and arms.

which the wiring of the detector can be altered in a moment without the need of the fiddling and time-wasting process of changing the leads over.

Fig. 6 shows a plan view of the finished detector. The cups, from three to six in number, are arranged on the circumference of a circle of 2½in. radius at whose centre stands the pillar supporting the contact arm and that upon which the adjusting screw is mounted. At the other end of the ebonite panel are two terminals for the leads from the set. Between them and the pillar is a double-pole change-over switch of the midget type, which can be bought complete, but unmounted, for about 2s. Those who prefer to make the switch can do so from descriptions given in these notes in previous weeks of switches of similar type though of larger size. The dimensions will have to be reduced in order to make a neat job. The length of the parallel arms will be 1in., and their distance apart half an inch.

Fig. 7 shows the layout of the panel, which is of ¼in. or ⅜in. ebonite measuring 6in. by 2¾in. The holes for the two terminals and for the clips of the switch are 4B.A. clearance. A 3B.A. hole is drilled to take the rod which forms the backbone of the pillar. The holes for the screws that fasten the cups in place are shown as 3B.A., since this is a common size for them. Some cups, however, have 4B.A. screws.

In Fig. 8 are seen the details of the pillar and the arms of the detector. A 3½in. length of 3B.A. screwed rod is inserted into the hole drilled for it and secured by nuts above and below the panel. A piece of ⅜in. brass tubing 1½in. in length is slipped over it, then comes the contact arm, to the far end of which a fine "cat whisker" has been soldered if the simplest form of the detector is being made up. Over this comes a short length of the ⅜in. tubing and then

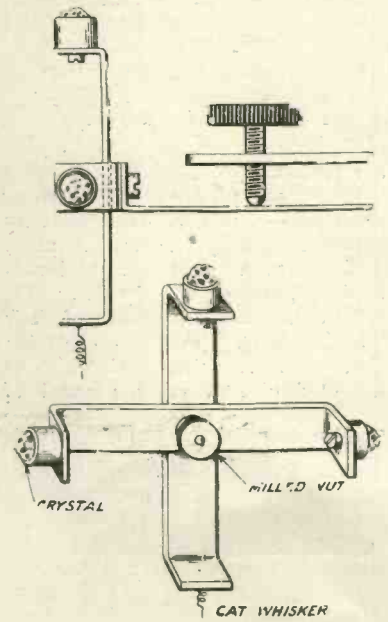


Fig. 9.—A suggestion for crystal-crystal combination.

the supporting arm for the adjusting screw. The contact arm is made of sheet brass of fairly heavy gauge. The supporting arm

should be cut from a piece of metal $\frac{3}{16}$in. in thickness so that the adjusting screw may have a good bearing surface. Most knobs are sold tapped or bushed to take a 2B.A. screw, whose thread is rather too coarse to allow delicate adjustments of contact pressure to be made. It is best therefore to procure if possible an undrilled knob, and to fit it with a length of 4B.A. screwed rod.

Above the supporting arm is a washer, and a milled headed nut, such as those used for the tops of the terminals, clamps the two arms in place. It will be seen that they can be swung over any of the cups by merely loosening this nut temporarily.

If the experimenter intends to use crystal-to-crystal combinations he will find the more elaborate arrangement shown in Fig. 9 very handy. In this case the contact arm is raised 2 inches instead of $1\frac{1}{2}$ from the panel Its end is turned up at right angles and drilled with a 4B.A. hole.

The revolving endpiece is made of two strips of sheet brass soldered together so as to form a cross. The ends of each of the four arms are bent at right angles,

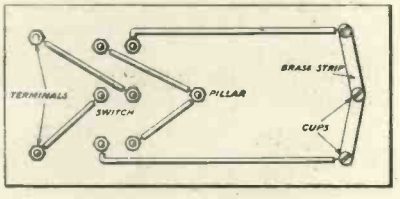


Fig. 10.—The underside of the panel.

little cups made from empty .22 bore copper cartridge cases being soldered to three of them to take the small pieces of crystal which form the upper contacts. The fourth arm carries a cat-whisker.

The endpiece is secured to the contact arm by means of a 4B.A. $\frac{1}{2}$in. screw, provided with a milled nut. Any contact can thus be brought into play by loosening the nut and revolving the endpiece.

Fig. 10 gives a wiring diagram of the detector. It will be noticed that a brass strip is placed under the heads of the screws which hold the crystal cups in place and that leads are taken from this to two of the clips of the D.P.C.O. switch.

The effectiveness of the switch can now be seen. If this is thrown over in the direction of the top of the diagram the upper terminal is connected to whichever crystal cup is in use, the lower via the pillar to the contact arm. When the switch is turned over the other way the upper terminal is connected to the contact arm, the lower to the crystal cup.

R. W. H.

A SLEEVE FOR FINE TWIST DRILLS

MOST of the smaller-sized twist drills are made so long that it is very difficult to use them successfully in the hand drill. They are so whippy that if one puts on any kind of pressure they either buckle or break very easily.

This difficulty can be got over by providing each of the small drills with a kind of sleeve, as shown in Fig. 11. This consists of a piece of brass or steel rod of appropriate diameter, in which is drilled an accurately centred hole into which the drill to be mounted is a tight fit. Since it is essential that they should be perfectly central and straight, these holes can be made only by means of a lathe; but if your own workshop does not contain one, the job will not cost more than a few pence to have done for you.

The drill is slipped into place in the sleeve and kept there by means of a setscrew, only a small amount of the business end being allowed to project. The sleeve can now be fixed in the chuck of the breast drill in the ordinary way, and as the drill is protected for the greater part of its length, quite a respectable amount of pressure can be exerted without fear of damaging it.

The sleeve has two other uses. By means of the setscrew the drill may be adjusted to bore holes of

Fig. 11.—The sleeve with drill attached.

any required depth, the shoulder of the sleeve acting as a stop when this is reached. This is a great advantage when one is making holes on the underside of a panel for screws securing condensers, gridleaks, and so on. One does not want these holes to disfigure the upper side of the ebonite by coming right through.

The second use is for mounting broken drills. In the ordinary way one grinds new cutting edges on to the part containing the shank, and throws away the pointed end, since it cannot be centred properly in the drill chuck. The sleeve enables one to use the pointed end of a broken drill, provided, of course, that the piece is long enough. R. W. H.

A USEFUL GADGET

ANYONE who has a set of B.A. taps can make for himself a most handy pocket gauge, which will enable him to measure in a moment the size of any screw in a piece of wireless apparatus to which a nut must be

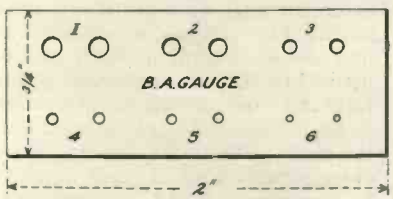


Fig. 12.—The pocket gauge.

fitted, or for which a thread has to be cut. If you have not the complete outfit of taps, you can have the gauge made for you at very little cost.

It consists of a piece of $\frac{1}{8}$in. sheet brass measuring 2in. by $\frac{3}{4}$in., in which are two holes, one tapped and the other clearance, for each B.A. size from No. 1 to No. 6. This can be carried in the waistcoat pocket, and its uses are legion. It enables you to discover whether the thread is one of the B.A. range or not, and, if so, what is its number. It also makes it easy to detect screws or threaded rod that, whilst purporting to be, say, 3B.A. are really either too big or too small to be a proper fit for standard nuts. A great deal of the screwed rod sold is made with worn-out

dies, and it is most exasperating to find that nuts have to be forced on to it, if, indeed, they will go anywhere near it. Sometimes, again, ready-made screwed rod is cut too small in diameter, in which case the thread strips when the slightest force is exerted upon the nut.

The gauge is also a time-saver when one is making up apparatus. The drill that will pass easily, but not too loosely, through the threaded holes is the correct size to use for tapping, whilst to make a well-fitting clearance hole in a panel you have only to select a drill that is a tight fit in the appropriate plain hole in the brass strip.

R. W. H.

FINISHING EBONITE PANELS

NOTHING has a greater effect upon the appearance of a home-made wireless set than the quality of the finish given to the ebonite panels. If left with scratches and tool marks upon them, or with rough, only partly trimmed edges, these defects attract the eye and divert attention from workmanship that is otherwise good. External finish makes no difference at all to the set's performance, but far more pride is felt for any piece of apparatus that is well finished in appearance, and further, one takes more pleasure in using it. The extra time needed to make a really good job of things will not exceed ten minutes or a quarter of an hour in the case of a 9 by 6in. panel, and the results are so satisfactory that it is well worth while.

No matter how careful one may be, the surface of the panel is pretty sure to be scratched a little during the processes of cutting, drilling and tapping. You need not sigh over the spoilt beauty of its glossy exterior, for the high polish that it bears is an eyesore from the wireless man's point of view. The more shiny the ebonite the more likely is it to be a poor insulator of oscillating currents, for that polished surface, especially when it has collected a thin film of moisture deposited by the natural dampness of the air of the room, is very apt to provide high resistance leaks in all directions. Much of the ebonite now sold receives its gloss by being pressed when hot between tin plates. A little of the metal may be deposited, with results fatal to insulating qualities.

The polish, then, is best removed. Do this with a piece of the finest grade of emery cloth, working smoothly and evenly over *both* sides of the panel. The underside may be left with no further attention, but the other must be polished with a mixture of knife powder and turpentine applied with a rag. This gives a dead-black semi-matt finish which, besides looking extremely well, is thoroughly efficient from the point of view of insulation. When this has been done give the panel a thorough washing under the tap to remove all traces of corundum powder, which is of course a conductor.

The edges of the panel should be made smooth and square with a fine file. They should then be finished up with the very useful tool shown in the drawing. This consists simply of a block of hard wood to the lower concave edge of which

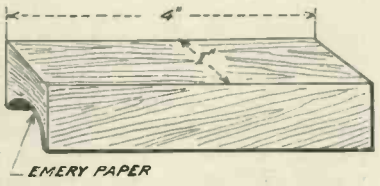


Fig. 13.—The "finishing" tool.

is glued a strip of emery cloth. Its use enables the edges of the panel to be very slightly bevelled off, which adds much to its appearance. Once shaped, the edges should receive a final treatment with knife powder and turpentine.

One final hint. Never clamp a panel between the bare jaws of a vice. By so doing you may cause deep indentations to be formed which are most difficult to polish out. Cut out two pieces of stout cardboard and bend them to the shape of the jaws. They can be kept lying handy on the bench and slipped into place whenever a piece of ebonite is to be held in the vice. A little care, however, should be taken to keep them clean and free from grit, metallic chips, or other abrasive matter capable of producing scratches on the finished surface of the panel or other work.

R. W. H.

ADJUSTABLE FEET FOR BASEBOARDS

WHEN a flat baseboard is made to receive the various components which make up the circuit, it is not usually efficient if it is not provided with four feet. However true it may be from a constructional point of view, unless it rests evenly on a table, irrespective of the surface of the table, a baseboard is of little use for those who employ a cat-whisker crystal detector. A simple device for providing feet, which are both rigid and ornamental, for a baseboard, is made by screwing four telephone terminals into each corner on the underside. By adjusting the heads of the terminals a perfect level can be obtained with very little trouble. For those who desire feet of a more ornamental nature ebonite knobs may be used. In this case four ebonite knobs of a suitable pattern are procured with 2B.A. tapped bushes. Short lengths of 2B.A. rod are screwed into each corner of the baseboard on the underside, and the knobs screwed on to the projecting portion. To adjust to a true level the knobs are simply unscrewed for one or two turns.

H. B.

MAKING BRASS WASHERS

IT is not always convenient to run out to procure a few urgently needed brass washers, and it is the little odds and ends that count in wireless construction. Brass washers are easily made by procuring a piece of strip brass, marking it off in squares, and punching a hole in the centre of each square with a riveting punch and die. After the holes are punched, cut up in squares; these may be trimmed round if desired. The process is quite quick and easy.

H. B.

Broadcasting News

By OUR SPECIAL CORRESPONDENTS

LONDON.—The B.B.C. received about five thousand postcards in answer to their broadcast appeal for suggestions. A very large number were couched in the most laudatory vein. The senders seemed to be so pleased with the fare provided that they had no suggestions to make as to possible improvements. There were some, however, who had some excellent constructive criticism to offer, and a very negligible minority were critical without being constructive. It may be taken for granted that as a result of the communications received the programmes will contain more humorous items, also more topical allusions.

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It will possibly be found that the half-hour close down will be used from time to time as a kind of stop press, for important and interesting items arising out of the news of the day. If possible the witnesses or actors in the important events of the day will be asked to talk about these events. This new departure will not interfere in the slightest with the press. After the press has given the thrilling story of a shipwreck, say, and interviewed some of the survivors, we would like to hear one of those survivors telling his own tale. This idea will take some pains to work out properly, but if it is well done it will greatly enhance the usefulness of broadcasting.

* * *

The wireless man hunt on the 13th of July or thereabouts promises to be very intriguing. While the details have still to be filled in the idea is as follows: The story of an imaginary crime will be broadcast. Three different persons are supposed to have a share in the crime and to have an hour's start. One is believed to have escaped from London in a fast car, and at the time of the alarm may be forty miles away; a second may have decamped with the swag on a heavy lorry, and a third will possibly be wandering about London. In the case of the men on the motor vehicles only the vaguest description will be given and possibly the numbers on the cars, but the man who is wandering about London will be fully described. The "criminals" will keep a log of all their movements, and prizes will be awarded to those who within 48 hours send the best description of the missing men and the cars.

* * *

Mr. Arthur Burrows now spends a great deal more of his time in visiting all the broadcasting stations. Mr. Percy Pitt, now that he has the Covent Garden Season over, will be free to do the same. The results of the peregrinations of these gentlemen ought to be an improved standard of programmes in the provinces. It must be confessed, however, that the provincial programmes are very good considering the comparatively limited range of artists which the station directors have to draw upon.

* * *

We feel sure that 2LO's Sunday afternoon concerts will prove to be one of the most popular features yet introduced, and will appeal strongly to the general public. The B.B.C. should keep in mind, however, that if this latest innovation of theirs is to remain a popular success the nature of their programmes should be in keeping. A band or orchestra discoursing music similar to that comprising the average Sunday programme of the military bands in our parks, for instance, would be appreciated by the majority of Sunday listeners-in.

* * *

BIRMINGHAM. — At last something definite is known about the new studio for the Birmingham station. It is to be in New Street, right in the heart of the city, and, if all goes well, will be opened on August 7th.

Arrangements are now being proceeded with for the perfection of the new studio on lines similar to that at London. The ceiling and walls are to be heavily draped so that undesirable resonance effects will be entirely eliminated. In addition to the studio itself there will be a reception room and a couple of offices. It is worth noting that the studio is within a few hundred yards of the city's leading theatres, hotels, and railway stations, so that every facility will be offered to artistes and others who may contribute to the programmes.

While the studio is being completed new transmitting plant is being erected at the Summer Lane power station, a distance of

half a mile or so, and a special cable will be laid.

* * *

CARDIFF.—A good deal of dissatisfaction is stated to exist among South Wales listeners-in in regard to the alleged deficiency of the broadcasting service. When this was inaugurated it was declared that the Cardiff station would prove adequate for the whole area, but this does not seem to be the case, and bad reception is reported from many places. Results are possible, of course, with elaborate valve receivers, but owners of crystal sets find that their standard range is greatly reduced when operating in South Wales. For example, a case is quoted of a crystal set giving first-class results up to a thirty-mile range in other parts of the country which fails to do so when only ten miles from the Cardiff station. There is a demand that the British Broadcasting Company shall regard South Wales as a "blind spot," and another suggestion is that a relay station be erected at Swansea.

* * *

A wireless section will be one of the features of the forthcoming semi-National Eisteddfod at Newport. Essays are invited on three subjects—"The Educational Possibilities of Wireless," "The Possibilities of Wireless other than Educational," and "Why I Like Listening-in," the last being for juveniles only. For the best essay on the first-named subject a wireless set is offered as a prize. Mr. H. E. Huntley, of Weston-super-Mare, is to adjudicate the intermediate stages of the competition, and Major A. Corbett-Smith, the director of the Cardiff broadcasting station, will act as adjudicator in the finals.

* * *

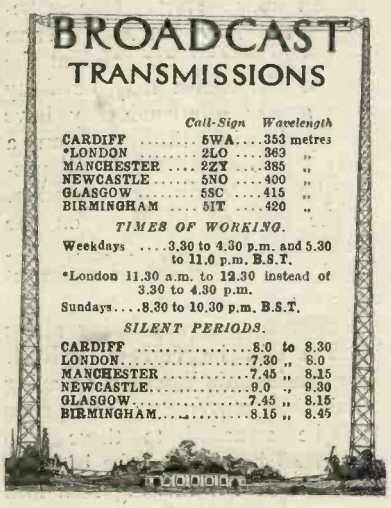
GLASGOW.—The jazz programmes on Monday evenings from the Glasgow station are proving immensely popular. It is bright, sparkling music, and the jazz drummer adds to the hilarity of the programme by singing several numbers. Who says now that the Scots are a solemn race?

* * *

Brass band and pipe band music are also an attractive innovation, and, judging by the letters that Mr. Carruthers, the station director, receives, music of this kind is highly appreciated by listeners-in. Already the City of Glasgow Police Band and the Parkhead Forge Silver Band have contributed excellent items.

* * *

Several picture-house proprietors in the city have seized upon the wireless as an accessory of the picture theatre orchestra. At intervals in the evening the orchestra is "closed down" and



selections from the broadcasting station are provided. By this means many have had their first introduction to wireless music.

* * *

Wireless sets on motor cars are now becoming more common in the Glasgow district. During the past week several cars with their distinguishing aerials were seen in the city's busiest thoroughfares.

* * *

MANCHESTER.—The concert given by the Royal Air Force Band was an unqualified success; the programme was well chosen and well executed, especially the item, "In a Monastery Garden," which well deserved its encore. To finish such a perfect programme, those responsible could hardly have chosen a better singer than Mr. Joseph Rosenblatt, Cantor of the Hungarian Synagogue in New York. The three items he gave were all too short, though long enough to convince us that he thoroughly deserved the title of the "Jewish Caruso."

* * *

The performance of the "Doit" concert party, under the leadership of Mr. Victor Smythe, was so successful that we hope it will be repeated at an early date. The "Doits" recalled memories of the early life of 2ZY, when at very short notice the staff had to amuse us for half an hour, which they did under the title of the "Uniqué" concert party. The item "A Scene in a London Tube" is still fresh in our memory, and we wish that the station would repeat it for the benefit of those who had not the pleasure of hearing it.

* * *

The first Shakespeare night from 2ZY will be given on July 18th, when "Twelfth Night" will be broadcast. This will be followed on August 8th by "As You Like It." The next visit of the Grenadier Guards is to be on August 3rd.

* * *

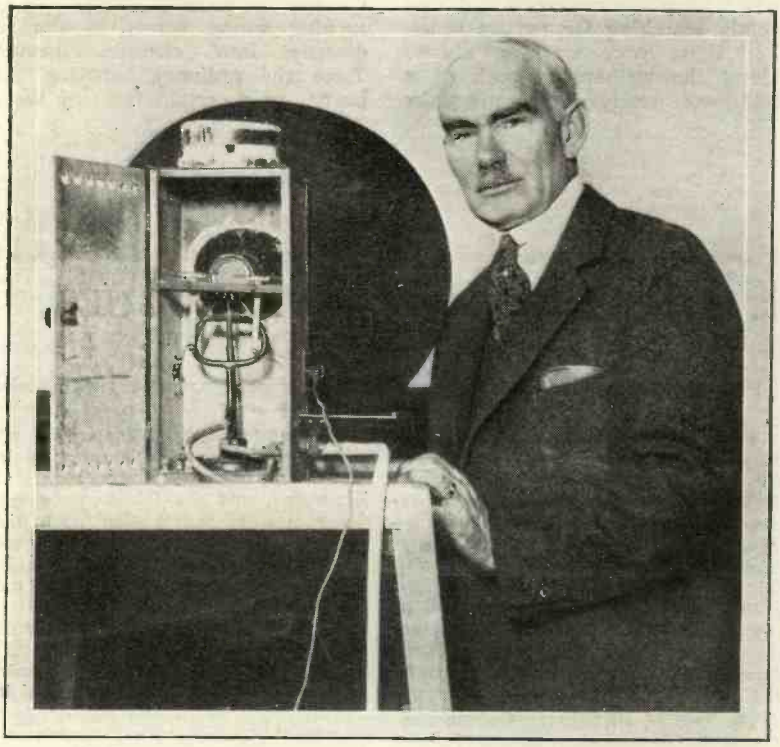
SHEFFIELD.—The work on the Sheffield broadcasting station is progressing slowly but surely. There is now installed at the University, under Captain A. G. D. West's direction, a transmitting apparatus of 100 watts power, with a new type of modulator. This has been tried out during the past week on reduced power, and the results proved quite satisfactory. Messages were picked up on crystal sets at places as far apart as Stocksbridge and Hope. A week's silence may be expected from the University, then will follow more testing transmissions and eventually an improvised programme of music and songs until the extensive experiments are concluded satisfactorily.

THE FLAME MICROPHONE

By DR. LEE DE FOREST

The following article deals with an entirely new device, by means of which sound waves are converted into electrical impulses without the aid of a vibrating diaphragm.

IN response to the numberless enquiries of scientists, educators, engineers, and others directly interested in the development of the talking motion picture art, I should like to take this occasion to announce that, as a result of my development of the new Phonofilm, my investigations and experiments have resulted in revealing what I consider will be another revolutionary step forward in the transmission of the human voice or sound through space. The advance itself may be regarded as a technical one from the engineering point of view, and yet, from the benefits to be derived by the world at large, the improvement is somewhat marvellous in that by means of it hereafter we shall be enabled to change voice or sound waves directly into electrical energy.



Dr. de Forest and his new microphone which he developed for the Phonofilm.

Distortion Due to the Diaphragm

It has for a long time been realised by telephone and acoustic engineers that the necessity for a diaphragm at the transmitter introduces at the very outset of the sound translation problem a source of distortion and imperfection. It is the diaphragm more than any one element which introduces the deformation in recording and in reproducing voice and music on the phonograph, as well as in telephone transmission. Therefore, for many years efforts of telephone and phonograph engineers have been devoted to reducing as far as possible distortions thus introduced by the natural period of vibration of the diaphragm, or membrane, against which the sound waves impinge. But these engineers have not looked elsewhere in the realm of physics with sufficient scrutiny. Otherwise we should long ago have been free of the necessity for using any diaphragm whatsoever at the transmitter element of apparatus, the object of which is to translate sound into electric currents with the minimum possible distortion, regardless of the expense or the elaborateness of the apparatus thereby involved. I do not here refer to the ordinary microphone transmitter, millions of which are in use throughout the world, and which must necessarily be as simple and cheap as possible. For such telephone apparatus the carbon microphone with diaphragm may possibly always be used.

Front view of the Flame Microphone. The large horn concentrates the sound on the flame.

Provide Accurate Translation

But where exact and accurate translation of sound waves into electric currents is desired it is

quite unnecessary to use a vibrating diaphragm. There are, I have found, a variety of ways of doing this. The discovery of the audion first came to me as a result of observation of a sensitive gas flame. From this rudimentary idea, which originated in 1900, was developed, during the ensuing five years, the three-electrode vacuum tube which was destined to become the telephone repeater or amplifier for which telephone engineers had been vainly searching for twenty years. For these were working always along the well-beaten path of a telephone receiver operating by some more or less ingenious method in conjunction with a carbon microphone transmitter controlling a local source of electric energy.

And now in exactly the same way, starting from exactly the same point of investigation—the sensitive gas flame—has been evolved a new form of microphonic device, which does directly what the telephone engineers have so long vainly dreamed of accomplishing—that is, turning sound waves in the air directly into electric currents. Take the ordinary bat-wing gas burner or a certain form of Welsbach mantle gas light, or special forms of oxy-acetylene gas flames, insert two heat-resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes to an appropriate electromotive force. You will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame, which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device using a diaphragm, whether this be of the carbon, electromagnetic, or electrostatic variety.

BOOKLETS AND CATALOGUES RECEIVED

The Bell Battery and Accessory Co., Ltd., have forwarded to us a leaflet relating to a new H.T. Battery box which they are about to place on the market. Arrangements are made whereby any faulty cell may be removed and substituted at a moment's notice. Experimenters may obtain information regarding this battery from the makers, at 21-23, King Street West, Manchester, or 29, Wilson Street, E.C.2.

The firm of **Richard F. Gordon** has placed on the market an anti-glare valve sleeve which may be used with any make of receiving valve. Particulars may be obtained from the firm's address, 5, Lansdowne Square, Weymouth.

Autoveyors, Ltd., have just published a new "temporary" catalogue containing complete details and prices of their wide range of sets and accessories. Experimenters will find much to interest them in the pages of this booklet.

Messrs. Burndept, Ltd., have sent to us for our inspection catalogues of their experimental and broadcast receiving apparatus; descriptional remarks are embodied and suitable sets for special purposes are suggested. Fully illustrated, with details as to prices, etc., these catalogues make interesting reading for prospective purchasers. London showrooms, 15, Bedford Street, W.C.

The Service Co., Ltd., have sent us a copy of their new catalogue of complete sets, accessories, and materials. A very wide range of instruments of well-known makes is illustrated, and the list forms a useful source of information upon the current prices of materials and components. Complete lists of parts for the construction of various panel sets are also listed.

St. Dunstan's Review.—A copy of the house magazine of the St. Dunstan's Home for the Blind has been forwarded to us by the editor. A perusal of its pages reveals the interesting fact that, though blind, very considerable enthusiasm with regard to wireless is displayed by the inmates of the home. The magazine tells of how the blinded sailors and soldiers spend their hours at work and at play, of how they are cared for, and of how this wonderful home does its best to substitute the sight of its unfortunate patients. The magazine is well produced, well illustrated, and costs but sixpence. Obtainable from the publishers, St. Dunstan's Hostel for Blinded Soldiers and Sailors, Regent's Park, London, N.W.1.

The North-East Coast Wireless Co., Ltd., are prepared to send to applicants their illustrated catalogue of complete receiving sets and accessories. The catalogue is well illustrated and gives price details. Applications to Blenheim Chambers, Crowtree Road, Sunderland.

The Lisenin Wireless Co. have forwarded an illustrated booklet dealing with their receiving sets and accessories, which may be obtained upon application to the company's address, 59, Edgware Road, Marble Arch, W.2.

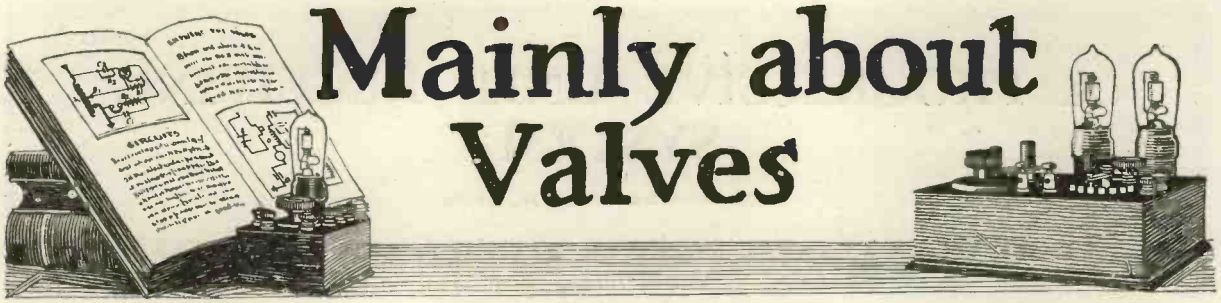
Messrs. C. F. Elwell, Ltd.—We have received an exceedingly well illustrated and complete catalogue of wireless apparatus for broadcast reception, and also "The Elwell Book of Diagrams," for which a small charge of 1s. each is made. The diagrams show how to build up complete sets from rectifying and amplifying units, and each is given in triplicate. Firstly, a theoretical diagram is given; secondly, a wiring diagram; and, thirdly, a diagram showing how various filament resistances and jacks may be included in circuit for switching purposes.

Messrs. J. W. Barnard & Haynes, Ltd.—We are in receipt of a leaflet describing a complete range of J.W.B. accumulators. Strong wooden crates and polished mahogany cases with leather strap handles for these accumulators are also supplied by this firm.

Messrs. Lionel Robinson & Co.—This firm has forwarded to us a leaflet describing a charging converter, a voltmeter with a 100-volt and 10-volt scale, and other useful wireless accessories, which should be of great assistance to the experimenter.

Messrs. C. L. Malone.—We have received a booklet describing wireless sets and components for experimental purposes, and also a leaflet describing the "Alva" accumulator. This accumulator may be charged from D.C. mains, the cells being connected in series. When in use the cells are connected in parallel, and will supply filament current for three valves. A rectifier is also supplied for use with alternating current.

Abbey Industries, Ltd.—This firm has forwarded to us copies of their latest illustrated catalogue describing crystal and valve sets, and also accessories for broadcast reception.

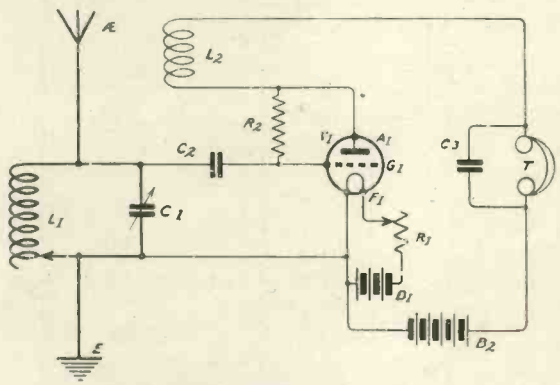


Mainly about Valves

Our weekly causerie written by the Editor.

An Unusual Position of the Gridleak

EXPERIMENTERS who have not yet tried this connection should note what advantages may be obtained by connecting the grid through a very high resistance to the anode of the valve. The usual position for the gridleak, of course, is either across the grid condenser or across grid and filament, but in some cases it may be advantageous to connect the gridleak between the grid and



Illustrating the position of the resistance.

anode. Although I have never found any advantage in doing this myself, it has been reported to me that the low-frequency hum obtained in houses fitted with A.C. lighting current may be largely eliminated. Whether or not this may be taken as applying to special or all cases, the idea is worth trying out. The ordinary gridleaks are not suitable for this purpose, and it is much easier to make one's own. A piece of blotting paper, soaked in Indian ink mixed with powdered graphite from a pencil, will do admirably. The blotting paper should be cut to the best size to give the resistance required. This will depend upon the consistency of the ink, the number of soakings, and the blotting paper employed. It is simply a matter of trial and error to arrive at the best leak for this purpose.

The accompanying circuit shows how the connections might be made in the case of a reaction receiver.

Dual Amplification

It is surprising how few experimenters have carried out any successful work with dual amplification circuits. It is to be admitted that if the wrong values of the different components are chosen considerable trouble will be experienced, but, given the right values and the right circuits, there is no doubt that the dual amplification type of circuit, or "reflex" circuit, as it is called in America, is very sensitive. The idea of dual amplification is by no means new, and it was published early in 1914. There are, however, various minor refinements which have been made since then, and I have myself been carrying out tests recently with this type of circuit with very great success. I find it possible to receive with two Ora valves the broadcasting from 2LO at a distance of 15 miles on a loud-speaker so that the results are audible throughout the house without the least sign of distortion. No crystal is used.

The circuit is perfectly stable, and full details of the apparatus with all values will be given in next week's issue.

A PROGRESSIVE UNIT RECEIVING SYSTEM

(Continued from page 510, No. 8.)

PART VII.—A CRYSTAL RECEIVER WITH H.F. AND L.F. VALVES.

IN this section we propose to deal with a receiver which may be made up of the following parts:—

Two variable inductances, as previously described, consisting of 100 turns, tapped at every 20 turns.

Two variable inductances, as previously described, consisting of 20 turns, tapped at every turn.

Two valve panels of the type described previously.

One crystal detector.

One step-up intervalve transformer.

One pair of high-resistance telephone receivers.

One 6-volt accumulator.

One 60-volt high-tension battery.

The circuit to be used as shown in Fig. 1. In this arrangement the first valve V_1 acts as a high-frequency amplifier, while the second valve acts as a low-frequency amplifier. The high-frequency currents are amplified and reproduced on a larger scale in the anode circuit of the first valve V_1. By connecting the crystal detector D in the primary T_1 of the step-up intervalve transformer T_1 T_2, across the two coils L_3 and L_4, rectified impulses pass through the primary T_1 and are then passed on to the grid circuit of the second valve V_2, which amplifies them. The amplified signals

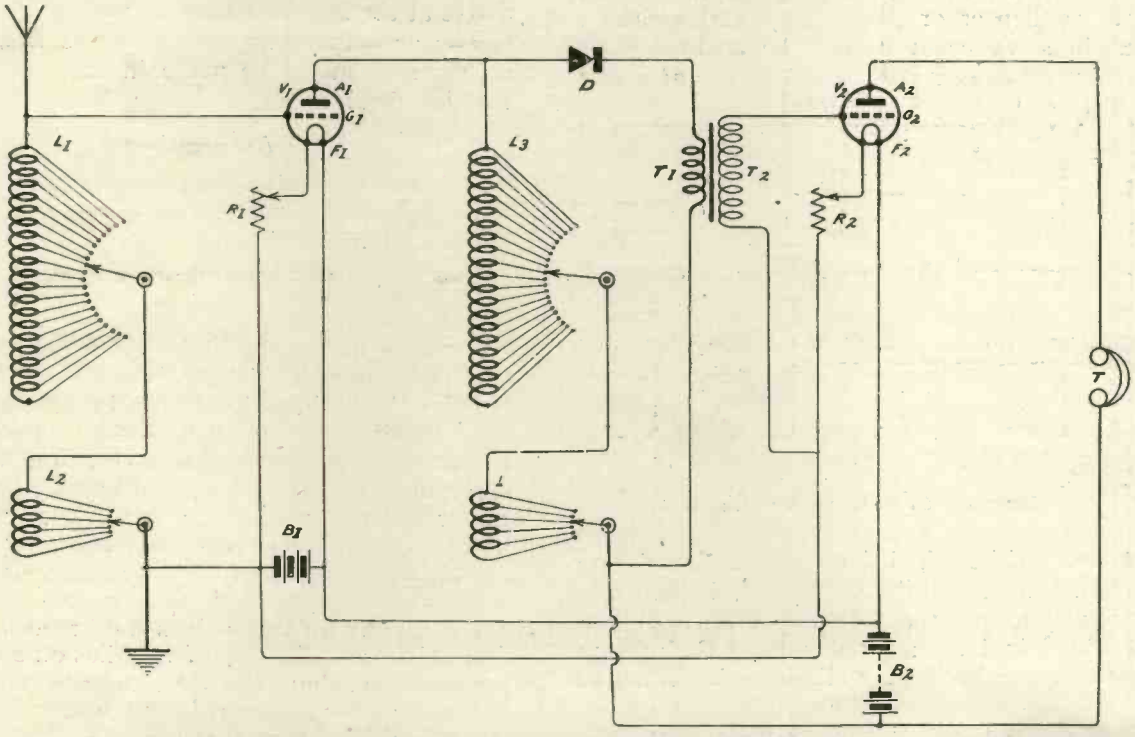


Fig. 1.—Arrangement of circuit with the first valve acting as a high-frequency amplifier, with the second valve functioning as a low-frequency amplifier.

operate the high-resistance telephones T connected in the anode circuit of the second valve. The high-tension battery B_2 is connected in the position shown, so that it feeds the anode circuit of both valves.

Fig. 2 shows the arrangement of the different component parts, the construction of which has been described in previous issues of this journal.

As regards the operation of this circuit, it is only necessary to adjust L_1 and L_2 until the loudest signals are heard in the telephone receivers. This may be done with all the inductance L_3 and all the inductance L_4 in the circuit. That is to say that the two handles which control the value of these latter two inductances should be in such a position that the full amount of inductance is included in the anode circuit. A more careful adjustment may then be made by altering the value of L_3 and L_4. The usual finer adjustments to the crystal detector, the filament current, and the high-tension voltages are then to be made.

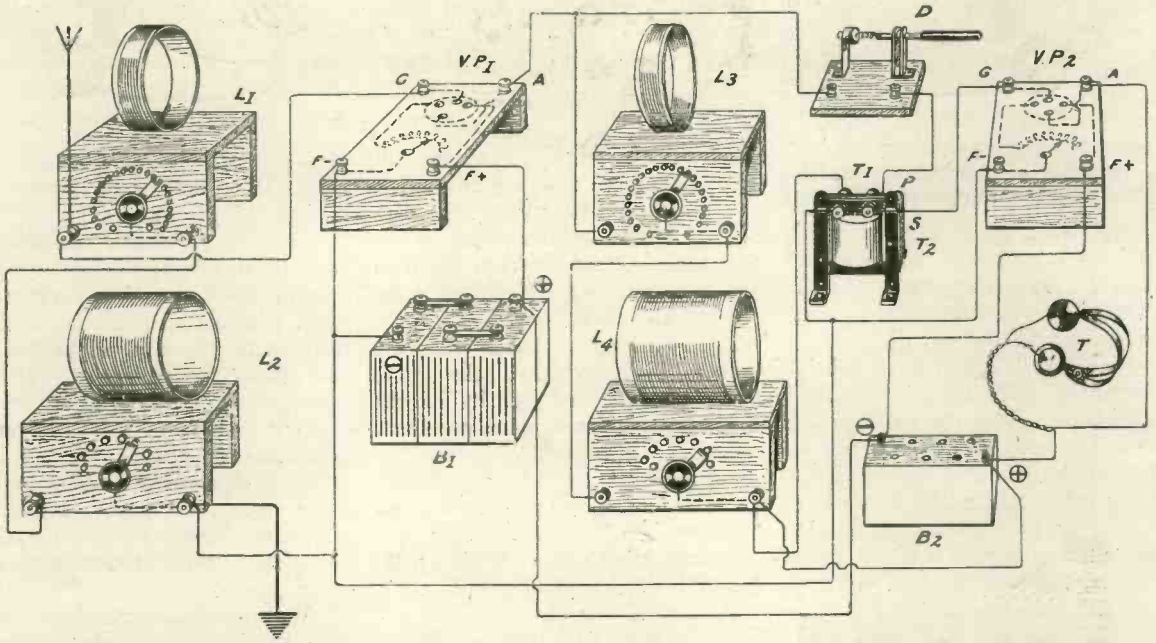


Fig. 2.—A pictorial display of apparatus connected in such a manner as to form the circuit illustrated in Fig. 1.

NEXT WEEK'S ISSUE — OUR SUMMER NUMBER,

amongst other interesting items will contain the following :—

"A New and Highly Sensitive Reflex Circuit," by John Scott-Taggart (an ideal arrangement for a portable receiving set).

"The Radio Society Outing."

"An S.T.100 Receiver for the Car."

"A Three-Valve Broadcast Receiver," by E. Redpath (constructional details of a complete self-contained set for the tent or garden).

"Radio Experiments Out-of-Doors," by Percy W. Harris.

Radio Societies

ILFORD AND DISTRICT RADIO SOCIETY (Affiliated with the Radio Society of Great Britain)

On June 28th, before an audience of about 350 people, Mr. John Scott-Taggart, M.C., F.Inst.P., our President, demonstrated his ST100 circuit.

Mr. Scott-Taggart gave a brief résumé of the changes that had taken place since the days of the crystal to the present era of the thermionic valve. He explained that, although, by means of valves, we could obtain practically unlimited amplification of radio signals, the problem that engaged the attention of the radio world to-day was how to obtain sufficient amplification with the use of the minimum number of valves.

A solution of this problem, he said, lay in the application of the principle of " dual amplification " or making one valve do the work of two. The principle was not new, but dated from 1913; it had not been adopted at all extensively owing to the lack of data with regard to its application to practice and owing to the instability of most suggested circuits.

Mr. Scott-Taggart then gave his demonstration and showed the extraordinary amplifying properties of the ST100 circuit. By means of this circuit and a loud-speaker, broadcast reception was rendered audible to the whole of the audience which filled a large hall. The results were remarkable considering the poor single-wire aerial, which was only about 1 foot above the roof. The strength and quality of the speech reproduced were excellent, and once it was adjusted the circuit appeared to be very stable. A three-valve ST100 gave even louder results. Altogether the demonstration was a striking testimonial to the good qualities of this remarkable circuit.

Mr. Scott-Taggart also demonstrated another " reflex " (or dual amplification circuit) which he has perfected. It employs 3 valves and most certainly gives amplification many times greater than one would expect from such a combination of valves.

The evening, which was one of the most successful in the history of the Society, was, of course, an ordinary formal meeting, but was thrown open to the public. It was certainly a remarkable proof of the great interest that has been created among wireless enthusiasts by the introduction of this circuit, as people were present who had come from distances of 30 and 40 miles.

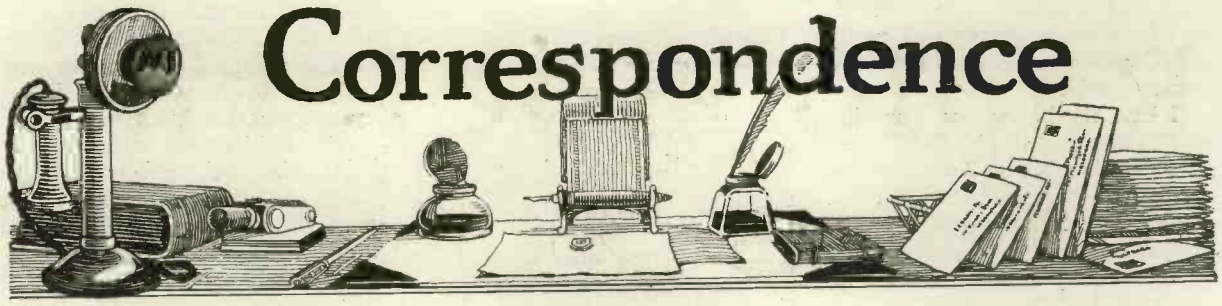
Our very hearty thanks are due to Mr. Scott-Taggart for providing such an interesting evening, and we also thank all those non-members who supported us at what we believe to be the first public demonstration of the ST100 circuit since its introduction by our President. We trust that many of those present will join our ranks, and can promise them some interesting evenings during the coming session.

We have arranged a most enterprising programme, and intend to engage in some serious experimental work, and also to provide instruction for those new to radio. In this connection we are fast acquiring some very useful apparatus, and our thanks are particularly due to Mr. W. W. Burnham, M.I.R.E., one of our Vice-Presidents, for the presentation of a complete set of Burndept tuning coils.

Any person interested in joining our Society should communicate with the Secretary :—

Mr. L. Vizard,
12, Seymour Gardens,
Ilford.

We are in receipt of a very neat single-valve panel made by the firm of N. V. Webber. Connections from the valve socket are made to terminals marked Grid, Plate, and Filament. The panel is fitted with an Igranic resistance particularly smooth in action, together with a " Polar " Safety Fuse for protecting the filament in the event of an accidental application of high voltage.



TERMINOLOGY

To the Editor, *Wireless Weekly*.

Sir,—I notice that an increasing use is being made of the word "vernier," as in "vernier condenser," "vernier slider," and so on. This is quite a wrong use of the word. A vernier is a small, movable auxiliary scale for obtaining fractional parts of the subdivisions of a fixed scale. Doubtless your readers are familiar with the principle. The word has no other meaning. It seems to have been applied to instruments in which a small effect (as in tuning, etc.) is produced by a comparatively large movement of a handle or knob, great accuracy of adjustment thus being obtainable. Thus a so-called vernier condenser is only a variable condenser of small maximum capacity.

It is in the interest of the science that such loose terminology should not be used.

I am, etc.,
D. A. Fairweather, B.Sc.

PORTABILITY

To the Editor, *Wireless Weekly*.

Sir,—Within a few hours of getting my copy of the June *Modern Wireless* I had the ST100 circuit receiving Glasgow—twelve miles—on a loud-speaker.

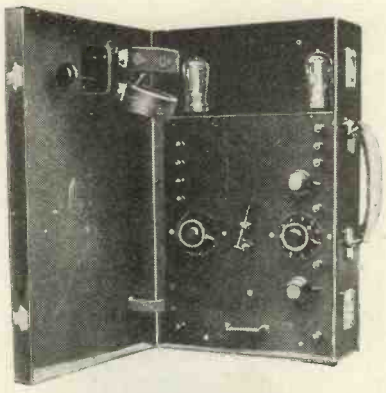
So good were the results that I decided at once to use this circuit for a portable set, of which I give the following description.

I procured an attaché case, the inside measuring 17in. × 10in. × 5in.

Next, I cut three pieces of ¼in. ebonite, one for the panel 10in. × 12in., and two for the sides 3¼in. × 10in. I fixed the sides to the panel with small angle plates.

The Radio Instrument transformers were fitted to the sides at right angles to each other.

If you study the original diagram of the circuit in *Modern Wireless* and take the "in primary" and "in secondary" to be the top connections in the case of the first valve transformer and the bottom connections in the case of the second transformer, you will have the connections which I found to give the best results.



ST100 in attaché case.

The valves I fitted in the space at the top of the case seen in the illustration.

If the valve sockets are let in flush, this will leave just enough room to remove the valves when not in use, and permit of 15-volt H.T. units being carried during transportation of the set.

If V24 valves are used, these could be fitted flat on top of panel, which would allow lid of case to close without removing them, the H.T battery could then be carried permanently in the case.

I might state that I found V24 valves to give very good results with this set, although they require more critical adjustment, especially the first valve.

I use filament resistances with vernier control.

I got the best results using two Polar condensers, each 0.0005 μF.

The coil-holder is secured to the lid, which when closed permits the holder to pass between the valves. If the H.T battery is fitted permanently in the case as described, the holder could be made to plug-in on the panel instead of being fitted to the lid.

On three occasions when Glasgow closed down I had 2LO coming in on the loud-speaker, loud enough to fill an ordinary room, although London is 390 miles away. I hope to be able to cut Glasgow out entirely by using the more selective tuning described in *Wireless Weekly*, June 13th.

The set, I might say, is almost entirely free from distortion and the usual unwanted noises, and is remarkably easy to control.

I am, etc.,
A. G. Johnston.
Hamilton.

INTERFERENCE

To the Editor, *Wireless Weekly*.

Sir,—With reference to "Nearly Fed-up's" letter in No. 10 of your excellent paper, I too live on the South Coast, and often experience evenings when it is only possible to hear the B.B.C. transmissions for a quarter of an hour at a stretch without, *not* interference, but complete obliteration by morse.

The chief offenders appear to

have a wavelength below Cardiff, and therefore are probably broadly tuned 300-metre French shore stations (spark).

I have tried very loose coupling but to no avail, and others living close by have tried frame aerials with 2 or more stages H.F., but again there is not much improvement.

In asking you to let us have an early article on the subject, I feel I am voicing the wish of many hundreds of listeners-in on the coast, some of whom are not finding any entertainment in broadcasting.

At the present moment I am putting great hopes into Mr. Chapman's 3 E.V.C. condenser used in a rejector circuit which I hear has worked wonders on the East Kent coast. *Verb. sap.*

I am, etc.,
W. I. G. PAGE.

Bognor, Sussex.

ST100 DE LUXE

TO THE EDITOR, *Wireless Weekly.*

SIR,—You have no doubt had many replies to your invitation to readers for their opinions on the ST100 circuit.

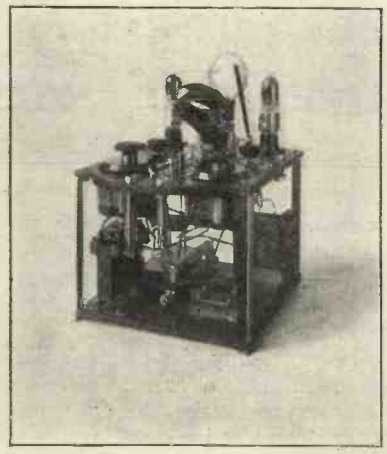
I have experimented with it and can endorse all your claims. The result was so satisfactory that I decided to build a compact set. Perhaps these photographs and few details might be of interest.

The case shown for the set was an old knife cabinet of Sheraton pattern which in size and shape proved very suitable. Size inside 8½in. × 10¾in., 10in. to 14in. deep.

To avoid making any attachments to the box an inner frame was constructed to fit inside. This consisted of a top panel of ebonite joined to a lower one by brass strips. This cage is 7in. high.

The condensers, valves, etc., were then mounted on the top panel, most of the wiring being done on the underneath of this panel, keeping wires as far apart as possible.

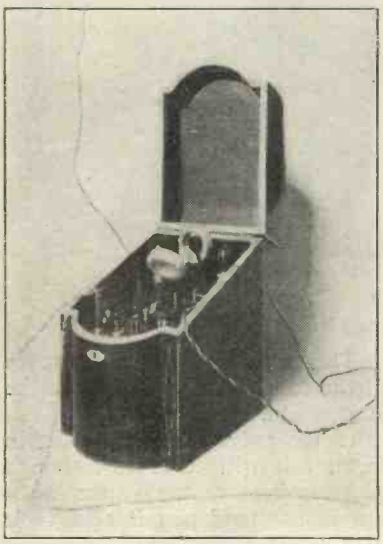
The transformers and resistance (100,000 ohms) were then mounted on the lower panel, the two joined together, and the remaining connections made between the two. This arrangement made it possible to use very short wires for connecting. The transformers were placed



The set removed from case

at opposite corners and at right angles to each other.

No alterations were made to the circuit as first published, except the inclusion of a 2 μF condenser across the H.T battery The crystal used was a Perikon combination Condenser C, was found



The complete set in case.

to give best results in the series position.

You will note the absence of terminals; all connections are made by plugs and jacks. A telephone transformer is fitted for use on L.R. 'phones. This is a distinct advantage, doing away with body capacity. One jack is arranged for H.R. 'phones.

The finished set is quite compact, and on withdrawing the plugs can be closed with all the parts in position. It has been tested on an indoor aerial 30ft. long, hung under the roof at a distance of 15 miles from London 2LO came in strongly on a loudspeaker. The music and speech are particularly clear. Birmingham could be heard nicely on the headphones.

I am pleased with its stability and ease of control.

I have tried connecting a further stage L.F. amplification with disappointing results. I am anxious to know if others have succeeded in doing this.

I am, etc.,
Middlesex. G. BURTON.

RESULTS

TO THE EDITOR, *Wireless Weekly.*

SIR,—I have been trying your new circuit ST100, using a twin aerial 100ft. Cardiff, 26 miles distant, comes in well, and is too loud on headphones for some people; with Cardiff closed down I get all the other English stations. London (166 miles) is fairly loud; Manchester (160 miles) is quite clear; Birmingham (125 miles) not so good; Newcastle (270 miles) is quite clear; Glasgow (330 miles) is faint; Paris (Eiffel Tower) concerts quite loud, also Radiola (300 miles). Paris time signals I can hear 40ft. away from 'phones resting on table, along a passage and landing. I use Marconite crystal.

My only trouble is that I cannot tune out Cardiff to get other stations. I have fitted a series parallel switch for condenser, and my transformers are Lissen's. Ora valves, using four volts on filament and 42 to 54 volts on anode. The tone of music and voices is better than any other circuit I have tried.

I am, etc.,
Somerset. J. ACLAND.

Information Department

Conducted by J. H. T. ROBERTS, D.Sc. F.Inst.P., assisted by A. L. M. DOUGLAS.

In this section will appear only selected replies to queries of general interest or arising from articles in "Wireless Weekly," "Modern Wireless" or from any Radio Press Handbook.

All queries will be replied to by post, as promptly as possible, providing the following conditions are complied with.

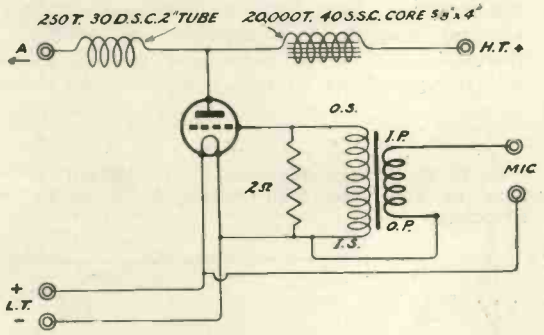
1. A Postal Order to the value of 1s. for each question must be enclosed, together with the Coupon from the current issue, and a stamped addressed envelope.

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

3. Queries should be forwarded in an envelope marked "Query" in the top left-hand corner and addressed to Information Dept., Radio Press, Limited, Devereux Court, Strand, London, W.C.2.

4. Registered Subscribers receiving copies by post will not pay any fee but should merely enclose the current Coupon, and quote their Subscriber's Number in the space provided.

O. M. McC. (ABERDEEN) asks for a circuit diagram to construct a control attachment for his C.W. valve transmitter, so that he may use it for telephony.



Microphone transformer: core ⅛in. diameter × 4in. iron wire.
Primary winding: 360 turns, No. 22 d.s.c. wire.
Secondary winding: 20,000 turns, No. 40 s.s.c. wire.
Primary to pass 0·36 amp. at 6 volts.

We give herewith a sketch showing how such a device may be connected up. The H.T. + is transferred from the original transmitter to H.T. + in control, other connections remaining unaltered. The valve used should have the same impedance as the oscillation generator.

C. H. S. (REIGATE) refers to the variable grid-leak shown in "WIRELESS WEEKLY," Volume I, No. 1, and asks what size of slate pencil should be used and what kind of wire is best for tapping purposes.

A slate pencil about ⅛in. thick will be satisfactory, and any gauge of bare copper wire may be used to effect the tappings with.

R. H. L. (WALSALL) is interested in various reaction effects, and asks if we can advise him as to any suitable book which will explain these effects.

"Wireless Valves Simply Explained," Radio Press, Limited, deals with the subject in an exhaustive manner.

E. B. B. has a certain commercial make of receiver, and complains that after it has been in use for about 10 minutes the signals gradually fade away until they disappear altogether. He asks if we can help him.

We think that probably your high-tension battery is nearly exhausted, or else that your accumulators are in a very low state. There is no other reason why signals should fade away, and we advise you to pay attention to these points, checking the voltage with a meter.

J. W. (CAMBERLEY) asks for a certain circuit which has appeared in "MODERN WIRELESS," but using a carborundum crystal with a potentiometer.

Circuit No. ST9 "Practical Wireless Valve Circuits," Radio Press, Limited, will show you how this crystal is inserted into a valve circuit. With reference to the question about outlay upon apparatus, we cannot, we are afraid, advise you as to any particular make of receiver. Any reputable dealer should be able to supply you with a good set for the sum mentioned.

J. E. B. (BIRMINGHAM) asks questions about an unknown Broadcasting Station he has heard working.

This station would be the French School of Posts and Telegraphs, which generally transmits in the evening on a wavelength somewhat higher than 2LO. Under favourable circumstances the transmissions can be heard in all parts of the British Isles.

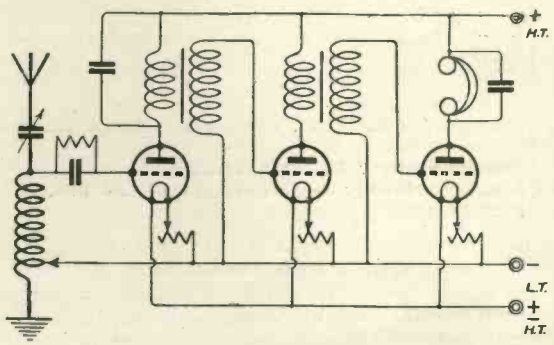
F. E. (RADCLIFF) wishes to build a receiving set comprising one high-frequency valve, a rectifier and one low-frequency valve, and asks where he may find a suitable diagram, and what approximate range might be expected from such apparatus.

Circuit No. ST45, "Practical Wireless Valve Circuits," Radio Press, Limited, will show you a very useful arrangement for Broadcast reception. A range of 50 miles might be expected on a loud-speaker with this set, and possibly up to 200 miles with head-phones.

A. P. M. (CAMPBELTOWN) asks (1) For dimensions for tuned anode and appropriate coupling coils for wavelengths from 180 to 450 metres. (2) What is the most satisfactory type of milliammeter. (3) Questions about using different types of valves in his apparatus.

(1) The tuned anode coil might be made from a cardboard tube 3in. in diameter and 3½in. long, wound with 70 turns of No. 20 s.w.g. double cotton covered wire, tapped at every fifth turn. A small condenser such as you specify should be shunted across the coil. The reaction coil might consist of a tube of the same length and 2½in. in diameter, wound full of No. 26 s.w.g. double cotton covered wire. (2) Any good type of moving coil meter is suitable for your purpose. The advantage of the particular make you mention is that it responds to high-frequency alternating currents and may, therefore, be used to determine the output of a continuous wave transmitter. (3) The rheostat controls both currents and voltage, and, therefore, no further alterations will be necessary for your apparatus for testing out different makes of valve.

H. G. S. (CARLISLE) asks for a circuit showing how to add two L.F. valves to a single valve detector.



We reproduce herewith a suitable diagram showing how this may be carried out.

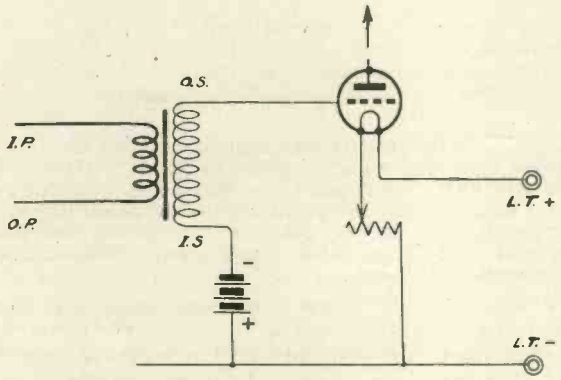
R. T. F. (HENDON) has made a 2-valve circuit, and complains that the addition of a low-frequency valve results in a decrease in signal strength instead of an increase. He asks our advice.

We suspect that the connections of the transformer are reversed. You should carefully check the direction of winding of this instrument, and make sure that the input of the primary goes to the plate of the valve prior to the transformer, and the output of

the primary to the high-tension positive wire. The input of the secondary of the transformer should go to the negative leg of the filament, and the output of the secondary to the grid of the next valve.

E. B. W. (MARDY) sends us a blue print of his apparatus, and asks (1) whether it is correct. (2) How to add grid cells to the low-frequency valve and (3) why there should be a condenser across the primary of the first low-frequency transformer and not the second.

(1) Your circuit appears quite correct, although you show a condenser across both the primaries of the intervalve transformers. (2) Sketch herewith. (3) The condenser is placed across the primary of the intervalve low-frequency transformer to provide an easy path for any high-frequency current which may have leaked past the detector valve. The high inductance of the low-frequency transformer primary winding introduces serious losses into the circuit if



high-frequency current is allowed to pass through it, and for this reason a large condenser will provide a more ready by-path. There is no reason for a condenser across the second transformer, as all the high-frequency current (if any) will have passed through the first. It is, however, an advantage to shunt the telephone with a large fixed condenser, as this sometimes controls reaction effects and increases signal strength.

G. H. W. (EALING) sends us a circuit diagram of his proposed single valve receiver, and wishes to know (1) whether it is a good arrangement. (2) What capacity the grid and telephone condensers should have. (3) What range he might expect with this instrument.

(1) The arrangement is good, but the range would be much extended by the introduction of reaction. (2) The grid condenser might have a value of 0.003 μF, and the telephone condenser 0.002 μF. (3) This circuit might have a range of 50 miles for Morse messages, and about 15 to 20 miles for Broadcasting under favourable conditions.

A. W. (GOOLE) specifies certain apparatus which he possesses, and with which he wishes to make a recording panel. He asks (1) Whether any combination of the instruments he possesses could be used satisfactorily. (2) If not could we supply him with a suitable diagram.

(1) None of the apparatus you possess is really suitable, as the key to the whole situation is the relay, and the type you mention is not at all useful for general work. (2) A suitable arrangement for your purpose is described in *Wireless Weekly* No. 3, on pages 138 and 139.

F. A. I. (FOREST GATE) is disturbed by persistent crackling sounds in his valve receiver. He asks whether this can be due to the telephones, which, however, appear to work satisfactorily when used on a crystal set.

It is possible, of course, that the insulation of the phones has broken down and the steady plate current through the valve causes the sound. On the other hand, it is much more likely to be your high-tension battery or gridleak, or possibly some badly-made joint in your apparatus.

R. T. (ESSEX) has built the progressive unit receiving system described in "WIRELESS WEEKLY" and has wound the same number of turns as were specified for a 5in. tube on a 4in. tube. He asks (1) whether this will make any difference and (2) whether the fact that the two baseboards are different heights makes any difference to the working of the instrument.

(1) If your tube is 4 inches in diameter, you should wind 10 more turns upon it. (2) The size and shape of the baseboard makes, of course, no difference whatsoever to the working of the apparatus.

A. L. (BIRMINGHAM) wishes to build the two-valve broadcast receiver given in No. 1 "MODERN WIRELESS," and asks the following questions: (1) What arrangement of valves is used in this instrument? (2) Is there any reaction in the circuit? (3) Can this cause any interference through oscillating?

(1) This receiver is an instrument employing one high-frequency valve and a detector. (2) Slight reaction effects are produced which strengthens signals at certain settings of the variometer. (3) No interference is caused through oscillation, as none is transferred to the aerial circuit.

E. A. D. G. (EASTBOURNE) asks certain questions about the projected constructor's licence and other matters.

The constructor's licence will permit you to add a single-valve unit to your crystal set without any risk of infringement of regulations. The Post Office do not allow their earth wire to be used as a wireless earth, although your wireless earth and their earth may go to, practically speaking, the same point in the ground. When reception alone is indulged in, you cannot affect the land-line telephone.

E. A. C. (LONDON, W.2) has built up a circuit on the lines of ST45, but whilst obtaining remarkably good results from local Broadcasting, is unable to hear PCGG. He submits particulars of his tuning coils, etc., and asks whether they are quite correct.

Your anode and reaction coils are obviously of the wrong size for 1,085 metres. We suggest you use 100 "Igranic" coils in the aerial circuit, with the condenser in parallel with it. In the anode circuit you should use a 150 "Igranic" coil tuned with a very small variable condenser having a maximum capacity of 0.0002 μF, and for a reaction coil you might use a 100 or a 150 "Igranic" coil also. We think with careful tuning you will certainly hear PCGG with this arrangement, because it has been heard at very much greater distances on a similar circuit. You must not, of course, expect satisfactory results unless your aerial is good and free from screening.

An Experimenter's Licence

is well worth having.

This is what the P.M.G. said

"In order to ascertain my position I felt it my duty to place the whole facts before the Law Officers of the Crown, and I have just received the opinions of the Attorney-General and the Solicitor-General.
These are that I am not only entitled, but compelled by law to issue an Experimenter's Licence to those applicants in regard to whom I am honestly satisfied that they are genuine experimenters.
This being so, while it would be wrong to issue an Experimenter's Licence to the man who is obviously merely a broadcast listener-in, it would be equally wrong to decline to issue such licences on a wholesale scale."

To a Representative of the Press.

UNDOUBTEDLY a very large number of wireless enthusiasts are contravening the present regulations regarding licences. Some through ignorance, others wilfully because their applications for Experimental Licences have been turned down.

If you are a genuine Experimenter, prepared to take up Wireless as a serious hobby and not merely as a means of passing a pleasant hour in listening to broadcast Concerts, then you are **entitled** to an Experimenter's Licence.

Many applications for Licences have been turned down by the authorities because the applicants were not fully aware of the necessary requirements which had to be fulfilled.

This little book by E. Redpath (assistant Editor of Wireless Weekly) has been written to explain exactly what an Experimenter should know and how he should set about obtaining his Licence.

Remember this important point—even if a Constructor's Licence is issued, it is practically certain to contain special restrictions regarding the use of Receiving Sets and Circuits. With an Experimenter's Licence your work is practically unhampered. Why not get a copy of this book to-day and legalise your position at once and for always?

Gilbert Ad.

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