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Wireless Weekly

and The Wireless Constructor

No. 13

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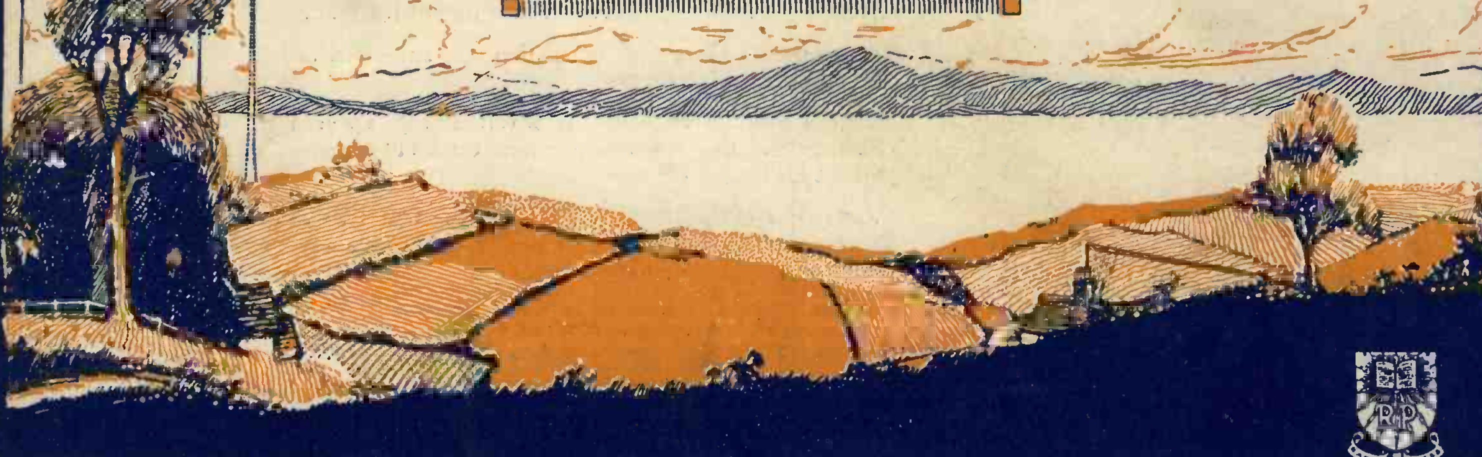

An Improved S.T.100 Circuit.

Wireless Weekly

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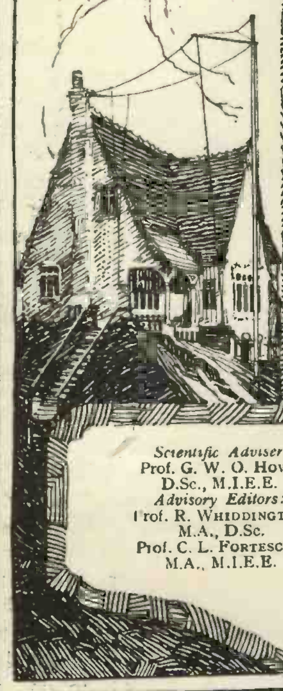

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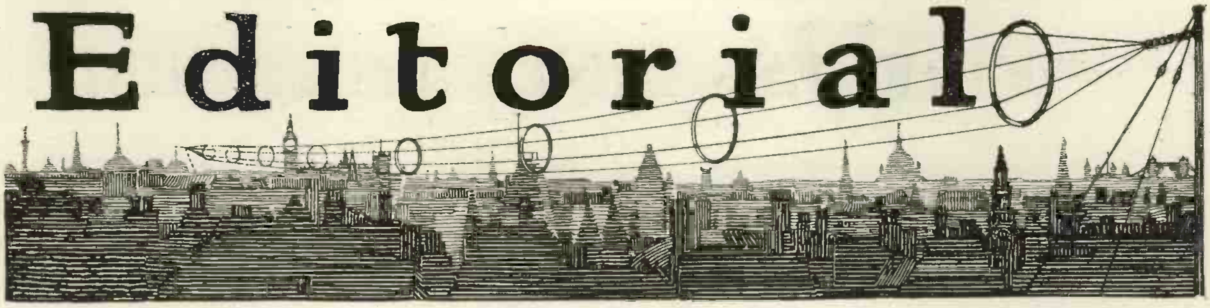
Editorial



The Possibilities of Summer Radio

WE often hear the remark that "this next winter" will probably witness great activity in the field of wireless as far as broadcasting is concerned.

Whilst concurring in this opinion, we regret the inference that in the summer period, wireless is to be regarded as more or less "out of season," and consider that, on the contrary, during our all-too-brief and on this occasion very belated summer, wireless can add considerably to the enjoyment of days and evenings in the open air.

What more delightful addition to the pleasures of a holiday under canvas, for instance, than the musical evenings obtainable by the installation of a receiving outfit and loud-speaker, operating in conjunction with a temporary aerial suspended between convenient trees.

True, there is the accumulator charging difficulty, but with the assistance of the local motor garage this should be fairly easy of solution.

Already successful experiments have been made in connection with the installation of wireless receiving apparatus on motor cars and chars-à-banc, whilst more recently a river punt has been equipped to give wireless demonstrations on the Thames. This class of equipment, however, to enable really good results to be obtained upon very small aerials, is probably beyond the means of the average listener-in.

What is required to make summer-time radio really popular is a compact, portable receiving outfit, fitted with low-temperature valves which can be operated for a satisfactorily long period from dry cell batteries. Both filament lighting and anode batteries could then be included in the set, making it entirely self-contained and dispensing with the troublesome accumulator.

As, in most cases, a fairly efficient aerial could be used, a well-designed three- or, at the most, a four-valve set would probably meet requirements, and there should be a good market for a set of this description at a reasonably low price.

We have noted with considerable interest the enterprise of many local authorities in making use of wireless as a means of providing musical entertainment in public parks, on piers, and in other popular public resorts. Promoters of open-air festivities are rapidly realising the value of an efficient receiving apparatus complete with loud-speaking equipment as an adjunct to garden parties, *fêtes*, etc., and in this connection we should imagine that there is considerable scope for enterprise in the direction of a complete hire-service which would include the erection of the necessary aerial, the supply on loan and the operation of satisfactory equipment.

We feel sure that promoters of many small open-air events, thus relieved of the anxiety of providing the necessary apparatus, and, possibly of doubts as to the success of the experiment, would be only too pleased to avail themselves of such a service.

With regard to the regular wireless experimenter, we regret to learn that many flourishing amateur radio societies find it necessary to suspend activities during the summer months. Obviously, only the most enthusiastic of experimenters will attend the usual buzzer-practice, lectures, or demonstrations in the Club rooms on a fine summer evening, and the Radio Society which desires to perform its intended function of providing for the wireless interests of its members, will do well to make special arrangements for the summer period.

Wireless field days, or even week-ends, with portable apparatus and tent, not only prove healthful and enjoyable, but afford opportunity for much experimental work of a nature which cannot be conveniently carried out during inclement weather.

Visits to neighbouring commercial wireless stations can usually be arranged without much difficulty, and will generally be found extremely interesting.

Altogether we fail to see why this should not prove a very successful radio summer. We intend to devote space in our journal to both technical and general aspects of summer radio. For your part, you can help by dispelling the impression that summer is not a suitable time for wireless activity. The industry will be greatly assisted over this period by helping to popularise the attractions of a wireless summer, and the B.B.C. can help by giving full-length afternoon concerts, particularly on Saturday afternoons.

WIRELESS AND THE FILM

By C. F. ELWELL, Fellow I.R.E.

This article is based on an exclusive interview with Dr. de Forest, obtained for this journal by Mr. Elwell, the well-known wireless expert, who is responsible for the technical development of the Phonofilm in Europe.

AT the Finsbury Park Rink Cinema, films have recently been shown which talk and sing in absolute synchronism with the picture on the screen.

Attempts have, of course, been made in many quarters to achieve this result, but as a general rule there have been employed complicated mechanisms with the idea of giving synchronism by mechanical means, and very little success has resulted.

The method used by Dr. de Forest will appeal to all readers of *Wireless Weekly* as the proper and scientific method by which to bring about results of the greatest popular interest and utility. Particularly is it interesting as an inspiration to wireless experimenters in its direct application of methods and devices developed by Dr. de Forest, in the first place, for wireless.

An enlarged view of the film showing small space occupied by the speech record.

Dr. de Forest, interviewed in London on Saturday, June 16th, gave some particulars of his invention to which he gives the name of the Phonofilm.

The Phonofilm, as its name implies, is the combination on the same film of picture with voice or music photographically recorded. Standard cinematograph film is used. The sound record occupies a very narrow strip of film about $\frac{3}{32}$ in. wide on the margin, and does not materially reduce the width of the picture.

RECORDING.—An especially designed gas-filled lamp, called the Photion light, is inserted in the moving picture camera a short distance away from the usual objective lens. The light from this Photion tube passes through an extremely narrow slit and falls directly upon one margin of the film. This margin is screened from the picture itself so that only the light from the Photion falls upon it. The film is driven continuously in front of this narrow slit, at an even speed, but with the usual intermittent step-by-step motion in front of the picture aperture.

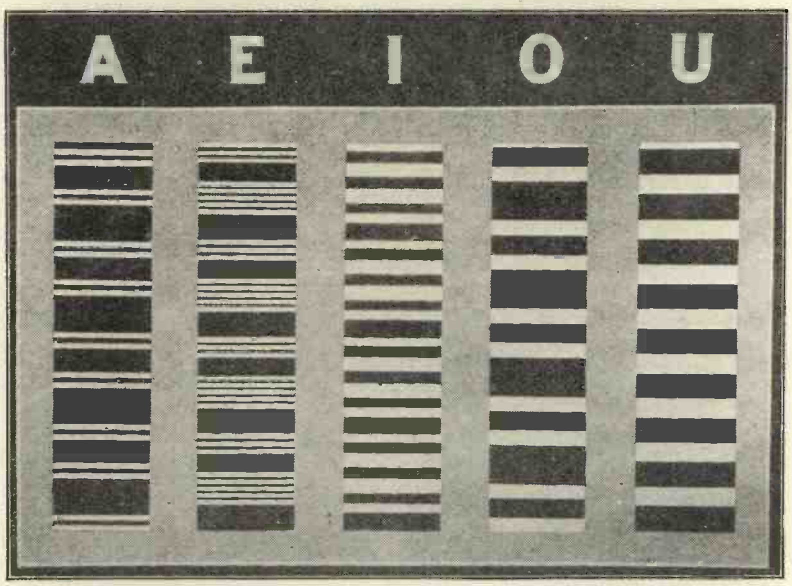
Now the light in the Photion tube is generated by the electric current which is passing through the gas enclosed therein. The intensity of the light depends on the intensity of the electric current. Therefore, if a powerful telephonic current is passed through the Photion, light emitted varies exactly in accordance with the strength of the telephonic current at any instant. This light therefore fluctuates in brightness hundreds of thousands of times a second in perfect rhythm with the telephonic current pulses, and varies in strength with the current.

This telephonic current originates in the first place from the special microphone transmitter which, though quite unlike the ordinary telephonic microphone, serves the same general purpose; the transmitter picks up the sound waves at distances of five to fifteen feet from the source of sound, transforming these sound waves into very weak telephonic currents. The audion amplifier is then used to amplify these weak currents 100,000 times to bring them up to sufficient strength to influence the Photion lamp in the camera. Without the audion amplifier the entire arrangement would be utterly impractical because of the weakness of the voice currents.

Thus we have three transformations—first sound waves into electric currents, then the amplification of these currents into light waves, and the registering of these light waves through the narrow slit upon the photographic film.

REPRODUCING.—The negative film, carrying picture and sound record, is now developed in the usual manner, but using a special developer to bring out the details of the sound record. Positive prints are made through a special printer to give the necessary light values for picture and sound record. This positive print is then run through the moving picture projector machine. This is a standard projector machine such as is found in any moving picture theatre. A small attachment is added to this projector which in no way interferes with its ordinary use. This attachment includes a small incandescent lamp and a highly sensitive photo-electric cell, the latter being the invention of T. W. Case. The film as it travels through the projector machine passes between the lamp and the photo-electric cell; the light from this incandescent lamp being concentrated upon a tiny slit similar to that above described in the motion picture camera. This light therefore passes through the sound record which has been photographed on the film, and on into the chamber containing the photo-electric cell. The passage of the sound record across this narrow slit, therefore, controls the intensity of the light falling upon the sensitive cell.

The photo-electric cell has the peculiar property that its electrical resistance at any instant is determined by the amount of light falling upon the cell.



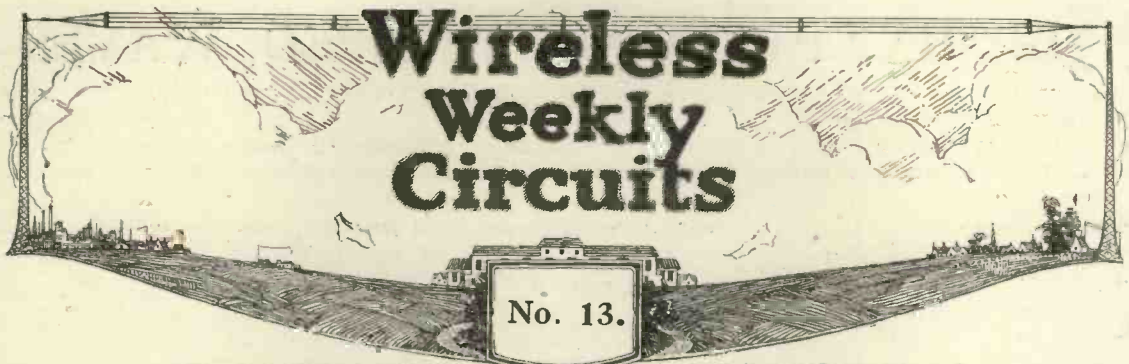
A micro-photo of portions of a speech record of vowel sounds.

Therefore, as the film travels across the slit and the light falling upon the cell is made to fluctuate hundreds or thousands of times per second, the electrical resistance of the cell is varied in strict accordance therewith.

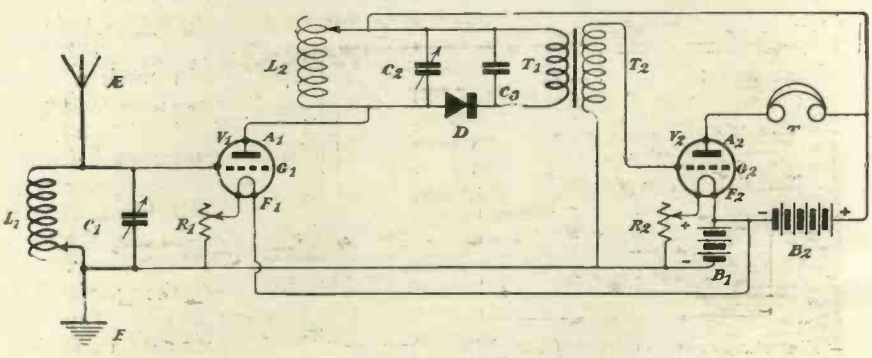
Connected to this photo-electric cell is a small battery for supplying current, which is controlled by the light falling upon the cell, and thereby made to exactly reproduce the original telephonic current from the transmitter when the sound picture was first recorded. This new telephonic current, however, is extremely weak, and must be amplified, again and again, through a series of especially designed valve audion amplifiers until it is increased in power hundreds of thousands of times. The amplified telephonic current is then passed through especially designed loud-speakers, which are placed behind or beside the moving picture screen, upon which the picture itself is being thrown from the projector In this way the reproduced sound appears to come from the actual speaker or the musical instrument whose picture is being shown upon the screen simultaneously.

The problem of synchronism is obviously completely solved. The photograph of the sound and of the object are always together on the same film and always at the same relative positions thereon. Should the film break at any time it is only necessary to repair it in the usual manner, when the synchronism remains unimpaired.

As demonstrated in London the process seems to be practical and commercial. Only standard film is used, and the reproducing attachment, designed for either the Simplex or Powers machine, is quickly installed with a minimum of time and expense. Thus any motion picture theatre can be easily equipped for Phonofilm productions.



A Valve-Crystal Receiver with Note-Magnifier



COMPONENTS REQUIRED.

- L_1 : Fixed or tapped inductance.
- C_1 : Variable condenser having a maximum capacity of 0.0005 μF or 0.001 μF.
- L_2 : Fixed or tapped inductance.
- C_2 : Variable condenser having a maximum capacity of 0.0005 μF or 0.001 μF.
- D : Crystal detector.
- C_3 : Fixed condenser of 0.002 μF.
- T_1 } T_2 } Step-up intervalve transformer.
- R_1 } R_2 } Standard filament resistances.
- T : High resistance telephone receivers.

GENERAL NOTES.

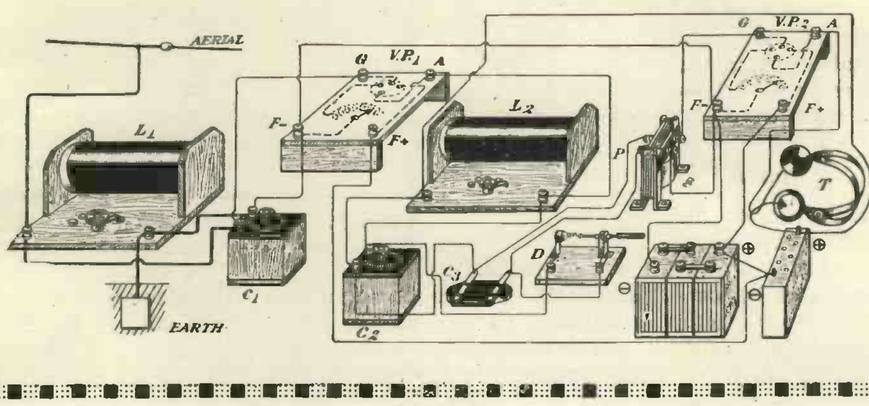
In this circuit the first valve acts as a high-frequency amplifier, the magnified oscillations being detected by the crystal detector D and the low-frequency currents then amplified by the second valve. It is important to tune the circuit L_2 C_2 to the same wavelength as the incoming signals.

VALUES OF COMPONENTS.

The inductance L_1 may be a No. S_2, S_3 or S_4 Burndept coil or a No. 25, 35 or 50 Igranic honeycomb coil, according to the size of aerial. The condenser C_1 should be tried in series with the aerial. L_1 might be an inductance coil consisting of 80 turns of No. 26 d.c.c. wire wound on a 4in. tube and tapped at every ten turns. The inductance L_2 is an S_4 or No. 75 Burndept or a No. 50 or 75 Igranic coil or a similar inductance to L_1.

NOTES ON OPERATION.

Both circuits L_1 C_1 and L_2 C_2 should be tuned to the incoming wavelength. C_3 may easily be omitted.



THE RECEPTION OF DAMPED WAVES

By E. REDPATH, Assistant Editor.

This is the first of a series of separate complete articles explaining in an easily understood manner the theoretical principles of various methods of wireless reception.

ALMOST everyone who possesses a wireless receiving set will find that a knowledge of the principles upon which it works adds considerably to the interest in its operation.

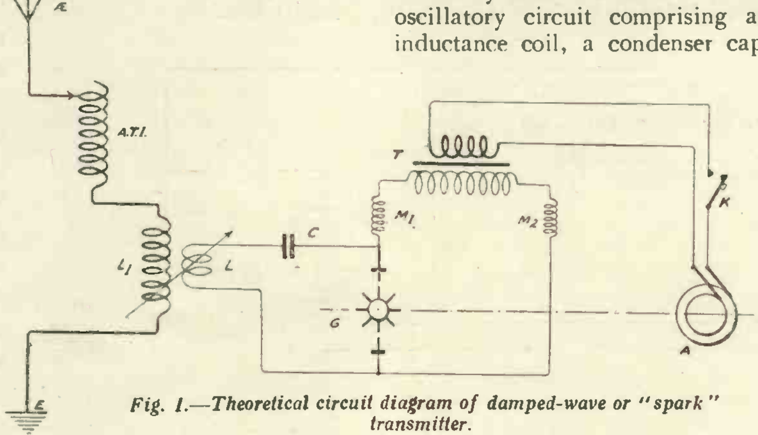


Fig. 1.—Theoretical circuit diagram of damped-wave or "spark" transmitter.

In the present article the functions of the various components comprising a typical crystal receiving set, together with the action involved in the reception of damped-wave or spark signals, will be dealt with.

In order to obtain a clear understanding of the work which has to be performed by the receiving set, it is desirable to consider, in a general way at all events, the source of the waves with which the receiver has to deal.

The Transmitting Station

At any transmitting station the two main essentials are, firstly, an aerial system which, when traversed by high-frequency currents, radiates electro-magnetic waves; and, secondly, apparatus capable of supplying high-frequency currents to the aerial system.

In the case of a commercial "spark" station high-frequency currents are set up in the aerial circuit by induction from a closed oscillatory circuit comprising an inductance coil, a condenser capable of withstanding high voltages, and a spark gap. The condenser in this latter circuit is charged to a high voltage by the currents from the secondary of a transformer, the primary of which

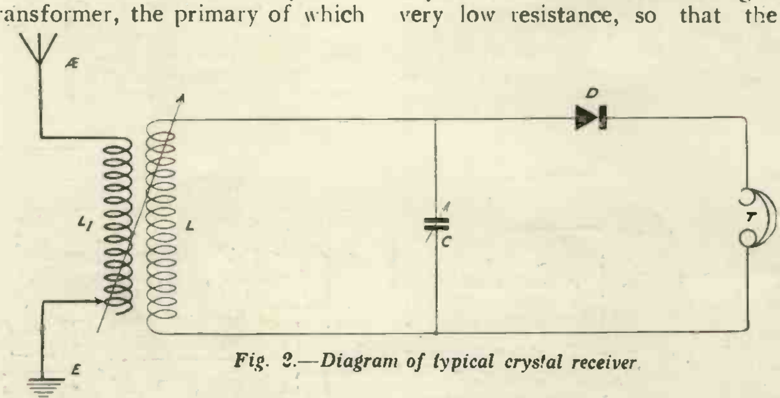


Fig. 2.—Diagram of typical crystal receiver

is connected to an alternator, *via* a transmitting key.

Each time the key is depressed, the condenser in the closed oscillatory circuit is charged to a high potential, first in one direction and then in the other. In other words, each set of plates in the condenser is charged positively and negatively at the frequency of the alternating current supply.

The Spark Discharge

In modern spark transmitting sets the spark gap consists of two fixed electrodes between which rotates an insulated metal disc or rim with projecting studs, the disc itself being attached to the shaft of the alternator.

When correctly adjusted two of the projecting studs almost touch the fixed electrodes at the moment that the condenser is charged to its highest potential, and a spark occurs which, for an instant, practically short-circuits the spark gap.

The condenser discharge takes place in a circuit possessing capacity and inductance and having a very low resistance, so that the discharge is oscillatory, the energy originally in the condenser oscillating to and fro at a frequency which depends only upon the inductance-capacity value of the circuit, until damped out, the damping being due partly to the transference of energy to the aerial circuit, and partly to heat losses in the circuit itself and at the spark gap.

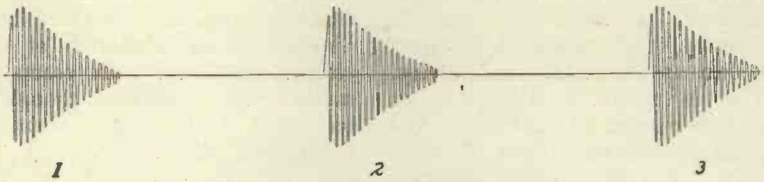


Fig. 3.—Groups of damped oscillations.

Wave Groups

Each spark, therefore, gives rise to the radiation of a group of waves from the aerial, each wave being of smaller amplitude than the wave preceding it, and each complete group of waves being succeeded by a blank space, during which the aerial is idle and the condenser in the closed circuit is being recharged in the opposite direction ready for the next spark. The complete circuit arrangement of a typical spark transmitting station is shown in Fig. 1, in which A represents the alternator; K, the transmitting key; T, the transformer which steps-up the supply voltage to sparking pressure; G, the spark gap; C, the main condenser; and L, the closed circuit inductance. The aerial circuit comprises the aerial itself, an aerial tuning inductance ATI, the inductance L_1 and earth E. The inductance coil L_1 forms the secondary winding of an oscillation transformer, being inductively coupled to the closed circuit inductance L. The two coils M_1 and M_2 are highly inductive air-core chokes, introduced in order to prevent oscillatory currents from reaching and possibly damaging the secondary winding of the transformer T.

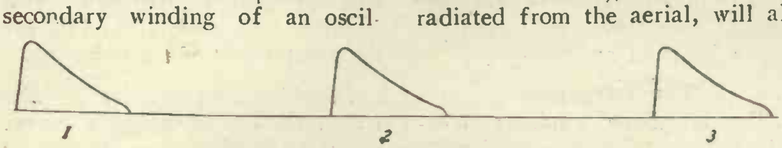


Fig. 5.—The resultant telephone currents.

Spark Frequency

Suppose, for example, the alternator A has a frequency of 150 complete cycles per second, and that the spark gap G is properly adjusted so that the condenser is discharged each time it is fully charged in either a positive or negative sense. The number of sparks per second occurring at the gap G will therefore be 300. This is known as the spark frequency of the transmitter.

Radio Frequency

If the values of the condenser C and the inductance L are such that the closed oscillatory circuit has a wavelength of 300 metres, equivalent to a frequency of one million per second, then the oscillations set up in this circuit, and inductively transferred to the aerial circuit (which, of course, must be tuned to resonance with the closed circuit), also the waves radiated from the aerial, will all have the same frequency, namely, one million per second. This is termed "radio frequency."

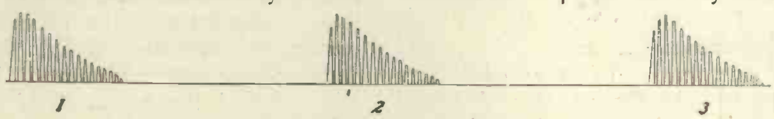


Fig. 4.—The same groups after rectification.

In the one transmitting set, therefore, we have two frequencies—the spark frequency of 300 per second and the oscillation frequency of one million per second. This means that waves at a frequency of one million per second are radiated from the aerial in groups, with separating intervals, and the number of groups per second is 300.

The Receiving Station

Now let us consider what takes place at a receiving station when a crystal receiving set is employed.

Fig. 2 represents a typical inductively-coupled crystal receiving set, comprising the aerial Æ, aerial tuning inductance L_1, earth connection E. The secondary circuit comprises the inductance L and variable condenser C, with the crystal detector D and telephones T connected across it.

Some receiving sets, of course, are not provided with a secondary circuit, the condenser C being connected across the active turns of the ATI, a method known as "direct" coupling.

The Aerial Circuit

The object of the aerial tuning inductance L_1 is to vary the *electrical length* of the aerial, and alternatives to the single-slide inductance, shown in Fig. 2, may be a tapped inductance, with or without a variable condenser in series or in parallel, a fixed coil with a series or parallel variable condenser, or a variometer.

For our present purpose, it is assumed that the winding of the coil L_1 is such that it is capable of tuning the aerial circuit to a wavelength of 300 metres, under which condition, of course, the natural frequency of the aerial circuit will be one million per second.

The Secondary Circuit

The secondary inductance L and the variable condenser C must have such values that the closed oscillatory circuit which they form can also be adjusted to the same frequency, in which circumstances the maximum transference of energy from the aerial to the closed oscillatory circuit will take place.

Although theoretically it does not matter whether the inductance value of the coil L is large and the capacity of the condenser C small, or *vice versa*, so long as their combined effects tune the circuit to the correct frequency, for practical reasons the former arrangement is preferable.

Now suppose the transmitting station represented in Fig. 1 to be operated and the receiving station represented by Fig. 2 to be within the normal range of the radiated waves. During the arrival of each group of waves the receiving aerial is, as it were, intercepting impulses having a frequency of one million per second, and, as the receiving aerial circuit is tuned to this frequency, oscillatory currents are set up in the coil L, and induced in the closed oscillatory circuit L C, by reason of the electro-magnetic coupling between the two coils L and L_1.

The amplitude of the succeeding waves of each group, and consequently of the oscillatory current in the aerial and closed circuits of the receiver, is constantly decreasing and finally dies away altogether.

This effect is shown graphically in Fig. 3, in which three groups of oscillations, as produced in the aerial and closed oscillatory circuits of the receiver, are shown.

The Crystal Detector

Referring again to Fig. 2, it will be noted that the crystal detector D is interposed between the telephone receivers T and one side of the variable condenser C. There are, of course, various types of crystal detector, some consisting of two crystals such as zincite and bornite pressed together in fairly close contact, and others in which a wire presses, usually only lightly, upon the surface of a crystal such as silicon, galena, or one of the special crystals now so extensively advertised.

Whatever its particular form, however, a satisfactory crystal detector must possess a property known as unilateral conductivity. That is to say, it will allow an electric current to pass across the point of contact in one direction only, or, at all events, it conducts electricity very much better in one direction than in the other.

The oscillatory currents in the closed circuit L C charge up the condenser C, making the opposite sets of plates alternatively positive and negative. When the upper plate of the condenser in Fig. 2 is (say) positive, a pulse of current passes through the detector and telephones, but when the lower plate is similarly charged no pulse of current can take place in the reverse direction. Consequently the effective passage of currents through the detector are as represented in Fig. 4, and the action itself is termed *rectification*.

It will be seen that although the oscillatory currents have been rectified, the frequency of the individual impulses is still that of the original oscillations, namely, one million per second.

This frequency, of course, is much too high for the telephone diaphragms to respond to, and, even if they could do so, the note emitted would be far beyond the upper limits of audibility.

The Telephones

The telephone windings themselves also offer a considerable opposition to such rapid current changes—a property known as impedance—so that the impulses of each complete group are made to have a cumulative effect, the actual current flowing through the telephone windings having an average value as shown in Fig. 5. From this it will be understood that, in effect, the telephone diaphragms are deflected at the commencement of each group of waves; remain deflected, though to an ever - decreasing amount, throughout the group, and by the time the amplitude of the waves of each group has decreased to zero, the diaphragm is back in its normal position ready for the arrival of the next group.

The number of deflections of the telephone diaphragms, and consequently the pitch of the note emitted, depends entirely upon the number of *groups* per second, and this in turn depends only upon the rate of sparking at the transmitting station. Hence the note heard in the telephones corresponds exactly to the note of the distant spark, and is altogether independent of the wavelength and frequency of the wireless waves.

Referring to Figs. 3, 4, and 5, special attention is drawn to the fact that the actual duration of each group of waves or impulses is extremely short compared to the duration of the idle period or interval separating the groups, so that as far as "spark" methods are concerned, it may be said that even during actual transmission and reception between two stations, both aerials are idle for the greater part of the time.

In subsequent articles of this series, the reception of continuous waves and radio-telephony will be dealt with.—Ed.

HIGH-SPEED WIRELESS TELEGRAPHY

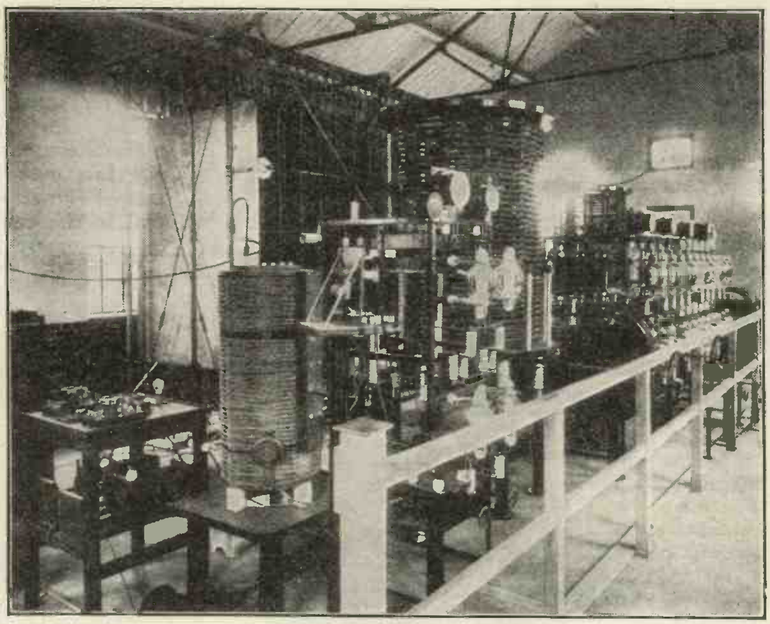
An interesting description of the Marconi high-speed commercial station at Ongar and the central control organisation at Radio House.

THE quarter of a century which has witnessed the development of commercial wireless telegraphy from the sending of the first tentative signal to the establishment of high-speed telegraph services to all parts of the world has been a period of incessant progress.

Every year has brought some fresh invention to increase the speed of signalling or to improve methods of working, but a stage has now been reached when certain basic principles have been established and can be incorporated in standard practice. Two of the most important of these are the ascendency of continuous wave wireless telegraphy by means of valve transmission, and the distant control of the transmitting and receiving stations from a central office.

These modern methods are to be seen at their highest state of efficiency in the group of Marconi stations comprising Radio House, Ongar, Brentwood, and Carnarvon, from which high-speed commercial services are conducted with France, Switzerland, Spain, Canada, and the United States of America.

The wireless stations at Ongar and Brentwood are situated in Essex, some 20 miles from London, but full control is centred at Radio House, Wilson Street, in the City, the relaying of signals from the land lines to the wireless transmitters at Ongar transmitting station, and from the wireless receivers to the land lines at Brentwood receiving station being entirely automatic. The transmitting plant at Carnarvon used for communication to the United States is also controlled automatically from Radio House, and the signals from the United States are received at Brentwood and relayed automatically to Radio House.



Continuous wave transmitter, showing, from left to right: (1) high-speed signalling relays; (2) independent drive; (3) rectifier and oscillator valve panel.

The whole of the telegraphist staff is concentrated at the traffic headquarters, Radio House. Messages are thus actually dispatched from the building where they are handed in by the public, and are received at the telegraph office abroad at the same instant that the signalling apparatus is actuated in London, all the operations between the two offices being entirely automatic.

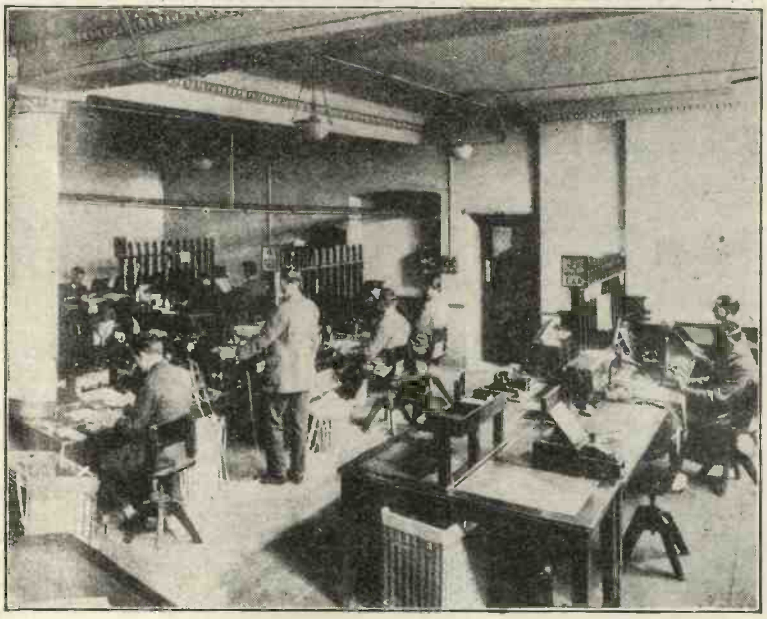
Any number of commercial services can thus be brought under the personal supervision of the Operating Controller, with considerable advantage in efficiency and economy.

Radio House is the nerve centre of the Marconi high-speed commercial services.

In the equipment of this building the special needs of speed and accuracy have been kept in mind, and wherever a design or piece of apparatus has been forthcoming which could be proved to raise the efficiency of the Marconi service, that apparatus has been employed.

From the counter, in the public office, a conveyer runs into the main operating room, and deposits messages on the circulation table which is equipped with numerous time-saving devices. From this table each message is rapidly distributed to its proper circuit.

Having arrived at the circuit, the message is reproduced in Morse characters in the form of perforations on a paper tape. This is done by means of an instrument known as a keyboard perforator which is operated in much the same way as a typewriter. The paper tape is then fed into an automatic high-speed transmitter which actuates the wireless transmitting plant at Ongar or Carnarvon, according to the destination of the message.



RADIO HOUSE. The Continental circuits, showing tape passing through the printer and being gummed on message forms ready for use.

By the side of each of the automatic high-speed transmitting instruments is the receiving instrument for that particular service, and it is therefore possible for the operator engaged in transmission to receive immediate acknowledgment of the messages he sends.

The high-speed automatic apparatus employed in reception on the European circuits operates a printer which transforms the signals into Roman characters, and prints them on a continuous paper tape.

This printed tape is drawn through a gumming machine and affixed in suitable lengths to a form ready for delivery.

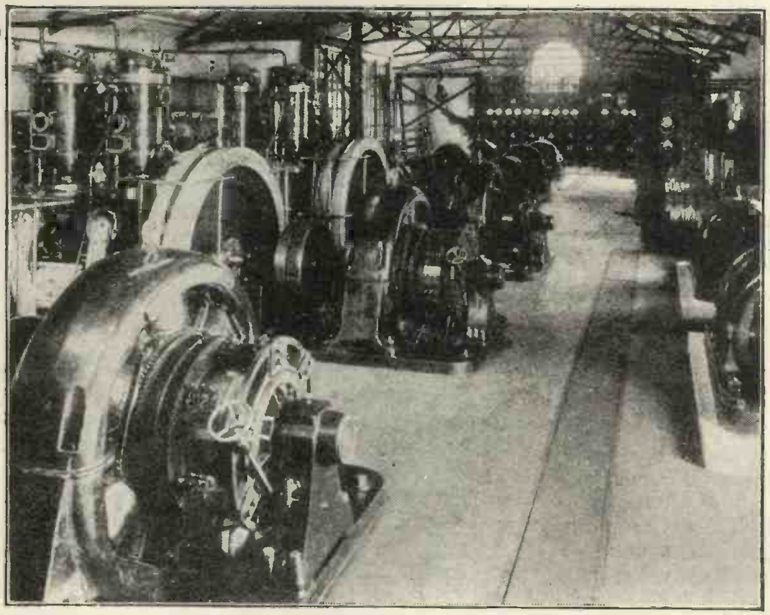
The message is then sent to the telephone room, or one of the private wire circuits, for immediate transmission to the addressee, or to the messenger department for delivery by hand. Before passing to the messenger department the message is conveyed automatically to the "unpacking" room, where, by means of a comprehensive card index, an "unpacker" is enabled to place it in the appropriate envelope bearing the full address required for delivery.

Many of the delivery envelopes bear addresses already printed, and means are provided for locating any envelope instantly, and without risk of error. Thus the whole process of decoding a telegraphic address and enveloping a message is a matter of a few seconds only. One of the most interesting points about Radio House is the special provision made for express private delivery and collection where the traffic is consistently heavy. Apart from a number of telephone circuits available for the public, numerous private telegraph and telephone lines are rented by financial and commercial houses having traffic of a heavy and urgent character. Some of the telegraph circuits are operated with Teletype instruments by means of which messages are reproduced in typewritten characters at the other end of a telegraph line.

It is an interesting point that from the moment a message is accepted, until its final handling, its passage through the office is timed at various stages by automatic electric time-stamps, controlled by a master clock. By means of this and other systematic methods of checking, wireless maintains its unsurpassed reputation for speed and accuracy.

The Ongar group of wireless transmitting stations is built on a site just over one square mile in area. The site is on high ground, and in the centre of it there still exists one of the large but little known forts built many years ago

(*Continued on page* 755.)



View of the central power house, showing direct-current generator and motor alternators.

A SPECIAL METHOD OF HIGH-FREQUENCY AMPLIFICATION

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

Further notes on the bridge method of high-frequency amplification which is one solution of the problem of effective high-frequency amplification.

PART II.—(Continued from page 713, No. 12.)

FIG. 9 shows the new circuit. The only alteration which has been made is that the variable condenser C_2 has been cut out, and, of course, the aerial circuit has been modified merely to show the usual alternative of a parallel tuning condenser. By showing connections going to each side of the grid, it is possible to place the condenser C_3 and C_4 in a more logical position.

This bridge method of high-frequency amplification may be applied to a number of valves with success.

Fig. 10 shows a circuit in which the first two valves act as high-frequency amplifiers, and the third as a detector. It will be seen that the separate grid tuning condenser is left out in this circuit, as in Fig. 9; but to those first experimenting with this method of amplification, the use of the condenser C_2 in Fig. 8 is to be recommended.

Like most circuits having a maximum sensitivity and selectivity, those employing this bridge method of amplification are by no means simple to operate. Both manipulative skill and a full knowledge of the effect of every adjustment is necessary to obtain good results.

No doubt, however, it will be possible to arrange a fairly easily operated circuit over, say, the broadcasting waveband.

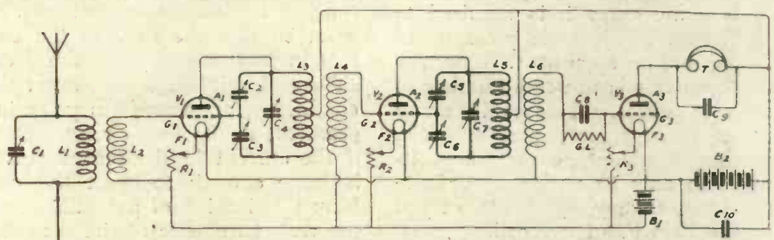


Fig. 10.—The bridge method applied to two H.F. valves with a third, acting as a detector.

In arranging the apparatus every effort should be made to maintain a symmetrical disposition of the different components, and no attempts should be made, at any rate in the first place, to box up all the coils close together. The best arrangement is to lay them out on a table or on a board.

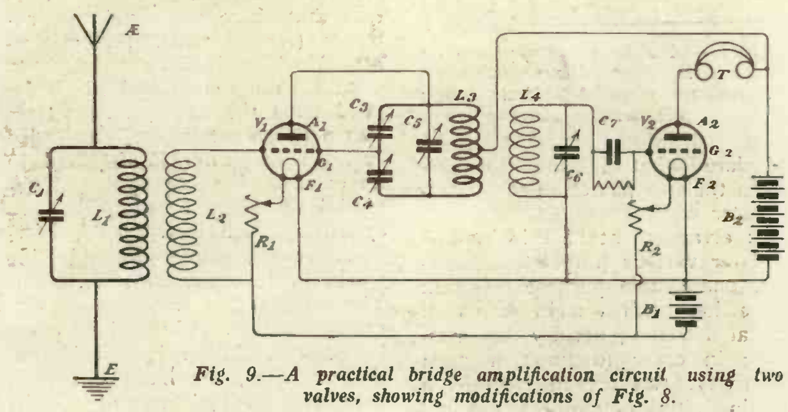
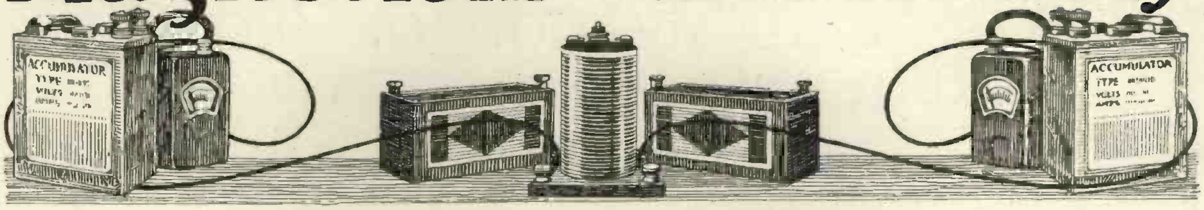


Fig. 9.—A practical bridge amplification circuit using two valves, showing modifications of Fig. 8.

The inductances may be of any type, but it is desirable that the two portions of the anode inductances should be equal. It is not sufficient to find the approximate half-way point; the actual point should be found. Instead of using an inductance tapped in the middle—and for this purpose a single-layer inductance wound on a tube is practically essential—two separate plug-in coils may be used with success; for example, two S_1 coils may be connected in series and placed in the outside holders of a three-coil holder. The middle tapping between the two coils is easily obtained. In between the two outside coils is arranged the grid coil of the next valve, which is then symmetrically placed with regard to the two outside coils forming the tuned anode circuit. This arrangement of the apparatus enables symmetry to be obtained, but it is important, of course, to see that the two coils have the same effect on the grid coil, and that they do not balance out in their effect.

As regards the condensers, separate condensers may be used to obtain the bridge, or else a condenser of the type known as the "three-electrode" condenser may be used. This is an arrangement of two variable condensers in one, and should prove of particular value in this particular class of circuit.

Magnetism & Electricity



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

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

PART XII

(Concluded from No. 11, page 656).

The Potentiometer

In some cases it is required to apply an adjustable potential to parts of an apparatus. One way of doing this is to use a number of cells in series. This is in many cases inconvenient, and has the further disadvantage that the voltage can only be varied by definite amounts, namely, by amounts equal to the E.M.F. of one cell.

If the current which will flow through the apparatus to which it is required to apply the potential is very small, there is a simple arrangement by which a continuously adjustable potential may readily be obtained.

This arrangement is known as a "potentiometer," and is illustrated in Fig. 1 (a). If the terminals of a battery are connected together by means of a piece of wire (having sufficient resistance to limit the current to a suitable amount, so as not to harm the batteries) there will be a uniform potential-gradient along the wire from one end to the other, as indicated in Fig. 1 (*b*). If now we take a connection from one end of the wire and another connection from some intermediate point of the wire, there will be a difference of potential between these two points, this p.d. being proportional to the distance between the points. Hence by shifting the second point along the wire any potential difference may be obtained (within the limits of the battery) and this may be varied continuously by sliding the second contact along the wire. Of course, it is assumed that the current, tapped from the resistance wire which is connected across the terminals of the battery, is very small compared with the current in that wire, so that the flow of the current in what we may call the "subsidiary circuit" does not upset the conditions, as to uniform potential-gradient, in the first circuit. Even if the current in the second circuit is large enough to upset the uniform distribution of potential along the resistance wire of the potentiometer, it is still possible to obtain adjustable potentials, but in the latter case it is not so simple to calculate what is the p.d. between the two points on the potentiometer wire.

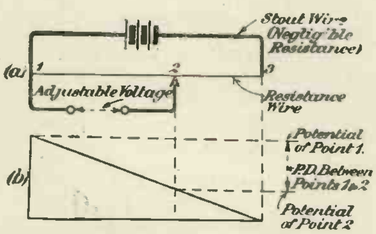


Fig. 1.—(A) Arrangement of potentiometer. (B) Graphical representation of uniform potential-gradient along potentiometer wire.

An arrangement of this kind is used for various purposes in wireless, one simple purpose being in connection with certain kinds of crystal detectors, notably carborundum; in order to function most effectively, this crystal requires a certain initial potential to be applied to it.

The Voltmeter

Instruments which are employed for measuring the strength of electric currents are usually known as "galvanometers" and "amperemeters" or "ammeters," the term "galvanometer" being applied to an instrument for measuring small currents and the term "ammeter" being used to designate an instrument for measuring relatively large currents, such as are used for various industrial purposes. The principle of these instruments has already been explained; the current to be measured (or a portion of it) is passed through coils, in the centre of which is a movable system which is deflected by the magnetic field produced by the current in the coils.

Instruments which are employed for measuring voltages or potential differences are usually known as "voltmeters." The beginner is often under the impression that the voltmeter is entirely different in principle from the ammeter. It is true that there are certain instruments (for example, the electrometer) which indicate voltages or potential differences and which depend upon the electrostatic attraction between a fixed and suspended system: the latter is deflected to an extent depending upon the potential difference between the two systems. Such instruments, however, are only employed in scientific work, in laboratories, and so on. The small voltmeter which is commonly used for industrial purposes is, in fact, similar in principle to the ammeter, the main difference being that the resistance of its coils is much higher than that of the coils of an ammeter, the instrument being correspondingly more delicate. When a potential difference is applied to its terminals, a very small current passes through the instrument, so small that the current does not appreciably lower the E.M.F. which existed in the circuit before the instrument was introduced. In common parlance, the voltmeter "takes practically no current," and so gives a fairly true indication of the voltage in the circuit.

Measurement of Electrical Resistance

Some experimenters may require to know the resistance of a particular coil or other conductor. One simple way to find the approximate resistance of a conductor is to connect the conductor in series with an accumulator, of known voltage, and an ammeter, and observe the current indicated by the ammeter. From this, by Ohm's law, the total resistance of the circuit will be known, and if the resistance of the ammeter is known, and the internal resistance of the accumulator be neglected, the resistance of the conductor in question can easily be found. (See Fig. 2.) This is not an accurate way of determining the resistance, nor is it always convenient, for if the resistance be very low, the current from the accumulator may be too large for safety. In such a case, if another resistance of known value is available, it may also be introduced in series so as to reduce current.

A more scientific way to determine resistance is by means of the arrangement known as "Wheatstone's bridge." This is indicated in Fig. 3, and consists of an arrangement of four resistances in the form of a quadrilateral figure, three of the resistances, R_1, R_2, R_3 being of known value, and the fourth, X, being the resistance whose value is to be determined. A battery is connected to the points A, B and a galvanometer across the points C, D. The resistances R_1, R_2, R_3 are adjustable and in practice take the form of Post Office boxes of known resistances. If the ratio $R_1 : R_2$ is the same as the ratio $R_3 : X$ there will be no deflection on the galvanometer. It will be easy to see why this should be so, for if we think of the potential gradient along the conductor R_1R_2 and of the potential-gradient along the conductor R_3X, we see that when $\frac{R_2}{R_1}$ is equal to $\frac{R_3}{X}$, the point C represents, in the electrical sense, the same proportion of the distance from A to B as is represented by the point D. For example, suppose R_1 is 1 ohm, R_2 3 ohms, so that $R_1 + R_2 = 4$, then R_1 represents one-quarter of the distance between A and B. If $R_3 = 4$ and $X = 12$, then A D represents one-quarter of the distance between A and B, and

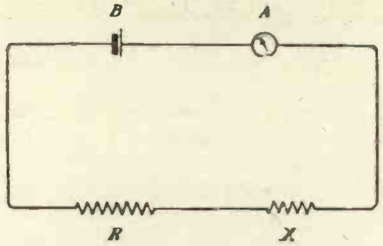


Fig. 2.—Rough method of measuring a resistance.

therefore the potential at C will be the same as the potential at D, so that the galvanometer, being connected between two points at the same potential, will be undeflected. If the relation $R_1/R_2 = R_3/X$ is not obeyed, there will be a difference of potential between the points C and D, and a deflection on the galvanometer. Thus the values for R_1, R_2 are chosen, and R_3 is adjusted until there is no deflection on the galvanometer, when the value

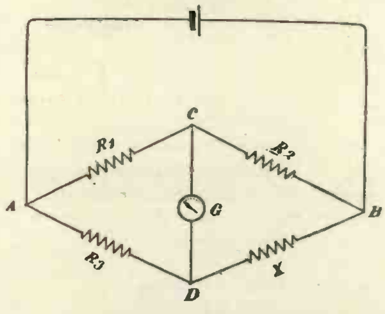


Fig. 3.—Wheatstone's bridge for accurate determination of resistance.

of the resistance X is readily determined.

Measurements of Inductances and Capacities

Inductances of coils and capacities of condensers can be determined by methods similar to the above, but as these are more suitably treated in connection with wireless, their discussion will be postponed.

In concluding this series on Electricity and Magnetism, it will be useful to say a few words about the units which are employed in electrical calculations.

C.G.S. System

The units of measurement used in electrical calculations are based on the metric system, or, as it is more usually called, the "centimetre, gramme, second" system, these words being abbreviated to the letters c.g.s. This system takes the centimetre as the unit of length, the gramme as the unit of mass, and the second as the unit of time, and it is possible to express any quantity, whether it be an electrical, a mechanical, or any other physical quantity, in terms of these three fundamental units. For example, we speak of the energy which is stored in an electrical accumulator, and this can alternatively be expressed in terms of mechanical energy, since it represents the total amount of mechanical work which can eventually be performed by the agency of the electrical energy stored in the accumulator. Similarly, we speak of the power which is absorbed by an electric lamp as being so many "watts," and this again is equivalent to a definite rate of performing mechanical work.

Power

Mechanically, power is defined as the rate at which work is done, and it may, therefore, be expressed as the total number of foot-pounds of work, divided by the time during which this work is done; in other words, the number of foot-pounds per second. For example, suppose a hoisting engine raises a weight from the ground to the top of a building in two minutes, and a second engine raises the same weight the same height in one minute. The work in each case is the same, but the second engine does the work twice as rapidly as the first, and is, therefore, said to have twice the power.

Horse-power

The common unit of power used in engineering is the horse-power. This unit of power originated in rather an interesting way. About 150 years ago, when Watt perfected his steam engine, it was proposed to introduce his engines to pump water from the mines in Cornwall.

Previously, the mine-owners had employed horses to operate the pumps, and they naturally required to know, before installing steam engines, how many horses they would be able to dispense with for each engine they installed. Watt carried out a series of tests to find how much work the average horse could do per day, and eventually he calculated that this was equivalent to the raising of about 33,000 lb. weight one foot per minute. This figure has since been accepted as the measure of a horse-power; or, taking the second as the unit of time instead of the minute, one horse-power is equal to 550 foot-pounds per second. For electrical measurements, this has to be translated into c.g.s. units, and the result is that one horse-power works out about equivalent to 746 watts.

The Watt

One watt is equal to the power produced by a current of 1 ampere flowing under an E.M.F. of 1 volt. Thus, if a current C is flowing under an E.M.F. of E volts, the power which is being expended is equal to CE watts. If a current of $3\frac{1}{2}$ amperes flows under an E.M.F. of 200 volts, the power is 700 watts, or rather less than 1 horse-power, so that a 1 h.p. electric motor, working from electric mains of 200 volts, will draw about 4 amperes.

For large powers, it is usual to employ the "kilowatt" as the unit of electrical power, 1 kw. being equal to 1,000 watts.

Electric lamps are often spoken of as "$\frac{1}{2}$-watt" lamps. This means that they consume $\frac{1}{2}$ a watt of power per candle-power of light emitted. A $\frac{1}{2}$-watt lamp of 100 c.p. will thus consume 50 watts, and if it is operated on a 200-volt circuit, it will draw $\frac{1}{4}$ of an ampere current.

Current

The unit of current on the c.g.s. system is defined in the following way. Suppose a wire is bent into the form of a circle of unit radius, the unit magnetic pole is placed at the centre of this circle, and that a current flows round the wire which causes unit force to be exerted upon the magnetic pole at the centre for each unit length of the wire, then the current flowing in the wire is unit current. The *practical* unit of current is the "ampere," which is one-tenth of the c.g.s. unit as defined above. The one-thousandth part of an ampere is called a *milliampere*, and the one-millionth part of an ampere is called a *microampere*. The current which flows through the filament of a wireless valve is usually between $\frac{1}{2}$ an ampere and 1 ampere, whilst the current in the head-telephones of a wireless receiving set is usually of the order of a few milliamperes.

To sum up these simple units:—

Mechanically, 1 horse-power = 33,000 ft.-lb. per minute, or 550 ft.-lb. per second.

Electrically, 1 horse-power = 746 watts.

1 watt = 1 ampere × 1 volt.

1 kilowatt (kw.) = 1,000 watts = $1\frac{1}{3}$ horse-power.

Power used in an electrical circuit (in watts) = Current (amperes) multiplied by E.M.F. (volts).

1 ampere = one-tenth c.g.s. unit of current.

1 milliamp. = 10^{-3} (1/1,000) ampere.

1 microamp. = 10^{-6} (1/1,000,000) ampere.

One or two examples may be given to illustrate the use of these units:—

An electric motor requires 5 amperes at 100 volts to drive it: what is the theoretical h.p. of the motor?

The power in watts is $100 \times 5 = 500$ watts $= \frac{1}{2}$ kw. 746 watts = 1 h.p.

$\therefore 500 \text{ watts} = \frac{500}{746} \text{ h.p.} = 0.65 \text{ h.p.}$

If the efficiency of the motor is 80%, what is its actual h.p.?

The actual h.p. will be

$$\frac{80}{100} \times \frac{500}{746} = 0.53 \text{ h.p.}$$

If an E.M.F. of 2 volts is applied to a circuit of 10,000 ohms resistance, what is the current?

By Ohm's law, the current will be $\frac{2}{10{,}000}$ amp. $= \frac{1}{5} \times \frac{1}{1{,}000}$ amp.

Now $\frac{1}{1{,}000}$ amp. = 1 milliamp.

Therefore, the current will be $\frac{1}{5}$ ma.

What current will flow through a 500 c.p. "$\frac{1}{2}$-watt" lamp on a 250-volt circuit?

500 c.p. $\frac{1}{2}$-watt = 250 watts.
Wattage = volts × amperes.
Therefore 250 = 250 × amperes
or the current will be 1 amp.

It should be noted that a so-called "$\frac{1}{2}$-watt" usually consumes rather more than $\frac{1}{2}$-watt per candle.

FORTHCOMING EVENTS.

JULY.

5th (Thurs.).—2LO. "Romeo and Juliet."

6th (Fri.).—Radio Society of Highgate. Mr. J. Steell will lecture at the 1919 Club, South Grove, Highgate, at 7.45 p.m.

6th (Fri.).—Leeds and District Amateur Wireless Society. Mr. H. F. Yardley lectures at 8.

7th (Sat.).—Ipswich and District Radio Society. Field Day at Hadleigh in charge of Mr. Barnard Smith.

7th (Sat.).—Cardiff and South Wales Wireless Society. Field Day.

9th (Mon.).—Hornsey and District Wireless Society. Mr. J. R. Hunting will lecture on "Faults in Valve Circuits."

9th (Mon.).—North London Wireless Association. Mr. W. L. Johnson will lecture at 8.30 on "Radio-Metal-Craft."

9th (Mon.).—2LO. Prof. W. A. J. Ford will speak on "Old English Folk Songs" at 7.15 p.m.

11th (Wed.).—Portsmouth and District Wireless Association. Mr. C. H. Warren will lecture at 7.30 p.m. on "Generators" at John Pile Memorial Rooms, Fratton Road, Portsmouth.

12th (Thurs.).—Cardiff and South Wales Wireless Society. Mr. H. C. Linck will take charge of experimental work.

13th (Fri.).—Radio Society of Highgate. Mr. H. Andrewes and Mr. F. G. S. Wise will give a lecture and demonstration at 7.45 p.m. at the 1919 Club, South Grove, Highgate.

25th (Wed.).—The Radio Society of Great Britain, which on July 5th will be ten years old, will hold its last meeting of the session. A paper entitled "Difficulties Encountered with Reception in the Tropics," and contributed by Lt. Hughes, will be read by Mr. P. R. Coursey.

Jottings by the way

Atmospherics to Order.

NOT long ago I became possessed of the world's worst low - frequency inter - valve transformer. To claim that it is the worst is, as I am well aware, a tall order. Many of you, no doubt, went forth in the days of your wireless youth, and recklessly blued several shillings in the purchase of nasty little horrors of waistcoat-pocket size, which you probably regard now as quite the vilest things ever conceived by the mind of man and put together by his hands. You cannot believe that anything more utterly despicable could exist outside a nightmare. But if a competition were organised, mine would give the worst thing you could produce, two sizzles and a crack and beat it by a broken ear-drum. It was given to me by a friend. When it was tested our friendship nearly came to an untimely end. I thought all kinds of awful things about him, crediting him with the most evil designs. Now I look upon him as a friend indeed, for I would not be parted from my little ear-splitter for anything. It is mounted on the set with a valve of its own. Normally it takes no part in the proceedings, for a neat little switch controls its activities. When, however, friends descend upon me for a demonstration it is there, ready at a moment's notice to come to my aid. Having discovered during frenzied tuning efforts that the inevitable has happened, I merely throw that switch over, and with a sigh of resignation invite them to listen to the atmospherics for a second. As soon as their temporary deafness has abated, they agree that they have never known such a night, and that to attempt to use that or any set in such conditions would be an act of considerable folly.

Honest Pride.

A little honest pride in the performances of one's set is, as I think you will agree, a very right and proper thing. You and I, if ever we meet, will vie with one another in recounting wondrous feats of long-distance reception. We shall, of course, each keep the long bow handy, in case any tendency on the other's part to wander into the realms of the improbable renders its drawing desirable; but as we are both completely respectable people, neither of us is likely to go beyond the reception of WDY. on one valve. Should you report this feat I shall smile indulgently and tell you how I do it with a lone "Toob" without the aid of reaction. You will then explain that all your reception is done upon a two-foot frame aerial; whereupon each of us will courteously raise his hat as a mark of respect to the other's skill both as a wireless man and as a *raconteur*. We shall not drag in the crystal, for that would be going too far. Now all this is as it should be. Your set plays up now and then just as mine does, but we will not speak of the nights when every valve becomes possessed of seven separate and distinct devils, or of those when some tiny fault causes us to spend profane and perspiring hours with screwdriver, pliers and other weapons of our calling in vain efforts to run it to earth. These things are quite private affairs, at least they would be did they not invariably happen when our most hypercritical friends are present. We shall not talk of them, for, like sundials, we mark only the sunny hours. Strong men do not parade their secret sorrows before the world.

Melba.

It was a sore disappointment to most of us to read or hear that we were not to be able to hear, once more, Dame Nellie Melba's beautiful voice in opera. When she sang in "La Bohême" earlier in the year one hoped that she would often give those who dwell in remote parts of the country a similar treat. Some voices come through well on wireless, others are indifferent, others frankly unmelodious. But Melba has a voice of pure gold, and her diction is so distinct that every word is plain. When she sang to us wireless folk before, we were, I think, as much carried away by enthusiasm as the audience, whose outbursts of applause made us long to be able to add our quota to it. And then, if you remember, she made a little speech at the end of the performance, and I'll wager that a good many of us found that our eyes were curiously watery as we listened to the words that came from her heart and the roars of cheering that greeted them.

Quaint Logic.

But one does feel that her agents adopted a curious standpoint when they published her reasons for being unable to consent in June to the broadcasting of operas in which she appeared. "Dame Melba," quoth they, "realises that by letting 100,000 people hear her for nothing she may lessen her value in the concert room." Well, well, well! Surely such a statement is far from being complimentary to our greatest singer. It's as good as saying, "Hear her once and you'll never want to again"—which is precisely the reverse of the truth. I confess that I have never been able to follow the reasoning of the theatre managers, or the music publishers, who have made such efforts to spike the guns (or should one say "short the circuits"?) of the B.B.C. If a man is manufacturing lemonade—let us say lemonade in case we rouse old, half-forgotten longings in the hearts of readers across the Herring Pond —he is not afraid of letting you taste his wares. He knows that he can never have a wide sale for them unless they are good enough to make you want more; he knows, too, that when you have tasted and approved you will tell your friends, and so become one of his best advertisers. If you glance through the advertisement columns of the newspapers you will notice any amount of offers of free samples; it pays to give them away because they create a demand.

Samples.

Surely it is the same with stories, songs, plays, and musical compositions. What finer publicity could an author want than to be allowed to read one of his short stories before the microphone? Thousands of his audience will never have heard of him before, but if the story is a good one they make a note of his name and order his books. So, too, with songs and instrumental pieces. If you're thinking of buying one of them you probably go and hear it in the music shop. Strange that you may do so there with no restrictions and yet become a suspected person when you do so on your wireless set! Writers and composers must derive benefit from broadcasting. I do not believe that, to mention one of them, Mr. Wilfrid Sanderson, many of whose baritone songs have been sung again and again from 2LO, can have found that wireless has had any reducing effect upon the amount of his receipts from royalties. Hear a good song, and if you have a voice you want to sing it yourself. Even if your finest note is like that of a foghorn afflicted with catarrh, you feel that you could make a hit at the next parish tea with a jolly song like that. Hence you fare forth and plank down the price like a man. Of plays we are treated to samples; and, as we have seen, there is nothing to equal these for creating a demand for a really good article. Think, for a second, of people living in the provinces who are to spend a few days in London. Would they not choose to go to plays of which they had heard excerpts and found them good rather than to those which were names in the entertainment list and nothing more?

The Wireless Tipster.

Americans, I see, are seriously worried over the problem of the man who makes use of the wireless telephone to broadcast talks on racing and all the latest tips. The trouble does not come from within, for the legislature has made its own ether as pure and as blameless as even the most crankish of cranks could desire. It seems that Canada has not taken similar steps to prevent her Captain Coes from sending out for all her sons and daughters to hear, if they are so minded. Wireless, unfortunately, knows no boundaries. Hence, if Uncle Sam's family likes to fit up sufficiently powerful receiving sets, it can cull all the information that is wafted over the border to its heart's content, and not improbably to the lightening of its pockets. This is very sad, and I do not know what is to be done. Even the most pussyfoot kind of laws cannot prevent people from listening-in to information that they want to hear. Perhaps some high-souled Society for the Prevention of Something or Other will finance powerful stations situated near large towns, whose mission in life will be to "jam," effectively and enthusiastically, anything of which the Society's censor does not approve.

A New Peril.

We appear to have been spared, so far as wireless is concerned, the oratorical efforts of politicians. In America, where people love to be talked either to or at, these wielders of winged words have already fastened on to the wireless telephone and forged from it one of their mightiest weapons. Our time will doubtless come. The opportunity of talking to an audience of perhaps a quarter of a million is one that no self-respecting politician could possibly miss. And then think of its advantages. No long journey to be made, no facing of a sneezing, coughing, foot-scuffling audience, no hecklers, no eggs. The great man settles down in his most comfy armchair, picks up a perfectly innocuous telephone, and gets it off his chest without let or hindrance. And we, the great army of free-born British electors, are left utterly defenceless, for we are disarmed. We shall no longer be able to shout "Oh!" or "Question," or "What did Gladstone say in 1885?" as our fathers did, or, at any rate, if we do utter the immemorial cries of our race, they will not be heard. We shall no longer be able to show our disgust, our scorn, our utter contempt, by making a dignified exit in the midst of the harangue. It will not even be possible for us to show the light of truth to those on the other side by beating in their heads or trampling them underfoot at the close of the speech. But we shall have, and we shall use it, the power to switch off instantly should any speaker become dull or prosy. That at any rate is a consoling thought.

Rain's Pranks.

As I write it raineth. There is nothing unusual in this, for it has done so at frequent intervals for a month. Rain has, nevertheless, been responsible in all probability for some rather curious effects produced in our wireless sets. During the curious weather we had in May and the early part of June, the atmosphere was in a weird state. The temperature was all over the place. At one moment you were huddled shivering over the fire; half an hour later you were basking (for but a few brief minutes, alas!) in a hammock in the garden. Hailstorms in the morning, thunderstorms in the afternoon; sunshine one day, snow the next; this was the kind of meteorological hotch-potch to which we were treated. Warm air currents were continually rising, whilst cold ones fell. When this sort of thing happens the clouds are apt to become heavily charged, and if rain, especially of the fine variety, descends from them upon our aerials its impact produces crackles of Nature's finest brand. A friend had a curious experience. He was using his set and wearing high-resistance 'phones on an evening when atmospherics were peculiarly bad. A large black cloud came slowly up over the sky, and when it was nearly overhead he received a shock that made him tear off the head-set as if it had been red-hot. He leapt to the earthing switch, which developed a recalcitrant fit and refused to close, a gap of about one-eighth of an inch remaining between the arm and the clip. Across this space a train of brilliant sparks flowed for several seconds.

WIRELESS WAYFARER.

AN IMPROVED ST100 CIRCUIT

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

This article deals with a form of ST100 circuit, which is the result of further experience.

SINCE the publication of the original ST100 circuit, the writer has been carrying out further tests with the object of improving its reliability and stability. In its original form, the ST100 was a distinct advance upon previous reflex or dual amplification circuits as regards its stability, but this has now been improved still further.

A reflex circuit is never as foolproof as one in which each valve carries out only one function. The use of different transformers, or a changing of different capacities, in a reflex circuit is always liable to cause inefficiency and low-frequency howling or buzzing.

Another point which, though not mentioned in the original article in *Modern Wireless*, has been found to be of considerable importance when certain kinds of valves are used; it is the application of a negative potential to both grids. This point is raised in the current issue of *Modern Wireless*.

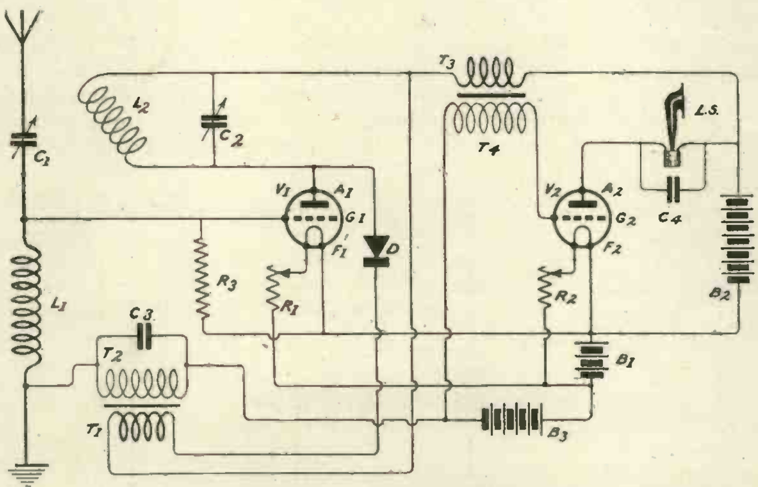


Fig. 1.—The original ST100 circuit with grid cells added at B_3.

Fig. 1 shows the original ST100 circuit with the addition of a grid battery B_3. This battery is included between the negative terminal of the accumulator B_1 and the filament end of the secondary T_4 of the intervalve transformer T_3, T_4, and also to the filament end of the secondary T_2 of the intervalve transformer T_1 T_2. The object of the grid battery B_3, which may have a value of from 0 to 18 volts, is to enable the valves V_1 and V_2 to operate at the middle point on their characteristic curves. It will usually not be necessary to have differing voltages on the grids, but it is desirable to be able to vary the values of the negative potentials applied to them. This may be done by having tappings on the battery B_3. The actual negative potential applied to the grids will depend partly on the type of valve used, partly on the filament current and partly on the high-tension voltage. When using 100 volts on the anode, a negative potential of -9 volts should be about suitable.

The value of the condenser C_3 is also rather an important factor, and in some cases the condenser may be left out altogether. Usually it will be found that the condenser C_3 should be fairly small, say, 0.0003 μF. It may, of course, be variable, in which case a 0.001 μF variable condenser may be used successfully.

A refinement consists in shunting the high-tension battery B_2 by a fixed condenser of at least 1 μF capacity.

The voltage of the high-tension battery is important, and not less than 100 volts should be used if the full effect is to be obtained. The writer uses a 100 volt Hellesen high-tension battery, as supplied by Messrs. A. H. Hunt.

Fig. 2 shows how it is possible to use the high-tension battery itself to provide the negative potential to the grid. It will be seen that a connection is taken from the negative of the filament accumulator B_1 to a point on the high-tension battery B_2. The negative terminal of this high-tension battery goes to the transformer secondaries as in Fig. 1. By varying the position of the wander plug W, we vary the negative potential on the grids, at the same time, of course, varying the high-tension voltage. As previously stated, the voltage on the anode should not be less than 100 volts if it is desired to obtain really powerful signals.

The Improved ST100 Circuit

The improved form of ST100 circuit is shown in Fig. 3. It will be seen that the chief alteration that has been made is to include the intervalve transformer T_1 T_2 in the aerial circuit, instead of between the earth and the filament accumulator. By making this change

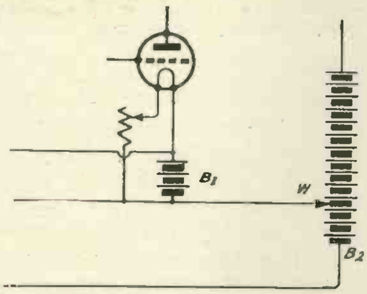


Fig. 2.—Method showing how the H.T. battery may be used for providing negative potential to the grid.

in position, the circuit is rendered more stable and stray capacities do not become as effective as before. It will be seen that the secondary T_2 is shunted by a variable condenser C_3, preferably having a capacity of 0.001 μF. This variable condenser affects the aerial tuning to a certain extent, but its main object is to control the tendency of the circuit to oscillate at low-frequencies, and also to vary the high-frequency reaction between the circuit L_2 C_2 and the aerial circuit. This is, of course, assuming that this reaction is applied, although, when receiving British Broadcasting, it is not permissible to couple L_2 to L_1 for the purpose of producing reaction. In any case, it is desirable that C_3 should be variable, but a fixed condenser of 0.0005 μF will be found quite satisfactory. A condenser of 0.0003 μF will also be found to give satisfaction in many cases. It must be borne in mind, however, that the condenser across T_2 may be considered as being connected directly in series with the aerial, and therefore its effect will be a reduction in the wavelength of the aerial circuit. For this reason, the writer would advise the reader to try different capacities for C_3; the larger the capacity across the transformer winding T_2 the less effect it will have on the tuning of the aerial circuit.

Speaking of tuning, this may be accomplished, apart from the condenser C_3, by varying the inductance L_1 or by using the variable condenser C_1. The condenser C_1 should be capable of being connected in parallel with L_1 instead of in series with it. Many may find that the circuit is more stable if the variable condenser is connected in parallel with the inductance instead of in series with it, but if the aerial consists of a number of wires, and therefore has a comparatively large capacity, the series connection will generally be found best.

The battery B_3 should have a value of from 0 to 18 volts, a value of 9 volts usually giving satisfactory results. This battery is for the the same purpose as before, namely, to give the grids G_1 and G_2 a negative potential. This lessens distortion and also results in greater amplification.

A word of warning should be uttered regarding the crystal detector D; the best type of crystal

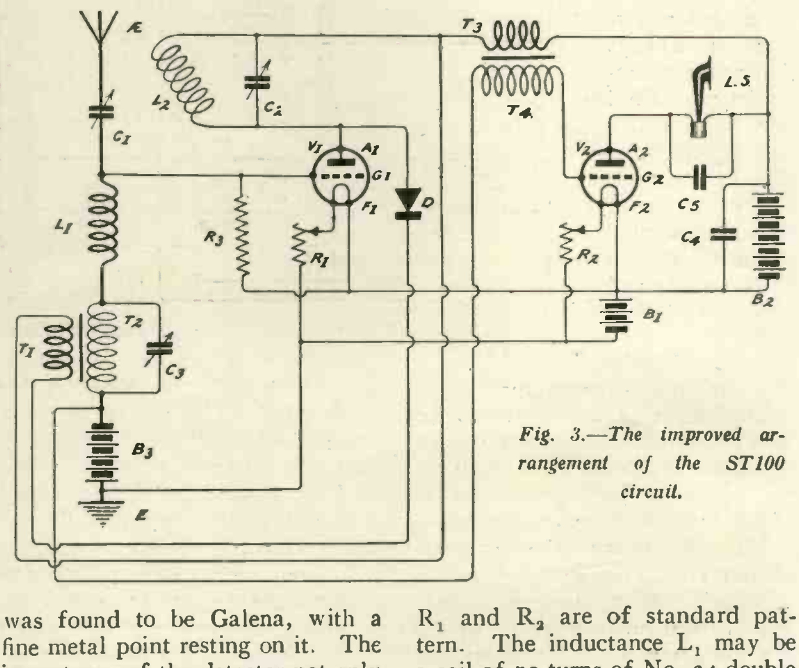


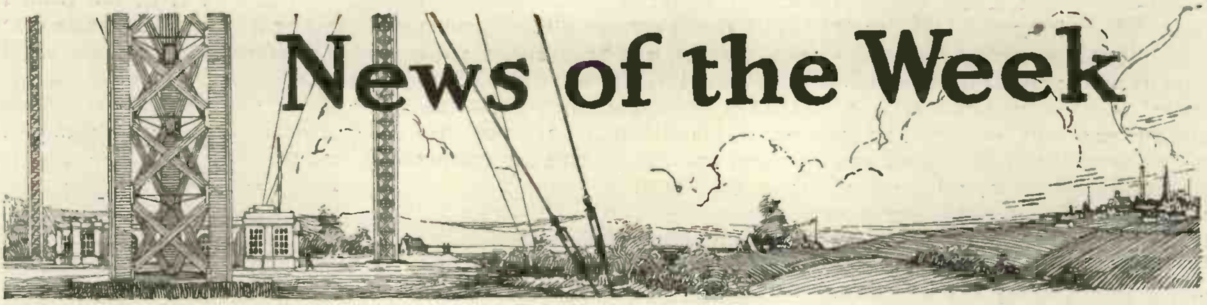
Fig. 3.—The improved arrangement of the ST100 circuit.

was found to be Galena, with a fine metal point resting on it. The importance of the detector not only lies in its actual rectifying properties, but also on its impedance. Not only does its impedance affect the tendency of the circuit to oscillate at high-frequency, but also it affects the stability of the whole circuit. There are several Galena crystals sold under different names and differing slightly in composition. The crystal Talite has been found to give excellent results.

As regards some of the actual values the following data may be of interest :—

The condenser C_1 has a capacity of 0.0005 μF or 0.001 μF, whilst C_2 has similar values. The variable condenser C_3 may also be of either capacity, preferably 0.001 μF. If fixed, C_3 should have a capacity of not less than 0.0005 μF. The resistance R_3 has a value of 100,000 ohms. The condenser C_3 across the loud-speaker L-S, should have a value of not less than 0.002 μF. A refinement consists in the condenser C_4, which should have a capacity of not less than 1 μF. The accumulator B_1 is of the six-volt type, while B_2 should have a value of not less than 100 volts, although results are obtainable with as low a voltage as 50. The rheostats R_1 and R_2 are of standard pattern. The inductance L_1 may be a coil of 70 turns of No. 24 double cotton-covered wire, wound on a

(*Continued on page 772.*)



CONSIDERABLE public interest was manifested at an exhibition of wireless sets and component parts held in Belfast recently. The exhibition was opened by the Right Honourable the Lord Mayor of Belfast (Alderman W. G. Turner, J.P.), for the Northern Radio Association. The apparatus displayed included a comprehensive list of valve sets ranging from one to six valves, together with a number of popular crystal sets.

* * *

According to the *Musical News and Herald*, Mr. James M. Glover is stated to have said in an article entitled "The Musical Box" appearing in *The Stage* on June 5th that a well-known artist was approached for broadcasting purposes, and, everything else being arranged, she enquired "What about terms," and the reply came that all the terms offered were the very great advertisement she would receive. "Very well, then," the great singer is reported to have replied, "my terms for advertising the B.B.C. are £1,000 per concert." We wonder how this would have gone down in America.

* * *

Reading through the pages of our contemporary *Ideas*, of June 23rd, we learn from an article entitled "Wireless for the Health" that many things have been done for the deaf by wireless telephony. One of the most interesting paragraphs is as follows :—

"It may be that our bodies act as aerials and our brains as a condenser system. Thus our bodies 'receive' the vibrating ether waves at the same time as our ears receive the waves after an instrument has transmitted them into sound. This double receiving enables the deaf to be sensitised to sounds which enter their body through their skin." Presumably a new "skin effect."

* * *

The *Leeds Mercury* tells the following story concerning Senator Marconi :—"Are you interested in wireless?" a young lady asked Senator Marconi, to whom she was introduced the other day. "Just a little," said the inventor. "Have you a broadcasting set?" the lady next asked, quite unaware of Senator Marconi's fame. "Yes, a few," was the reply. "Did you make them yourself?" "Yes." "How very clever you must be."

BROADCAST TRANSMISSIONS

	Call-Sign	Wavelength
CARDIFF	5WA	353 metres
*LONDON	2LO	369 ,,
MANCHESTER	2ZY	385 ,,
NEWCASTLE	5NO	400 ,,
GLASGOW	5SC	415 ,,
BIRMINGHAM	5IT	420 ,,

TIMES OF WORKING.

Weekdays ....3.30 to 4.30 p.m. and 5.30 to 11.0 p.m. B.S.T.

*London 11.30 a.m. to 12.30 instead of 3.30 to 4.30 p.m.

Sundays....8.30 to 10.30 p.m. B.S.T.

SILENT PERIODS.

CARDIFF	8.0 to 8.30
LONDON	7.30 ,, 8.0
MANCHESTER	7.45 ,, 8.15
NEWCASTLE	9.0 ,, 9.30
GLASGOW	7.45 ,, 8.15
BIRMINGHAM	8.15 ,, 8.45

* * *

The Governors of Glasgow Technical College recently approved a recommendation that Dr. G. W. O. Howe, Professor of Electrical Engineering at Glasgow University, be invited to give a course of lectures on wireless telegraphy and telephony during next session (September-December).

* * *

The fee chargeable to students will be 10s., and the course will be in the nature of an experiment upon which the consideration of more systematic teaching of the subject may be based.

* * *

We understand that, following the success attendant upon the experimental wireless traffic control vehicle, Scotland Yard are having a new van built at the Metropolitan Police Engineering Works. A special body is being built upon a Crossley chassis, and will contain the receiving and transmitting apparatus. Telescopic masts will be placed at each of the four corners of the van.

* * *

The Oxford Wireless Telephony Co. were asked recently to fit a char-à-banc belonging to the City of Oxford Motor 'Bus Co. with wireless. The work was completed and in perfect order within 36 hours. The aerial used was a battleship type hexagon, and the earth the char-à-banc chassis. The set in use was the Western Electric Co.'s high-frequency three-valve set and loud-speaking equipment. Tests were made at Stadhampton village, near Oxford, where the anthem sung by the St Stephen's choir of London was received so well that it was plainly audible 300 yards away.

* * *

Arrangements are being made by the Orleans Railway Co. for the installation of wireless apparatus in the Bordeaux-Paris expresses. During the past few days experiments have been made on these trains which leave no doubt as to the practical success of the venture. Loud-speakers have been installed in the dining-cars attached to the trains and the concerts transmitted from the Eiffel Tower and the Radiola Company have been received with marked success. Difficulties of fitting the trains with the necessary aerials, owing to the smallness of the space between the trains and bridges, have been overcome by running parallel wires along the whole length of the dining-car.

* * *

We have recently had an opportunity of witnessing a demonstration of apparatus designed for the elimination of interference. The success with which the demonstration was carried out leads us to believe that there is a considerable future before it. Details of the apparatus are to be found on another page of this issue.

* * *

In connection with the invitation on the part of 2LO for listeners-in to send postcards regarding the programmes of the London Station, it is amusing to note that one letter received was addressed to "The Foreman, The London Gas Works, 2, Savoy Hill." We understand that, in connection with this invitation, some thousands of postcards have been received and many more are coming with each post.

* * *

We understand that for the first time a British battleship was recently used as a wireless control target for important naval gunnery tests. It was the *Agamemnon*, sister ship to the *Lord Nelson*, completed in 1906 at the cost of £1,500,000, that thus ended its honourable career afloat. When the *Agamemnon* left Portland harbour, she presented a strange spectacle, with two huge, fan-shaped structures fore and aft, acting as intercepters for the wireless waves by which she was controlled from the destroyer *Snapdragon*.

* * *

California leads by possessing the greatest number of broadcasting stations of any of the United States, namely 59. Texas is next with 36 stations and Ohio third with 31.

* * *

The French Steamship Line plans to equip its passenger ships sailing out of New York with wireless receivers and amplifiers for the reception of broadcast programmes.

* * *

We deeply regret to learn from *The Times* of the death of Mr. Walter Seddon at the age of 31. He was senior operator in the steamship *Volturno* when it was burnt in the Atlantic in October in 1913 with a loss of 133 lives. The *Volturno* had on board several hundred emigrants, and when the fire broke out during rough weather many of them got out of hand and overloaded the boats.

Owing to the progress of the fire, the operators had to change to the emergency apparatus, but they continued on duty till an explosion brought the aerial down and nothing more could be done. Seddon accompanied the captain on his final search of the vessel, and left in the last boat.

Two of Manchester's best, Mr. Foden Williams, the entertainer, with Mr. Stephen Williams, pianist-baritone.

AERIAL RIGGING AND MAST BUILDING

By F. H. PHILPOTT.

A further article dealing with mast and aerial erection of especial interest to those who are not familiar with the practical side of this operation.

(Continued from No. 10, page 619.)

TO erect the mast using only three guys, proceed as follows:—

Mark out the ground for four pegs exactly as previously described. Three of these pegs will be only temporarily required during the actual erection, and will either have to be moved immediately the mast is vertical, or two additional pegs placed in the "permanent positions." If you can place these pegs firmly enough to support the mast during erection, but yet easily removable, so much the better.

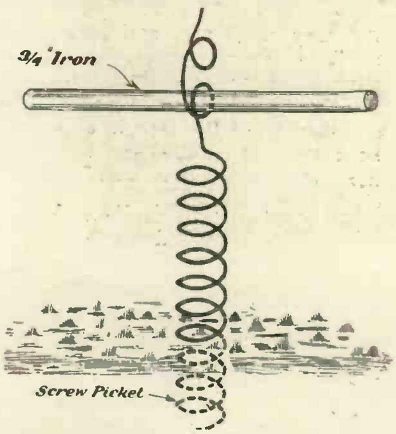


Fig. 11.—Showing the method of using a screw picket

The ideal things for the job are known as "screw-pickets," and consist of about ¾in. iron bar twisted after the manner of a gigantic cork-screw (Fig. 11). They are still obtainable at Government Surplus Stores, and are very suitable for this particular purpose as they can be screwed into the ground, and unscrewed when required to be moved.

Having placed your temporary pegs, mark out for the two additional ones in the following manner:

Using the string tacked to the foot of the mast as before, mark out a complete circle. Now select a convenient peg, which is to be one of the permanent ones, say No. 2. Attach the string to the *opposite* peg (in this case No. 1), and keeping the string the same length, mark each of the points A1 and A3 as shown in Fig. 12. The points A1, No. 2 and A3 should now be equal distances apart, and are the positions for your three permanent pegs. It is advisable to check and correct these by actual measurement, however.

If you are not using easily movable pegs, you should now plant your two additional permanent anchors and ignore them until required.

Proceed exactly as described previously, and as if you were using four guys, except that you must use your halyard temporarily as No. 1 guy. Remembering that there are no middle and lower guys on the No. 1 side of the mast, the halyard can really be considered only a safeguard to prevent any possibility of pulling the mast right over and letting it fall, and it should be your object to avoid letting any strain come upon the halyard. For this reason it is advisable to stop hauling *before* the mast attains a full vertical position, and on no account must the mast be hauled up when the wind is blowing *from* the position of No. 1 peg. It was a rule in France that all masts should be erected against the wind, and it is just as good a rule for amateurs.

Having the mast almost vertical (Fig. 13), take a turn with your rope round No. 2 peg, so that you can hold the mast steady, and then get your assistants to move the guys one at a time to the permanent pegs. The assistants should commence with a middle guy and move the complete set before commencing on the other set. These guys should be left fairly slack, as, of course, pulling the mast up to a true vertical position will tighten them up.

The procedure from now onwards will be obvious to those who have read the previous description.

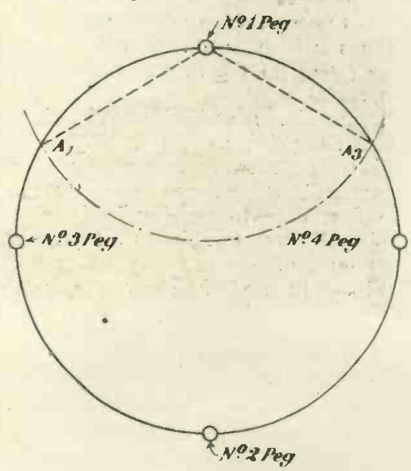


Fig. 12.—Ground plan of the pegs.

Almost the only advantage obtained by using only three sets of guys as against four is the saving in the expense of guy wire. This "economy" is not, however, advocated by the writer, as the erection is by no means so easy, neat, and safe as when using four sets of guys, although it is admitted that, when the mast is up, three sets, properly secured, are adequate support for the mast.

This description is chiefly given for the benefit of those who have purchased a mast ready made, most manufacturers supplying only three sets of guys.

Having explained the general principles of erecting a mast we must now consider the difficulties almost invariably present in actual cases.

It is not, of course, the purpose of these articles to instruct the reader in any technicalities of the subject, it being presumed that he has already acquired all that it is necessary to know of insulators, spreaders, etc. The writer's object is to endeavour to assist the reader by showing the easiest practical way of getting the aerial up (splitting as few infinitives as possible in the process). With this end in view I believe I cannot do better than describe some actual conditions met with in my own experience.

By far the most common inconveniences in the raising of a 45 ft mast are :—

(1) Lack of space, precluding the possibility of laying the mast out to its full length.

(2) Difficulty of getting a spread for the guys ; and

(3) Obstructions such as trees or bushes which interfere with the hauling up of the mast, and later, the aerial.

Items No. 1 and 2 are usually present together as will be obvious, and it is generally a question of compromising between the two ; the first case to be described includes all three troubles in a typical combination.

Fig. 14*a* and *b* show respectively, plan and perspective view of the aerial and property in question. It will be seen that the house end of the aerial was attached to a chimney, and satisfactory methods of doing this will be described.

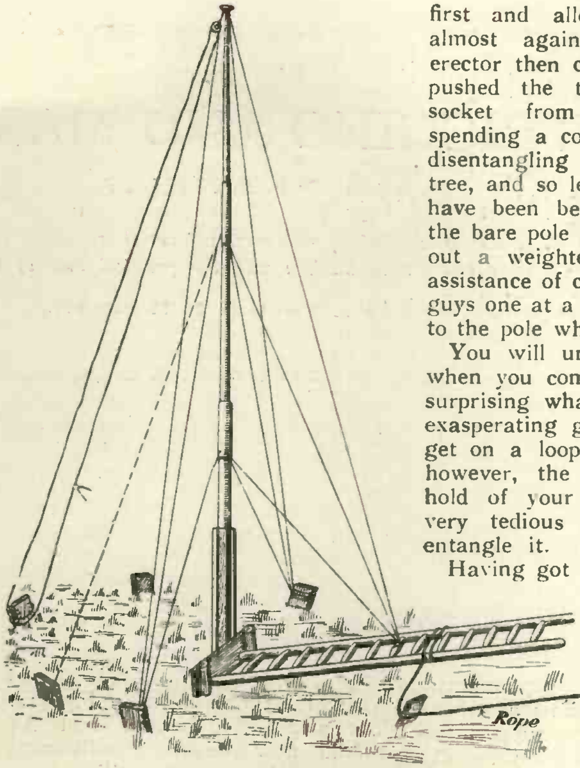


Fig. 13.—Raising the mast.

It will also be seen that to get the spread for the guys it was necessary to sacrifice some length of aerial (more will be said of this later), and incidentally introduced difficulty No. 1.

The two rear guys were attached to the garden wall as in Fig. 14, but actually the wall was somewhat higher than that shown, and the "holdfasts" for the guys were well out of reach.

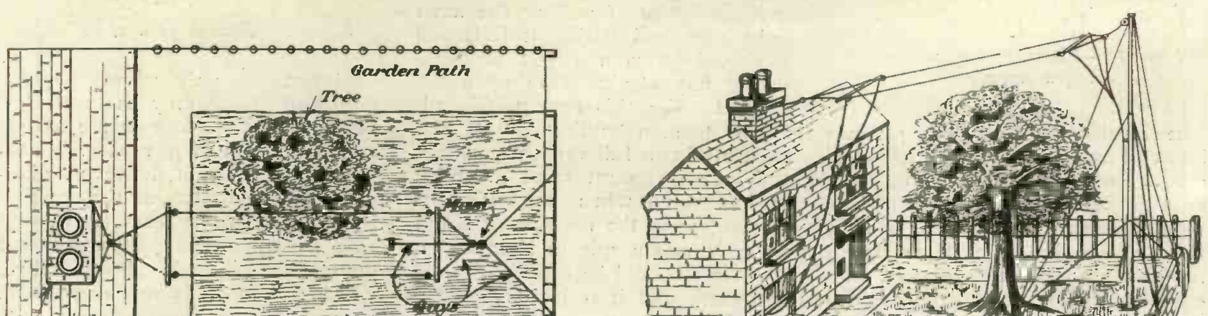
As the three sections of the mast could not be fitted together on the ground two sections were erected first and allowed to lean over almost against the tree. The erector then climbed the tree and pushed the top section into its socket from there, afterwards spending a couple of hours or so disentangling the guys from the tree, and so learning that it would have been better to have carried the bare pole into the tree, thrown out a weighted string and—with assistance of course—hauled up the guys one at a time, attaching them to the pole whilst in the tree.

You will understand this better when you come to try it, as it is surprising what a tenacious and exasperating grip a tiny twig can get on a loop of stiff wire. If, however, the tree gets a proper hold of your aerial you have a very tedious job indeed to disentangle it.

Having got the mast up, as will be seen by the illustration, the aerial had to be hauled up into a position actually over the tree.

To get the aerial to clear the tree on its way up, my assistant held a light string over the aerial wires and so guided them past. Another method of keeping the aerial clear of the tree would have been to have climbed the tree and held the aerial outwards with a clothes-prop. This latter "instrument," by the way, is invaluable in almost every case of aerial rigging.

If necessary, it is not difficult to haul a complete mast up with a very considerable slope towards one of the side pegs and straighten up



(*a*) (*b*)

Fig. 14.—A difficult situation for the erection of an aerial.

afterwards. Obstacles can often be neatly cleared in this way.

Two sections of the mast can be easily handled as mentioned before, and in very many cases they can be hauled partly up and the top section added from a roof, bedroom window, or other convenient point.

The stop guys would, of course, be fixed before letting go.

Remembering these two points, almost any obstruction, such as greenhouses, rose-beds, fountains, etc., can be avoided without fuss, and it is worth while doing so if only to watch people "cogitating."

In the very rare cases where it is absolutely impossible to get a spread for the guys, such as, for instance, in the space between two tennis courts, the only alternatives are either putting up a stout mast that needs no guys or else fitting your sectional mast with "outriggers." A description of the latter is rather beyond the scope of these articles, and must be left to some future date.

In the former case the pole should be set in concrete, and it is a job for skilled men. They are not quite so likely to forget the halyard as you would be, but it would do no harm to remind them.

If you have to choose between sacrificing 10 feet or so of ground space and having a "scaffold pole" mast, I advise the former for these reasons. Your sectional mast will almost certainly be 10 or 15ft. higher than the pole would be, as the latter needs to be sunk in the ground at least four feet. To get equal height the pole would have to be nearly 50ft. long, and a mast of this length would be difficult to obtain. Also the railway carriage rates make such a mast very expensive.

Taking everything into consideration, you may find you are not losing so much length of aerial by sacrificing 10ft. of ground for guys as you may at first have expected, and you will certainly save pounds. In every case the writer's advice is "aim for height rather than length," within reason, of course.

(To be continued.)

M.P.S AND WIRELESS

Mr. Godfrey C. Isaacs, Senator Marconi and Mr. Gratton Doyle, M.P., listening-in from a motor car on the occasion of a visit to Ongar and Brentwood Wireless Stations by Members of the Industrial Group of the House of Commons on June 27th.

A NEW INTERFERENCE ELIMINATOR

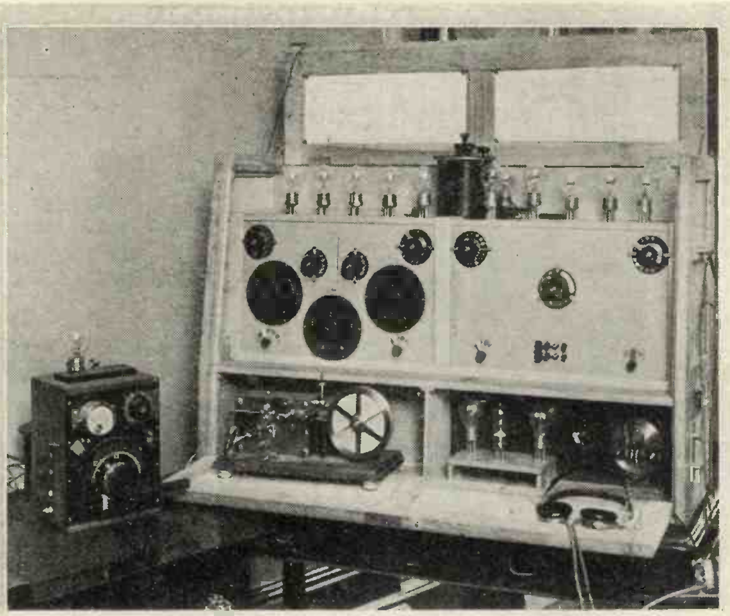
Particulars of a new and interesting invention designed to eliminate the undesirable interference experienced in commercial radio-telegraphic working.

READERS of *Wireless Weekly* will, no doubt, have read in the daily press some general remarks regarding an invention of Monsieur Marrec. Thinking that this would prove of interest to our many readers, we paid a special visit to Monsieur Marrec's demonstration room in London and received some interesting information regarding his invention.

It provides a means of receiving continuous waves with a minimum of interference from spark signals and atmospherics. It is not applicable to the reception of broadcasting, as the principle involved is note selection.

The accompanying photographs show Monsieur Marrec and also the apparatus he uses. The portion of the set to the left is the ordinary receiving circuit which uses high-frequency amplification. At the interview, M. Marrec was receiving signals on a large frame aerial, but he stated that improved results were obtainable on an open aerial. The portion of the apparatus to the right is a form of low-frequency selector.

The technical aspects, of course, interested us most, as a mere demonstration is very often unconvincing. The principle involved is that the low-frequency currents are first amplified and then are combined with other audio-frequency continuous oscillations of a different frequency. The resultant currents are then applied to two or three low-frequency amplifying valves having circuits selectively tuned to the frequency of the original low-frequency currents.



A general view of the apparatus.

The accompanying figure shows the principle of the arrangement. The box B is the usual receiving apparatus, and supplies the low-frequency signals produced by rectified beats, these low-frequency signals being applied to the valve V_1 which amplifies them. The valve V_2 also amplifies them. The valve V_3 has its grid circuit tuned to a frequency of 3,oco, and this valve, by judicious arrangement, is made to oscillate at a frequency of 3,000 per second. These currents mix with the low-frequency currents having a frequency of 1,000 which come from the receiver. The resultant currents, due to the combination of these two frequencies, are fed into a chain of three valves, V_4, V_5, and V_6, the grid circuits of each being tuned to a frequency of 1,oco.

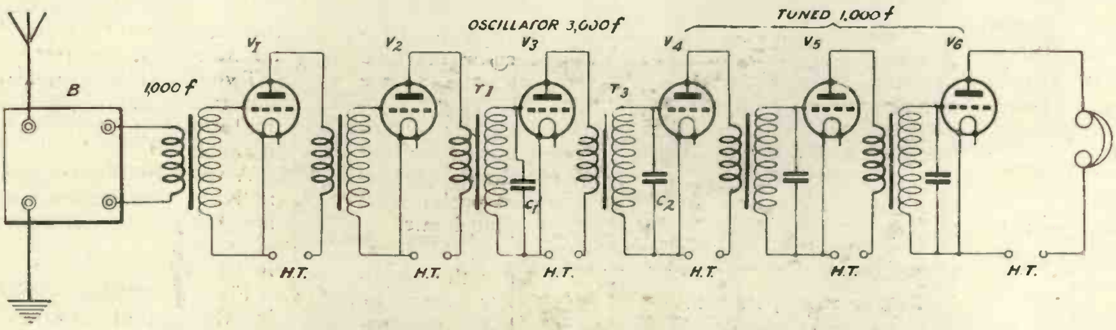
The demonstration, from a practical point of view, was distinctly successful, and continuous wave stations were received with a minimum of interference. Tuckerton was also received quite clearly with an absence of atmospherics. The result was certainly striking, but the Morse which came through seemed rather thick, and we had difficulty in reading it as the dashes seemed to be slightly mutilated. This effect was not noticed on signals from nearer stations, and we were informed that the hesitating character of the Morse C.W. signals from America did not affect the recording of the signals on a tape.

What, perhaps, struck us most was the statement by M. Marrec that his apparatus was entered for a competition held by the French Army authorities. Both Messieurs Levy and Bellescize were also competitors, and M. Marrec declares that his arrangement was adopted as the best.

M. Marrec, the inventor of the apparatus described herein.

The Hinton system of reception produces equivalent results, but with the distortion of long-distance signals.

A comparison, however, of the methods was, of course, impossible on a single test of this character.



Illustrating the principle of the eliminating circuit; B being the usual receiving apparatus.

HIGH-SPEED WIRELESS TELEGRAPHY

(Continued from page 740.)

for the defence of London, but since abandoned by the War Office.

Near this fort is the power house which supplies all the electric current required for running the transmitters and auxiliary apparatus.

At present there are three separate transmitting stations at Ongar. One is carrying on a service with France, another with Spain and Switzerland, and a third with Canada.

The aerial systems closely resemble one another, and consist, generally, of two circular cages with four wires suspended from two 300ft. self-supporting lattice towers.

The aerial or radiator is not connected directly to earth, but to an earth screen comprising a number of insulated wires supported on 30ft. lattice masts. The provision of this metallic conducting screen between the aerial and earth reduces the losses in the soil under the aerial, and results in greatly increased radiation efficiency and in stronger signals being produced at the receiving stations than would be the case with a buried earth.

The efficiency of a transmitting station, and the legibility of the signals under bad atmospheric conditions, depend largely on the steadiness of the transmitted wave.

This steadiness is attained at Ongar by the employment of the Independent Drive system. The fundamental principle of this system is the control of the main oscillations through the medium of a separate standard oscillation generator which, once adjusted to the required wavelength, maintains its adjustment with perfect constancy.

The transmitting plant is actuated by high-speed signalling keys, which are themselves controlled direct from the London central control office by means of land lines passing through the receiving centre at Brentwood.

It is perhaps worthy of note that valve transmitters have the advantage of not requiring a complete duplicate installation, since any valve burnt out can readily be replaced in a few minutes with no appreciable interruption of the service.

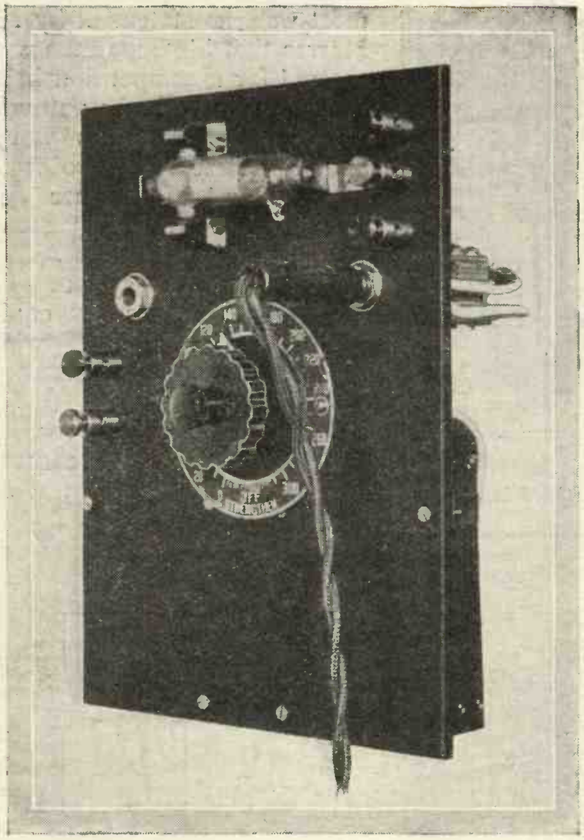


Fig. 1.—Exterior view of the unit.

A NOVEL LOW-FR

By ALAN L. M

This article describes a useful low-frequency receiver and is very suitable for use with the

THE following description of a simple note-magnifier will, no doubt, be found useful by all who wish to increase the output of sound from either their crystal or valve receivers. When satisfactorily designed, such a note-magnifier as here described will enable an increase in volume of from three to five times to be obtained, which in many cases enables a loud-speaker to be worked from a crystal receiver when several miles from the local broadcasting station.

The action of such an amplifier is also equally satisfactory, no matter what the wavelength of the received signal may be, and thus experimenters possessing resistance-coupled high-frequency amplifiers will find a great increase in signal strength if such a note-magnifier is added to the telephone terminals of their apparatus.

The switching arrangements, which are carried out automatically by the insertion of the telephone plug into its appropriate jack, enable either the output from the set to be made use of in the ordinary manner, or the signals can be amplified by inserting the plug in the other jack, the various circuits at the same time being electrically connected by the simple process of pushing the plug home.

In this manner the amplifier may be left permanently attached to any receiver, as if it is not desired to use it the telephone plug has simply to be inserted in the appropriate jack, and the telephones are thus connected directly to their terminals on the receiver.

Before actually describing the construction of the apparatus, it is as well to make a list of the necessary components. The following are the actual parts and material required for the construction of the instrument :—

One ebonite panel 8in. by 6¼in. by ¼in. thick.

One intervalve low-frequency transformer, preferably having a ratio greater than 3 to 1, but not more than 5 to 1.

One filament rheostat and the necessary screws, etc., for mounting.

Two small 1½ volt dry cells and suitable brass brackets for attaching them to the rear of the panel.

A valve holder or, alternatively, clips for use with any special type of valve, such as the QX illustrated in the photograph.

Five terminals, which in the actual apparatus are of the type with a spring push-down top.

Two telephone jacks, such as the Elwell type, with additional contacts as shown in the drawings.

One telephone plug.

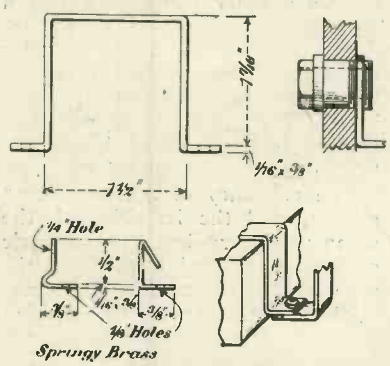


Fig. 4.—Giving dimensions of clips for holding the grid cells.

The first procedure is to mark out and drill the ebonite panel (Fig. 3) in such a manner that the components may be conveniently attached. It is not important in what position on the panel the apparatus is assembled, so that the final placing of the parts is purely a matter for convenience.

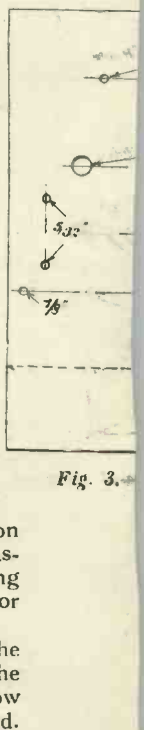


Fig. 3.—

Fig. 3 will make quite clear the position of the various holes in the writer's panel, and illustrates how the grid cells, etc., are attached. The low-frequency transformer used in this instrument should be of a reliable make, as it is false economy to buy cheap low-frequency transformers. Little care is devoted to the insulation of their windings, and in many cases very fine wire, generally enamel-covered, is used in their construction, which

EQUENCY AMPLIFIER

DOUGLAS (*Staff Editor*).

...mplifier, which may be connected to any type of ...tector unit described in "Wireless Weekly," No. 8.

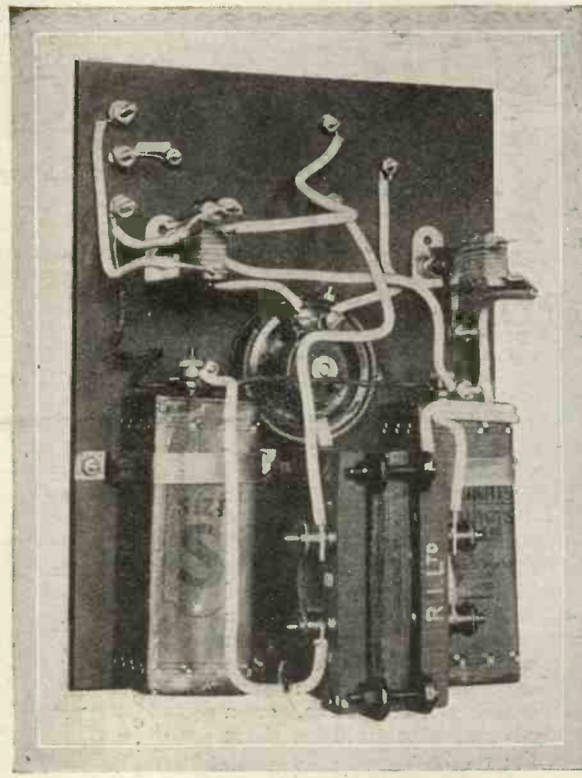
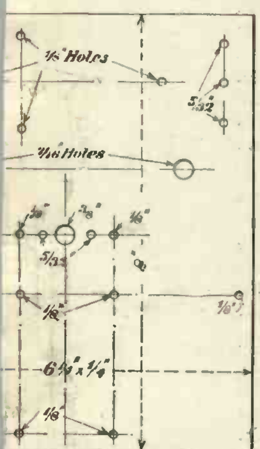


Fig. 2.—The back of the panel.

is not capable of dealing with the high voltages that may be encountered if several stages of note-magnification are employed.

Fig. 5 is a wiring diagram, from which the switching arrangements, etc., can be seen. An examination of the photographs Figs. 1 and 2 will show exactly how the telephone jacks controlling the various circuits are attached to the panel; while from Fig. 2 the general wiring arrangements will be obvious.



The panel markings.

It might be pointed out here that in low-frequency amplifiers it is very desirable that all connections should be soldered, as the slightest intermittency of contact produces greatly amplified scraping sounds in the telephones. The design of this instrument is of such a nature that all of the wires are accessible, and soldering may be very easily carried out.

The two small grid cells are arranged so as to give the grid the necessary negative potential with respect to the filament. The cells fix this at about $2\frac{1}{2}$ to 3 volts, and final adjustment can be carried out by means of the filament resistance itself. For this purpose the particular rheostat used is fitted with a vernier adjustment device, but it is frequently found that such critical regulation is not essential. Where the ordinary "R" type of valve is used it will often be found that the potential drop across the filament rheostat will ensure the grid working at a sufficiently negative voltage with respect to the filament to ensure satisfactory amplification.

For high anode voltages, however, it is necessary that the grid voltage be made more negative. If desired, two terminals might be fitted on the amplifier, to which any value of grid battery might be applied. This would be useful if it was intended to use the device as a power amplifier.

Fig. 4 illustrates how the brass brackets for holding the grid cells in place, and the small strips made from springy phosphor-bronze for attaching the particular type of valve used, are made. The method of mounting the telephone jacks on the panel will also be apparent from this illustration. No. 18 S.W.G. tinned copper wire will be found very convenient for wiring-up this amplifier, and, for safety's sake, it is advisable to enclose the leads in systoflex tubing. This may be obtained in various colours, so that the different circuits may be easily traced.

No further details of the construction are necessary, as with the aid of the photograph there should be no difficulty in assembling the complete instrument. If a QX valve is used (which has an amplification factor of about 12), the filament rheostat should be so adjusted that the total negative grid voltage is about 5. The applied anode voltage in order to get the maximum output from the valve when operating at this point should be about 120 to 150 volts. These values may be altered as necessary when other valves are employed.

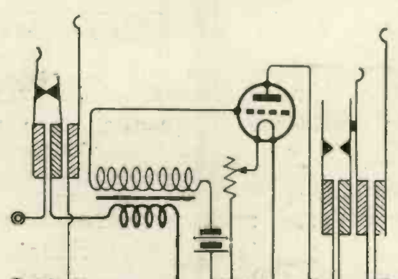


Fig. 5.—Wiring diagram.

Figs. 1 and 2 illustrate the complete amplifier, which might subsequently be enclosed in a wooden cabinet if desired, but is very convenient to operate as it stands. A simple note magnifier such as is here described is very useful, and should be in the possession of every experimenter. It may be noted that this instrument can be extended to several stages if desired, so that a large loud-speaker may be worked. The negative grid bias permits of great amplification without distortion even when three units are used with high values of anode voltage.

NOTES ON FADING

An interesting article telling the experiences of a northern experimenter with regard to the fading of signals.

SINCE the advent of Broadcasting, fading has become easier to observe and has increased in importance. These notes are written to indicate avenues to be explored rather than as an explanation of the phenomenon itself.

Fading may be divided into two general headings.

(*a*) Fading Proper.

(*b*) Fictitious Fading.

The first is obvious, the second has been so called for lack of a better name. At times a station appears to fade when in reality the wavelength has altered a few metres during transmission, or a hundred and one troubles have beset the receiver.

Near stations permit observations as well as those more distant. For instance, 5SC is 60 miles west of my aerial, and on the outside aerial signals appear constantly loud when using two H.F. valves. For fading tests I make use of a two-inch frame aerial (the tuning coil itself).

Using two H.F. valves speech is only just audible, and fading can be detected easily. One day a series of squalls with black clouds were approaching from the direction of Glasgow: as the squall approached signals weakened to inaudibility for a time about equal to the time taken for the squall to travel from Glasgow to Edinburgh. After the squall had passed signals increased to normal until another squall arrived. On the outside aerial no reduction was noticeable. The London station 2LO is a regular "fader," particularly about sunset. Using two H.F. valves fading occurs in cycles as follows :—

Time. Min.	Secs.	Sig. Strength.	
0	00	7	
0	15	6	
0	30	4	
0	45	3	
1	00	2	
1	15	1	
1	30	1	
1	45	0	Inaudible.
2	30	1	
2	45	2	
3	00	4	
3	15	6	
3	30	7	

These cycles occur at intervals of about five minutes, becoming more and more frequent until the sun sets and darkness comes. It will be noticed that signals weaken slower than they strengthen. After dark 2LO remains constant at about strength 8, unless there are thunderstorms in Yorkshire, in which case the fading cycles persist after dark.

Whilst 2LO is fading in this manner 2ZY is also very weak, 5IT almost inaudible, 5NO normal, and 5WA very weak. Thus it would appear that some intermittent obstruction exists along a line Yorkshire to N. Wales.

Eiffel telephony is fairly constant except when the French weather reports indicate hail or thunder over the north coast of France. At these times fading occurs in cycles that tend to become permanent throughout the transmission.

The Hague often affords a case of fictitious fading in that the wavelength wanders as much as five metres, otherwise these transmissions are fairly constant.

There appear to be particularly favourable days when amateur transmissions come in from all over the country, and those from the broadcasting stations are all steady and strong. These conditions generally occur with a fairly clear sky with perhaps high wispy clouds, after a day of soaking rain.

OUR QUESTIONNAIRE

We take this opportunity of thanking those of our readers who were good enough to forward their criticisms upon the form provided in our issue dated June 20th. Owing to the large number of replies received, it is impossible to acknowledge each individually. All criticisms received are being most carefully considered and, as a result of this experiment in co-operation, we hope to be able to effect certain improvements which will make "WIRELESS WEEKLY" more than ever *the journal par excellence* for the listener-in and the experimenter.

Constructional Notes

A THREE-SLIDER POTENTIOMETER.

THE set which is potentiometer-controlled is infinitely more pleasant to work with than that in which the various valves have to function as best they may with the potentials supplied to their grids from the low-tension leads to which they are connected directly. With the potentiometer one can adjust the potential until the valve is working upon the most suitable portion of its characteristic curve; one can also reduce any tendency to self-oscillation, together with the distortion and, possibly, radiation that accompany it, by moving the slider a little towards the positive end; but adjustment is so fine that one can avoid the heavy damping effect which occurs when the grid is connected either through an inductance, or by means of a leak, straight to the positive low-tension lead.

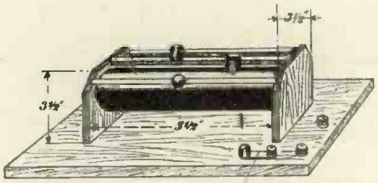


Fig. 1.—The three-slider potentiometer.

Many people use potentiometer control only for the first high-frequency amplifying valve. It is an advantage to use it for the others as well, and to apply it also to the low-frequency side of the set. But to fit up three separate potentiometers is not an attractive idea, for besides being rather costly instruments, they take up a certain amount of room on the already encumbered experimental table.

Actually, there is no need to use more than one potentiometer of special design. Besides eliminating the drawbacks mentioned this has the further advantage of using only one-third of the current needed by a trio.

A 300-ohm potentiometer passes 20 milliamperes when a 6-volt battery is in use. Even the 60 required by three may not seem much, but it all helps to run the battery down when the set is in use for long periods — and when one forgets to switch off!

This instrument is made on the lines of the ordinary tuning inductance provided with sliding contacts. It is the easiest thing in the world to make. Between two hard wood end-pieces 3½in. wide, 3½in. high, and shaped as shown in Fig. 1, is mounted a wooden roller (a piece of curtain pole will do) 2in. in diameter and 5½in. long. With the exception of half an inch at each end, which is left bare, the roller is wound full of No. 30 enamelled resistance wire, the winding being given a good coat of thick shellac as soon as it is in place. The two ends of the coil are taken to the terminals.

Three sliding contacts running on ¼in. square brass rods are now mounted as shown, a terminal being used to secure one end of each rod. Sliders and rods can be bought complete for less than a 1s. each from advertisers in this journal. Care must be taken to fit the rods so that the point of the slider presses firmly down on the wire throughout its travel. The enamel coating of the windings is scraped off so as to form a bare path about ¼in. wide for each slider. A small switch is fitted between one of the terminals and the end of the winding running to it so that when the set is not in

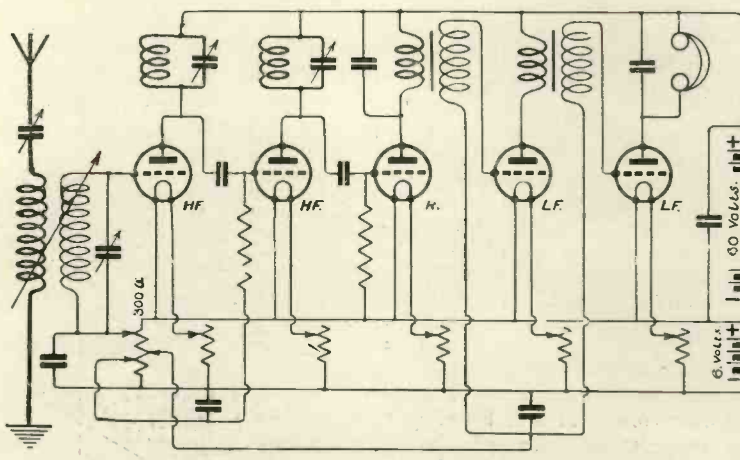


Fig. 2.—One method of using the three-slider potentiometer.

use the potentiometer will not be consuming current.

Fig. 2 shows one way of using the potentiometer for controlling a set consisting of 2 H.F. valves, a rectifier, and two note-magnifiers. Many other possible applications will occur to readers. R. W. H.

A SIMPLE FRAME AERIAL.

THE improvements embodied in this frame aerial are simplicity and low cost of construction, compactness, and ease in manipulation. The parts required

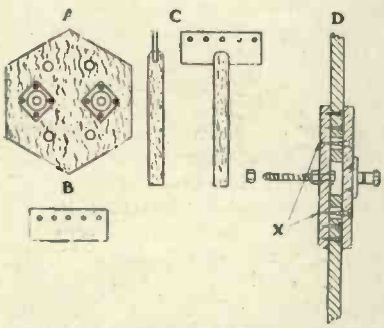


Fig. 3.—Parts required for constructing frame aerial.

to construct the frame are shown in Fig. 3. Two hexagonal hubs are cut out from a piece of $\frac{1}{2}$in. board, the diameter across the points being 8in. One of these is drilled through the centre to take a fairly long $\frac{3}{8}$in. Whitworth bolt, and the other, which is shown at A, is provided with two terminals suitably mounted on small pieces of sheet ebonite and drilled in the position shown to take four large wood screws or bolts which eventually secure one hub to the other.

The arms consist of 8in. lengths of $\frac{1}{2}$in. square section wood, slotted at one end to accommodate the spreaders B, which are cut from $\frac{1}{8}$in. sheet ebonite and drilled as shown to take the wire. These spreaders should be a "friction-tight" fit in the slots, and, if necessary, they should be secured by small bolts. The general arrangement is indicated at C.

Fig. 4 shows the position of the arms, each one being attached by means of screws or nails to the back hub in the manner indicated in the sectional diagram D (Fig. 3), so that the distance between the extreme ends of each pair of opposite arms is 20in. The front hub containing the terminals is screwed to the back hub by four wood screws, thus enclosing the lower ends of the arms between them. These screws are shown at X, Fig. 3. Fairly long bolts may be used for this purpose if it is not possible to obtain screws of the correct length. A small distance piece, comprising a short length of round wooden rod about $1\frac{1}{4}$in. in diameter by 3in. long, is drilled and slipped over the bolt attached to the back hub, and the frame is then fitted, as shown in Figs. 4 and 6, to a length of round wooden curtain rod about $1\frac{1}{2}$in. in diameter, the lower end of which is dropped into a 10in. or 12in. length of brass tubing secured to the upper end of another length of wooden curtain rod attached in any suitable manner to a supporting base as shown in Fig. 5. A side or end view of the completed instrument is given in Fig. 6.

A convenient manipulating device is provided by attaching a piece of round wooden rod to the movable pillar. The length of either pillar is optional, but the length of the brass tubular socket should not be less than 10in., otherwise the frame will not balance correctly. If desired, the pillar may be in one piece, integral with the base, in which

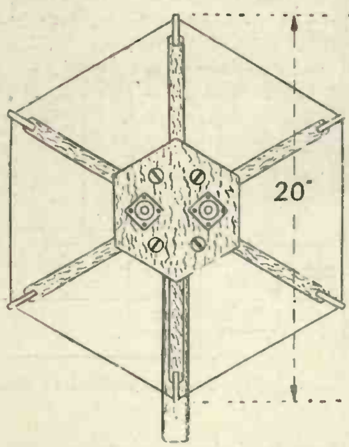


Fig. 4.—Illustrating the position of the arms.

case it would be convenient to provide four small castors under the base, preferably those having porcelain wheels. It will be seen that the instrument may be easily detached at any time.

The wire used for the winding may consist of ordinary lighting

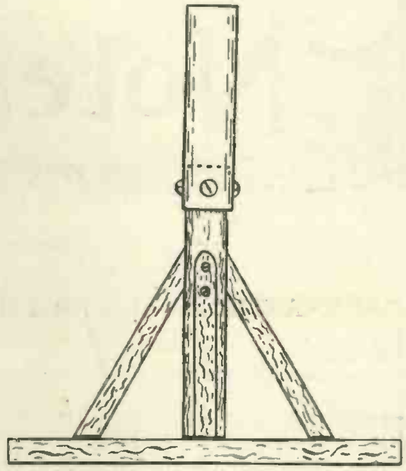


Fig. 5.—The supporting base.

flex with the outer insulation removed, or single 18 or 20 bare or cotton-covered wire, ten complete turns being sufficient for the broadcasting wavelengths. Tuning is accomplished by means of a 0.001 μF variable condenser connected in

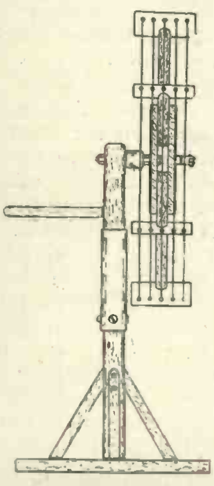


Fig. 6.—The complete frame aerial.

shunt with the winding. For longer wavelengths the arms should be made longer, and many interesting experiments may be carried out with different kinds of wire and various amounts of winding. Figures which should serve as a useful guide in such experiments were given in No. 9 of WIRELESS WEEKLY. O. J. R.

A FLASH-LAMP CIRCUIT TESTER.

THE flash-lamp circuit tester is one of the most useful gadgets that the wireless man can add to his outfit, for when obscure troubles occur, as they are bound to do in any set, it enables circuits to be tried out quickly, and so narrows down the search. It is an easy thing to put together, and the total cost need not exceed eighteenpence.

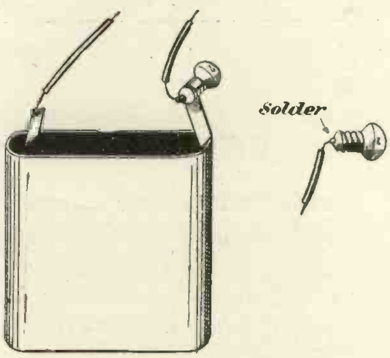


Fig. 7.—The completed tester.

The only materials required are a flash-lamp bulb, a battery, which should be of good quality, otherwise it may become rapidly useless, even if it is not often used; a small piece of ebonite, a pair of valve pins, and a couple of feet of thin "flex" wire.

The brass body of the bulb is first secured (see Fig. 7) to the long strip of the battery by means of solder, the strip being bent round as shown in order to make a firmer joint between the two. Next a foot-long piece of flex is soldered to the other contact at the end of the lamp's stem. This may be rather a tricky job owing to the smallness of the metal knob, but if one chooses a lamp with a fairly large contact matters become easier. The ends of the strands of the flex should first be twisted together and tinned. If this is done, a touch with a small soldering-iron will effect a satisfactory connection. The second length of flex is soldered to the short strip of the battery. The tester may be used in this form simply by baring the free ends of the flex and using them for making contact; but if a little more time can be spared, it is advisable to make up special contact pins, which will be found a great advantage. Fig. 8 shows how they are constructed.

Each has a little block of 1/4in. ebonite shaped as shown in the drawing. In this are drilled two 4B.A. tapping holes spaced 7/8in. apart. One of these is tapped to take the shank of a valve-prong, the other is left untouched. A third hole, through which the bared end of the flex is passed, is drilled right through the block from top to bottom.

The valve pin is now screwed in, the flex, sandwiched between two flat washers, being securely connected to it by means of a nut.

The great point about these end pieces is that they make a short circuit impossible when the tester is left lying about on the bench. The two are simply plugged into each other, and all is safe.

Many uses for the flash-lamp tester will suggest themselves at once. It can be employed to try out any circuit except those which contain resistances of so high an order that the current passed is in any case insufficient to heat the filament of the bulb. It is also most useful for testing the continuity of coil windings.

When the wiring of a panel has been completed, the tester may be

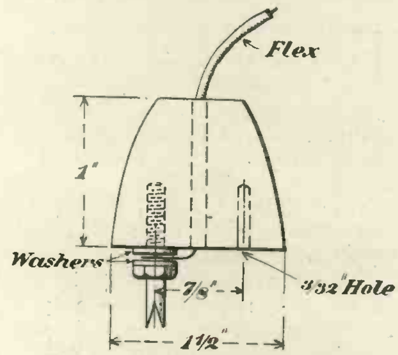


Fig. 8.—Details for contact pin.

used with great advantage to see that nothing is wrong with the battery connections. Plug its pins into the filament legs of the valve holder. If a mistake has been made—and it is easy to do so in an absent-minded moment—it is better to sacrifice a sixpenny flash-lamp bulb than a fifteen-shilling valve. R. W. H.

SLIDING CONTACTS.

TO test inductances provided with sliding contacts, connect one plug of the flash-lamp tester to a terminal of the inductance to which one end of the windings run, and the other to the terminal wired to the slider. Move the slider slowly up and down. The light should increase or diminish with absolute regularity as the slider is moved. Any flickering or failure of the light altogether at certain points will indicate faulty contact. R. W. H.

AN H.T. BATTERY BOX.

THERE are two decided advantages to be gained from housing the high-tension battery in a neat box provided with a selector switch. In the first place the switch, if properly fixed up, makes the connections more positive than in the case when wander-plugs, often rather wobbly in their fit, are used. Secondly, the battery is protected from the dust and moisture, and, to some extent, from the effects of heat.

The box to be described was designed to act as a container for a high-tension unit made up of flash-lamp batteries connected in the way described in these pages a few weeks ago, save that no sockets are soldered to their long strips. Eighteen of these provide a battery capable of giving plate potentials up to 81 volts, which should be ample for all ordinary purposes. They are arranged in the box in two parallel rows, each of which contains nine. The bottom of the box is covered with a layer of paraffin wax; strips of waxed cardboard are inserted between individual batteries and between the rows to ensure that they are properly insulated from one another. The *inside* dimensions of the box are, length 8in., width $5\frac{1}{2}$in., depth $4\frac{1}{2}$in. It may be made of any kind of wood; $\frac{3}{8}$in. oak, sandpapered smooth and well oiled, is perhaps as good as any.

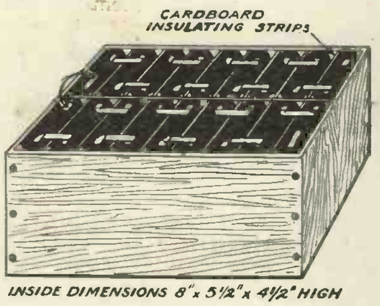


Fig. 9.—The H.T. battery in box with lid removed.

Fig. 10 shows the appearance of the top, which is of ebonite $\frac{1}{4}$in. in thickness The selector switch has ten "live" studs, giving $4\frac{1}{2}$ volt steps from $40\frac{1}{2}$ to 81 volts, and one "dead" stud, which serves as a cut-out when the battery is not in use. A 1μF Mansbridge type fixed condenser (not shown in the drawings) is mounted on the underside of the panels, and connected across the terminals.

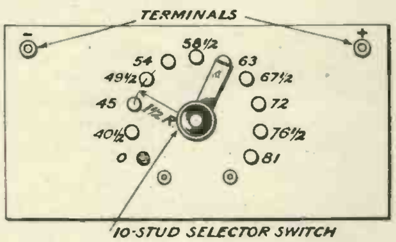


Fig. 10.—The top of the box.

The selector switch arm, with a radius of $1\frac{1}{2}$in., can be bought complete for eighteen pence or so from advertisers in this journal, so that it is hardly worth while to make it up. The studs should be of the smallest size.

It is very important that they should be so spaced that the arm cannot make contact with two at once, otherwise it will short-circuit each battery in turn as it is moved round. The holes for the studs (4B.A. clearance) are, therefore, drilled $\frac{3}{8}$in, apart round the circumference of a $1\frac{1}{2}$in. radius circle. This is all very well so far as it goes, but if we left such gaps between the studs the action of the switch would be very jerky, since the arm would spring down into them and have to be forced up on to the studs.

We can get over this difficulty in either of two ways. One is to place a dead stud between each pair of live ones (Fig. 11), drilling double the number of holes and making their centres $\frac{5}{16}$in. apart. The other is to cut out a circle (Fig. 12) of $\frac{1}{4}$in. ebonite and to countersink the heads of the studs into it until they are flush with the surface.

The wiring should be done with flex, for one is thus able to lift off the top of the box when necessary. The positive (short) strip of the first battery is connected to the + terminal, the other terminal being wired to the pivot of the switch. From the long strip of the ninth battery a lead runs to the first live stud; the tenth battery is connected to the second stud, and so on until the eighteenth is wired to the tenth stud. All connections should be soldered.

Batteries should be tested from time to time with the voltmeter; if any of them shows less than $3\frac{3}{4}$

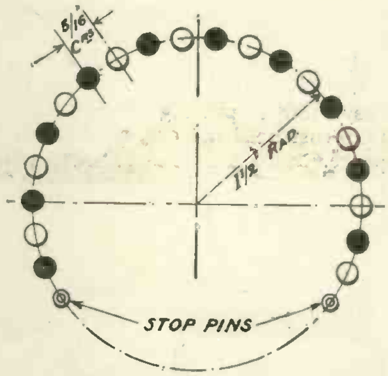


Fig. 11.—Suggested method for fitting studs.

volts it should be removed and replaced. The fact that this can be done with ease is one of the chief advantages of a H.T. unit made up and housed in this way.

R. W. H.

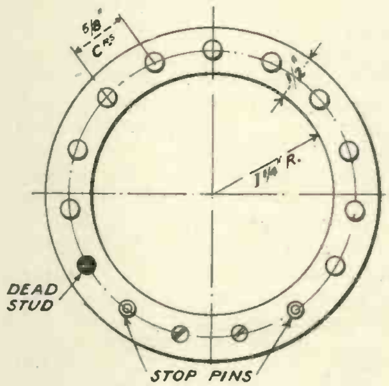


Fig. 12.—An alternative method.

A QUICKLY ADJUSTED EXTENDING BRIDGE CONNECTION.

IN many wireless sets adjustable bridge connections are used, especially in linking up unit panels. An extending connection of this type is of great use for these sets, and also for the experimenter who desires to make rapid connections between two points any reasonable distance apart.

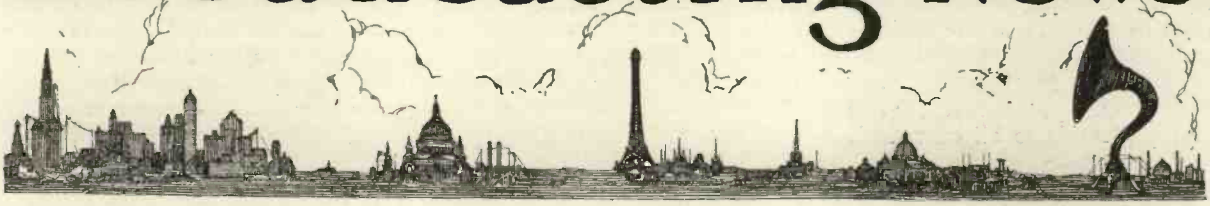
A simple and effective connection of this type can easily be made by attaching a spring under the heads of two wander plugs. The spring is made of any desired length from bare copper wire of about No. 20 S.W.G. The easiest way of forming this latter is to wind the wire round a pencil. The plugs are inserted into the terminals where the desired connection is to be made. This device can be adapted to other types of terminals by attaching spade tags to each end of the spring. In using several of these connections it may be found that a slight alteration in tuning is necessary, due to the addition of a small amount of inductance to the circuit.

H. B.

INSULATION OF PANELS.

IF apparatus is made up on wood or ebonite of poor quality, short circuits over the surface of the panels may occur. To test the quality of the insulation connect the H.T. battery leads to two of the terminals, attaching a 'phone lead also to one of them. Touch various parts of the panel with the other 'phone lead. If any clicks are heard the insulation is faulty R. H. W.

Broadcasting News



BY OUR SPECIAL CORRESPONDENTS

LONDON.—There is still no very exciting news regarding any of the broadcasting problems about which controversy was raised. It seems as if everyone was waiting for everyone else. That being so, it is rather encouraging to find that so well known a musical publisher as Mr. Broadhurst, the Managing Director of Enoch's, Ltd., has come out quite decisively on the side of the B.B.C.

* * *

Mr. Broadhurst has business interests in America, and he has just returned from a visit there, during which he made a special point of investigating American broadcasting conditions for himself. He finds that the B.B.C. has nothing to learn from America, so far as the provision of programmes is concerned. There is no one in America to prevent any artiste broadcasting, and it is an astonishing fact that artistes who are debarred from doing so in this country have been allowed to broadcast in America.

* * *

Mr. Broadhurst sees no reason why an arrangement cannot be come to in this country which would meet the interests of all parties concerned, and, coming from a music publisher of his standing, such a pronouncement is distinctly hopeful. We trust that it will be the beginning of a movement which will result in an amicable settlement being achieved at an early date.

* * *

And so Sunday afternoon programmes have come to stay. It will be difficult to suit all tastes with this Sunday programme, but it may be taken for granted that it will not be of the excessively melancholy order. There will probably be a good deal of orchestral music, and an organ may be introduced later.

* * *

Now that the British National Opera season is finished, Mr. Percy Pitt will be able to get around amongst the provincial broadcasting stations to form groups of singers who will act as choruses in operatic performances and as glee parties. It is also intended to have a number of leading artistes who will tour the country as stars in operatic performances.

* * *

General Sir Robert Baden-Powell, the Chief Scout, who has just returned from Canada with Lady Baden-Powell, will talk to the Boy Scouts of Great Britain from the London Station on Thursday evening, July 19th.

* * *

Mr. Frank Hodges is unable to broadcast to-night at 9 p.m. owing to another engagement. He has been offered Tuesday, July 31st, at 9 p.m. instead. The Labour leaders seem quite keen on broadcasting, and some of the speeches delivered by them have been exceedingly good. Of course, the ten minutes which is generally allotted is rather brief for the spreading of the full oratorical sail, but it is a wholesome discipline in the elimination of non-essentials. It wouldn't be a bad idea if all political speakers were limited to ten minutes on most occasions.

* * *

BIRMINGHAM.—5IT was received recently under somewhat remarkable circumstances. A motorist with a valve set installed in his car fixed an aerial in the heart of a large forest near Stafford, where a party of Boy Scouts were camped. The aerial was suspended from the branch of a tree, the earth wire was fastened to a tin can which was thrown into an adjacent brook, and the filament current for the valves was obtained from the car batteries.

* * *

The whole of the evening concert was heard so loudly that it could be enjoyed at a distance of over a hundred yards. The presence of so many trees close to the aerial, and the distance from Birmingham—approximately fifty miles—made this success particularly gratifying.

* * *

It would be interesting to know which broadcasting station has been received at the greatest distance. Birmingham has been received frequently in Massachusetts, a distance roughly of 3,000 miles, and the station director has carefully verified the reports, so that there was no doubt as to the accuracy of the reception. The station has been heard in Canada, too.

* * *

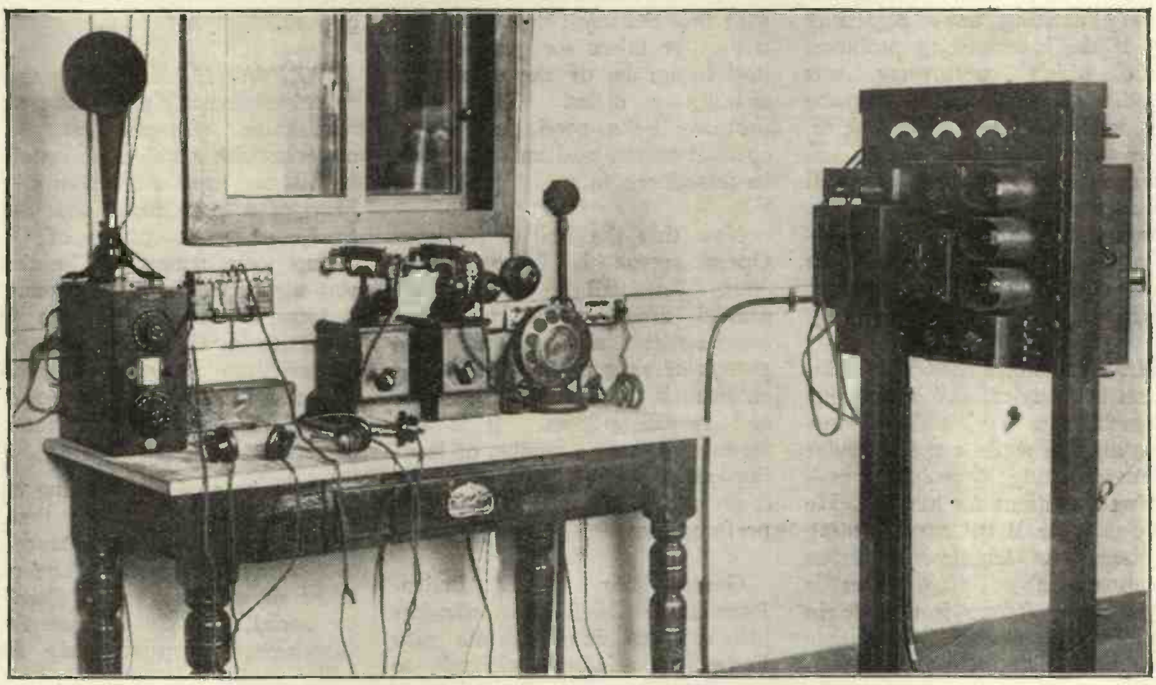
The broadcasting of a speech by the Prince of Wales evoked many letters of appreciation here. The clerical staff has counted them—no fewer than 700! Telegrams and telephone calls make a total of about a thousand messages of congratulation. It is impossible for a broadcasting station to do good by stealth, and the staff have perhaps become so inured that they do not blush to "find it fame." Still, such appreciation must be highly pleasing to all concerned.

* * *

CARDIFF. — Broadcasting at the Cardiff Station was delayed for half an hour on a recent occasion by an outbreak of fire in the Electrical Apparatus Room. A tube leading into the amplifier became ignited, but though it was necessary to seek the assistance of the Fire Brigade the damage done was very slight, and the programme was carried through as per usual.

* * *

Listeners-in were recently asked by the director of the Cardiff Broadcasting Station (Major Corbett-Smith) to send in suggestions for a more appropriate mode of address than the old and hackneyed term "Hello" when the station issues its preliminary call before the opening of the programme. An award of a guinea was offered for the best. The competition attracted a large number of suggestions, among them being "Hello, Radio Everybody," "Ethonians," or "My Ether Friends," "Radios," "Etherians," and "Radiophils." The prize was, however, awarded this week-end to Mr. J. W. Aspinall Gransden, Parabolo Road, Cheltenham, who suggested "Comradios." To Mr. Cecil Smith, of Earle Farm, Compton, Somerset, who sent in the same suggestion a few days later, a consolation prize has been awarded.



The control room at the Glasgow Station.

* * *

GLASGOW.—Another wireless concert was given on board the "Queen Alexandra" during her evening cruise to Kilchattan Bay on Thursday. The reception from the Glasgow Station was highly successful.

* * *

During the Golf Open Championship meeting at Troon a wireless demonstration was given in a large marquee on the course, with an inside aerial running along the tent poles about 10ft. high. An Ethophone V., with powerful amplifier, was used to operate five loud-speakers, and the results attained were excellent. It was observed that when the canvas of the marquee was wet with rain, the strength of the signals diminished.

* * *

MANCHESTER. — The two Shakespearean recitals we have heard from 2ZY, though rather on the morbid side, came through remarkably well; the fact that we did not miss the acting speaks volumes for the elocution and the choice of scenes.

* * *

One has got quite used to hearing of companies and societies who are fighting the B.B.C. over one thing or another, but we have yet to hear of the society that is grateful. The photographers ought to be among these latter, for there must be a veritable boom in their industry; what with all the photos that Uncle Humpty-Dumpty and Broadcast Bertha have sent out, not to mention the numerous children who have sent their wireless relatives a photo.

AN INTERESTING THREE-ELECTRODE VALVE

By W. J. JONES, B.Sc., A.M.I.E.E.

Readers who have not yet tried these valves will be interested in the following technical details.

THE advent of broadcasting has given a great incentive to the production of new wireless apparatus, but until recently little modification has taken place in the construction of valves for wireless reception.

Very early in the evolution of the thermionic valve it was realised that quite a lot of the extraneous noise could be attributed to the valve itself, particularly when the set was operating under conditions where slight mechanical vibrations were present. Moreover, the ordinary methods of assembly are such as to give a frail formation to the grid and filament. Very slight shock distorts the grid, and when glowing the filament has the disadvantage of sagging, and thus the characteristics of the valve vary during its life. It was with full consciousness of these difficulties that the Cossor valve was designed, and the construction of the finished valve is of such a robust character that these troubles are mitigated.

The filament of the Cossor valve is parabolic in shape and is electrically welded in a very secure manner to the filament leads. There is therefore no possibility of a partial connection, with its attendant troubles. The length of filament is automatically measured so as to ensure uniformity of manufacture. It will be apparent from an inspection of the shape of the filament (see Fig. 1) that any tendency to sag due to the high temperature at which the filament is run is completely resisted by its geometrical contour. This effectively ensures constant results being obtained throughout the whole life of the valve.

The grid (see Fig. 2) also possesses definite and valuable features. It will be seen that its contour follows that of the filament, but unlike most other makes the grid is constructed from a substantially-made metal band. The winding itself is carried out on a former, each turn being secured on either side of the metal band and by a lashing wire on the periphery. In other words, each turn is secured in three places. This is a great advance, for the ordinary spiral grid is only fastened in one place per turn, and the slightest vibration produces movement of the grid wiring and accounts in large measure for microphonic noises.

The Cossor valve possesses a rigid and well designed grid with each turn well anchored, obviating displacement and the resultant "valve noises." The grid extends well below the filament and anode, ensuring that the whole emission of electrons from the filament is effectively under the control of the grid, particularly that portion emitted from the ends of the filament. This feature is entirely novel.

The anode is hood-shaped, and almost completely shrouds the grid (see Fig. 3). The general disposition of the electrodes enables the valve to operate at a high efficiency, since it permits the total emission from the filament to be usefully employed and avoids the accumulation of electrostatic charges on the glass bulb, the discharge of which gives rise to parasitic noises.

All the electrodes and component parts are accurately assembled in manufacture to enable the bulk production to be uniform throughout, and the sturdiness of the design reduces the chance of breakage in transit to a minimum. Moreover, the shape of the anode effectively screens the luminous radiation of the filament from the direct line of vision, avoiding thereby injurious glare.

Electrical Characteristics

It will be obvious from the foregoing that the electrical characteristics are very uniform, and constant throughout life. The method of assembly ensures accurate disposition of the electrodes. Figures 5 and 6 show the characteristic curves for a P.1 valve, taken from an actual valve. It will be noted that very ample grid control is afforded and that the amplification factor is 6.6 to 1.

An important feature to notice is the very high grid voltage required to produce saturation. This property makes the valve of peculiar advantage for use with loud-speakers, where comparatively large currents are utilised. This is because a large range is obtained on the straight part of the curve where there is direct proportionality between plate current and grid volts. This obviously means that the valve does not limit the amplification at certain amplitudes, so that faithful reproduction is ensured, and the speech or music is obtained free from valve distortion.

The P.1 valve is essentially designed, however, for general use, such as detecting, and low-frequency amplification, and can replace the "R" valve for all purposes. It is usually found best to operate with an anode voltage 20-80, although 30 gives excellent results, and at zero grid volts.

The current consumption at 4 volts is 0.70 to 0.75 amperes. When the valve is used as a detector a grid voltage of -1 to -2 is usually required in order to procure optimum effects. This,, however, is entirely dependent upon the design of the actual receiving set in which it is being used.

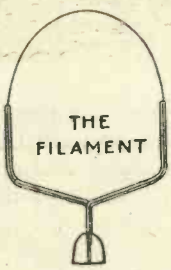


Fig. 1.

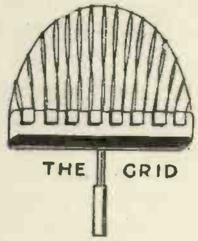


Fig. 2.

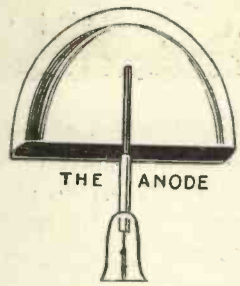


Fig. 3.

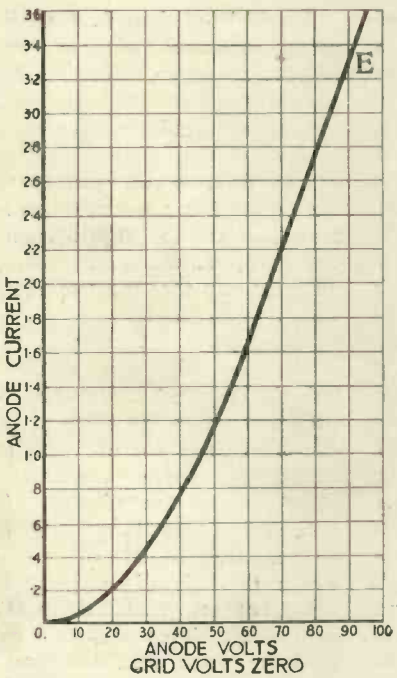


Fig. 5.—Showing the characteristic curve for a P.1 valve.

Fig. 4.—The Cossor P.1 valve.

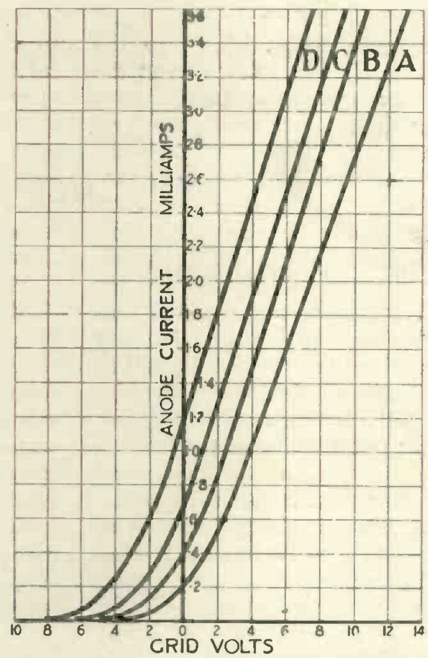


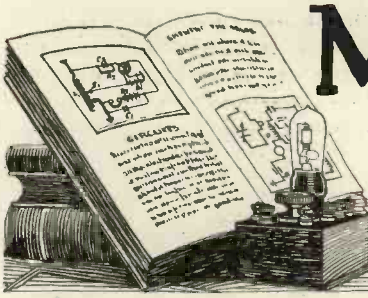
Fig. 6.—Curves illustrating the effects of various anode voltages with 4 volts on the filament. A, 20 volts; B, 30 volts; C, 40 volts; D, 50 volts.

The P.2 Valve (with Red Top)

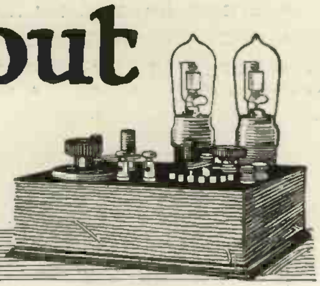
A more recent innovation is the P.2 valve, which can be readily distinguished by its "red top." In construction it is similar to the P.1 valve, but the dimensions of the electrodes are slightly different in order to modify its electrical characteristics. This valve is intended to be used as a special detecting valve, and for high-frequency amplification, and reports from users have fully borne out its usefulness in practice.

Its amplification factor is considerably higher than that of the P.1, so also is its impedance. It retains the property of high saturation point, and should therefore be of especial value to all experimenters. The amplification factor is 11, and the filament current at 4 volts is 0.70 to 0.75 amperes.

Good results, however, are usually obtained with about 3.5 volts or a little more on the filament.



Mainly about Valves



An Unusual Method of Applying Reaction

A FORM of reaction which, while not new, has rarely been used, is illustrated in Fig. 1. It will be seen that an additional inductance coil L_2 is included in the grid circuit of the valve and that the reaction coil L_3 is coupled to this inductance L_2. It will be seen, moreover, that this inductance L_2 is really outside the main oscillation circuit. Nevertheless, as the inductance L_2 is in the grid circuit of the valve, a reaction effect may be obtained by coupling L_3 the right way round to L_2. It will be found that the variation of the reaction will not produce very much variation in the tuning of the grid circuit.

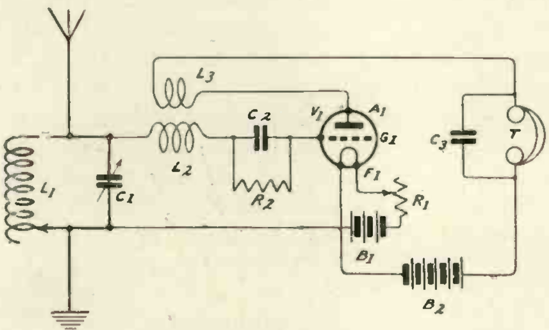


Fig. 1.—An uncommon method of reaction.

Fig. 2 shows how the method may be adapted to a tuned anode receiver. It will be seen that the additional inductance L_3 is included in the grid circuit of the second valve, while the reaction coil L_4 in the anode circuit of this valve is coupled to it.

Whenever this extra coil is included in a circuit, its best value should be found by experiment.

An Emergency Gridleak.

It may happen that no proper gridleak is at hand. It will be found that by simply taking a bit of cotton-covered wire and connecting a bared end to the grid and by twisting the other end to the positive lead to the filament terminal, a fairly good substitute is obtained. The end fixed to the filament lead is not bared, the leakage through the cotton covering the wire, however, usually being sufficient. If the insulation is too good, try moistening the cotton covering slightly with the finger. By twisting the two wires tightly or loosely together a resistance of suitable value may be obtained. This, of course, is only a temporary expedient.

Inductance Coils.

I have recently been carrying out some tests with the concert coils supplied by Burndept, Ltd. These coils are of the plug-in type, and they work exceedingly well. There are four coils, S1, S2, S3 and S4, the S4 size being about equivalent to a No. 50 honeycomb coil. Speaking of these latter, I have always thought that three coils, viz., 25, 35 and 50, are not sufficient to cover the broadcasting wavelength.

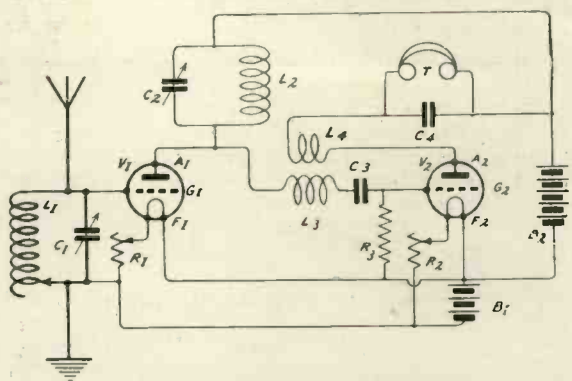


Fig. 2.—The same method of reaction applied to a high-frequency valve.

The S1, S2, S3 and S4 coils are quite adequate for all short wave experimental work, and may be used for work up to 600 metres. Two sets of these coils will prove a good investment to any experimenter.

Terminal Bushes

Another thing that I have wanted to see on the market is an ebonite bush suitable for terminals to be put in wood. Why should not some manufacturer place on the market 4B.A. Army type terminals with bushes, suitable for wood panels of from $\frac{3}{8}$in thick? Fig. 3 shows what I mean. On the left we have the two bushes, one on top of the wooden panel and the other on the bottom. It will be seen that the bushes are separated by an air space, and the size of this, of course, would depend upon the thickness of the wooden panel. I would suggest that the depth of ebonite below the surface of the wood be $\frac{1}{16}$in. or possibly $\frac{1}{8}$in., but not more.

It will be seen that the nut N clamps the whole together. On the right are shown two identical bushes of the same size which would be used.

A fitting of this kind would be invaluable to those who cannot work ebonite, or do not care to use it. These bushes would not only be useful for insulating terminals, but could also be used for mounting crystal detectors, fixed condensers, gridleaks and other pieces

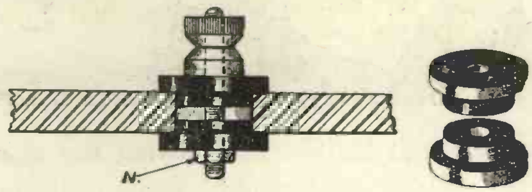


Fig. 3.—Ebonite bushes for insulating terminals fitted to wood panels.

of apparatus on to wooden panels. I would suggest having two diameters for the holes running through them. One size would be sufficient to clear a 4B.A. threaded rod, and the other to take a 2B.A. rod. It is quite possible that these are already made, but wireless people generally do not seem to have them brought to their notice.

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We would like you to consider the advantages obtained by placing your subscription for "Wireless Weekly" direct with us.

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Secondly.—Your copy of *Wireless Weekly* will be posted direct to your address, and can be upon your breakfast-table regularly each Wednesday morning. Thus, should you be indisposed and decide not to proceed to business, *Wireless Weekly* is to hand just when the relaxation which it affords is most needed. The particular advantage of this in inclement weather is obvious.

Thirdly.—As special evidence of our desire to give real service to those who support us by becoming regular subscribers, the services of our Information Department will be available *free of charge*. The fee of One Shilling per question, which comes into force with this present issue, will not apply to subscribers, who will merely require to quote their subscription number and enclose a stamped addressed envelope, when replies will be sent promptly by post.

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Apparatus we have tested

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

A High-frequency Amplifying Unit with Reaction

WE have had an opportunity of submitting to practical test a high-frequency reactance unit, incorporating reaction, made by Messrs. Radio Instruments, Ltd.

We understand that this unit is produced in two forms: for panel mounting and as a separate finished panel with terminals. The latter was the pattern tested.

This unit is designed for a range of wavelengths (when used in the ordinary way for reactance-capacity intervalve coupling) from 200 to 4,000 metres, with a 0.0001 μF parallel condenser, a five-point switch being provided. The tuning is fairly flat, particularly on the long waves. Variable reaction is provided over the whole range by means of a pivoted coil.

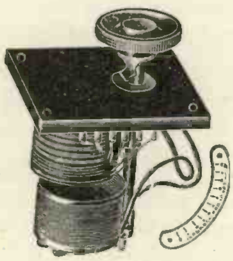
Tested upon a good suburban aerial, two valves being used with this H.F. unit between the first (amplifying) and the detector valve, ship-stations came in very noisily. Amateurs were also heard with good intensity, and one well-known London amateur at moderate loud-speaker strength.

The breadth of tuning proved quite convenient for following both sides of a conversation. On broadcasting—for which, it will be remembered, this form of reaction is allowed by the P.M.G.—the local station was uncomfortably loud; while in the silent interval of 2LO, Birmingham could be tuned in at very pleasant strength for several headphones.

The variable reaction was found convenient to adjust; the instrument in general shows a high degree of mechanical perfection and finish, and thoughtful design.

An Insulating Varnish

We have had an opportunity of testing an insulating shellac varnish prepared for wireless purposes by Messrs. M.T. Polishes, Ltd. This is a thick varnish, which on trial was found to dry fairly quickly, giving a hard, glossy surface when applied to smooth objects. The odour was much less objectionable than that of some varnishes made up with crude methylated spirit.



The H.F. Reactance Unit.

The insulating properties on test proved excellent, a very thin film sufficing for complete insulation for all ordinary purposes. It is very suitable for general use in practical radio construction.

A Combined Filament Resistance and Switch

Messrs. Electro Devices have submitted for test a switch, for panel mounting, which combines the duties of filament-controlling resistance and switch for cutting out one valve and its transformer in a multi-stage amplifier. The device is named the "Filafone" (provisionally protected), and is operated by one knob, but differs from the conventional type in having, in addition to the usual spiral resistance, a rotary switch mounted on the same spindle which performs the operation of disconnecting the plate of the preceding valve from the intervalve transformer, and connecting it direct to the output terminal, when the filament current has been switched right off. It will be seen that this device may effect a considerable simplification in the design and operation of a multi-valve receiver.

On practical trial, after the switch-blade had been slightly adjusted to give good contact on the spiral, the filament-control was smooth and silent, the "off" and "full-on" positions being marked by a positive stop; the rotary switch also being effective and making good steady contact.

The installation of the switch would require some careful work for an amateur constructor, as the terminal screws for the latter switch are necessarily very close together and small. The absence of a separate terminal screw for the end of the filament resistance was noted.

The makers suggest that the device can also be used for cutting out high-frequency valves at will; and give a circuit diagram for this purpose, both for transformer and reactance-capacity coupling. The not inconsiderable capacities across this little switch would have to be taken into account in such a case.

WE regret that our features "A Progressive Unit System" and "Questions and Answers on the Valve" are unavoidably held over, but will undoubtedly appear in our next issue.

Electrons, Electric Waves, and Wireless Telephony. J. A. Fleming. (Wireless Press, Ltd., 12, Henrietta Street, W.C. 320 pp. Price 7s. 6d.)

This volume is an amplified reproduction of the Christmas lectures delivered at the Royal Institution, December, 1921. On that occasion the interest in the subject of the lectures was so great that the theatre of the Royal Institution was insufficiently spacious to accommodate all those who desired to attend. The story of the invention and development of the thermionic valve is one of the fairy tales of science, and brings the student into contact with some of the most interesting problems of physics. The name of the author is a sufficient guarantee of the accuracy of the contents, and the book is written in a most interesting style. It includes chapters upon wave-motion, with many interesting practical illustrations; atmospheric waves with applications to the gramophone, the auxetophone, and the stentorphone; the architecture of the atom, with a discussion of the discharge of electricity through rarefied gases and the many interesting phenomena attending the same; electromagnetic fields, forces, and radiation, including radioactivity; the quantum theory and the theory of relativity; the production and detection of long electric waves; telephone and speech transmission; telephone receivers; the principles of wireless telephony; and a large amount of general information on wireless valves. The book is in no way constructional, nor has it any special reference to wireless, but it is essentially a popular account of a considerable range of electrical subjects which cannot fail to prove very interesting reading to anyone interested in wireless.

The Practical Electrician's Pocket Book, 1923. (S. Rentell & Co., Ltd. Price 3s. net.)

This is the twenty-fifth annual issue of this red-coated manual, and the Editor appears to have celebrated the quarter-century by making the book, if possible, more valuable than ever to its numerous readers. Various sections have been carefully re-written, and more special wiring systems have been added. The most recent developments in electric welding are treated by an expert, and an entirely new chapter has been added on Wireless Broadcasting. Absolute reliability is essential in any work which gains a place in the City and Guilds list of "Works of Reference," as has been done by this hardy annual, and the publishers aim at maintaining that reputation to the best of their ability. The book is compact and well printed, and covers a very wide ground in a concise and practical way which should ensure it a continued sale throughout the electrical profession.

Wireless Telephones. J. Erskine-Murray. (C. Lockwood & Son, London. Cr. 8vo. Pp. iv.-84. Price 4s. 6d. net.)

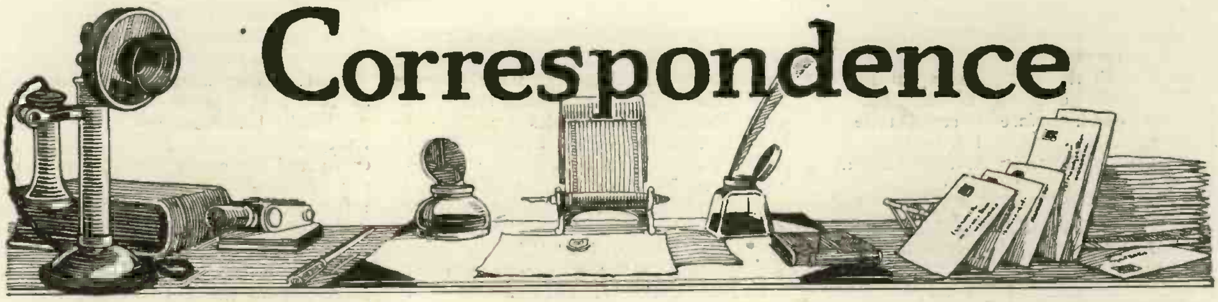
The author is very well known in the wireless world and is a past President of the Wireless Society of London, as well as author of numerous wireless textbooks. The present volume is an excellent little treatise on acoustics, the conversion of sound energy into electrical energy, wireless transmission, the production of alternating currents of high-frequency, the radiation and reception of wireless waves, and the well-known detecting and amplifying devices. It includes also a historical survey of the subject and a chapter of speculations as to future developments of the art of wireless telephony. It is a great achievement for the author to have covered such a large field in the available space and to have done so in such an interesting and accurate manner. The book is well illustrated and should prove very interesting reading to wireless experimenters.

A Beginner in Wireless. E. Alexander. (Drane's, London. Cr 8vo. Pp. 196. Price 3s. 6d. net.)

This volume is the outcome of an attempt on the part of the author to provide a simple explanation of the main phenomena of wireless communication together with some constructional details as to the apparatus and appliances involved. It must be admitted that the author has succeeded well, for the book comprises a complete survey of wireless apparatus and gives a very full account of the purposes and functions of the various parts. The book is very well illustrated with line sketches, which alone would be almost sufficient to enable the intelligent experimenter to construct apparatus for himself. In addition, however, in many of the chapters actual constructional drawings are included, and a considerable number of photographic representations of standard pieces of apparatus are given. A historical outline of the development of wireless and also a history of the development of the valve are included, as well as information on the question of obtaining licences, erecting aerial, etc., etc. Altogether we are very favourably impressed with the book and recommend it strongly.

J. H. T. R.

Correspondence



COIL-HOLDER ON BASE

To the Editor, *Wireless Weekly*.

Sir,—Referring to your article on page 576 in Vol. 1, No. 9, *Wireless Weekly* dated June 6th, under "Mainly about Valves," you mention the fact that a component which would be exceedingly useful would be a single coil-holder on a base (which could stand up) to take honeycomb coils and others, and which no manufacturer has attempted to produce. We beg to say that we have manufactured the identical article, for the past five weeks.

We are sending you two samples for your examination, and, if tested, will be found to be the very article which is required.

We might add that we tested these components and can testify to their value and efficiency in tuned-anode circuits and for other purposes such as described in *Modern Wireless* on page 269 of May issue.

Although we have previously only supplied the wholesale trade, we have decided to place it before the readers of *Modern Wireless* and *Wireless Weekly* at a price within the reach of all.

We are, etc.,
Leigh Bros.

1A, Prospect Terrace,
Gray's Inn Road,
London, W.C.1.

[These holders are similar to the kind advocated. The samples are being subjected to insulation tests, etc.—Ed.]

SPARK INTERFERENCE

To the Editor, *Wireless Weekly*.

Sir,—I notice, with some slight amusement (in your article "Broadcast Reception and Spark Interference," in No. 9 issue of *Wireless Weekly*), the statement that "this interference is particularly bad, etc." I think that the wireless amateur in this part of the country may claim to be suffering from the greatest hardships of any, for the following reasons:—

(1) Our nearest Broadcasting Station is Cardiff, which is screened so badly that it is inaudible on 5 valves (2 H.F., D., 2 L.F.) on six nights out of seven, and *when* received is only very poor.

(2) Land's End Station (GLD) is only 11 miles away and is very difficult to eliminate.

(3) Lizard D.F. Station (BVY) fox-trots on his key on 450 metres W.L. spark and spoils any music we are fortunate to receive. Also Ushant D.F. (FFU) causes almost similar interference.

(4) Many French trawlers fitted with wireless, work on 300 metres W.L. spark, and their sole occupation appears to be repeated "Bonsoirs" to each other. These are totally impossible to tune out.

(5) Plymouth now being dropped from the broadcast scheme, our nearest stations are London and Birmingham (distance approximately 250 miles), which necessitates a very expensive set.

(6) Natural screening very bad—presumably owing to amount of metal contained in ground.

(7) We are situated at a converging point for inward and outward bound merchant vessels, thus increasing the babel of spark stations.

I think you will grant that we are in a most unenviable position, and dealers down here who have had the initiative to lay in stock against the opening of Plymouth Station may as well shut up shop, as only a 4 or 5 valve set is any use at all, even *after dark*, and this limits the buying public tremendously.

Hoping you will see your way clear to air our point of view a little.

I am, etc.,
Cecil H. Wilkinson.

Cornwall.

MYSTERIOUS!

To the Editor, *Wireless Weekly*.

Sir,—While staying recently at a small farm about seventeen miles inland from Brighton I tried wireless reception on a small crystal set consisting of a variometer, built according to instructions contained in No. 1 *Modern Wireless*, with Hertzite for detector. The 'phones were Brown's best. The result was to me astonishing. Although so far from London, 2LO was strong and 2OM loud enough to hear well. Spark reception was, of course, excellent and an annoyance during broadcast hours.

The great astonishment, however, was the reception of the Newcastle Station, 5NO. For some mystic reason I was able to tune in that station after dark whether London was working or not, but could not receive any other of the provincial stations. The strength of the signals was, of course, weak, yet clear, and no great effort was required to hear them. Is there any reason for such exceptional reception?

As it may be of interest to other experimenters, I may say that the aerial was of full length and good height and was located on a ridge between East Grinstead and Haywards Heath.

Wishing your very excellent weekly and its companion, *Modern Wireless*, every success.

I am, etc.,
W. H. Darby.

Finsbury Park, N.4.

ST100

To the Editor, *Wireless Weekly*.

Sir,—As an experimenter of twelve years' experience, may I congratulate you on your famed dual amplification circuit ST100. The success of the arrangement depends largely on the low-frequency transformers, as you mentioned in *Modern Wireless*.

At present I am using two Wainwright transformers, and the following results may interest your readers: Cardiff, Birmingham, and Manchester can all be heard on a 10-foot indoor aerial, whilst on a good outdoor arrangement all the B.B.C. stations can be found and heard, even the North British stations—with patience.

I am, etc.,
Somerset. A. A. Turney.

THE "FLEWELLING" CIRCUIT

To the Editor, *Wireless Weekly*.

Sir,—With reference to the "Flewelling" circuit published by you some weeks ago. It may interest your readers to know that the results I have had are astounding. Using a D.E.R. valve, R.I. 0.0005 μF variable condenser and Igranic 35 and 50 coils, with a Ducon plug at this address I can go the round of *all* the B.B.C. stations. Cardiff comes in the faintest, Glasgow very strong. I was amazed to get further than Manchester or Birmingham, which, of course, come in very strong. I should like to hear of other readers' experiences with this set. A steel plate earthed, to counteract body capacity, appears to be essential, as is also a vernier condenser. I used no earth with the set. I also got Levallois faintly one night late, but he closed down before I could tune in strongly. I am, etc.,

CAPT. R. A. GROSVENOR.

Chester.

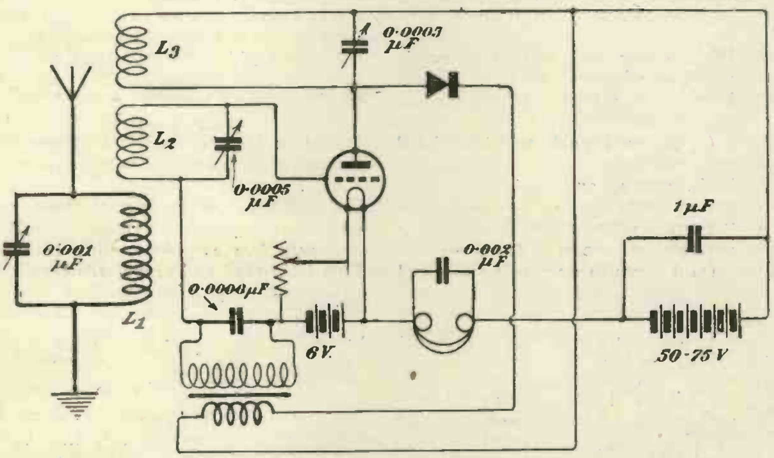
DUAL AMPLIFICATION

TO THE EDITOR, *Wireless Weekly*.

SIR,—I have been experimenting for some time past on "Dual Amplification" circuits, and have to acknowledge the many suggestions contained in *Modern Wireless*, No. 2, page 88, Fig. 4. A circuit is given by Mr. John Scott-Taggart, which was stated not to have been fully tried out. This circuit, which may be made to do wonderful things, is, I am aware, the basis of the ST100 circuit. I find, however, that a few modifications are required in order to render the circuit mentioned above stable when used without additional note-magnification.

In the first place, it is advisable to omit C4. The size of C3 is controlled by the type of transformer used. In many cases it is responsible for a considerable amount of instability. This appears to be the case when good transformers are used. I find the Igranic and Radio Instruments transformers are better without any condenser, but that equally good results can be obtained by careful selection of a suitable value for this condenser. An inductively coupled tuner is a vast improvement, and in this case the set is wonderfully selective. Efficient rectification is imperative. I use "Talite" and a fine (36 S.W.G.) gold wire, a combination which is both stable and sensitive.

I give herewith a sketch of the circuit as giving the best results. I prefer to place the 'phones as shown, since this appears to give marked stability.



A modified arrangement of the circuit appearing in "Modern Wireless" No. 2, page 88, Fig. 4.
L_1 50 turns, duolateral; L_2 35 turns, duolateral; L_3 75 turns, duolateral.

With a very poor aerial and earth system 2LO is deafeningly loud with 120 ohm 'phones in the plate circuit and no telephone transformer. On a really good aerial Glasgow, Birmingham, Cardiff come in strongly, as well as most of the London amateurs. Newcastle and Manchester are, for some reason, difficult to get.

I am, etc.,

F. G. FRANCIS, B.Sc., A.I.C.

London, N.16.

INTERFERENCE

TO THE EDITOR, *Wireless Weekly*.

SIR,—*Apropos* of one of your Manchester correspondent's remarks, Is it any use asking amateurs to keep silent until *all* broadcasting has stopped? Last Tuesday night 2ZY having closed down and the opera from Covent Garden was coming through very badly, I tuned in the School of Posts, which came through splendidly, but about 10.45 "a horde of shrieking, yelling demons descended on the music and proceeded to make the night hideous with their noise." I was compelled to follow your correspondent's example and close down. I am sure that all mere listeners-in like myself would be grateful if experimenters would remember that other stations are broadcasting when 2ZY has closed down, and would therefore be good enough not to begin their operations until after 11 p.m., or, as an alternative, use a wavelength which will not seriously interfere with the B.B.C. and School of Posts and Telegraphs programmes.

I am, etc.,

Heywood. (REV.) H. BRIERLEY.

SPARK INTERFERENCE

TO THE EDITOR, *Wireless Weekly*.

SIR,—Allow me to endorse fully the remarks of your "News of the Week" contributor *re* the above. As an old marine operator I think I am qualified to judge. At the present time the condition of the ether on the North East Coast is a disgrace to the operating fraternity. The principal offenders are (*a*) our coast stations—unnecessary repetition of messages, including navigation warnings; (*b*) foreign ships—testing, i.e., sitting on key five miles off the coast; sending half a T.R. and then the remainder in bits as prompted by coast stations, "QRF," etc.; and also bad telegraphy, resulting in wholesale repetition. British ships are remarkably good, but it is high time a move was made in the other two cases to enforce strictly the International Regulations. In these days a man thumping out on 3kw. ten miles out may be jamming thousands of assorted listeners-in and experimenters.

I am, etc.,

Northumberland. CARBORUNDUM.

AN IMPROVED ST100 CIRCUIT

(Continued from page 748.)

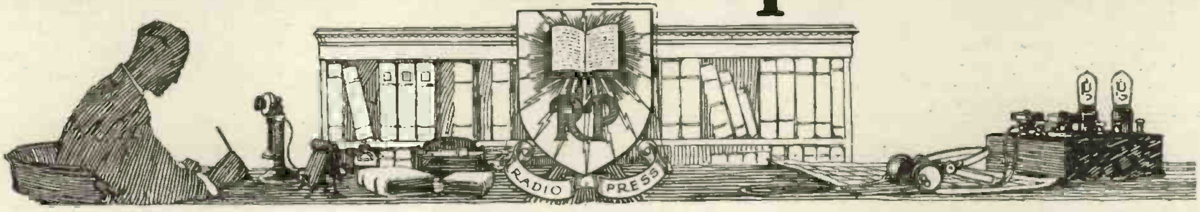
tube $3\frac{1}{2}$in. in diameter and tapped at every ten turns. The inductance L_2 may be a tube 3in. in diameter wound with 100 turns of No. 26 gauge D.C.C. wire and tapped at 50, 60, 70, 80, 90 and 100 turns.

It is, however, desirable to use fixed, interchangeable coils for the inductances L_1 and L_2, and Burndept concert coils will be found ideal for this purpose. These concert coils are made in four sizes, S_1, S_2, S_3 and S_4. The inductance L_2 will be an S_4 coil, while L_1 will usually be an S_3 or S_4.

Operational Notes

When working this receiver, the reaction coil L_2 should, to commence with, be well away from L_1, and the various condensers adjusted until the loudest results are obtained. The crystal detector is also adjusted to give the most sensitive results. It is always best to weaken the signals in some way, such as by detuning, while adjusting the detector. The value of the battery B_3 is important, and should be adjusted so that both loud and clear speech is obtained. The reaction coil L_2 may now be brought close to L_1 and the condensers C_1 and C_2 readjusted.

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.

From this date, all queries will be replied to by post, as promptly as possible, providing the following conditions are complied with.

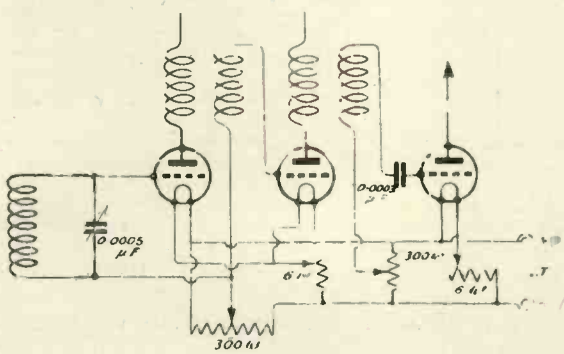
1. A Postal Order to the value of 1s. for each question must be enclosed, together with the Coupon from the current issue, and a stamped addressed envelope.

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.

T. F. E. (PLUMSTEAD) asks (1) Whether the condenser in the aerial circuit of an inductively coupled tuner controls the wavelength range which the instrument is capable of receiving. (2) If there is any definite ratio between 4 particular coils. (3) Whether the potentiometer for controlling the grids of the high-frequency valves should be connected to them alone, or whether this connection should also include the detector valve.



(1) The aerial circuit condenser is there for the purpose of controlling the wavelength of the receiver. (2) There is no definite ratio between the sizes of the coils you mention; it is more a matter of experiment than anything else. (3) The potentiometer should control the high-frequency valves alone, but under certain circumstances an additional potentiometer is useful to control the grid of the rectifying valve. See Fig. above.

H. J. C. (EPSOM) has built a three-valve set, from which he does not obtain satisfactory results. He submits full particulars of it, and asks our opinion

In the first place your aerial circuit condenser is rather small. This should be, when used in series, of a value not lower than 0·001 μF. In the second place your low-tension battery should be 6 volts, otherwise the rheostats will cause too big a drop to allow the valve to work satisfactorily. We think your 26 turn coil is too small for Broadcasting, and suggest a 50 turn coil. Unless your aerial is very good, you cannot expect to receive all the British Broadcasting Company's Stations. Regarding your question about the Eureka wire, without knowing for what purpose you propose to use it, we cannot tell you how to employ it.

A. E. (ASHFORD) refers to the variometer described in No. 1 of "MODERN WIRELESS," and wishes to know the correct value of a gridleak and condenser suitable for this instrument.

The particular make of leak and condenser you mention is very suitable, and the leak should hav. a value of 2 megohms, the condenser 0·0003 μF. No other condenser or leak is necessary.

J. W. L. (SOUTHEND-ON-SEA) sends us a diagram of a circuit he proposes to use, and asks whether it is a good one.

Your projected arrangement is quite suitable for the purpose you mention

C. J. E. (W.C.1) has constructed a Neutrodyne circuit as described in "WIRELESS WEEKLY," but experiences some trouble with it. He asks our advice.

We suspect the small tubular condensers. These do not appear to have a sufficiently large capacity, and if you make them a little larger so that they are readily variable, you will probably obtain more satisfactory results. The windings of your transformer appear to be quite correct.

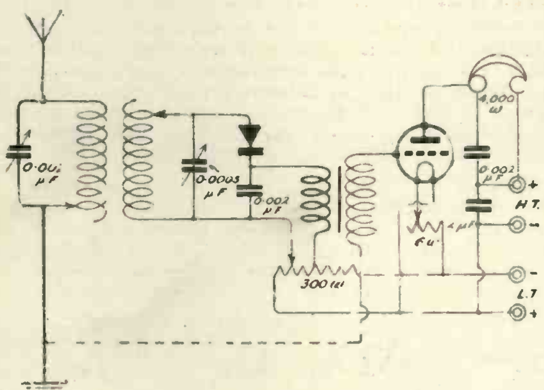
W. T. E. (LISTOWEL) refers to the telephone transformer shown on page 69 of "MODERN WIRELESS," No. 1, and asks how much wire is necessary to wind this.

For the secondary winding, about $1\frac{3}{4}$ ounces of No. 28 s.w.g. wire will be required, and for the primary winding about 2½ ounces of No. 44 s.w.g. copper wire.

D. H. R. (ILKLEY) submits a circuit diagram of his proposed transmitter, and asks (1) Whether it is correct. (2) What range might be expected using certain apparatus in his possession; and (3) Why with a spark transmitter he cannot obtain a pure note like certain Coast Stations.

(1 and 2) We do not like your circuit. You should try circuit No. ST60 "Practical Wireless Valve Circuits," Radio Press, Limited, and under the circumstances you might expect a range of 10 to 20 miles. (3) The reason you cannot obtain a pure note is because these stations you mention use a spark system in which the spark note is twice that of the frequency of the alternator, which is normally high. The pitch of the note of your spark transmitter is determined by the speed at which the make and break vibrates, and, therefore, you could not expect more than 80 per second with very careful adjustment. The note does not become musical until the frequency becomes at least 300 per second

J. M. H. (W.8) proposes to add a valve amplifier to a crystal set as shown on page 286 of "MODERN WIRELESS," No. 4. He asks (1) What value the condensers C1 and C2, Fig. 8, should be.



Coil L_1 might have 35 turns of No. 20 s.w.g. wire wound on a 3in. tube. Coil L_2 should have 50 turns of similar wire. The value of C1 might be 0.0015 μF and C2 0.002 μF. High resistance telephones may, of course, be used in place of a telephone transformer, as shown above.

F. W. C. has a quantity of No. 26 s.w.g. Eureka wire, and wishes to know what size of former will be necessary to make a potentiometer of about 300 ohms resistance with this wire.

You will require a former 2in. square and very nearly 2ft. long to obtain this resistance. It would be much more satisfactory if you were to purchase a small quantity of No. 40 s.w.g. Eureka wire and wind it in the conventional manner.

L. H. (BRISTOL) submits a diagram of his circuit, and asks whether certain alterations he proposes would raise the efficiency of the set.

You will not serve any useful purpose by fitting a potentiometer to this apparatus. Referring to the suggestion for a counterpoise earth, this should be as nearly directly under the aerial as possible.

G. H. (RAVENSCOURT PARK) sends us a circuit diagram of a dual amplification arrangement he proposes to try, and asks our opinion.

The circuit you suggest is quite suitable, but will probably need a certain amount of experimental work before it can be made to give thoroughly practical results. It should be very sensitive.

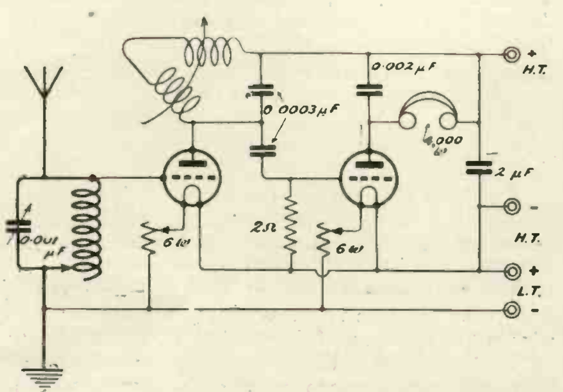
H. L. P. (WIMBLEDON) asks particulars for a choke for regulating alternating current supply for a transformer in his possession.

A suitable choke coil might consist of a well-insulated brass tube 12 inches long and 1 inch internal diameter, on which should be wound 4 pounds of No. 18 s.w.g. double cotton covered wire. A sliding iron wire core which will just conveniently fit inside the tube should be used to regulate the flow of current. Such a choke does not consume or waste any current.

H. J. M. (CORNWALL) asks questions about the construction of a low-frequency and high-frequency amplifier which he has in mind, and also asks our advice on certain points regarding operation.

We do not think it requires much ingenuity to assemble a 2-valve low-frequency amplifier from 2 separate low-frequency units. The article by Mr. Redpath in No. 3 of *Wireless Weekly*, will show you exactly how to do this. With regard to your question about high-frequency amplification, the unit you mention is very suitable as it stands. With regard to the whistling noise you mention, this indicates that you are using reaction, otherwise you would not be able to hear the carrier wave. This is not permitted, and we cannot give you advice which will assist in contravening the regulations.

C. J. N. (WEST HAMPSTEAD, N.W.6) submits a diagram of a circuit he has been trying, not, however, with very much success. He asks whether we could give him a diagram which would produce good results, and also what range might be expected for telephony with this set.



We give you herewith a suitable circuit diagram. The range you might expect from this set would be in the neighbourhood of 50 to 80 miles.

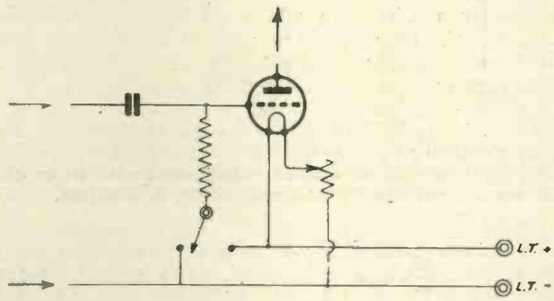
L. W. (LEVEN) is constructing the progressive unit system described in "WIRELESS WEEKLY," and wishes to know if with this apparatus he would succeed in hearing 5SC, from which he is 54 miles distant.

Under favourable conditions, and if you have a good aerial, you should have no difficulty in hearing the Glasgow Broadcasting Station with this set.

A. W. (DALMUIR) has a 3-valve set with which he uses a certain make of telephones, and says that he is experiencing trouble, which he puts down to these telephones. He asks whether we can help him at all.

We do not think it at all likely that your telephones are the cause of the trouble, especially as you mention the symptoms. It is much more probable that your high tension battery is at fault, and you should test this with a voltmeter.

F. W. (BIRMINGHAM) submits a circuit diagram of his apparatus, which is designed as a non-radiating circuit, but apparently causes oscillation in the aerial circuit. He asks how this could be stopped.



Your reaction coil appears to be much too large. The coupling with the anode coil should be just sufficient to raise signal strength to the maximum, and no more. Instead of connecting your gridleak as shown, one end of it should be attached to the positive filament leg. This will still further decrease any tendency to oscillate.

E. M. B. (PORTOBELLO) proposes to make up the 2-valve Broadcast receiver described in No. 4 "WIRELESS WEEKLY," and wishes to know (1) what range this instrument would have and (2) what would be the cost of such an instrument.

(1) Several factors determine the probable range of this set, but with a good aerial from 80 to 100 miles might be expected. (2) We cannot give you any definite figures, but sets of parts can be obtained from advertisers in *Wireless Weekly*.

B. A. B. (CAMBRIDGE) asks how to apply for an experimental transmitting licence.

"Wireless Licences and How to Obtain Them," Radio Press, Limited, will give you the fullest possible particulars.

G. T. (MANCHESTER) has a quantity of No. 36 gauge d.s.c. wire in his possession, and wishes to know whether with this he could wind 2 low-frequency intervalve transformers. He also asks questions about a certain pattern of valve.

No. 36 s.w.g. wire is rather heavy for the secondary winding of such transformers, but 4,000 turns of this might be used for the primary winding of each transformer and 11,000 turns of 40 s.w.g. wire for the secondary winding. The valve you mention is suitable for low-frequency amplification.

D. R. (SOUTH WALES) has a 4-valve receiver which appears to consume a great deal of electricity. He asks how long his 50 ampere-hour accumulator should last, and whether there is anything the matter with his apparatus.

The effective life of the accumulator is determined by the type of valves in use, but average valves consume about $\frac{3}{4}$ of an ampere each, and therefore your battery would last about 16 hours if it were in good condition

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Wireless Weekly

and The Wireless Constructor

No. 14

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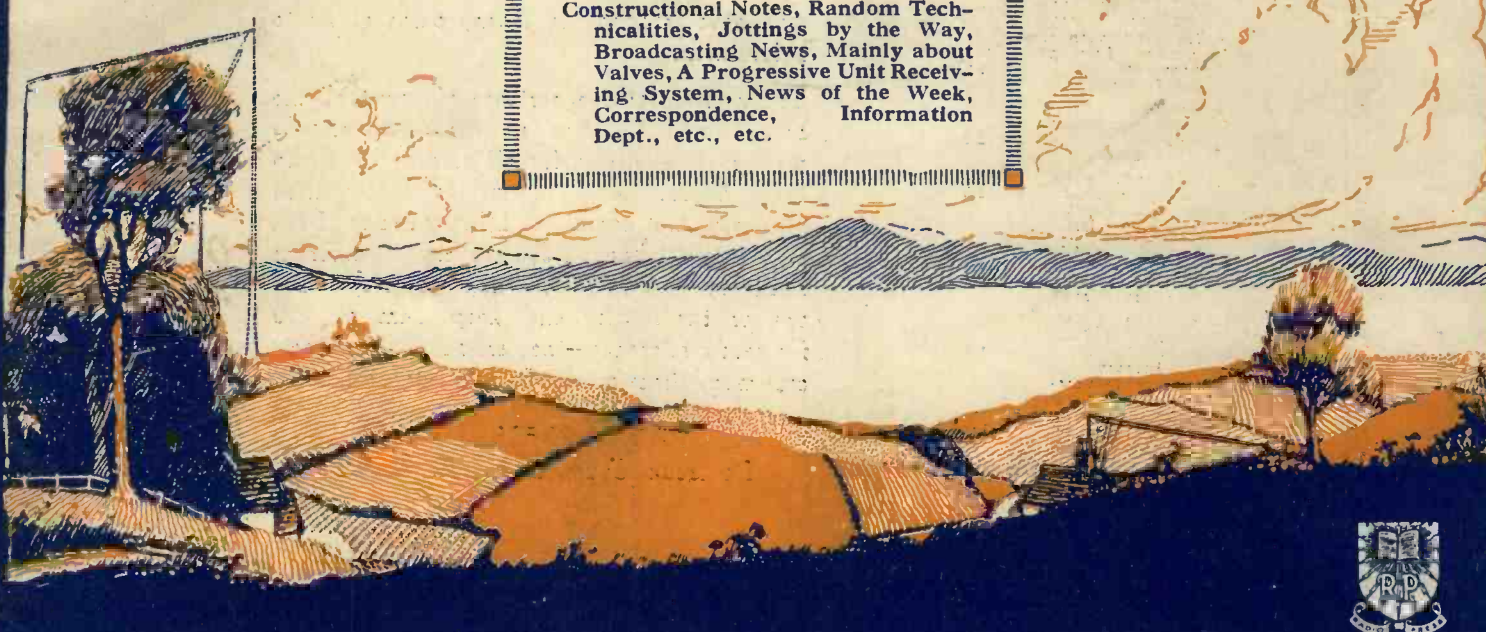

The Flame Microphone.—By Dr. De Forest.

Wireless Weekly

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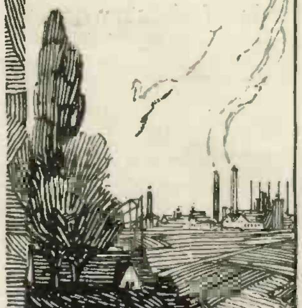

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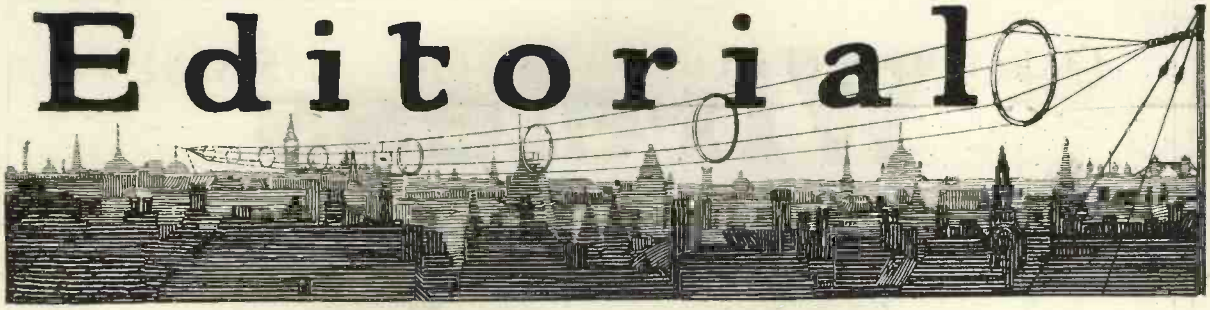
Editorial



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.

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.

The never open door.

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.

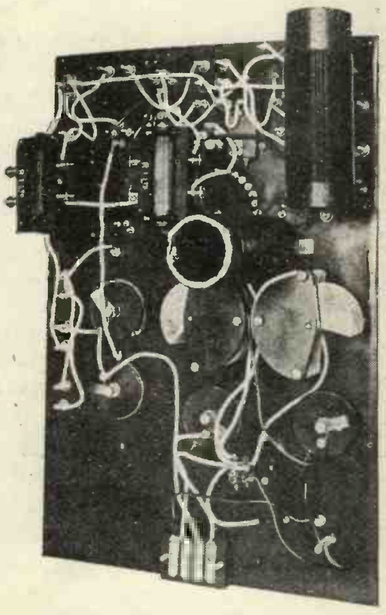


Fig. 1.—Rear view of amplifier panel, showing wiring.

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.

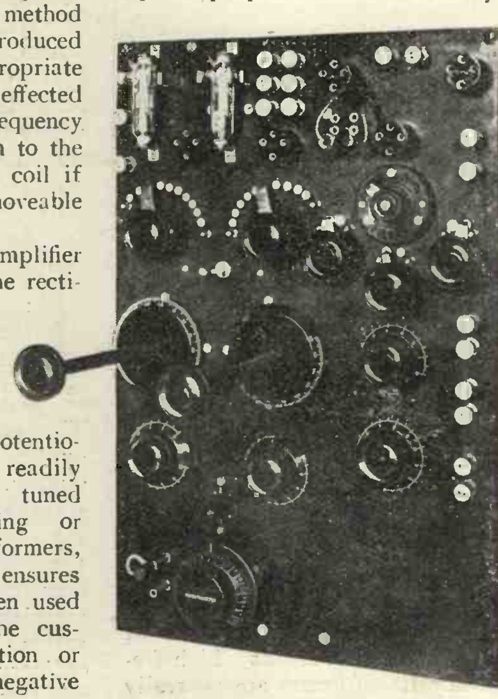


Fig. 2.—The complete instrument.

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

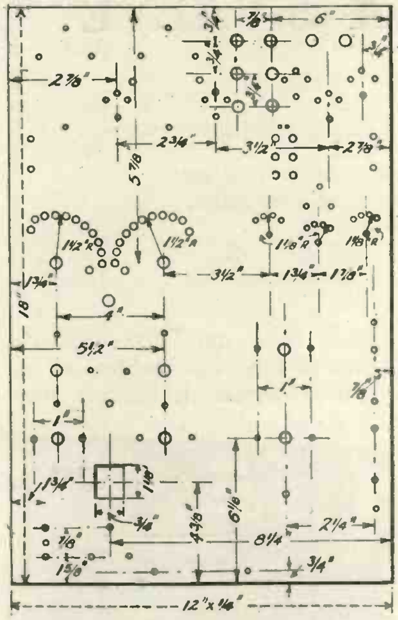


Fig. 3.—Drilling plan of panel.

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 ⅜in. Whitworth.
1 2 B.A. Clearing.
1 4 B.A. Clearing.
1 6 B.A. Clearing.

The ebonite panel, 12in. by 18in. by ¼in. 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, 6½in. long by 1¾in. external diameter, and one piece of cardboard tube 1½in. long by 1½in. 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.

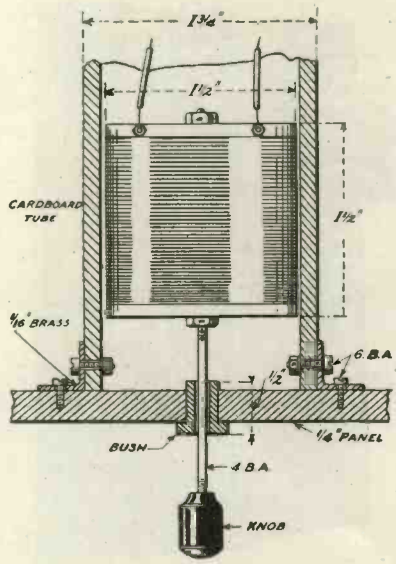


Fig. 4.—Illustrating the sliding reaction coil.

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

About $\frac{1}{4}$ of a pound of No. 26 s.w.g. enamelled copper wire will also be required, together with about $\frac{1}{2}$ a pound of No. 18 s.w.g. tinned copper wire with appropriate Systoflex tubing for wiring up.

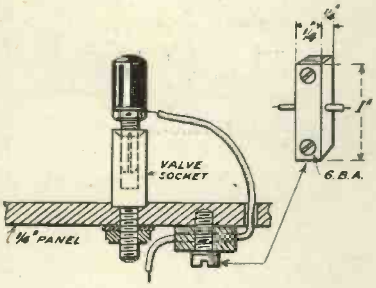


Fig. 5.—Selector plug and socket.

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 $6\frac{1}{2}$ in. in length by $1\frac{3}{4}$ 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 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.

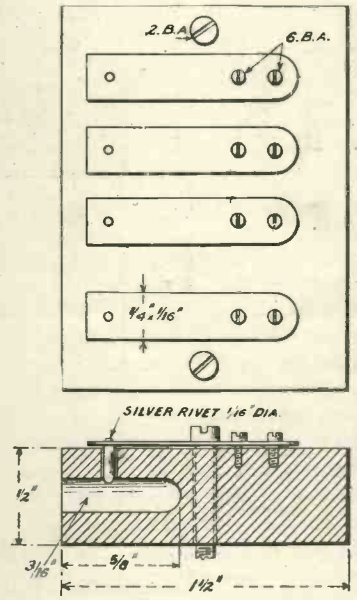
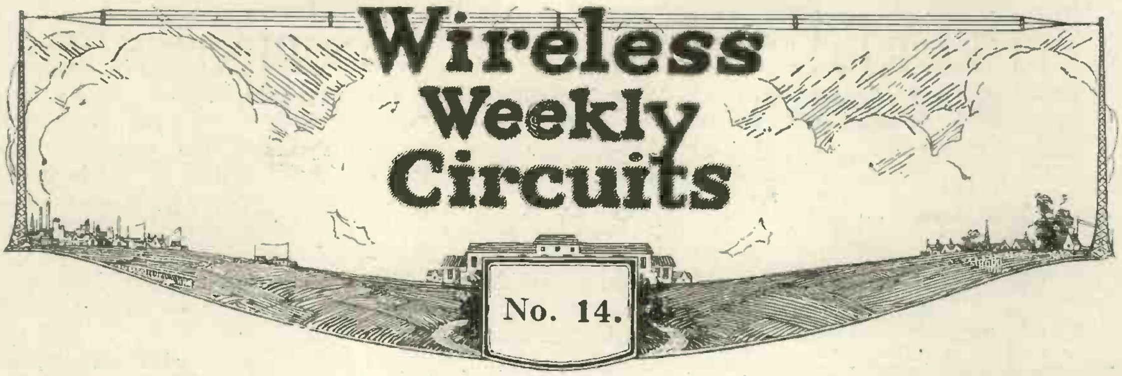


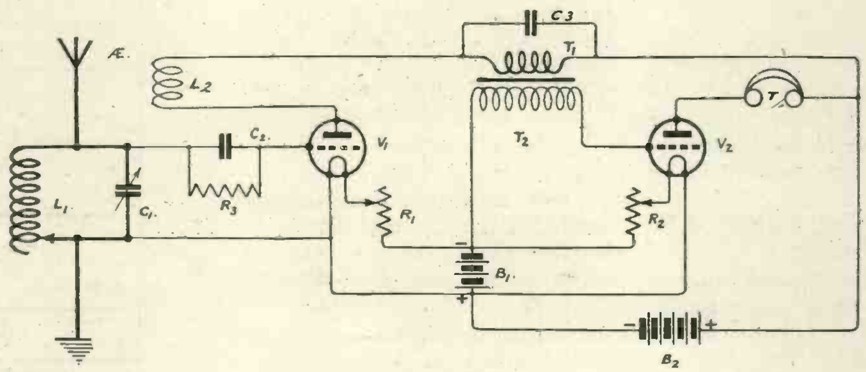
Fig. 6.—Plug block for H.T. and L.T. connections.

(*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."



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.

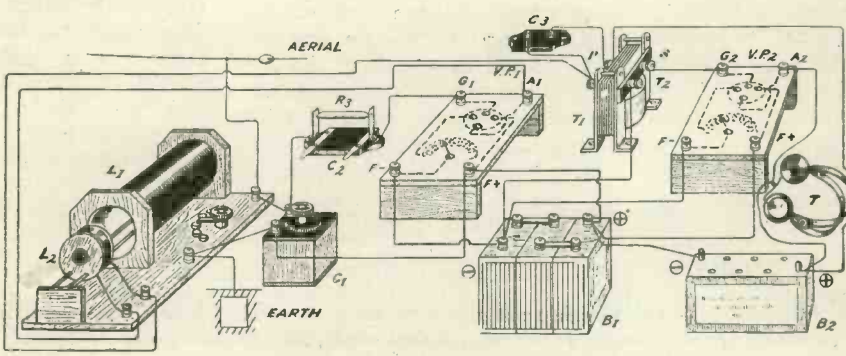
This circuit is a reaction circuit which may not be used for the reception of British broadcasting, but is useful for other reception. By coupling L_2 sufficiently tightly to L_1, the first valve may be caused to oscillate, when continuous waves may be received.

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 electro magnetic 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 electromechanical 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 recharged, 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.

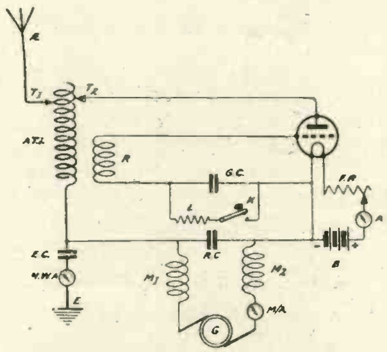


Fig. 1.—Circuit diagram of typical CW transmitter.

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.

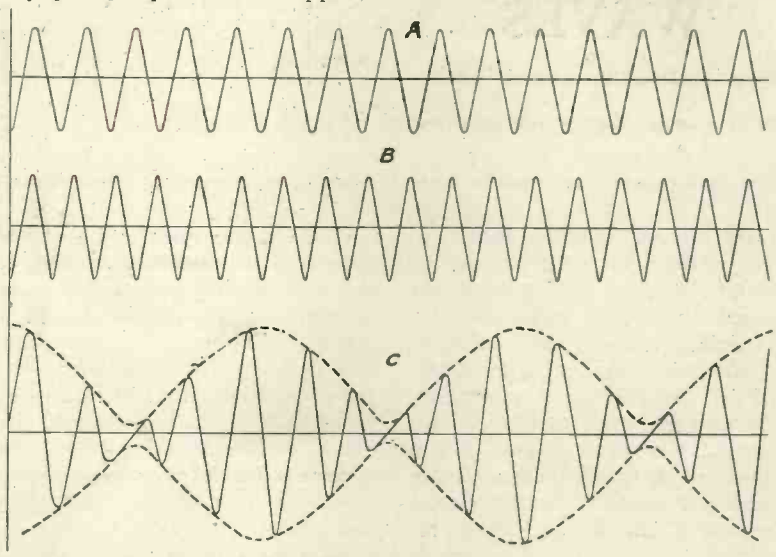


Fig. 2.—Showing "beats" produced by interference between waves of slightly different frequencies.

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.

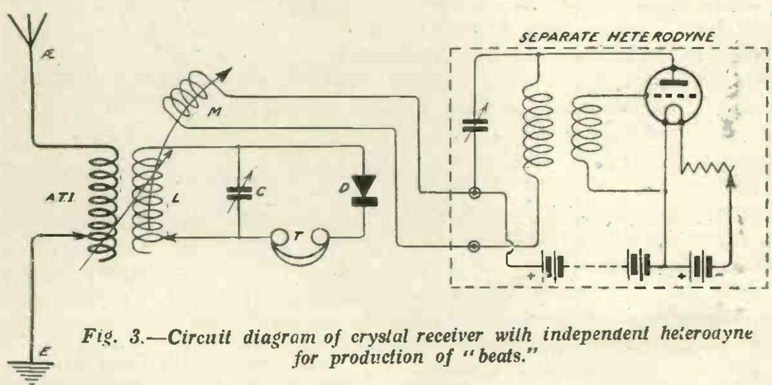


Fig. 3.—Circuit diagram of crystal receiver with independent heterodyne for production of "beats."

It is obvious that an audible

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 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

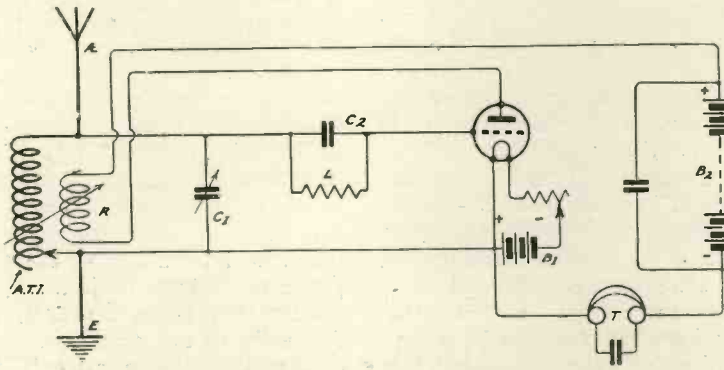


Fig. 4.—Circuit diagram of modern self-oscillating valve receiver.

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 being determined only by the tuning of the separate heterodyne.

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.

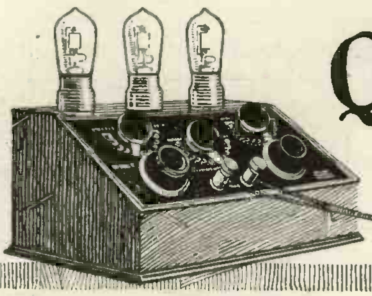
Any slight change of grid potential causes a variation of anode current traversing the coil R, and if the coupling between this coil and the ATI is made sufficiently tight, and provided that the respective windings are in the correct "sense," the impulses inductively transferred to the aerial circuit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

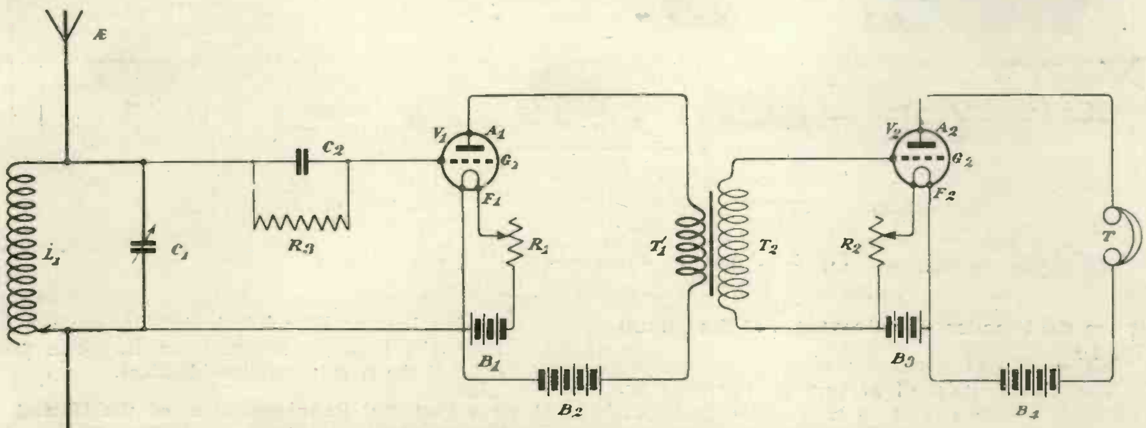


Fig. 1.—Illustrating a simple circuit wherein the first valve acts as a detector and the second as a low-frequency amplifier.

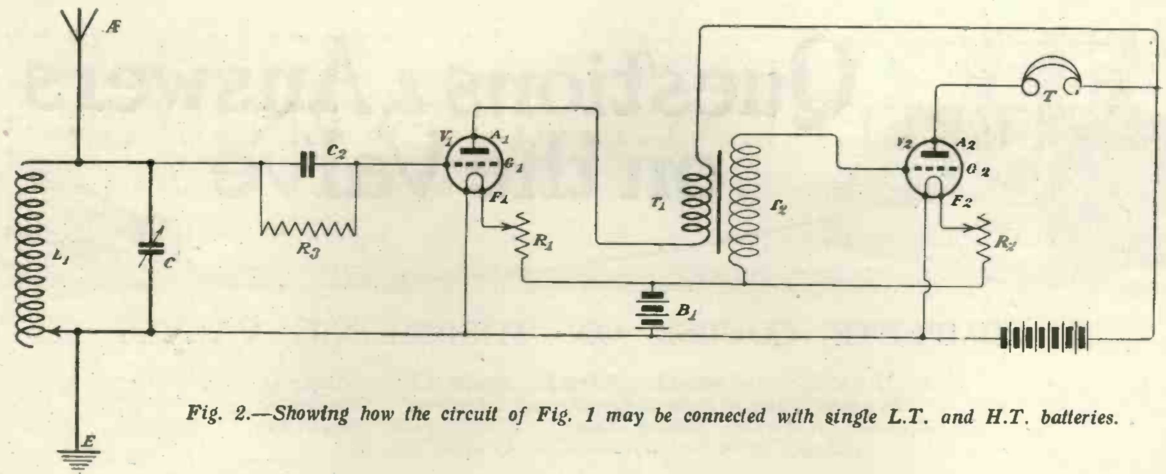


Fig. 2.—Showing how the circuit of Fig. 1 may be connected with single L.T. and H.T. batteries.

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-

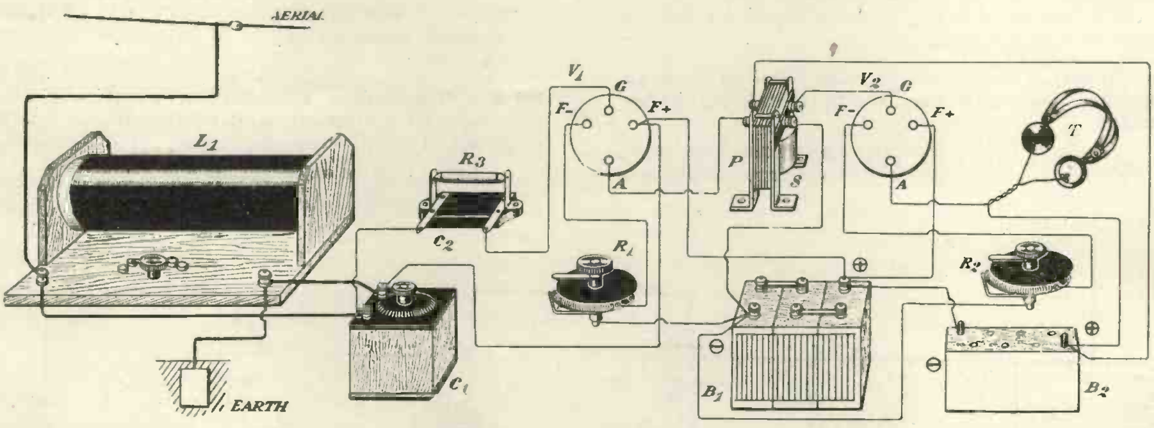


Fig. 3.—A pictorial arrangement of the circuit in Fig. 2.

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.

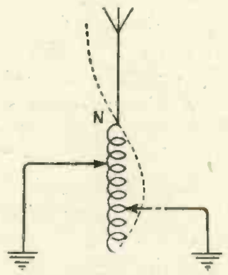


Fig. 1.—Potential nodes in aerial system.

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, 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.

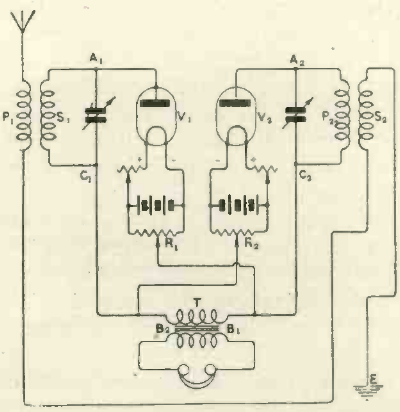


Fig. 2.—Circuit arranged to eliminate interference.

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

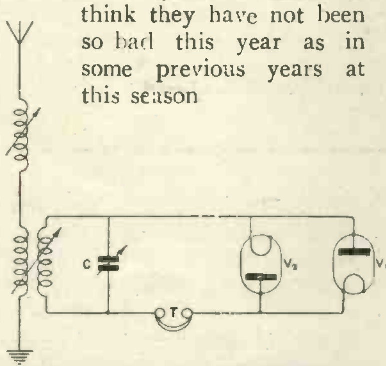


Fig. 3.—Balanced valve circuit.

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.

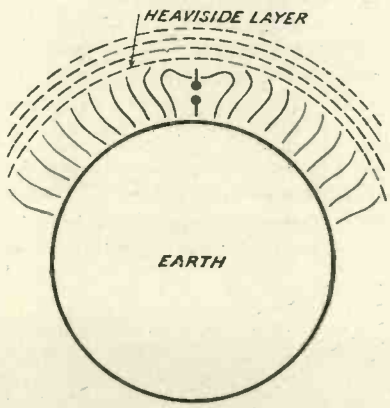


Fig. 1.—Illustrating the "Heaviside layer" theory, supported by Lodge and many other eminent scientists. The Fig. represents the "whispering gallery" referred to in the text.

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 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.

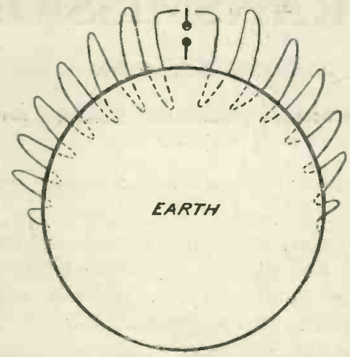


Fig. 2.—Illustrating the "gliding" theory, which supposes that the waves follow the curvature of the earth, without depending upon reflection.

Influence of the Atmosphere

It seems probable that the atmosphere has an important influence 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.

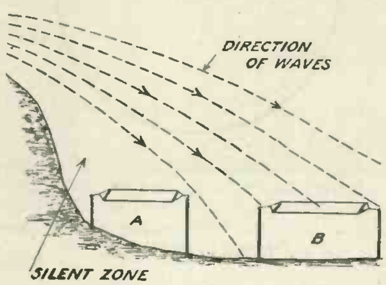


Fig. 3.—Shielding effect of high ground. Aerial A is in silent zone. Position B should be at distance from A equal to about 5 times the height of the mountain or hill.

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 considerable 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

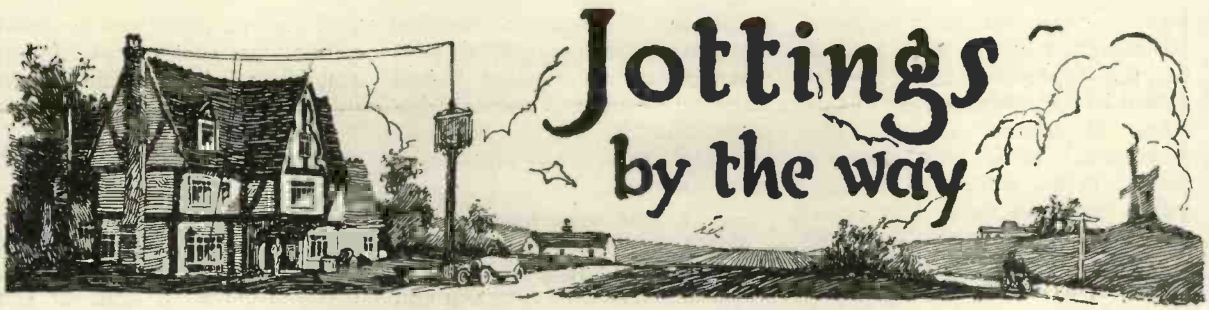
Every wireless experimenter is familiar with the disturbances which interfere with reception and which are variously known as "atmospherics," "static," "strays," etc. These may be described as natural electric waves, as they are produced by a variety of natural disturbances. Many of these disturbances 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."

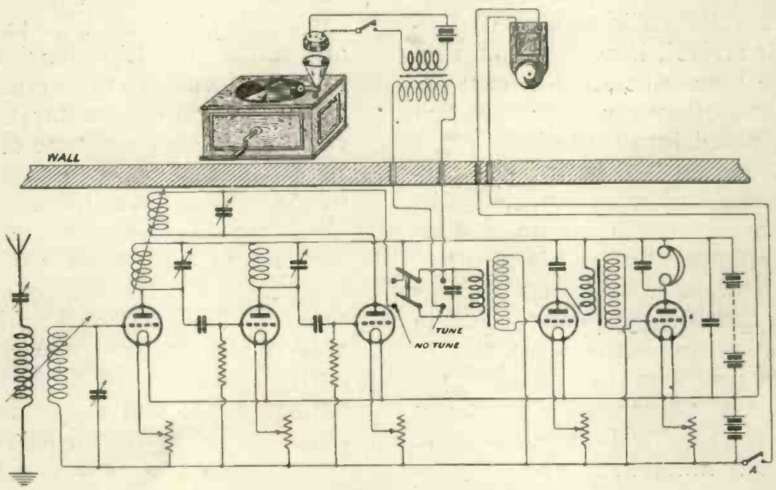
American Transmissions in Summer.

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.

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.



"Wireless Wayfarer," No. 1.

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."

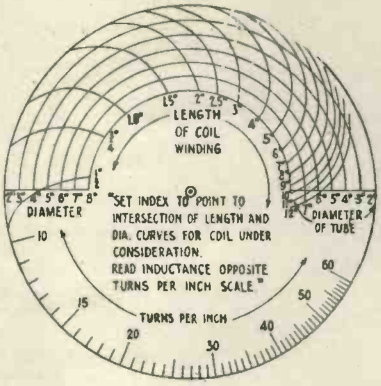
We learn from New York that an invention which makes possible privacy of conversation by wireless telephony has been perfected by engineers of the Bell Telephony system, and is already working successfully over a thirty-mile stretch of ocean between Los Angeles and Catalina Island.

A PRACTICAL RADIO SLIDE RULE

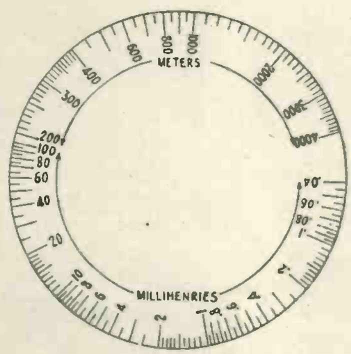
The following article gives some valuable hints on the calculation of various constants.

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 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 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.

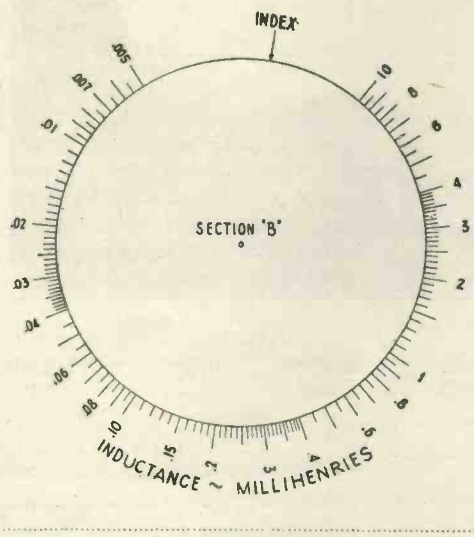


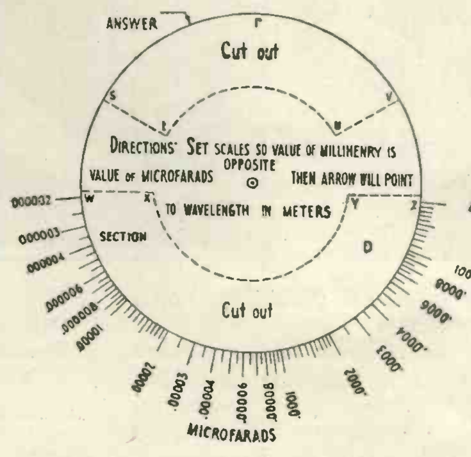
SECTION "A"



SECTION C

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.





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 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 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 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.

WIRELESS I

By R. J. HIB

The following article tells how wi
of the pupils of the Grayswood Sch
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Explaining high- and low-frequency methods to an advanced class of students.

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.

less 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 approximately 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 rag-time 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 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.

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

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.

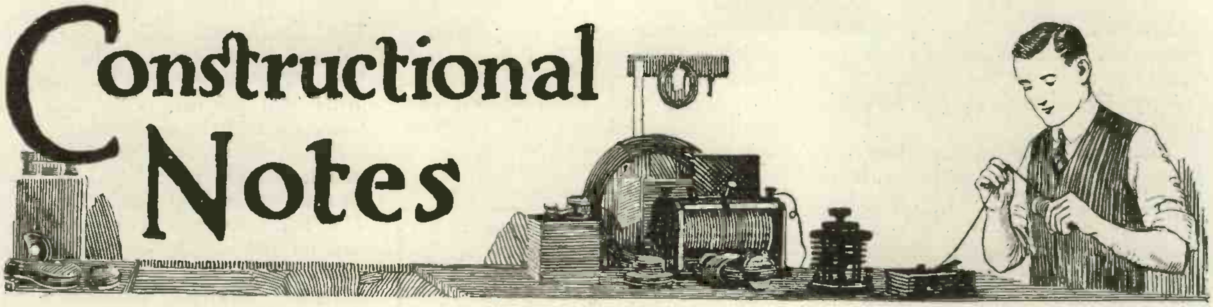
Pupils in the upper class found no difficulty in working out problems relating to the subject. The types and variations of such problems are unlimited. They have the advantage over text-books as being of real interest.

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

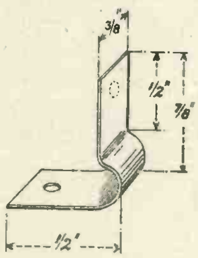


Fig. 1.—Dimensions for clips.

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

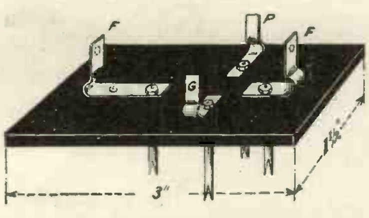


Fig. 2.—A horizontal adaptor.

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 $\frac{1}{4}$in. 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 $2\frac{5}{8}$in. apart. The distance between those for plate and grid is $\frac{7}{8}$in.

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. × $1\frac{1}{2}$in. × $\frac{1}{4}$in. 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-

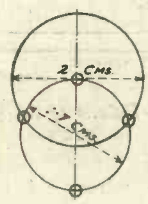


Fig. 3.—Position of valve legs.

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.

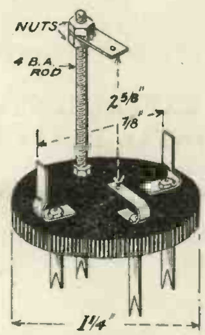


Fig. 4.—An adaptor for vertical mounting.

The ebonite base is either circular with a diameter of $1\frac{1}{4}$in, or $1\frac{1}{4}$in. 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 $1\frac{5}{8}$in. long by $\frac{3}{8}$in. wide. Its end having been secured to its valve pin, the strip is bent over as shown in the drawing.

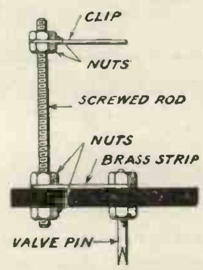


Fig. 5.—Details of vertical clip.

The upper filament clip is just a plain flat strip. It is mounted between nuts on a $3\frac{1}{2}$in. 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

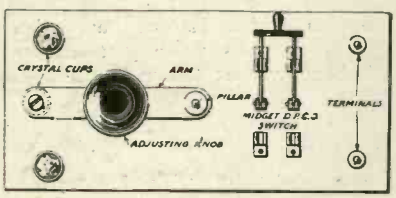


Fig. 6.—Showing plan of the finished detector

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

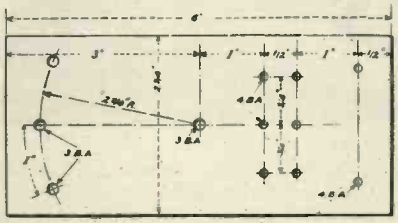


Fig. 7.—Layout of the panel.

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

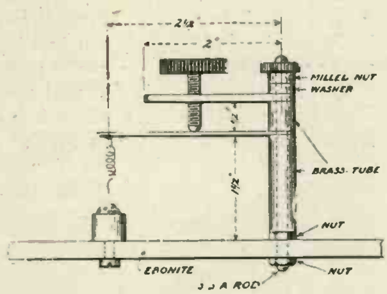


Fig. 8.—Details of the pillar and arms.

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 $2\frac{1}{2}$in. 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 $\frac{1}{4}$in. or $\frac{3}{8}$in. ebonite measuring 6in. by $2\frac{3}{4}$in. 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 $3\frac{1}{2}$in. 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 $\frac{3}{8}$in. brass tubing $1\frac{1}{2}$in. 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 $\frac{3}{8}$in. tubing and then

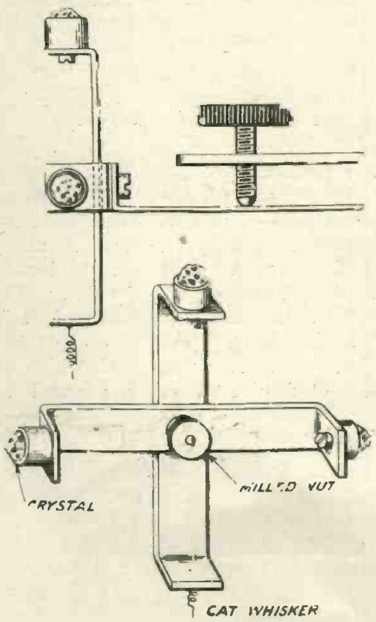


Fig. 9.—A suggestion for crystal-crystal combination.

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 $\frac{1}{16}$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,

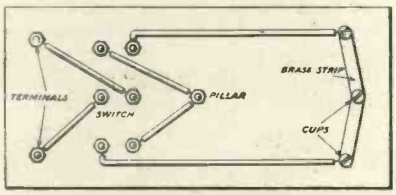


Fig. 10.—The underside of the panel.

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

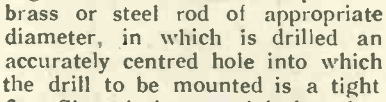


Fig. 11.—The sleeve with drill attached.

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

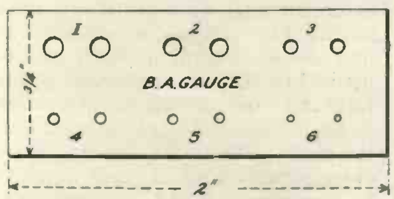


Fig. 12.—The pocket gauge.

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 noles, 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

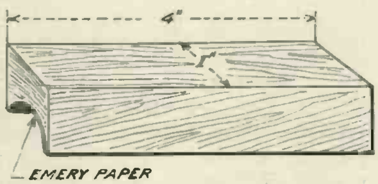


Fig. 13.—The "finishing" tool.

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.

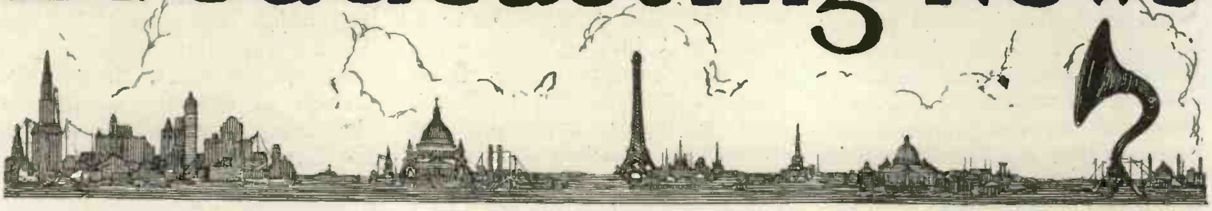
H. B.

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.

* * *

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.

BROADCAST TRANSMISSIONS

	Call-Sign	Wavelength
CARDIFF	5WA	353 metres
*LONDON	2LO	363 ,,
MANCHESTER	2ZY	385 ,,
NEWCASTLE	5NO	400 ,,
GLASGOW	5SC	415 ,,
BIRMINGHAM	5IT	420 ,,

TIMES OF WORKING.

Weekdays ....3.30 to 4.30 p.m. and 5.30 to 11.0 p.m. B.S.T.

*London 11.30 a.m. to 12.30 instead of 3.30 to 4.30 p.m.

Sundays....8.30 to 10.30 p.m. B.S.T.

SILENT PERIODS.

CARDIFF	8.0 to 8.30
LONDON	7.30 ,, 8.0
MANCHESTER	7.45 ,, 8.15
NEWCASTLE	9.0 ,, 9.30
GLASGOW	7.45 ,, 8.15
BIRMINGHAM	8.15 ,, 8.45

* * *

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.

* * *

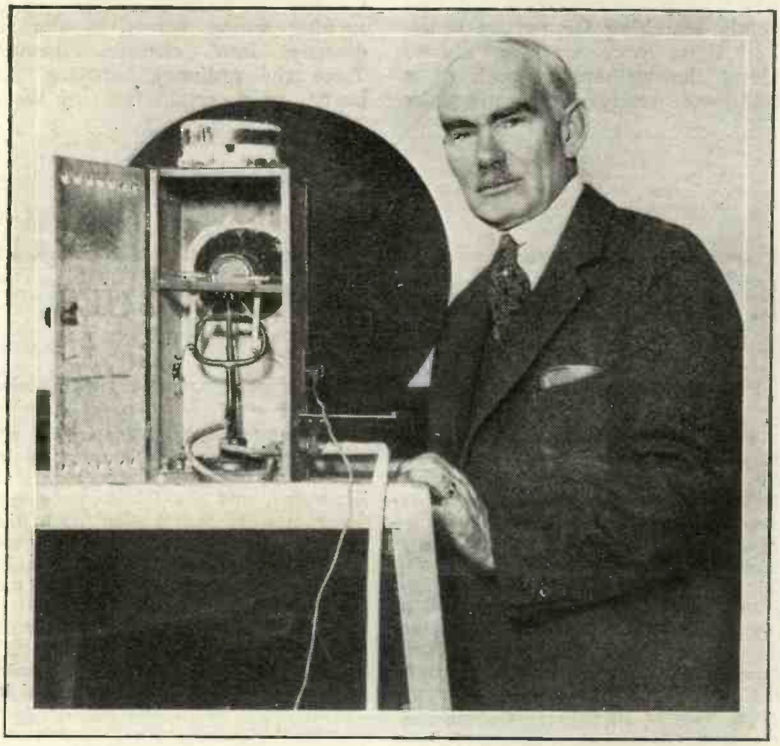
SHEFFIELD.—The work on the Sheffield broadcasting station is progressing slowly but surely. There is now installed at the University, under Captain A. G. D. West's direction, a transmitting apparatus of 100 watts power, with a new type of modulator. This has been tried out during the past week on reduced 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.

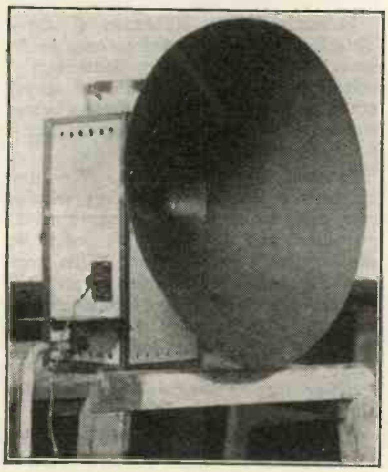
IN response to the numberless enquiries of scientists, educators, engineers, and others directly interested in the development of the talking motion picture art, I should like to take this occasion to announce that, as a result of my development of the new Phonofilm, my investigations and experiments 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.

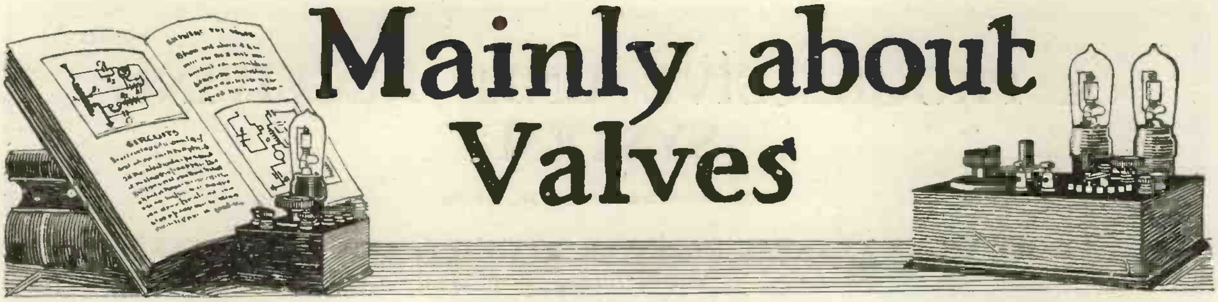
Messrs. J. W. Barnard & Haynes, Ltd.—We are in receipt of a leaflet describing a complete range of J.W.B. accumulators. Strong wooden crates and polished mahogany cases with leather strap handles for these accumulators are also supplied by this firm.

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.

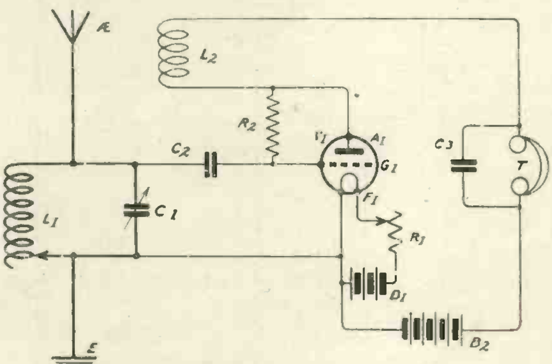
Mainly about Valves



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 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.



Illustrating the position of the resistance.

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

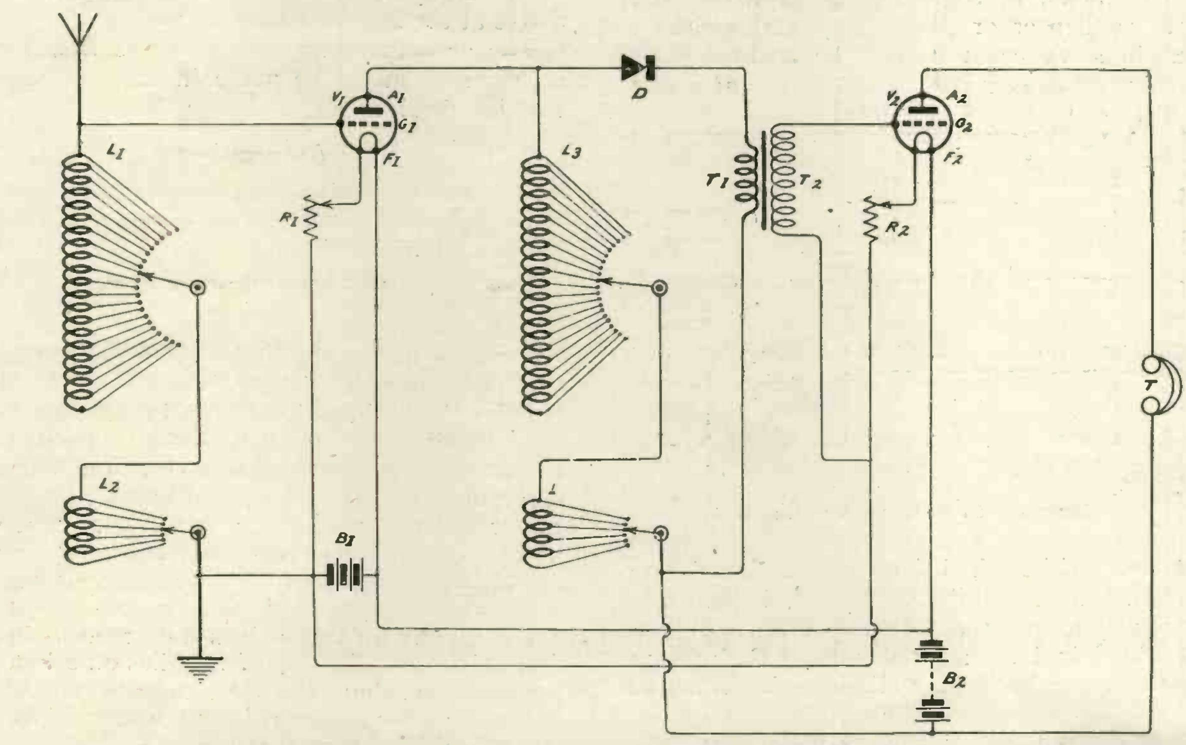


Fig. 1.—Arrangement of circuit with the first valve acting as a high-frequency amplifier, with the second valve functioning as a low-frequency amplifier.

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.

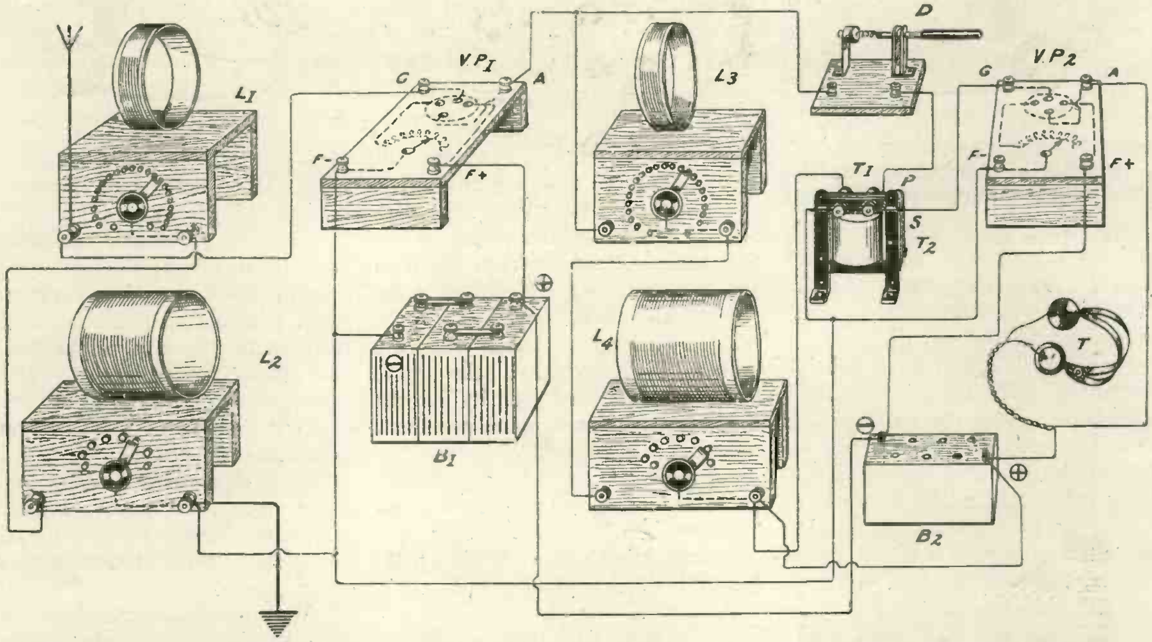


Fig. 2.—A pictorial display of apparatus connected in such a manner as to form the circuit illustrated in Fig. 1.

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.

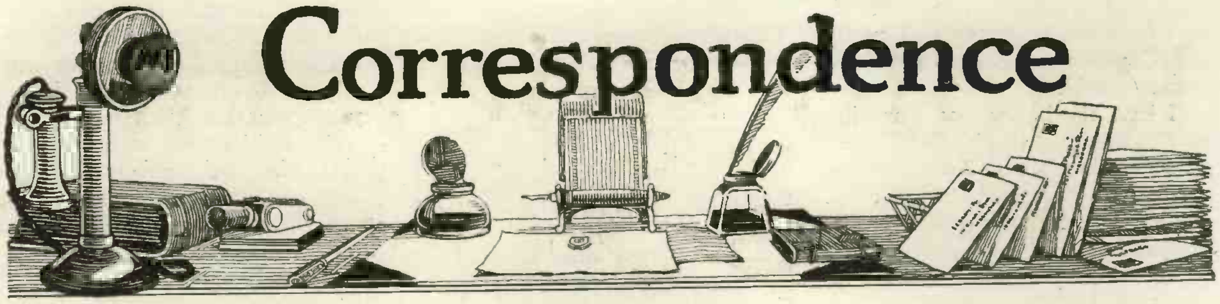
We have arranged a most enterprising programme, and intend to engage in some serious experimental work, and also to provide instruction for those new to radio. In this connection we are fast acquiring some very useful apparatus, and our thanks are particularly due to Mr. W. W. Burnham, M.I.R.E., one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

Correspondence



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.

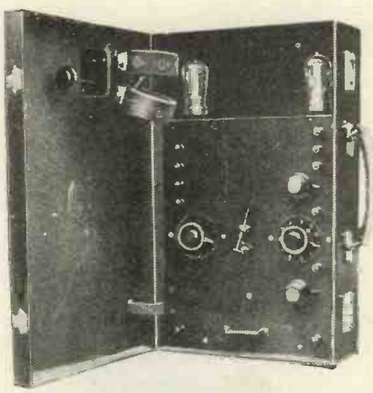
So good were the results that I decided at once to use this circuit for a portable set, of which I give the following description.

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.

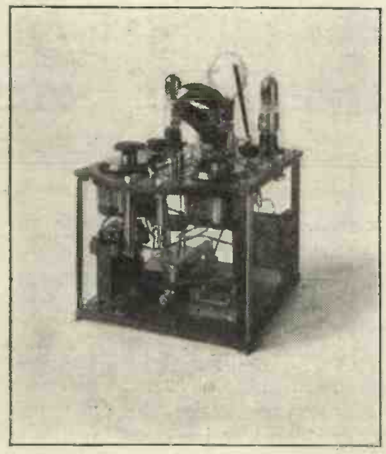
I have experimented with it and can endorse all your claims. The result was so satisfactory that I decided to build a compact set. Perhaps these photographs and few details might be of interest.

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. x 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.

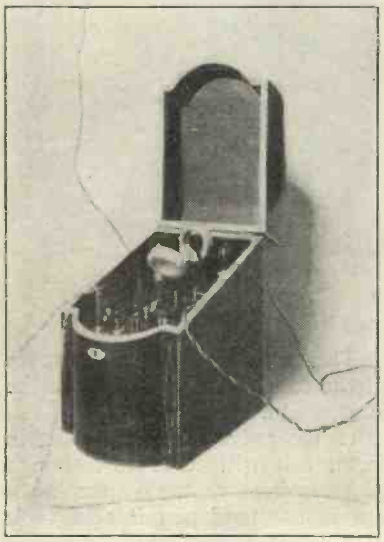
The transformers and resistance (100,000 ohms) were then mounted on the lower panel, the two joined together, and the remaining connections made between the two. This arrangement made it possible to use very short wires for connecting. The transformers were placed



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.

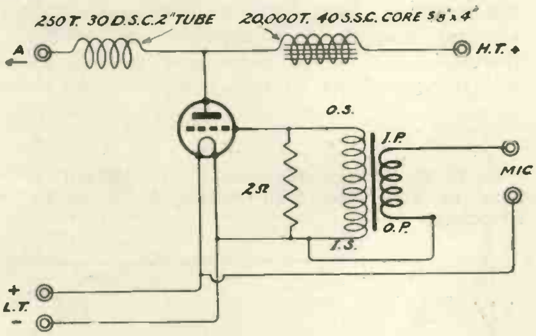
1. A Postal Order to the value of 1s. for each question must be enclosed, together with the Coupon from the current issue, and a stamped addressed envelope.

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 ⅝in. 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 re-action 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.

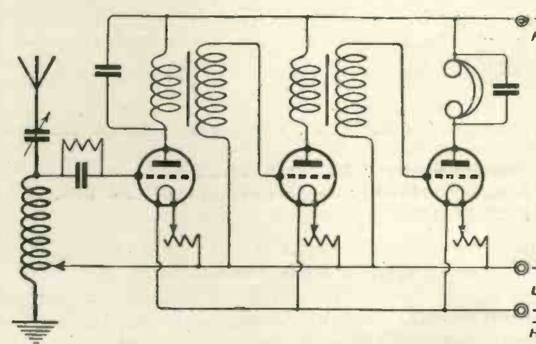
F. E. (RADCLIFF) wishes to build a receiving set comprising one high-frequency valve, a rectifier and one low-frequency valve, and asks where he may find a suitable diagram, and what approximate range might be expected from such apparatus.

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 headphones.

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.



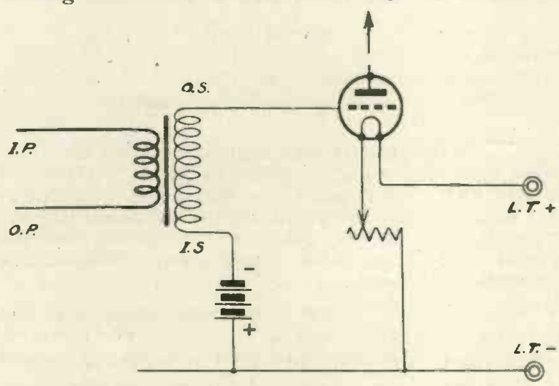
We reproduce herewith a suitable diagram showing how this may be carried out.

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. L. (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.

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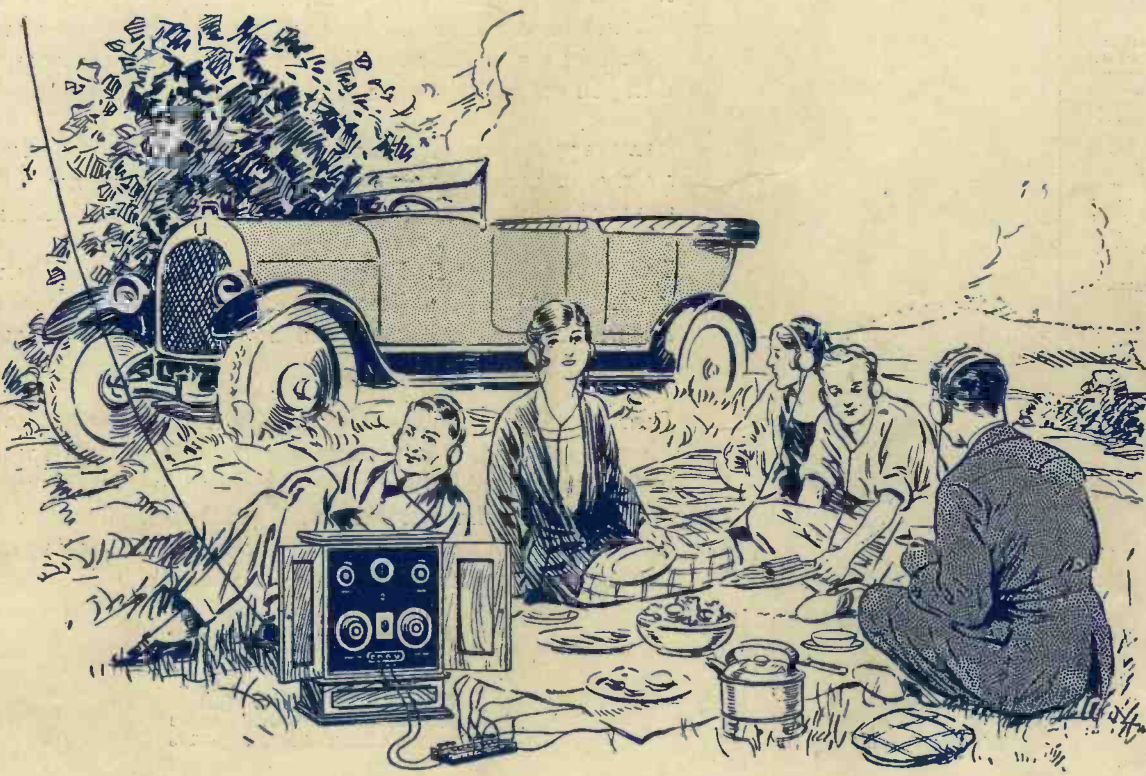

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Wireless Weekly

and The Wireless Constructor

No. 15

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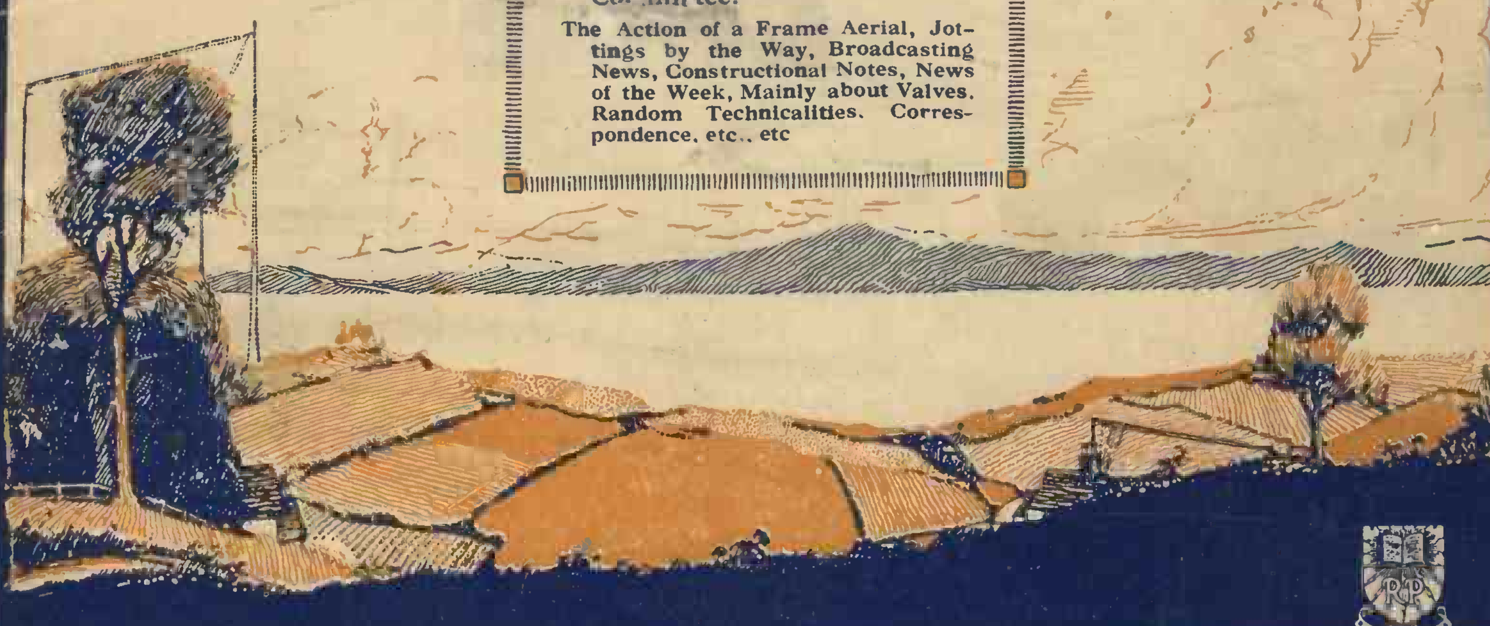

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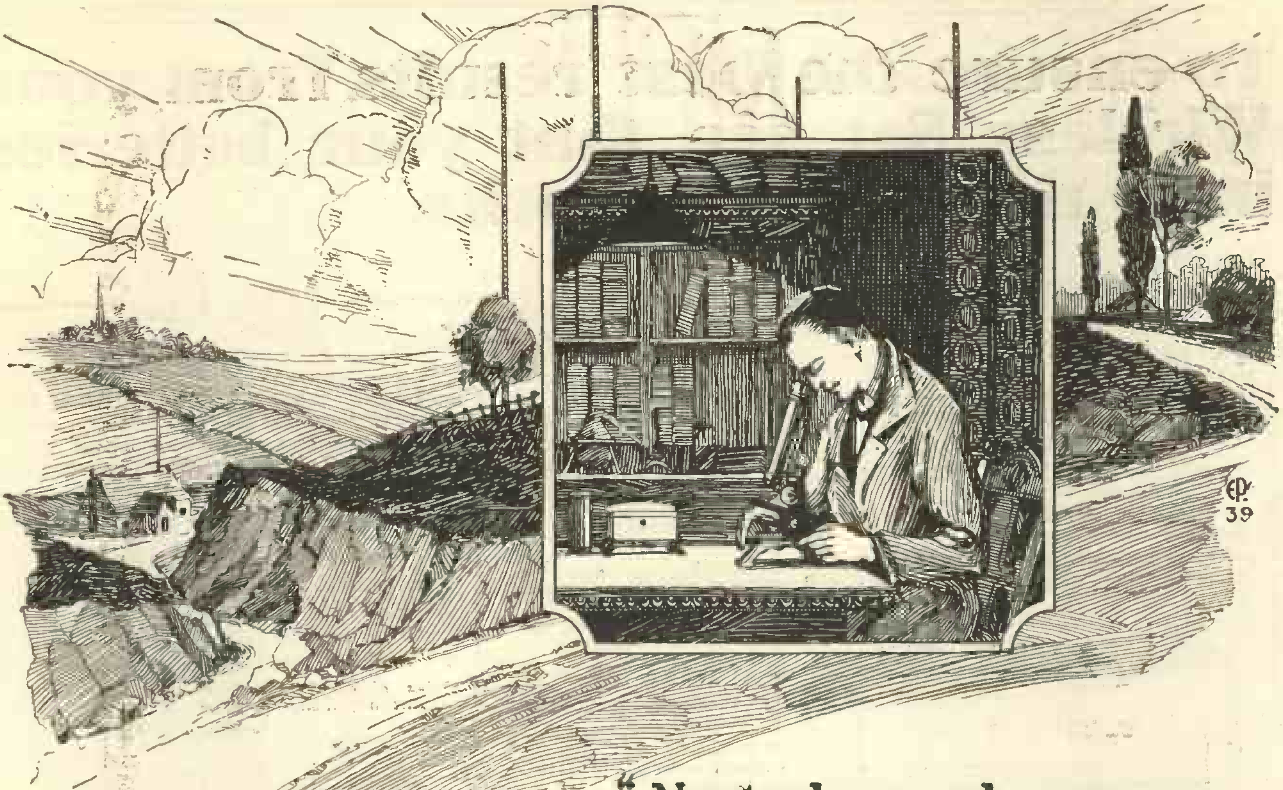

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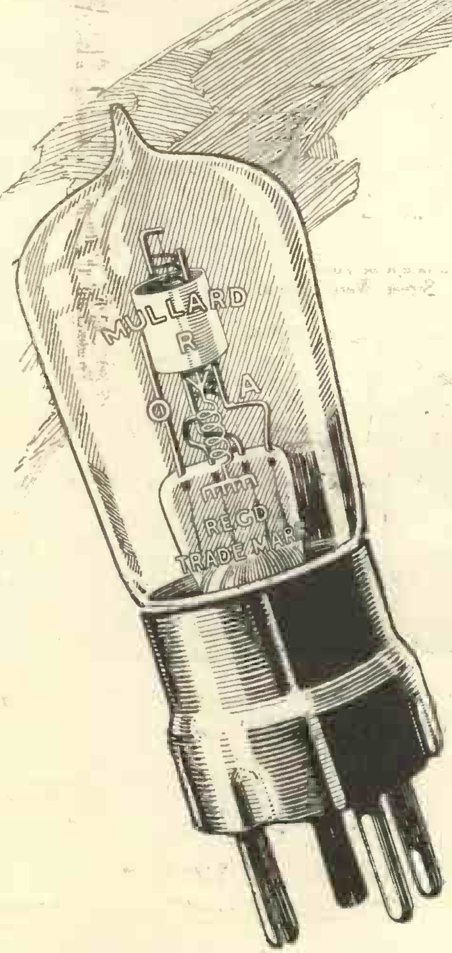

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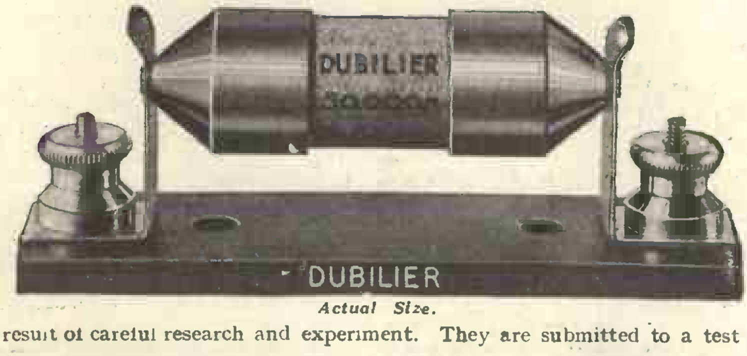

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Wireless Weekly

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July 18, 1923

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Editorial

An Undesirable Policy

THE time has come when we feel that silence can no longer be maintained with regard to the various movements which are afoot to shake the solidarity of the Radio Society of Great Britain. Strangely enough, this Society is apparently regarding with equanimity the disturbing influences which will tend to rob it of its chief influence in the country.

The particular matter which brings the subject to a head is the question of the experimental transmitting fraternity. The body of transmitters in this country represent the highest type of experimenter. Not only are they keen, but they possess far more than the average technical ability. There must be some 500 experimental transmitting stations more or less actively at work. Their interests must be safeguarded, and there must be some sort of organisation which can look after their interests. Since the inauguration of broadcasting, the experimental transmitters in this country have been the worst sufferers. Unless they stop up until midnight they have little opportunity of carrying out their work.

About a year ago an organisation calling itself the British Wireless Relay League was formed, and the object of this league was chiefly to bind the transmitters together and to conduct the relaying of messages up and down the country, and the transmission of messages to foreign countries. In our opinion this league should never have been formed.

In the first place, the transmitters in this country do not want to carry on wireless traffic up and down the country. At least, those who claim to be doing genuine experimental work do not want to waste their time in trying to see how fast a message can go up to the North of Scotland and back again. Little technical advantage is to be gained from this kind of work, which is bound to fill up the ether and prevent genuine experiments being carried out. As a means of improving Morse speed and gaining acquaintance with the procedure of message handling, the idea is quite good, but this is not the purpose of the experimental transmitting licence. In any case, this is too small a country for carrying out such work.

As regards test communications with foreign countries, this is admirable, and it is certainly desirable that there should be some organisation which can deal with tests with foreign wireless societies. In our opinion, however, such work should not be carried out either by the British Wireless Relay League or by any other independent organisation of wireless transmitters. The whole control should rest in the hands of the Radio Society of Great Britain, and should be dealt with by a special sub-committee. This committee should not necessarily be composed entirely of members of the Radio Society. We hold no brief for the Radio Society, but we are convinced that the only policy worth maintaining is to establish a central body which can negotiate with the Postmaster-General or with foreign radio societies, and which will have the official backing of the experimental movement in this country.

To have separate societies for separate phases of experimental work is, in our opinion, a move, not only in the wrong direction, but in a direction which will result in a total absence of real control.

That wireless transmitters should come under some form of discipline of their own deciding is acknowledged by all to be necessary. Is this discipline to be maintained by the British Wireless Relay League, or by the Radio Society of Great Britain, or by some other society of transmitters? The Postmaster-General now looks to the Radio Society of Great Britain to a certain extent to take any disciplinary action that may be necessary, and this confidence placed in the Radio Society is a very valuable asset. We would much rather be controlled by our own organisation than by the Postmaster-General, who, chiefly in view of the pressure which is always being brought to bear on him by the Services, would probably prefer to ease the situation by declining to issue licences except in very special cases.

It is obviously a ridiculous position for the wireless transmitting movement to be in. There must be one master, and that master, in our opinion, should be the Radio Society of Great Britain.

Curiously enough, this society has shown a lamentable lack of judgment in this matter. Not only have no steps been taken to exercise sole control themselves, but last year they even went so far as to pat the Wireless Relay League on the back and give it their blessing. At the same time, they patronisingly informed the League that their executive ought to contain more prominent names. Whether the Wireless Relay League considered this as an impertinence or not, we do not know, but at any rate it has not thought fit to supplement its committee by enlisting the services of some of our better-known wireless transmission organisers.

Instead it has tried to carry out an ineffectual programme, and has done so ineffectually. Wireless transmitters, as a body, have been slow to appreciate the League. Not merely because the Wireless Relay League has failed, however, do we consider that it should be wound up. It is simply a question of principle, and we believe that the principle should be definitely laid down that experimental wireless should be controlled by one central body, and that body should be the Radio Society of Great Britain. If any special action has to be taken, whether disciplinary or in connection with negotiations with the Postmaster-General, the Radio Society of Great Britain can bring its whole influence to bear, influence which is incomparable with any action which a sectional society could bring.

By all means elect a special sub-committee of the Radio Society of Great Britain to deal with transmitting. Have another one to deal with wireless in schools. If the present policy of decentralisation goes on, we shall have a separate society for crystal users, another society for two-valve people, and a specially select society for users of super-regenerative sets. The secretarial and organising work of the League is in excellent hands, but the whole principle is wrong.

Unless the Radio Society of Great Britain pulls itself together and asserts its authority, it will wake up one day to find that its influence has practically disappeared. We regard it as a weak policy to allow these specialised societies to spring up and then to try to gain control over them by persuading them to accept members of the Radio Society of Great Britain on their executives. Our advice to the Radio Society is: Do the work yourself and do it properly.

We believe that the experimental movement in this country will back up the Radio Society of Great Britain in the matter. Whether the Society, as at present constituted, is truly representative of wireless interests in this country is a matter of considerable doubt, but this is likely to be put right shortly. Past history has shown that London can learn a great deal from Manchester. The organiser of the British Wireless Relay League is one of the most able experimenters and organisers in this country. If, instead of trying to run a league which will never be a success, whether patronised or not by the Radio Society of Great Britain, he would act on a sub-committee of the Radio Society of Great Britain for doing the same class of work, he would be helping the ideal of a *national* experimental movement.

The Radio Society of Great Britain needs an influx of provincial talent, and when it possesses this, the energy and initiative of the North will no doubt make itself felt. The Radio Society is by no means perfect; let us make it so, rather than start new societies.

As for the parent society itself, let it take a firm stand and increase its prestige, both with the Government and with the mass of experimenters as a whole. A weak-kneed policy of decentralising its authority will only lead to trouble and confusion in the immediate future.

OUTDOOR EXPERIMENTS WITH RADIO

By PERCY W. HARRIS, Staff Editor.

Some suggestions for a fascinating series of experiments during the summer months.

MOST talk about radio in summer time deals merely with the pleasures of broadcast reception in the open air and pleasant surroundings, for portable aerials, high-power amplifiers, loud-speaking equipment, and other luxuries have brought radio to such a pitch of perfection that it can be truly so enjoyed. But radio in summer-time may mean much more than this. It may mean glorious opportunities for original experiment on the part of the numerous devotees of the art to whom the mere listening to broadcasting is but one aspect of the finest hobby in the world.

Strangely enough the opportunities for experimenting in radio during holiday time and in the open country do not seem to be fully realised, although it is quite a simple matter to build a portable receiver, whilst the invention of dull-emitter valves has lightened the burden of accumulator carrying.

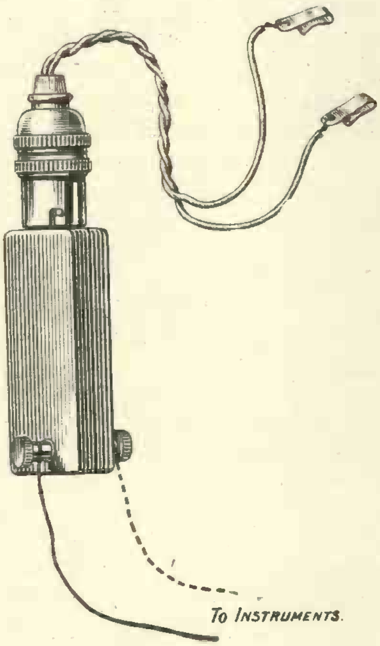


Fig 1.—Fittings for use with a Ducon.

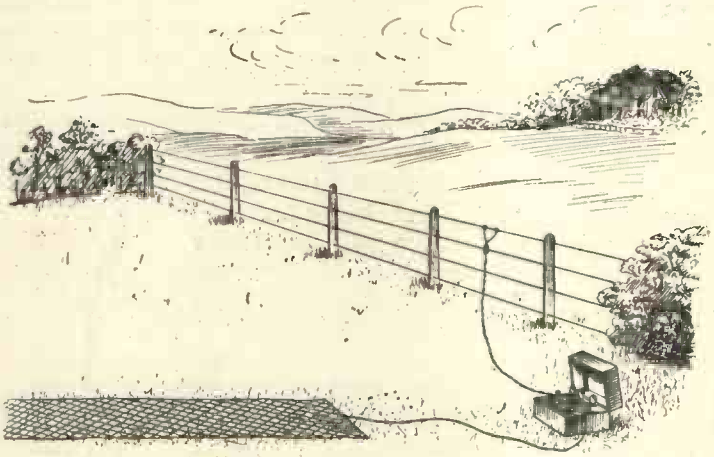


Fig. 2.—Using a fence as an aerial.

The purpose of this article is not to add one more to the already large number of descriptions of portable sets, but to indicate to the experimenter a number of lines of research which badly need following out and which are peculiarly suited to the summer months and the holiday season.

The parts of a home wireless installation which receive the smallest amount of attention are usually the aerial and earth. In a recent issue of *Modern Wireless* the present writer described some experiments which have gone to show that much remains to be done in this direction. It should be pointed out here that the main reason why so little experimental work has been done is that the average wireless man is limited in the space available for the erection of an aerial and frequently, whatever his personal tastes may be, they must conform to somewhat irksome restrictions of his space and general requirements. Out in the open country, with the aid of a few friends and a quantity of wire (either ordinary aerial wire, flexible wire similar to that used for electric lighting pendants, or even the Disposals Board wire, which is now being sold in large quantities so cheaply), he can occupy all the time at his disposal in fascinating experiments which will teach him much that is new, and may probably lead to several useful discoveries. It is not necessary that a tent and a large field should be placed at the experimenter's disposal—even a country walk with a portable set will give a host of opportunities—but, of course, if a permanent location is available, with plenty of open ground in conditions which are not likely to be disturbed by idle sightseers, the experiments will be the more valuable.

We have heard much during the last year or two about the reception of wireless signals by the aid of the electric light wires, which, connected to the set through a filter, act as a great untuned receiving aerial. How many experimenters know that a long wire fence can be similarly used to pick up wireless messages? If when next you take a country walk with your portable set, you slip a Ducon, and the attachment shown in Fig. 1, into your pocket, you will soon be able to test out this statement and verify it for yourself.

The apparatus required is quite simple, and consists, in addition to the Ducon, of an ordinary electric lamp socket, such as is suspended from the ceiling of a living room, the wires which normally connect with the mains being bared at their ends and attached to a pair of suitable clips ("bull-dog" clips will do if others are not available). Some kind of earth connection will be necessary, and it will usually be found that a length of wire run out on the ground will be just as effective as a buried earth plate. Of course, if a pond is handy it is convenient to throw a length of netting or a coil of wire into the water, as this will form an excellent earth connection for any experiment that may be carried out near by.

Fig. 2 shows a very simple experiment which can be performed with the apparatus described. It will be seen that one or both of the free ends of the flexible wire should be clipped tightly to the fencing wire which had previously been scraped with a knife to expose a clean surface. Practically any portable valve set will do for the receiver, but the apparatus used should preferably have at least one stage of high-frequency amplification. It may be necessary to place the aerial tuning condenser in series, but occasionally better results will be obtained by placing it in parallel. The Ducon should be reversed in its socket, and the effect should be compared of using one wire or both wires attached to the fencing to see which connection gives the best signals. No general rule can be given, and the individual experimenter should try the arrangements for himself.

If a Ducon is not handy a few fixed condensers may be taken in the pocket and tried, or even a variable condenser of 0.001 μF or larger, if it is convenient to carry it. The condensers should be connected as shown in Figure 3, and a trial of various values made until the best results are obtained. It should be remembered that fencing aerials, owing to their great length in comparison with their height, are very directional, and, therefore, it is useful to have a pocket compass available so that when one has a choice of two or three fences for the experiment, that which lies in a line with the station it is desired to receive can be chosen. It is not necessary that the apparatus should be attached to the ends of the fencing wire, since it may be connected to the middle or any other convenient point.

Many interesting experiments can be carried out with "tree aerials." By a tree aerial, we do not mean one which is merely an ordinary aerial suspended from the upper portions of a tree or between two trees. A tree aerial is one in which the trunk of the tree forms an integral part.

It was found a few years ago, during some experiments in America, that if two nails are driven into a trunk of a tree twenty feet apart, signals can be received over quite considerable distances. The greater the distance the two nails are apart the better the signals are received. It is not clear exactly how reception is effected, and it is possible that the effect is mostly produced by the wire which runs from the apparatus to the upper nail.

The aerial connection of the apparatus may go to the upper nail, and the earth connection to the lower nail. An alternative arrangement consists in using the upper nail as the aerial with a separate earth connection. A length of wire laid on the ground, a buried plate, or a roll of wire netting run for 6 or 10 feet may be tried to see which results are the best.

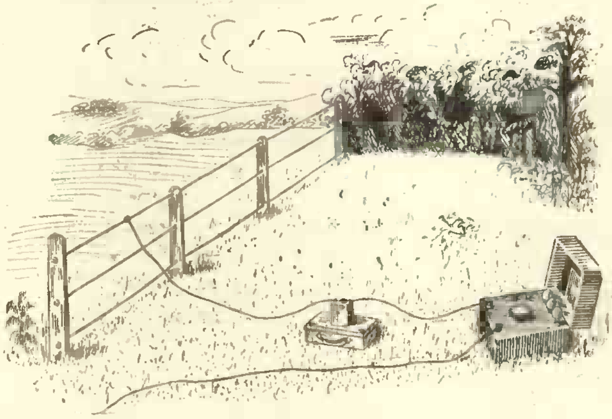


Fig. 3.—Another way of using a fence.

Fig. 4.—A ground aerial.

Fig. 5.—A low directional aerial.

as those of the Eiffel Tower, this form of aerial may need to be wound with a considerable number of turns.

The unlimited space available out of doors should certainly tempt the experimenter to try the results of very large loop aerials for broadcast reception. If, for example, a couple of trees are available as shown in Fig. 8, a frame or loop aerial consisting of a single loop of wire with sides about 10ft. or 15ft. long, threaded through aerial insulators may be tried. Here again, of course, care must be taken to see that the loop is properly arranged so as to utilise the directional effect, inherent in this type of aerial. The wire should be kept well away from any foliage, for which reason the insulators are indicated as suspended on lengths of rope, so as to take them well away from the leaves.

Another very interesting form of aerial which can be tried by the outdoor experimenter consists of two lengths of insulated wire laid along the ground on each side of the apparatus, like some gigantic Hertz oscillator. Such a ground aerial is very directional, and should be suitably laid out in the direction of the station from which it is desired to receive. Extraordinarily good reception is sometimes obtainable with such an arrangement, particularly on long waves, and the results may be compared with those given by similar lengths of wire supported, say, 2ft. or 3ft. above the ground on short sticks Fig. 4 indicates the general arrangement of such a ground aerial, and Fig 5 shows how the wire may be supported for the other experiments.

A form of aerial which seems to offer considerable possibilities, and which I have not known to be used in this country, is shown in Fig. 6. It consists of a coil, and for the purposes of outdoor experiment it can very conveniently be made by winding the wire round in an open spiral on five or six lengths of cord suspended between trees or posts. An earth connection will be needed, and this may consist of two or three lengths of wire separated 3 or 4ft. from one another, running immediately underneath the coil aerial for its entire length, and, advantageously, for a few feet further.

Fig. 6.—A coiled aerial.

For broadcast reception comparatively few turns will be needed, but for longer waves, such

There are a number of more obvious experiments which would well repay the trouble given to them by the amateur, such as the testing of signal strength to compare it with that obtainable at home on a similar sized aerial; observations to see whether the relative strength of signals from the various stations is the same out in the country as at home. This may lead to some interesting results when investigating screening, blind spots, etc. Further, a series of experiments to show whether aerials of the length usually erected by amateurs are really as directional as they are

(*Continued on p. 22.*)

Fig. 7.—Using a large loop aerial.

A THREE-VALVE BROADCAST RECEIVER

By E. REDPATH, Assistant Editor.

The following article deals with the construction of a complete receiving set, self-contained except for the usual aerial and earth connections.

As will be seen from the accompanying photographs, Figs. 1, 2 and 3, the apparatus now to be described is a three-valve receiving set mounted upon a single ebonite panel and built into a containing box in which provision is made for the high-tension and filament-lighting battery.

In the original set three dull emitter valves are used, the necessary dry-cell lighting batteries being carried in the small square space behind the right-hand row of terminals. The ordinary type of valves may, however, readily be used, in which case a small accumulator may be carried in the battery space, although naturally under these circumstances the complete set will not be so readily portable.

The provision of all necessary terminals enables separate external batteries to be employed if desired, also any type of loud-speaker such as the T.M.C. loud-speaker illustrated in Fig. 3, whilst the compact arrangement shown in Fig. 1, in which one of the well-known Violina loud-speakers is fitted and forms a cover for the complete outfit, can be adopted if desired, the result being an instrument of "table-grand" appearance and yielding excellent results.

Referring to the photograph (Fig. 3), the three valves will be seen arranged in a row along the back of the ebonite panel with a single filament rheostat on the left. On the left-hand side of the panel are the aerial and earth terminals, the aerial terminal being to the rear. Of the six terminals on the right-hand side, the rear two are for the loud-speaker, and the remaining four are H.T. + ; H.T. − ; L.T. + ; L.T. − ; in that order counting from the back.

The three dials and knobs along the front of the instrument operate the tuning variometers, the first variometer tuning the aerial circuit, the centre one tuning the plate oscillatory circuit connected to the grid and filament of the second valve.

The crystal detector of the "cat-whisker" type, and enclosed in a small glass cylinder, will be seen upon the right-hand side of the panel. The detector itself

Fig. 1.—The set complete with its "Violina" lid.

circuit of the first or high-frequency amplifying valve, and the third one (on the right) the plate circuit of the second valve.

Between the plate circuit of the first valve and the grid circuit of the second, a variable inductive coupling is provided, the degree of coupling being controlled by the knob on the left with a pointer moving over a 90-degree scale, whilst the central knob, with dial, actuates a variable condenser to give accurate tuning of the closed may, of course, be of any type, that shown being fitted in preference to a zincite-bornite detector which, upon test, did not give such good results, though it was thought that this may have been due to the crystals themselves.

Materials Required

Apart from the containing box itself, the choice of material for which will be left to the taste of the individual reader, the follow-

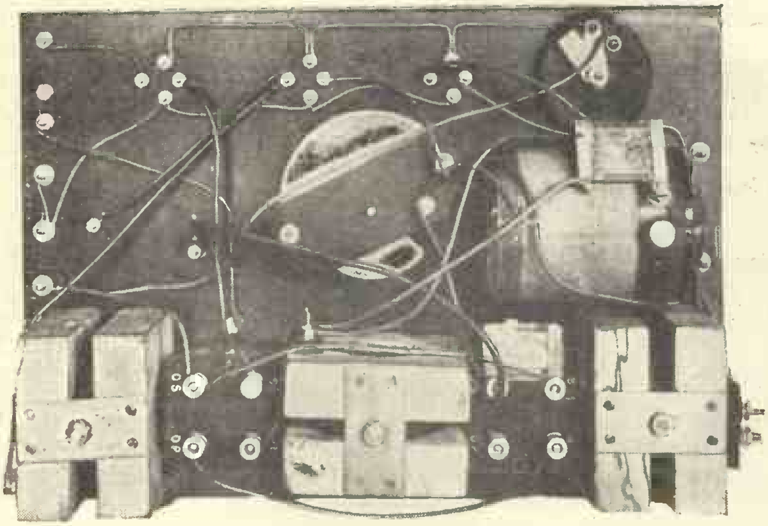


Fig. 2.—The interior of the receiver.

ing materials and components are required for the complete set :—

One ebonite panel 13in. by 9in. by ¼in. thick. (On account of the size of this panel, ¼in. ebonite is the minimum thickness recommended.)

Three standard valve holders.

One filament rheostat complete.

Four ebonite knobs and dials, or alternatively knobs with brass pointers and separate engraved scales.

One ebonite knob, pointer, and 90-degree scale. (This scale may easily be cut from one of the usual 180-degree scales.)

One crystal detector complete.

Eight brass terminals.

Two L.F. iron-core intervalve transformers. Those fitted to the original set are of the ironclad type made by Elwells.

Three variometers complete, or, alternatively, the necessary wood, wire, small ebonite plates and terminals to construct them in accordance with particulars to be given later. The specially small variometers employed in the writer's set are by the Crayford Radio Supplies.

One cardboard or ebonite tube, 2½in. diam. × 3¼in. long, and one wooden ball former for intervalve coupling coils.

One variable condenser (capacity 0·0003 μF), or alternatively the standard components to build this up, namely, 5 fixed and 4 movable vanes.

¼ lb. (approx.) No. 22 s.w.g. d.c.c. copper wire.

¼ lb. (approx.) No. 36 s.w.g. d.c.c. copper wire.

A supply of copper foil, ¾in. wide, thin mica of good quality, and thin soft brass sheet, for the construction of small fixed condensers.

A supply of No. 18 or No. 20 s.w.g. tinned copper connecting wire with insulating sleeving, preferably of different colours.

As the writer is well aware that many readers experience considerable difficulty in obtaining entirely satisfactory results from a somewhat complex receiving set assembled complete without preliminary trial, it is recommended that the completed components be assembled temporarily upon a board and carefully tested and adjusted as may be found necessary, before the apparatus is finally assembled upon the ebonite panel and fitted into the containing box.

This will be referred to again presently, but it should be understood that the construction or purchase of the various components may be proceeded with and the provision of the ebonite panel and containing box may be left until later.

It is hoped that this method of preliminary trial will commend itself to experimenters as affording them a certain amount of practical experimental work, and, at the same time, tending to prevent the disappointment experienced

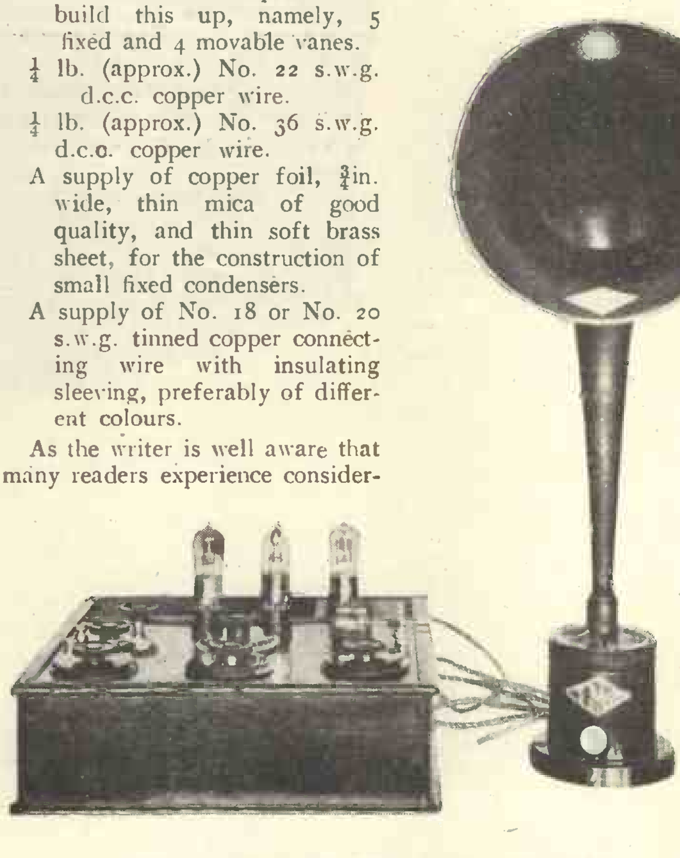


Fig. 3.—The set used with a T.M.C. loud-speaker.

when a completely assembled set either fails to work at all for some reason or does not give really good results.

The Circuit Arrangement

Reference to Fig. 4, which is a complete theoretical circuit diagram, will show the arrangement of the various components in this set.

The aerial circuit comprises the aerial itself connected to the aerial terminal Æ, the aerial tuning variometer VR_1, earth terminal E, and the earth connection. The aerial end of the variometer is connected to the grid and the earth side to the negative side of the filament of the first valve V_1.

The anode circuit of this first valve is tuned by means of the variometer VR_2, in series with which is the primary coupling coil L_1, whilst both coupling coil and variometer are shunted by the small fixed condenser C_1.

High-frequency oscillations from the primary coupling coil L_1 are induced into the closed oscillatory circuit L_2 C_2, duly connected to the grid and filament of the second valve V_2, the last-named connection being made via the secondary winding of an iron-core intervalve transformer T_1 and fixed condenser C_4.

The anode circuit of the second valve V_2 is tuned by means of a variometer VR_3, shunted by the small fixed condenser C_3, and the connection from this variometer to the H.T. positive is made via the primary winding of a second iron-core intervalve transformer T_2, the secondary winding of which is connected to the grid and negative of filament of the third or low-frequency amplifying valve V_3, in the anode circuit of which are connected the telephone receivers or loud-speaker.

Rectification is effected by the crystal detector D, which, in series with the *primary* winding of the transformer T_1, is shunted across the variometer VR_3, this particular application of the transformer enabling dual amplification to be obtained in the second valve. The fixed condenser C_4, connected across the secondary winding of the transformer T_1, affords a path for the high-frequency currents in the oscillatory circuit L_2 C_2. The fixed condenser C_5 is a similar by-pass condenser across the primary winding of the second transformer T_2. This condenser, together with the condenser C_6, shown as being connected across the telephones, may frequently be omitted without any apparent ill effects.

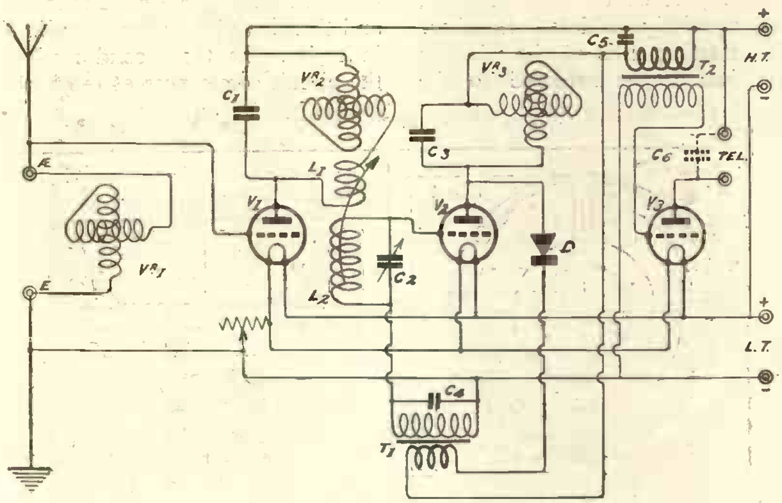


Fig. 4.—The circuit of the receiver.

The actual tuning adjustments of the set therefore comprise the three variometers VR_1, VR_2 and VR_3; the variable condenser C_2; and, lastly, the coupling between the coils L_1 and L_2. These rather numerous adjustments afford considerable opportunity for skill in manipulation, and, when they are properly carried out, excellent results will be obtained, the use of the independent high-frequency valve, the first valve in the set, enabling distant stations to be tuned in with good effect. At all events there should be no complaints that the manipulation is too simple to be really interesting.

In common with most reflex circuits, with certain critical adjustments, particularly of the crystal contact, or when the crystal contact is broken altogether, the set may be found to "howl" strongly. This is not experienced in actual working, and the set is particularly free from tendency to high-frequency oscillation, but, if trouble is experienced, the addition of a leak of suitable value as determined by actual experiment (probably 100,000 ohms), connected between the grid and the positive side of the filament of the second valve V_2, will usually effect a satisfactory cure.

The Aerial Tuning Variometer

Fig. 5 shows one of the variometers in parts with sizes of rotor, one half-stator, one bearing plate, and the necessary winding jig. This variometer is to be wound with No. 22 s.w.g. d.c.c. copper wire, the rotor to have 36 turns and the complete stator an equal number. The actual method of winding this type of variometer has been described by the writer on previous occasions—see *Wireless Weekly*, No. 5—but, for the benefit of new readers, the method will be described briefly.

Each half of the rotor is to be wound separately, commencing by threading the end of the wire through the small hole shown at S_1 and S_2 respectively in Fig. 5, the finishing end of each half-winding being temporarily secured to the small screw shown at M. After having varnished the winding and allowed the varnish to become thoroughly dry, the two finishing ends of the wire are to be laid in a groove cut in the central part of the rotor former, and carefully soldered together. The starting ends of the winding are then to be soldered to the rotor winding, the second spindle, and then both half-stator windings in series. In the second method the circuit commences at (say) one two methods gives very good results and a trial of each will afford interested readers some little experimental work.

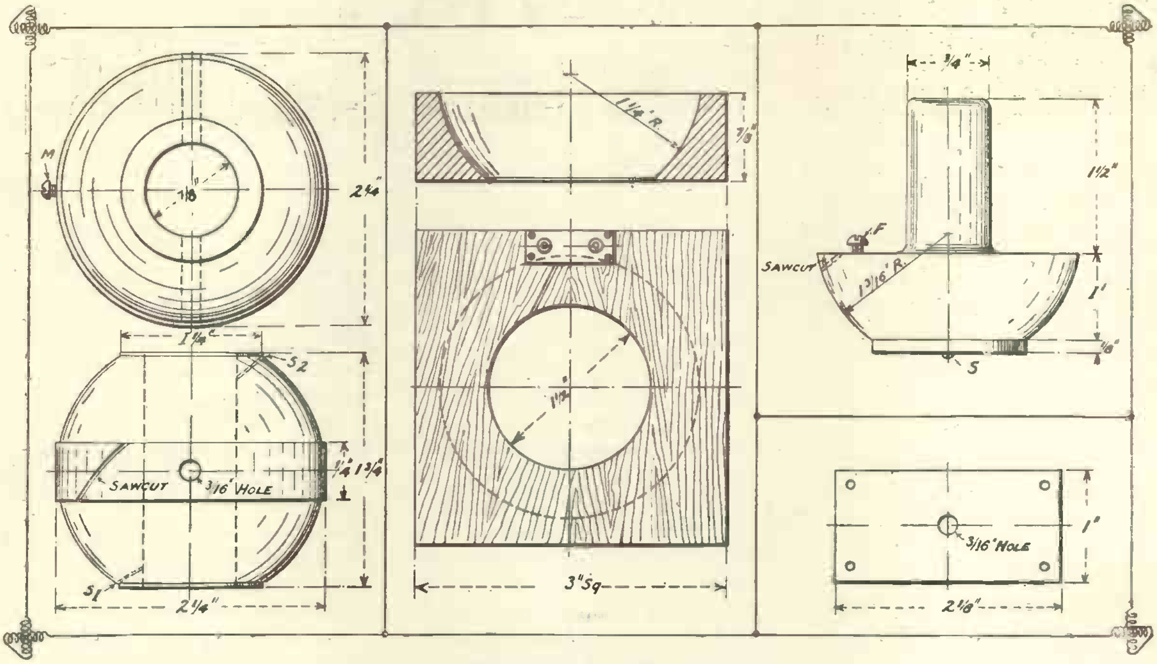


Fig. 5.—Details of the aerial variometer.

inner ends of the brass spindles, one to each.

Each half-stator winding is to be wound upon the "jig" and temporarily secured there, whilst a good coat of thick shellac varnish is applied to the inner surface of the half-stator former in the position which the winding itself will ultimately occupy. When the varnish is *almost* dry, the winding upon the "jig" is to be carefully and firmly pressed into position and held for a few moments, when the "jig" must be carefully detached, leaving the wire secured on the inner concave surface of the half-stator former.

There are two well-known methods of connecting up the windings of a variometer of this type. In the first method, the circuit commences at (say) one of the rotor spindles and includes the of the small diameter turns of the half-stator and, having passed through the half-winding, the

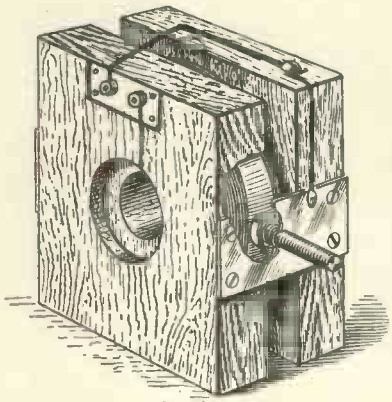


Fig. 6.—A completed variometer.

currents next traverse the rotor, and finally the remaining half-stator winding. Either of these

The Anode Variometers

Each of the two anode tuning variometers is to be exactly similar to the aerial tuning variometer as regards the dimensions of the "formers," but is to be wound with No. 36 c.w.g. d.c.c. copper wire instead of with No. 22.

The same method of winding may be adopted, but care must be exercised in the process or the turns of wire will slip and become displaced, especially during the winding of the first dozen or so turns on both rotor and winding jig. If this difficulty is experienced to any serious extent, it may be desirable to apply a little thin shellac varnish at intervals during the winding operation. Either of the two methods of connecting up already mentioned may be employed.

(*To be continued.*)

Jottings by the way

A Grim Jest.

THERE should be nothing in our pleasant wireless intercourse that could be dubbed ostentatious, blatant, overweening, or swollen-headed. We shall not thump the drum nor be guilty of undue (that word has its importance) exaggeration. The term "swank" could not possibly be applied to our conduct.

This, I am sorry to say, is not true of that fellow Tupkins, who dwells not far from me—no one can be very far from anyone else in Little Puddleton, which, though it boasts a Chamber of Commerce, a municipal band, and four platforms at the railway station, is marked by the merest dot on maps of quite respectable size. The purpose of those four platforms, two up and two down, is entirely to provide the station master with the opportunity of enlivening his otherwise dull existence.

On a hot morning you may see scores of us assembled on No. 4, the "Up Slow," awaiting the arrival of the 8.27. Just as a few puffs of smoke arise above the cutting, heralding the instant approach of our train, the stationmaster rushes on and roars: "Fast side the up train." Then all of us, lean and stout, young and old, first and third alike, join in one unseemly scramble down the stairs, through the subway, and up the other stairs to No. 2, where we arrive breathless and dishevelled—a grim jest which succeeds every time.

Vulgar Swank.

But I digress. I was telling you of Tupkins, who has of late overstepped the limits of real wireless decency. Here is what happened; pray judge for yourself from these facts.

I was strolling in my garden the other evening picking fat caterpillars from promising cabbages and showing Percy, the greenfly, that he was not wanted upon the rosebuds, when suddenly my peace was rudely disturbed. Tupkins's window was flung up, and out of it was thrust the spout of his loud-speaker. In a few moments the strains of 2LO's dance band were filling the air.

Within ten minutes the largest crowd ever seen in Little Puddleton had collected, and the fat policeman who looks after our lives and liberties had waddled up in two minds about moving on the dozen or so who constituted it. Amongst the serried ranks I saw the chief reporter, who is also editor, sub-editor, and "Clubman" of the *Little Puddleton Gazette*. The whole thing was too disgusting for words. Here was Tupkins showing off in the most hideously unashamed manner and no doubt visualising a vast heading for the *Gazette's* splash article in its next issue, "Local Expert Gives Wireless Treat."

You know the kind of article: it is all about "a fine experimental set," "a revelation to the uninitiated," and all that kind of thing, and drags in remarks about such well-known wireless instruments as tuning inductions, variocondensers, inaction coils, eyetension batteries, potiometers, and rearstates. But, anyhow, it is publicity, and advertisement pure and simple was what the mean soul of Tupkins was seeking.

Reprisals.

Such conduct would spur any decent-minded radiophile (is not that a beautiful word?) to instant action. Immediate reprisals were indicated, you will admit. Without unseemly haste I left the caterpillars to gnaw, and Percy to work his will for the nonce upon the rosebuds. A score of virile strides brought me to my wireless room. My jaw jutted like that of a cinema hero. A twist here, a touch there, and *my* loud-speaker was announcing an item not from near-by London, but from distant Birmingham.

The crowd began to move towards my habitation. The reporter-editor sharpened a fresh pencil. When 5IT had done his bit Tupkins turned on the still more distant Cardiff, and for a few brief moments the battle swayed in his favour. But with the help of a hefty reaction coil I responded with a cornet solo from Newcastle. This damped his ardour for a moment, and I began to believe that modesty and common decency had won the day.

My triumph was short-lived. Within a minute the crowd, now a full score strong, had stampeded to his hovel to hear a Burns recitation from Glasgow.

Victory.

Lesser men might have given in at this point and acknowledged themselves wiped metaphorically off the face of the ether. But your "Wireless Wayfarer" is of the bulldog breed that never knows when it is beaten. Hardly had the "aiblins," the "airts," the "Guid-willie Waughts," and the "Drumlies" of 5SC ceased to perplex the Sassenach listeners when accents of quite another kind fell athwart the evening airs, flung far and wide from the business end of *my* loud-speaker. "Say bo," the voice drawled, "this is WJZ, the broadcasting station of Nooark, Noo Jersey, in the Yewnited States of America, calling. Our next cahntributions to your enjoyment will be some hop stuff. The orchestra will now dish out 'Kitten on the Keys.'"

Wonder, amazement, stupefaction on the part of the mob, who now dropped Tupkins and did a concerted sprint to my abode. I observed the editor-reporter tearing out and destroying the already written pages of his notebook and feverishly resharpening his pencil. The first selection was followed by "Where the Bamboo Babies Grow," and later by "At the Bobbed Haired Babies' Ball," of which *The Gazette* was good enough to remark: "Every note was as clear as if it had been played by our own band in our own town."

How the Right was Vindicated.

That remark was intended to be complimentary, and I take it in the spirit in which it was meant; strictly it might be regarded as an insult, for the Little Puddleton band has an absent-minded cornet player who frequently manifests his dislike of merely following where others lead by playing in an entirely different key from the rest of his fellow-criminals.

Still, the writer was not as far from the track as he might excusably have been in his glowing appreciation of "Our Wizard of the Ether," for, as a matter of absolute fact, the tunes *were* played in Little Puddleton, though not by the town band.

You remember, perhaps, the super-circuit which I gave in these columns only last week? Foolish ones have scoffed at it; others more appreciative of true genius, declare that they would not be without it. Anyhow, thanks to it, a cold in the head—which rendered the nasal accents easy—and three excellent gramophone records, I have so shivered the timbers of Tupkins that his windows have remained hermetically sealed ever since, and I see that his loud-speaker is one of the most desirable lots at the forthcoming sale of furniture and miscellaneous effects billed to take place at the Town Hall next week.

A Sad Case.

We have one rather sad case amongst our little community. It is that of Slobbsmith, who until recently held his head high in our midst and was universally regarded as a coming Chairman of the Sanitary Committee. He was already a man of some note, having climbed the initial rungs of the ladder that leads to power by winning the last place on the list of Parish Councillors after the most spirited contest that had ever taken place within the memory of the oldest inhabitant.

His credit was good; his wife garbed herself in the most expensive confections created by our local *modiste*. He was, in fact, regarded as a safe man with a safe future. Now he slinks furtively about in trousers that bag at the knees and a hat that would be an insult to a self-respecting scarecrow, whilst Mrs. Slobbsmith's once ample form is clad in the nearest possible approach to sackcloth and ashes.

The Dire Cause.

He scoffed at first at wireless. Then he took to dropping in upon those of us who possess sets, and, after making disparaging remarks about us and our obsession, as he called it, expressing a desire that we should "turn the thing on so that he might hear how bad it could be."

When he had visited me on various pretexts five times in one week I diagnosed the early symptoms of an attack of acute radiomania. The following week I observed two perspiring workmen bearing a scaffold pole into his back garden.

When I remarked: "Hulloa, hulloa, *hulloa!*" he turned rather red about the gills and explained that he had always wanted a weathercock. Within a couple of days a wire had joined the top of that pole to a top-floor window, and the progressive flattening down of Slobbsmith's projecting ears marked him out as a habitual user of headphones.

The Rake's Progress.

He began with a crystal: "All you need, my boy; why waste a pot of money on valves and things when a little set like this lets you hear as much as any reasonable man can want?" He became dissatisfied with concertite as a rectifier, and tried in due sequence hearite, allrite, deafenite, thunderite, and blatherskite.

His collection of crystals soon required a whole cupboard to itself. Then he added one valve, which shortly found itself lonely and demanded a brother. Variometers, variocouplers, vernier condensers, variable gridleaks increased and multiplied upon his shelves.

Whenever he went up to London, he returned laden with parcels. If you met him in the train he would unpack them to show you his latest purchases. His wife asked for bread, or, at all events, something to buy it with, and he begged her not to talk whilst he was engaged in tuning in.

Last Stage of All.

He cannot pass a wireless shop. His last penny has gone—on gadgets. The tradesmen sue him for their unpaid accounts, and he received them with headphones clamped about his ears, explaining that he can hear nothing whilst wearing them. His bosom friend is now the potboy of the "Pig and Whistle," with whom he spends hours in discussing circuits of so intricate a type that they make sane mortals' brains reel. His once fat bank balance has become an overdraft. His only future is in the workhouse, the destinies of which he might have directed from the chairman's seat of authority had not the fell disease obtained a grip upon him. Yes, it is a heartrending story and a warning to all of us.

WIRELESS WAYFARER.

THREE MONTHS OLD

A few remarks regarding the progress and policy of "Wireless Weekly," by the Editor.

THIS issue is No. 1 of the second volume. This journal is now a little over three months old, and I am anxious to take this opportunity of reviewing, not only the progress already made, but the future policy of the journal.

During the past three months many changes have taken place. *Wireless Weekly* was published at the beginning of the depression which resulted from the attacks on the Broadcasting Company, and the dilatory manner in which the licence problem was handled. We came into a field already full of wireless periodicals, and even those who looked forward to another publication from Radio Press were sceptical of success.

This three months has more than fully justified our enterprise. This period of depression has proved that there are two distinct classes of those interested in wireless. We have the superficially interested, who crumple up and become deserters the moment popular fancy changes. On the other hand, there are some 50,000 really keen devotees.

The whole policy of this journal has been to appeal to this latter type of radioist. In this we have succeeded, and anyone interested in the relative position of *Wireless Weekly* and the other wireless papers has only to ask a bookstall manager whom he knows personally how the sales of this periodical compare with others. This crucial test of popularity is one which we would only ask readers to apply if we were certain of the result. It will be found that *Wireless Weekly* now heads the list of the weekly wireless papers, although a couple of months ago it was third on the list.

The competition of wireless periodicals has become severe, owing to the entry of general publishers into a field which promised to be remunerative. The success of *Wireless Weekly*, in spite of its youth and the depressing conditions existing in the wireless industry to-day, is eloquent proof that a wireless paper, to achieve permanent success, must be run by wireless people.

I hope my readers will forgive me if I touch on the question of advertising. It is a matter which affects the reader profoundly, and I believe that only good can come of taking him into our confidence.

Advertisements are not only interesting reading matter, but they are essential to a periodical. The reader has no conception of the costs involved in the production a periodical of this kind. The expenses of a hightly specialised editorial staff constitute only one item of the high costs of production.

Anyone who looks at the list of staff on the contents page will see that I have gathered round me the majority of the leading wireless writers in the country.

With regard to the class of articles published, I find that readers' tastes vary enormously, but, judging from the satisfactory position of the journal to-day, I can only infer that the editorial contents are appreciated. Nevertheless, we are all constantly striving to improve matters, and we are happy to consider any suggestions for doing so. I want every reader to feel that there is a bond of sympathy between Devereux Court and himself. We are giving of our best.

To return to the question of advertisements, it is a remarkable tribute that, in spite of the depression, our average advertising has increased materially. I ask the readers of this journal to buy their apparatus from advertisers in it. No doubtful advertisement is passed, and immediate action will be taken should any of our readers at any time make a complaint. Our advertisers know this, and by mentioning *Wireless Weekly* you are not only pleasing them and us, but you are safeguarding yourself.

With regard to the policy of the paper, I am anxious to emphasise the independence of its outlook. It is the official organ of nobody, untrammelled by any association which might influence our judgment, and we intend to criticise impartially and fearlessly whenever there is necessity for such criticism.

THE RADIO SOCIETY OUTING

By GEO. SUTTON.

The following article describes a radio club's summer outing during which several interesting experiments were conducted.

MEMBERS of most wireless associations are in great danger of becoming very insular. They rightly enough consider that there is no club like their own. They become regular attenders, for the reason that their committee always have something new by way of valuable information to broadcast to them.

Whatever the motive, they go and they come away again and go next week, and wireless science is bounded by the four walls of their meeting-room. Very wideawake and up-to-date clubs exchange lecturers with neighbouring clubs and so get a breath of fresh air in from outside. Occasionally, wireless clubs hold a demonstration in a near-by hall or respond to an appeal for assistance from the promoters of a Church Bazaar.

This sort of thing grows by what it feeds on, and, once having broken bounds, so to speak, the members long for even greater freedom. Why cannot we have an outing? Well, really, why not? The one who seems least enthusiastic is the secretary, for he well knows the amount of work which will devolve upon him from the moment that the decision is arrived at till the last letter, written to the railway company after the event, asking for news of the club accumulator left under the seat of the carriage by the club member who vociferously demanded the honour of taking charge of it on the way home. But we are anticipating.

Having decided that it is in the interests of wireless in general and our club in particular that an *al fresco* demonstration should take place, the first thing to fix upon is the day. If there were many more than seven days in the week, there would always be one day upon which it would be impossible for some important member to attend.

At last a day is found which suits the majority, and the disappointed ones, assuming a badly-fitting air of martyrdom, subside to console themselves with the reflection that they will not have to buy railway tickets, and perhaps, after all, they will have something more worth while on their own home sets.

The next debatable point is the place where the meeting is to take place, but this is not nearly so exciting.

A member asks if ladies will be invited, as his sister would like to go. Several others have sisters of their own or who could be adopted for the occasion and who would also like to go, and it is decided to include ladies.

A list of requirements is made out, and it is found that there is enough loanable equipment amongst the members to equip six expeditions. How we wished afterwards that we had caused the material to be dumped some days before the date at our headquarters. We should not then have found ourselves possessed of six accumulators and not a single spare valve in hand. But again we are hurrying too fast.

The day fixed upon for our excursion event duly arrived, and at 1 p.m. we congregated at the railway station. We had taken the names of forty members who desired transport tickets, and though we fixed the time of meeting at the station a quarter of an hour before the advertised time of the train, and so permitted the ever-tardy Smith to join us ten minutes late, we only mustered twenty-five persons.

We had thoughtfully collected the 2*s.* 6*d*. per ticket in advance, but we wanted the attendance rather than the money. The journey down and the half-hour walk at the other end were most enjoyable, and on a fine, high, rolling hill we erected our temporary aerial (100ft. long and 10ft. above the ground) upon a couple of well-stayed bamboo rods which we had brought along for the purpose. We immediately obtained good signals on our club set, whilst other little groups which had gathered together also got good signals on all sorts of comic aerials, some a very few inches off the ground.

We suspected our earth connection to have high resistance, but could not think of any permissible way of improving it, as the ground was very open and dry. There was about as much chattering as is usual from sparrows in the ivy at bed-time, before we settled down, but we were all quiet at last. Never did we before set such store by the Children's Hour from 2LO, that station being clearly received, as were signals from GNF and several ships.

As this was a trial outing, we had not thought it advisable to apply to the authorities for an extension of any of our several club members' transmitting licences to cover this excursion, but we are determined to do so next time.

After tea the return of some to the sets, and the brief exploring rambles of others, after being given strict instructions to meet at the railway station for the last train at 8.30 p.m., for the return journey, wound up the day.

News of the Week

A THRILLING instance of assistance given by wireless to disabled vessels in mid-ocean is reported from the Furness liner *Sachem*. After a strenuous battle with Atlantic storms during a tow of 750 miles this vessel has brought the Norwegian ore-carrying steamer *Capto* safely to harbour at St. John's, Newfoundland.

The *Capto's* wireless distress call, reporting the loss of a rudder and asking for assistance, was picked up by the *Sachem* when the vessels were about 100 miles apart, and the *Sachem* immediately steered in the direction given. A heavy gale was raging, and although the *Sachem* searched thoroughly she could not locate the disabled ship. The Canadian Pacific liner *Montclare*, equipped with Marconi direction-finding apparatus, plotted the exact position of the two ships from the signals they were sending out, and communicated the information to the *Sachem*, which then soon came up with the *Capto*.

After many hours' strenuous work a hawser was connected, and the long tow began. That evening the hawser parted, and the ships drifted about until morning owing to heavy seas. With great difficulty the towline was restored, and again the hawser failed, this time in field ice with the gale increasing and developing into a blizzard with blinding snow. The wireless operators were continuously on duty in order to maintain communication between the two ships. It took ten days to weather the conditions and reach harbour, and it was a welcome sight when the worn-out mariners made Cape Spear, and ended one of the longest tows of recent times.

There have been numerous instances during the last few years of vessels in distress miscalculating their positions by dead reckoning and only being saved from complete disaster by the assistance given by other vessels, which have been able to take bearings with direction-finders, and this adds another instance to the list. But on this occasion the value of wireless was demonstrated in more than one direction. By its means the call for assistance was sent out, the correct position of the disabled vessel was determined by wireless direction-finding apparatus, and it was a means of constant communication between the two ships from the time the distress call was sent until both vessels were safely anchored in St. John's Harbour, some thousands of words being exchanged.

Steamboats on the Lake of Geneva are being equipped with wireless sets so that passengers may hear the wireless news and concerts.

We hear that each of the five "Bay" ships of the Commonwealth Government Line carries two motor lifeboats fitted with wireless transmitting and receiving sets, having a range of fifty miles. These lifeboats are, it is stated, capable of towing all the other boats at a good speed.

With regard to the question of broadcasting in Sweden the Government has decided that the Telegraph Board shall invite offers for the right of carrying on the broadcasting service and shall confer with the military authorities and the Meteorological Institution. It was also decided that the Government shall establish broadcasting stations and control the development of the service.

The reception of news on board a ship in mid-ocean is always an event of importance. For business men the information received is often of great value, and from the social point of view the news is a great source of interest and whiles away the tedium of the long days of sea travel. Even on such a voyage as that to Australia the passengers can be kept informed of the latest "home" news. Voyaging to Australia *via* Cape Town recently, the Aberdeen liner *Themistocles*—fitted with the latest Marconi wireless apparatus—was in touch with land stations in Great Britain the whole time, and was able to receive 65,000 words of news, representing 738 words daily throughout the trip.

Now that the saloon steamer *Greyhound* is making long trips between Belfast and Douglas the entertainment facilities afforded by the excellent wireless receiving set aboard are much enjoyed. On the occasion of the recent trip to Manxland organised by the Belfast Sporting Guardian Society, the programmes received were voted excellent. Naturally there was a multiplicity of communication between steamers on all sides, but interference from these was practically eliminated by the ship's operator.

The Department of Overseas Trade has received copies and translations of Royal Decrees No. 1067 and 1262 of the 8th February and 5th June, 1923, published in the Italian *Gazzette Ufficiali* of 29th May and 20th June respectively. These decrees, which contain regulations concerning the wireless service in Italy and the granting of concessions and licences to companies, public bodies and private individuals for the installation and use of wireless plant, may be inspected by interested persons on application to the Department of Overseas Trade.

A special message was broadcast on Thursday, the 5th of July, at 7.15 p.m., congratulating the Radio Society of Great Britain on the attainment of its tenth anniversary. The message took the following form :—

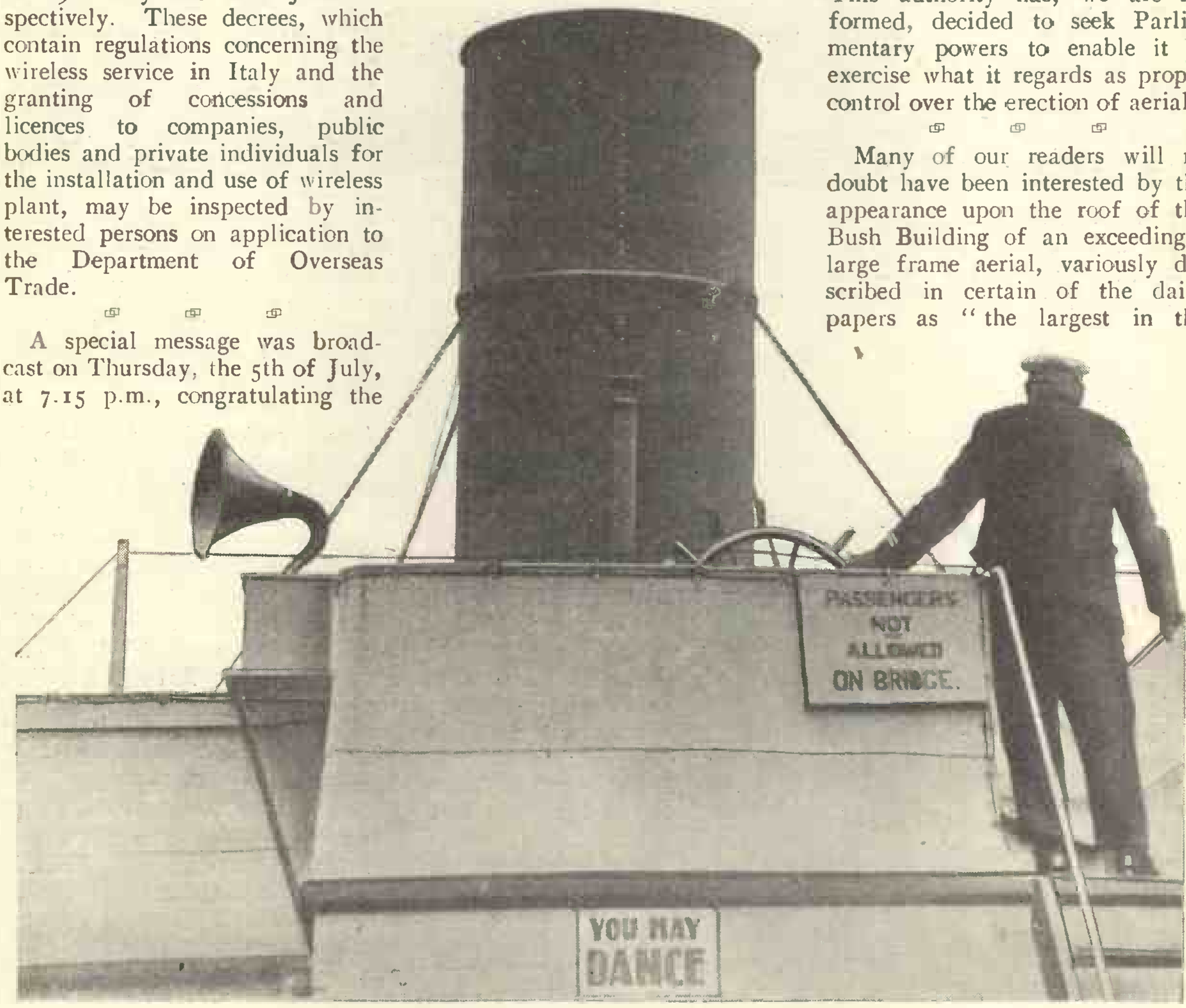
" We understand that to-night is the tenth anniversary of the foundation of the Radio Society of Great Britain, originally known as the Wireless Society of London, which institution is now the parent of close on two hundred radio societies throughout the provinces.

" Three of the original officers of the Committee, Messrs. L. McMichael, R. H. Klein, and L. F. Fogarty, have held office for the whole period of 10 years.

" It is interesting to note that the first general meeting of this Society was held at the Institution of Electrical Engineers. which is almost directly beneath the present studio of the London Station, and at that meeting General Ferrié sent a special message of congratulation, which was received on a crystal set and projected by an inking device and lantern on to a screen in the hall."

The tendency of local governing bodies to attempt to impose restrictions upon the installation of receiving sets is further exemplified by the recently reported action of the Leeds Corporation. This authority has, we are informed, decided to seek Parliamentary powers to enable it to exercise what it regards as proper control over the erection of aerials.

Many of our readers will no doubt have been interested by the appearance upon the roof of the Bush Building of an exceedingly large frame aerial, variously described in certain of the daily papers as " the largest in the world," " the world's record frame," and so forth. This frame forms part of the receiving equipment of a United States Government Station, used by the United States Shipping Board for reception from the American station at Annapolis. The frame is 23ft. long and 12ft. high, with 33 turns of wire, and it gives strong signals with a three-valve Navy receiver. The station is in charge of Mr. R. H. Redmond, late of the United States Navy, and has recently been transferred to the Bush Building from another address, where it had been in use for some years.



Wireless for the holiday-maker is provided on a Brighton steamer, loud-speakers being distributed over the vessel.

THE ACTION OF THE FRAME AERIAL

By J. H. T. ROBERTS, D.Sc., F.Inst.P.

A clear exposition of the manner in which a frame aerial picks up energy from passing electro-magnetic waves.

THE frame or loop aerial, owing to its portability and the facility with which it may be erected and manipulated, has recently come much into favour. Although a great deal has been written upon the theory of the vertical outdoor aerial, the *modus operandi* of the frame

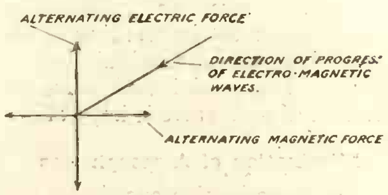


Fig. 1.—Perspective view, showing the direction of the components in electro-magnetic waves.

aerial is often little understood, and questions as to the action of the frame aerial are frequently received from wireless amateurs. For this reason, I thought it would be useful to give a simple account of the manner in which the loop aerial acts as a receiver of electro-magnetic radiation, and also to describe some of its principal characteristics.

It is probably well known that electromagnetic waves, such as those employed in wireless tranmission, include two components, known as the electric component and the magnetic component. These two forces operate in directions at right angles to one another and to the direction of progress of the waves, and under ordinary conditions the electric force in the advancing wave is in the vertical direction and the magnetic force in the horizontal direction. If a vertical conductor, such as an ordinary vertical outdoor aerial, be encountered by the waves, the electric force, being parallel to the aerial, sets up electrical oscillations which are detected in the usual way.

Now if we have a loop of wire in a vertical plane and edge-on to the advancing electromagnetic waves, it will be evident that the magnetic forces (being horizontal and at right angles to the direction of propagation) will be at right angles to the plane of the loop. As the waves advance, therefore, there will be "puffs" of magnetic force passing through the loop, and consequently induced currents will be created in the coil.

In some ways this effect is similar to that which is familiar in electromagnetism, namely, the production of an induced current when a magnetic flux is created within a coil of wire. Whereas, however, in ordinary applications of electromagnetism we usually have a coil moving through a variable magnetic field, in the case of the loop aerial we have an alternating magnetic field travelling past the coil with great velocity (the velocity of light). The electromotive forces generated in the two sides of the coil are equal to one another, but since the travelling wave strikes one side of the coil before the other, there is a difference in time-phase; this difference will evidently be greatest when the coil is edge-on to the direction of travel of the waves, for in this position of the loop the wave has to travel the greatest distance between passing one side of the coil and reaching the other side. It is, therefore, in this position of the coil that the greatest voltage is generated by the incidence of the waves. If the coil is flat-on to the waves, there is no difference in time-phase between the electromotive forces generated in the two sides of the coil; the two electromotive forces neutralise one another and there is no electromotive force created in the coil. In other words, the coil has its maximum sensitivity when placed edge-on to the advancing waves, and zero sensitivity when placed flat-on to the advancing waves. The preceding remarks are on the assumption that the coil is always in the vertical plane, that is, capable of rotation about a vertical axis. It will be seen that if the coil is laid in a horizontal plane it will be insensitive to horizontally propagated waves, for no voltage will be generated in the coil owing to the fact that the magnetic lines of rofrce slide past the wires without cutting across them.

Directional Properties of Loop Aerial

In ordinary practice, a loop aerial would never be laid flat

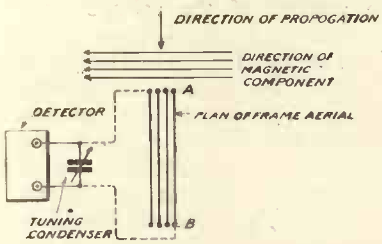


Fig. 2.—Illustrating phase-effect in a frame edge-on to advancing waves.

upon the ground, but would be mounted so as to be capable of rotation about a vertical axis. Since the loop gives the maximum effect when edge-on to the waves and zero (or minimum) effect when flat-on to the waves, it may be used for determining the direction from which the waves are proceeding. Many types of wireless direction-finding apparatus are based upon the directional properties of frame aerials.

When making experiments with a frame aerial with a view to locating the direction of a transmitting station, it should be remembered that the frame aerial only indicates the direction in which the waves are travelling in the immediate vicinity of the aerial. If there has been no interference with the direction of travel from the transmitting station to the aerial, the directional indications of the aerial will be correct. These conditions are usually realised in open spaces where there is little or no distortion. But if the aerial is located within a building, particularly one which contains many steel girders, etc., there will usually be considerable distortion of the waves, and the direction in which the waves are travelling at any particular point in the building may be very different from that which would correspond to the true bearing of the transmitting station.

In Fig. 2 is shown a plan of the loop aerial, where it will be noticed that the two sides A and B are cut by the horizontal magnetic lines of force. The voltage produced in both of the sides A and B is upwards (at the moment represented by the figure), and if the amount of the voltage were the same in A and B, there would be no resultant induced current in the coil. But as has already been explained, owing to the distance apart of the wires at A and B, the two induced voltages are not in step; or, to express the matter more correctly, there is a difference in phase, and consequently a resultant electromotive force is created at the terminals of the coil.

It will be evident that the greatest useful difference of phase is that corresponding to *half a wavelength*, for then the voltages created in the two sides of the coil have a phase-difference of 180 deg. and their two effects add together. In the case of the wavelengths employed for broadcasting purposes in England, half a wavelength is of the order of 200 metres, and it is obviously impossible to employ a coil 200 metres across. It is remarkable, however, that even when a coil of 1 metre side is employed (which represents only one-half of 1 per cent. of the optimum dimensions), satisfactory results are still obtainable. With suitable amplifiers, waves up to 20,000 metres in length are easily picked up on a frame aerial of 1 metre side. This is in many ways a most extraordinary result: in fact, the simple theory of the action of the frame aerial does not entirely explain the properties of the coil, and the sensitivity which is obtainable is greater than that which would be anticipated from the theory. It may be remarked in passing that the theory of the action of a frame aerial, although a large amount of theoretical and mathematical work has been carried out in connection with it, is still somewhat obscure.

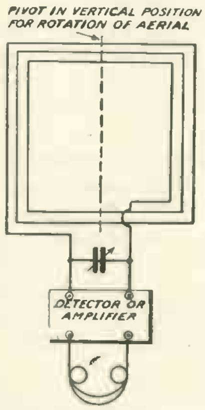


Fig. 3.—Frame arranged for rotation about vertical axis

Although the results obtainable from a frame aerial are so extraordinary as compared with what might be expected from theory, it must be remembered that the total amount of energy intercepted by the frame aerial is excessively small, and it is very important, in using such an aerial, to avoid as far as possible all losses of energy and also to tune the coil by means of a condenser so as to respond most effectively to the incoming waves. It is in fact only by the use of amplifiers that satisfactory results can be obtained from a loop aerial of ordinary dimensions, and crystal or single-valve receivers are useless for this particular class of reception. The amplified current should be arranged to react upon the coil or frame aerial (which is equivalent to reducing the resistance of the coil), and with reaction in this way extraordinary sensitiveness has been obtained, as shown by the remarkable achievements with frame aerial reception for transatlantic working. It must be repeated, however, that for exceptional results of this kind every possible refinement must be introduced; each valve must be working at its best, and careful manipulation of the grid potential and filament current of each valve is imperative.

Elimination of Atmospherics

The directional properties of the frame aerial have already been discussed, and we have remarked how the presence of steel girders, etc., in a building in the proxmity to the frame aerial may give rise to shadow and distortional effects. The directional properties of the aerial permit also the cutting out of unwanted stations in reception, for by rotating the aerial about its vertical axis it can be adjusted to the best position for the desired station, which, in general, will not be the best position for the unwanted stations.

An important special case of this cutting out of interference has reference to the elimination of atmospherics. In Great Britain the atmospherics are found to arrive principally from a southerly direction; if a frame aerial, therefore, is placed east and west, that is, so that it is flat-on to the southerly direction, it will be found to be comparatively free from disturbances due to these atmospherics, which would have a considerable effect upon an ordinary outdoor antenna.

It has been mentioned above that for satisfactory working of the frame aerial, reaction coupling in the amplifier is desirable. The radiation from a frame aerial, when oscillations are set up therein by reaction with a valve amplifier, is much less than that from an extended antenna, and consequently a much greater degree of reaction may be employed, in accordance with the regulations regarding receiving sets, when using a frame aerial than when using a line aerial.

Another interesting application of the directional properties of the frame aerial is the foreshadowing and tracking of thunderstorms.

Plain Aerial Effects

Owing to the capacity of the frame aerial system (residing largely in the batteries, etc.), a condenser effect to earth is set up, and the frame aerial acts in addition as a plain vertical aerial; this results in a reduction of its directional effect. Or, to put the matter in another way, the capacity current flowing to earth through the tuning condenser (regarding the frame aerial as a plain vertical aerial) is practically independent of the orientation of the frame aerial; thus the position of *minimum* sensitivity of the frame aerial is not one of *zero* sensitivity. It is found that this effect is to a large extent overcome if the frame aerial and the whole of the receiving circuit is raised from 10 to 20 ft. above the earth.

Amplifiers with Frame Aerial

For wavelengths below about 2,000 metres, the high-frequency transformer type of coupling has proved most suitable for use in frame aerial reception, whilst for longer wavelengths, resistance coupling is quite satisfactory. In general experimental work a combination of the two is frequently used; this is on account of the extra stability of the amplifier when made up into the form of one or two H.F. transformer stages, followed by several resistance-coupled stages with one or two L.F. stages with iron core transformers.

Six valves were commonly regarded as necessary for satisfactory reception with a frame aerial, but recent developments in the use of special circuits (employing the Armstrong super-regenerative valve circuit) have shown the possibility of obtaining the necessary degree of amplification with only one or two valves.

Dimensions and Details of Frame Aerial

The insulators employed in the construction of a frame aerial should be ebonite or porcelain, and the adjacent turns should be spaced at least 1 centimetre apart, for frames of about 1 metre side, up to 3 centimetres for frames of 3 or 4 metres side.

If the wires are spaced in this way, the natural wavelength of the frame aerial will be about 5 to 10 times the length (in metres) of the wire used, provided that the space between the turns is occupied by air. For example, in an ordinary frame aerial consisting of a square frame of 1 metre side wound with 24 metres of wire spaced 1 centimetre apart, the natural wavelength would be approximately 200 metres.

Size of Wire

The size of the wire employed for winding a frame aerial is not particularly important, and a wire about 1 millimetre in diameter, or 20 s.w.g., is quite suitable. Since the sensitiveness is so extremely small compared to that of a good outdoor aerial, and since it is therefore absolutely essential to rely upon a considerable degree of amplification, there is very little point in going to the refinement of using stranded enamelled wire in the frame aerial, the adjustment of the amplifier being of enormously more importance. It has been found in practice that it is best for short wavelengths to employ a small number of turns of wire on a frame as large as convenient, the natural wavelength of the frame aerial being arranged to be below that of the shortest waves which it is desired to receive.

Tuning

Usually the capacity required for the tuning of a frame aerial is not greater than about 0·001 μF. If it is desired to receive a considerable range of wavelengths, it is best to divide the aerial into different numbers of turns, switches being arranged so as to include in the circuit different numbers as required. It is desirable, however, as far as possible to avoid dead turns, this being particularly important for short wavelengths. It has also been found in practice that the best results are obtained with high-power amplifiers when the frame aerial has a natural wave-length about one-third of that of the incoming signals.

The electromotive force produced in a loop aerial, according to Dellinger, is proportional (amongst other things) to the height of the loop, the horizontal length of the loop, and the number of turns, and inversely proportional to the square of the wavelength. Thus E.M.F. is proportional to

$$\frac{h\,l\,n}{w^2},$$

where

h = height of frame;
l = horizontal length of frame;
n = number of turns;
w = wavelength.

Since the E.M.F. is proportional to the number of turns, the horizontal length, and the height, it is obviously proportional to the area-turns, that is, to the summation of the areas of all the turns.

It is advisable to make the linear dimensions as large as possible. This, however, limits the number of turns, since for any particular wavelength the total inductance is limited (the wavelength depends upon the product of the capacity and the inductance, and there must be some capacity in the circuit).

Comparison of the electromotive force generated in a 3-metre loop aerial having 3 turns of wire, the wavelength being 1,000 metres, with the electromotive force generated in a plain aerial 20 metres high, has shown the ratio to be 1 : 72, which emphasises the need for using amplifiers in connection with loop reception.

INTERFERENCE PREVENTION

By Prof. E. W. MARCHANT.

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

(Concluded from No. 14, page 790.)

A VERY ingenious arrangement has been devised by Mr. Weagant, of New York. It is a device which has been applied to long waves with considerable success. Weagant uses two aerials. Fig. 4 illustrates the principle.

There are two aerials or two frames. These are arranged half a wavelength apart. If one is working on a 5,000 metre wave, they would be 2,500 metres apart. A positive current is produced in one loop of the aerial and a negative current in the other loop. These currents go through C_1 and C_3, and the circuits are so arranged that they produce opposite E.M.F.s in the coil C_2, so that if the waves produce positive current in one aerial and a negative current in the other aerial there will be a signal in the detector. If the waves strike the two coils simultaneously, they will produce two equal currents. These two equal currents produce opposite effects in the receiving circuit and balance each other out.

The two loop antennæ are both tuned for the wave it is desired to receive. They are connected up to two coils, inside which is a rotating coil which is coupled to both. This rotating coil can be moved so as to obtain equality of E.M.F. from the two receiving circuits, the circuit coupled to the rotating coil being also tuned to the received wavelength. This arrangement cuts out all disturbances that strike the two loops at the same time. Mr. Weagant found that a large number of atmospherics appeared to come from a vertical direction and struck both antennæ simultaneously. These atmospherics he called "grinders" because of the noise they made in the telephones. Grinders were got rid of altogether by this arrangement, but it

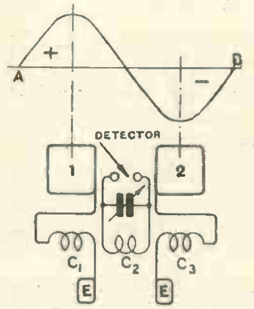


Fig. 4.—Principle of the Weagant arrangement.

was not effective in getting rid of a second type of disturbance which he called "click." "Grinders" were supposed to be due to thunderstorms occurring in the upper regions of the atmosphere and "clicks" to thunderstorms and lightning discharges near the surface of the ground, and, of course, a thunderstorm near the surface of the ground produces a

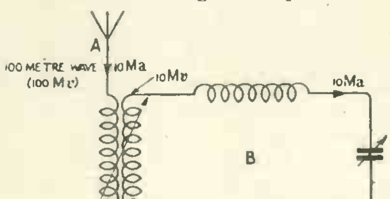


Fig. 5.—Distribution of current and potential in receiving oscillatory circuits.

wave which would not necessarily strike the two coil aerials at the same instant.

(Prof. Marchant then gave details of the Weagant tank method of eliminating atmospherics, a description of which appeared in the *Proceedings of the Institute of Radio Engineers.*)

Interference from Other Transmitting Stations

Getting rid of signals from other stations is a very much easier problem to solve than getting rid of atmospherics, because the wavelength of the interfering signal is known, and, as a rule, the signals are due to continuous waves. The most effective way of eliminating the influence of other stations is, of course, by accurate tuning. There are two methods of tuning which are important. One can get accurate tuning (selectivity) by using a number of circuits. That was the old way.

Take the case of a receiving circuit which is accurately tuned (see Fig. 5). Suppose there is an aerial A, and a secondary circuit B tuned to it. Now assume that all these are tuned for waves of 100 metres, and that there are also waves of, say, 99 metres wavelength striking it. With a sharply tuned circuit one can make the current in the antenna circuit about one-tenth (or even less) as strong for the 99 metre wave as for the 100 metre wave, so that if one supposes that two waves are reaching the aerial A simultaneously, of 99 metres and 100 metres wavelength respectively, the current in the antenna will be one-tenth as strong for the 99 metre wave as for the 100 metre wave. If the circuit B is also tuned for 100 metres let us assume that, when it has a certain E.M.F. applied, corresponding with a wavelength of 100 metres, there is, say, 1 milliampere flowing, but that the same E.M.F. of a frequency corresponding to 99 metres will give 1-10th of a milliampere. If one compares the effect of two waves of the same amplitude reaching A, one of 100 metres wavelength and the other of 99 metres wavelength, there will be a current of 10 milliamperes in the aerial A and an E.M.F. of, say, 10 millivolts in the circuit B, due to the 100 metre wave, as compared with a current of 1 milliampere in the aerial A, and an E.M.F. of 1 millivolt in the circuit B, due to the 99 metre wave. Since the circuit B is tuned for the 100 metre wave, there will be a current round it of, say, 10 milliamperes due to the 100 metre wave, as compared with 1-10th of a milliampere due to the 99 metre wave.

Theoretically, the more circuits there are, the sharper the tuning, but one cannot go on increasing the number indefinitely because every time there is a transformation or coupling, there is loss of energy, and it is not practicable to use more than four or five circuits. This principle was made use of many years ago in the Marconi multiple tuner. The thing that has improved sharpness of

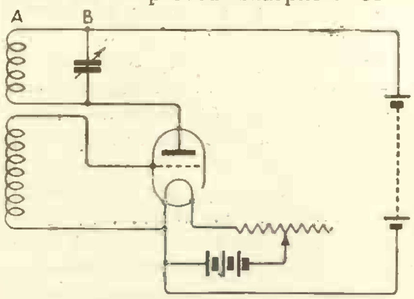


Fig. 6.—Reacting valve for reducing the effective resistance of the grid circuit.

tuning most, during recent years, has been the use of reaction. If reaction is used in the receiving circuit, the effective resistance of the receiving circuit may be reduced to zero. With an ordinary detector valve, the plate circuit of the valve may be made to react on the grid circuit in the ordinary way (see Fig. 6), with the result that the effective resistance of the grid circuit=0. The "steepness" of the tuning curve for an oscillating circuit depends upon the resistance in the circuit. If there is a large resistance the

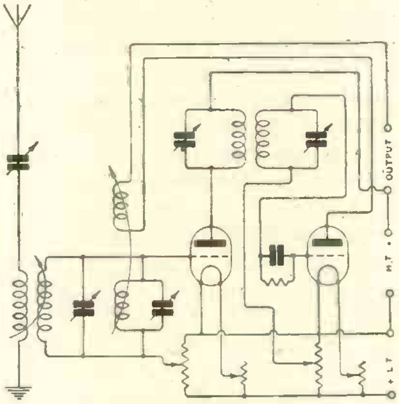


Fig. 7.—One of the most successful circuits for reducing interference.

resonance curve is flat and relatively broad, whereas if there is a very small resistance, the resonance curve becomes steeper, and the tuning is very sharp. Therefore, if one uses reaction one can get a much sharper tuning than is possible without it, and the use of reaction has done probably as much as multiple circuits did to improve the sharpness of tuning. Anyone who has had experience of the use of reaction knows how much the sharpness of tuning is improved by its use. Of course, one must not use reaction in the aerial circuit, but one can use it in the other circuits. We have not found reaction completely effective, however, as far as getting rid of disturbance from ships is concerned, and we have been making a good many experiments lately on the tuned circuits which I think were described in the first number of *Modern Wireless*. For convenience one may call them the Hinton rejector circuits, though I am not sure that Mr. Hinton was the first person to use them.

The circuit which we have found most satisfactory from the point of view of reducing disturbance is shown in Fig. 7. A shunt is connected across the tuned secondary circuit (see Fig. 7) consisting of a condenser and inductance with reaction coupled back on to the plate circuit of the detector valve, both the secondary circuit and the shunt circuit being tuned for the received wavelength. Now in such a circuit, if one calls $L\omega$ the reactance of the coil, then the impedance across the circuit for currents of the frequency for which it is tuned is $\frac{L\omega^2}{R}$, R being the sum of the resistances of the condenser and the coil. Therefore, one can make this circuit of practically infinite impedance for signal currents that it is desired to receive, and one can make the circuit of relatively low impedance for such signals as it is desired to eliminate; one can design the coil within limits, to give very high selectivity. We have found this circuit extremely good. The signal comes in and produces a current in the antenna, and is received on the tuned circuit coupled to the antenna, but if anything comes in that is not of the right frequency it goes through the rejector circuit. If it is of the right frequency, it goes on to the grid of the valve

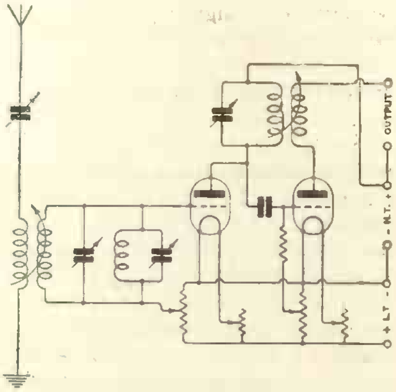


Fig. 8.—Circuit with rejector arrangement.

and then through the transformer and so on to the next rectifying valve which is coupled to it through a transformer in the ordinary way.

Another circuit which is very good is the tuned anode circuit with which I expect most people are now familiar. We have also experimented with this circuit as shown in Fig. 8, the rejector circuit being used also, but without reaction.

The "tuned anode" circuit seems to give stronger signals than the tuned transformer circuit, with the rejector circuit.

With these circuits we can get Birmingham and Glasgow separately and clearly. We also get London and Manchester without any mutual interference. We also get Cardiff without any appreciable interference. I do not claim that as anything very remarkable, but it is something that we find is possible to do with these circuits. The arrangement we have had most experience with is the Hinton rejector circuit, and with that we have almost got rid of ships, but not completely. Seaforth station is a very difficult station to eliminate because it uses a rapidly damped spark. Such stations are more difficult to cut than those using continuous waves.

The last thing I want to speak about is disturbance due to direct induction. That is, of course, very troublesome and particularly with us, because we are working in a laboratory where there are a great many varying currents which cause induced E.M.F.s. The method we have tried to get rid of these disturbances has been to put the receiving circuits in metal cases. That is not completely effective. Another method that can be used if there is an alternating current disturbance is a "resonance" shunt on the antenna. That is a shunt which is tuned for the frequency of the disturbance that it is wished to get rid of. Another method which I have not actually tried but which does almost as well (so I was told by one of my old students who has an alternating current lighting supply) is simply to screen the valve. I do not know whether this would be effective in all cases, I rather doubt it, but in his case the unpleasant hum that is produced by alternating current induction almost entirely disappeared.

I have only touched on a few of the methods that have been tried for getting rid of these disturbances, and if I have said anything to interest you or to promote a discussion of other devices which other people have tried with equal or greater success, I shall feel that my lecture has not been in vain.

OUTDOOR EXPERIMENTS WITH RADIO

By PERCY W. HARRIS, Staff Editor.

(Continued from page 6.)

frequently stated to be may be tried.

The writer believes that very rarely is an aerial using the amount of wire allowed by the Postmaster-General really directional, for even when the lead-in comes from one end, it is only when the height of the aerial is a very small fraction of its total length, that the directional length is shown. A few experiments in the open air on an aerial of about 20ft. high and 50ft. long, capable of being moved about easily and placed in various directions, will prove once and for all to what extent the average amateur's reception is directional.

The few experiments outlined will probably suggest to the amateur many other methods of receiving signals, without the ordinary conventional aerial. In addition to experiments with aerials it would be very useful for two friends to set up their receivers within, say, 20 or 30 yards of one another, and to try out several doubtful arrangements to see whether they radiate, and thus cause interference. To give and receive such radiation, it is necessary that the sets should be oscillating, so as to produce a beat note with the interference, and for this reason such experiments should only be carried out when both experimenters are perfectly certain that there is no other receiving set within many miles and with very small aerials. Out on the open moors, for example, such experiments can be carried out quite well.

While writing on special aerials it should be mentioned that occasionally very good results can be obtained by using some large elevated metal structure (such as an iron bridge) as the aerial. Such structures are frequently supported at each end on some material which is either an insulator, or at least a poor conductor, and if a condenser is placed in series with the receiving apparatus, it may be possible to receive signals with very considerable strength and sharp tuning.

In all the experiments outlined in the preceding notes it is, of course, of great value for the experimenter to have a good knowledge of the Morse code, so that he may be able to identify signals and their sources. Such a knowledge should be acquired by every serious experimenter who intends to make real progress.

RANDOM TECHNICALITIES

By PERCY W. HARRIS, Staff Editor.

In these notes are discussed many points of interest to the radio experimenter and listener-in.

(Continued from No. 14, page 797.)

HOME battery chargers are far more popular in the States than they are here, although I have no doubt that before long the British public will be as tired as the Americans of carrying their heavy accumulators to the nearest garage or charging station.

The Tungar rectifier, which, of course, is also available in the English market, is widely sold, but perhaps the most popular are those operating with a vibrating contact. One of these, the "Homcharger," is also sold in England, but many other makes are also available to the American "listener-in." Unfortunately, in this country, there are so many variations in voltage and frequency that it is quite impossible to standardise these vibrating rectifiers in the way they are standardised in America. Practically all of them work with a tuned reed, *i.e.*, a reed which is made to have a natural frequency corresponding with that of the alternating current supply. A reed which is tuned for, say, 50 cycles, is quite unsuitable for either 60 or 25—two other frequencies used in this country. Again, we find wide variations in voltages here.

* * * *

Judging from the advertised charging rates of these devices, the Americans are in the habit of using much larger accumulators than are the rule in England. Thirty or forty ampere hours (actual) is about the average figure for our wireless accumulators, and a safe charging rate for these is about 3 amperes. Many of the American battery chargers charge the cells at 5 to 8 amperes, which of course is too high for most of the batteries we are in the custom of using. I recently tried a well-known American make on which the charging rate was not marked, and found on test that it was charging one of my accumulators at 8 amperes, a figure too high for even the large battery I was using. To charge a 30 ampere hour accumulator at this high rate is to ruin it rapidly, and any readers who contemplate purchasing a battery-charging device are warned to make sure that the charging rate is suitable for the cells they have. Most of these rectifiers are so arranged that it is not possible to vary the charging rate conveniently.

My own rectifier charges at 2 amperes; and although this may strike some readers as being a very low rate, actually it is a very convenient one, for if a battery should be run down at the end of an evening's broadcast programme it can be put on charge all night and left a considerable portion of the next day without any harm coming to it. Further, it will always be ready in time for the next evening's programme. All of the good makes of rectifier are quite safe to use, as they are fitted with fuses, and if for any reason the current supply should fail it is not possible for the accumulator to discharge back through the device.

* * * *

The result of the transatlantic tests, which were so successful last winter, demonstrated quite clearly that, so far as receiving technique is concerned, the British amateur is superior to his American confrères. This statement is not made without evidence, for the Secretary of the American Radio Relay League has admitted as much in the League's own magazine, *Q.S.T.* Much of this superiority is due to the British amateurs' long experience in handling radio frequency amplification. The methods of radio frequency amplification are quite different in the two countries, and it will perhaps be of interest to compare the two methods. At least one stage of tuned radio frequency amplification is the rule in most British amateur sets, and very often two or three stages are used. Reaction (or as it is called in America, regeneration) is now customarily effected in such a way that there is no direct reaction on the aerial circuit. Probably the tuned anode method of coupling is most popular here, a good second being the tuned transformer using plug-in transformers mounted on four pin bases of the kind used in our valves, so that standard valve sockets can be used. This method was, I believe, first introduced by Mr. H. H. Burbury, of Wakefield, and was brought to the attention of British amateurs in an admirable paper delivered by Mr. Campbell Swinton before the Wireless Society of London (now the Radio Society of Great Britain). The tuned anode method of coupling was evolved during the war, and reaction on to the tuned anode was first introduced, I believe, by Mr. Scott-Taggart, for its merits are mentioned in his book, *Thermionic Tubes in Radio Telegraphy and Telephony*, and I have not been able to trace any earlier reference to it. The very convenient method of using plug-in coils for the tuned anode was brought to the attention of British amateurs by Mr. C. F. Phillips in a paper delivered before the Wireless Society of London, and printed in the official organ for April 8th, 1922. The resistance coupling of high-frequency valves, largely used before broadcasting started (when the only regular telephony available was that sent out from Hague on a wavelength of 1,050 metres), has now been practically abandoned, save for the reception of long waves, as this form of coupling is only efficient above about 1,000 metres. On the British broadcast wavelengths used at the present time it is quite useless, and should be interchangeable with reactance coupling for this purpose.

STATEMENT BY THE BROADCASTING COMMITTEE

We give below the text of a statement issued by the Secretary of the Broadcasting Committee:—

The Broadcasting Committee, under the chairmanship of Major-General Sir Frederick Sykes, having held 23 meetings and heard a large amount of evidence, are now considering the terms of their Report, a draft of which has recently been prepared.

It will be remembered that the immediate question which led to the Committee's appointment was the difficulty of licensing home-made wireless sets, and suggestions were made that the Committee should confine themselves to this question with the object of issuing an early interim report, leaving other branches of the subject to be dealt with in a later report. The Committee, however, whilst recognising the urgency of the licensing question, came to the conclusion that they could not deal with it in a satisfactory manner without taking evidence from all the interests concerned and considering the broadcasting question as a whole.

This course has been followed, and the Committee hope to be able to present their Report at an early date.

CATALOGUES RECEIVED

Tingey Wireless, Ltd.—One of the original firms to supply parts and sets to the pre-broadcasting experimenters, Messrs. Tingey Wireless, Ltd., have sent us a copy of their latest catalogue. The list, which is arranged upon the commendable loose-leaf principle, contains illustrations and details of a series of well-designed receivers ranging from one valve to five, and also of the Tingey unit system. A special point in the catalogue is the inclusion of very full instructions for the operation of each set. We feel sure our readers will find it of considerable interest.

Metropolitan-Vickers Electrical Co., Ltd.—We have received from this company copies of their Supply Leaflets 640/2 and 660/1, describing the "Cosmos" crystal set amplifier and "Cosmos" radiophone protective device respectively. The former may easily be used in conjunction with an existing set, whilst the latter gives protection against lightning or atmospheric discharges.

Siemens Brothers & Co., Ltd.—Copies of leaflets 595.11 and 595.111, describing loud speaking equipment and dry batteries for "low temperature" or "dull emitter" valves respectively, have been sent to us by this firm. Full particulars are given, and in the latter case a table shows which battery is most suitable for a certain type of valve.

PIEZO-ELECTRIC CRYSTALS

By J. H. T. ROBERTS, D.Sc., F.Inst.P., Staff Editor.

A few interesting particulars regarding a new application of this principle.

AT the Institute of Civil Engineers, on the 12th inst., the Western Electric Company exhibited some Rochelle salt crystals which are utilised in various ways, depending upon their piezo-electric properties. The piezo-electric effect was discovered towards the end of the nineteenth century by Curie, who found that if a piece of quartz, cut in a special way, were suddenly subjected to stress, such as tension or compression, it developed an electric charge upon its surface. This property has since been found to be possessed by a variety of solids in the crystalline state. In general, a substance which becomes electrically polarised on being stressed also exhibits the converse phenomenon, and if a potential difference be applied to its opposite faces, the substance suffers a minute change in dimensions.

Rochelle salt is particularly active piezo-electrically on account of its individual crystalline structural asymmetry.

The phenomenon is a molecular one, and there is extremely little delay, or "lag," between the application of the stress and the production of the electric polarisation. Consequently if a Rochelle salt crystal be suitably provided with tin-foil contacts on its opposite sides, and the alternating current from a telephone line be applied to these two contacts, a diaphragm in the form of a disc being attached to one end of the crystal, the alternations in the length of the crystal due to the alternating applied voltage will cause the disc to vibrate, and the arrangement thus acts as a telephone *receiver*. Owing to the very small lag and the exceedingly high natural period of vibration of the system, the reproduction of a sound by its agency, although very feeble, is extremely pure.

The crystal also acts as a high-impedance telephone *transmitter*, and is particularly suitable for measuring sound-waves in what may be called high-impedance media, such as water. A gramophone was exhibited by the Western Electric Company in which the vibratory motion of the gramophone needle, due to the record, was made to have a stressing effect upon a Rochelle salt crystal. The resultant current was amplified by a valve-amplifier, and the sound reproduced in the head telephones was remarkably faithful to the original, surface noise from the record being almost entirely eliminated.

The piezo effect may also be utilised to measure small electric charges by measuring the strain produced when the charge is applied to the crystal. If the crystal is used, as explained above, as a telephone receiver, it acts, of course, as though it possessed a high impedance. The relation between the applied stress and the electric charge developed has been mathematically worked out, so that the crystal may be used either to produce a given electric charge from a known stress, or to produce a known amplitude of motion from a given applied potential. Curie employed the piezo-electric quartz for the production of definite electric charges to be applied to his electrometer in his early experiments upon radioactivity.

The production of Rochelle salt crystals is a highly technical process which has been largely developed in the American laboratories of the Western Electric Company. It seems probable that these crystals will find many important applications in telephone and wireless work, and much experimental investigation is being carried on by a number of research workers upon this very fascinating subject at the present time.

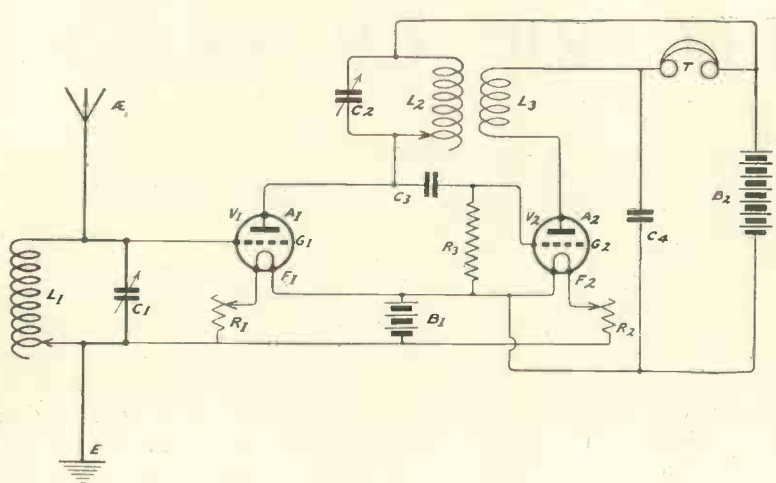


Fig. 1.—The original ST34 receiver, in which the valves perform single functions and the reaction is upon the intervalve tuned circuit.

A NEW AND H
REFLEX

By JOHN SCOTT-TAG

This article deals with a very
reaction but may be used for

REFLEX, or dual amplification, circuits have, up to now, been very rarely used in this country. Those which have proved successful have employed a crystal detector which, while possessing many advantages, has also an equal number of disadvantages. In the first place, a crystal detector is liable to respond to microphonic effects. It will not remain permanently sensitive, and a certain amount of knowledge is required to adjust it to the best efficiency.

The reason why crystal detectors have been almost invariably used in these reflex circuits is that by the use of this form of detector it is possible to arrange circuits in such a way that there is no deliberate low-frequency reaction. The crystal detector enables a separating link to be inserted in the low-frequency amplifying chain. This, for example, is why a crystal detector is necessary in a single-valve dual amplification circuit. If we tried to do away with the crystal detector, we would obtain low-frequency reaction in a most undesirable form.

Realising the necessity of developing a circuit which would not only obviate the necessity of a crystal detector, but which would also enable reaction to be used, while conforming to the Postmaster-General's regulations, the writer has produced a class of circuit which is really a development of the much earlier ST34—which is the "tuned anode with reaction" type of circuit so commonly used nowadays for broadcast reception.

The new circuit, to which the name of ST75 has been given, is capable of giving about seven times the signal strength of the ST34.

It might be as well here to explain how these circuits come to be numbered. No doubt most of the readers of this journal have by them the present writer's book, "Practical Wireless Valve Circuits," in which the different circuits are given specific numbers. Many of these circuits are common property, whereas some, such as the ST34 and derivatives of it, are original. In any case, it is extremely useful to be able to describe by number a circuit which would take half a page and a diagram to explain. The numbers ST100, ST75, and ST76 are original circuits which will figure in a new book of valve circuits which will be a continuation of the first book, "Practical Wireless Valve Circuits."

Fig. 1 shows the ST34 circuit; the ST75 circuit is shown in Fig. 2. It will be seen that the first valve acts as a high-frequency amplifier, and the second as a detector. In the anode circuit of the detector valve V_2, we have the reaction coil L_3 and also the primary T_1 of the step-up intervalve transformer $T_1 T_2$. The purpose of this intervalve transformer is to amplify the low-frequency rectified currents which would ordinarily go to the

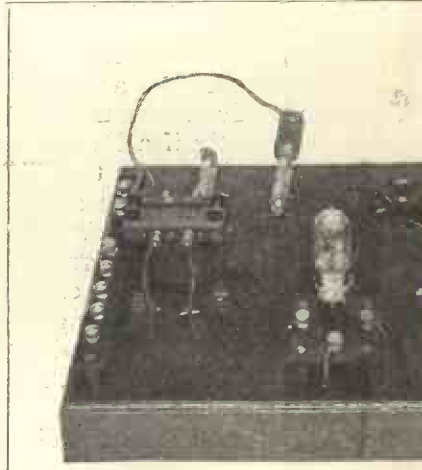


Fig. 3.—ST76

IGHLY SENSITIVE CIRCUIT

F.Inst.P., Member I.R.E.

reliable two-valve circuit which employs the reception of British broadcasting.

telephone receivers and to cause magnified low-frequency current variations to flow in the anode circuit of the first valve. In this anode circuit is included the loud speaker LS or the telephone receivers.

There are one or two peculiarities about the circuit which need explanation. In the first place, it will be seen that the grid G_2 of the valve V_2 is connected, not to the anode of the first valve, as in the case of the ordinary tuned anode circuit, but to the bottom end of the tuned circuit L_2 C_2, while between the anode and the bottom of the tuned circuit L_2 C_2 we have the loud-speaker LS,

made up on a board.

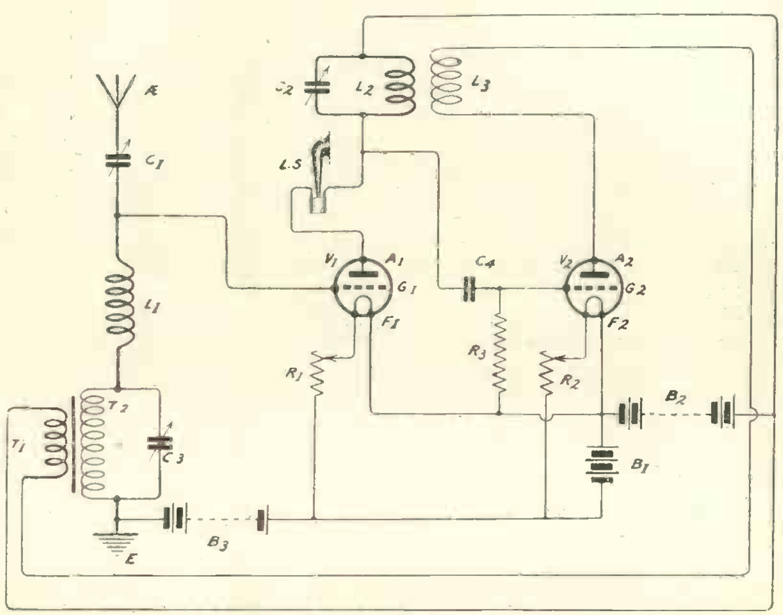


Fig. 2.—The ST75 receiver.

which is preferably unshunted by a condenser. The reason why the connection to the grid of the second valve is taken from the point shown is that, if the connection were taken from the anode of the first valve, or if the loud-speaker were included on the other side of the circuit L_2 C_2 in the anode circuit, there would be a low-frequency coupling between the first and second valve as well as the high-frequency one. The loud-speaker windings would act as a choke coil, and the traversing by the low-frequency currents of the windings would set up low-frequency impulses which would be communicated to the grid of the second valve and amplified. There would thus be established the low-frequency reaction chain, which is usually so fatal to good reception.

At the same time, the position of the loud-speaker in the ST75 is technically wrong, as it is an established rule in wireless design not to include any apparatus likely to produce a leakage to earth, or a capacity effect to earth at a point at a high-frequency potential to earth. All such apparatus should, if possible, be placed at earth potential, but in the present case this is not possible. As a matter of fact, if the loud-speaker is well insulated and kept fairly clear of accumulators, high-tension batteries, and earth wires, it will not materially reduce the high-frequency potentials established across the oscillation circuit L_2 C_2. If telephone receivers are employed instead of a loud-speaker, it will be desirable to connect a telephone step-down transformer with its secondary in place of the loud-speaker LS in the diagram, the low-resistance telephones being connected across the low-resistance winding.

Values of Components

Coming now to the values of the different components in the circuit, the following data should prove a guide :

The condensers C_1 and C_2 may be either 0.0005 μF or 0.001 μF maximum capacity. The condenser C_1 may be shunted across the inductance L_1 instead of in series with it. This depends upon the size of the aerial and the size of the inductance L_1. The inductance L_1 may be a tapped coil, a variometer, or an inductance with a slider. If a fixed coil is used, an S_3 or S_4 Burndept coil may be recommended. An inductance coil, consisting of seventy turns of No. 26 double-cotton-covered wire, wound on a 3½in. tube and tapped at every seven turns or at every ten turns will be found effective over the broadcast waveband. The inductance L_2 of the tuned anode circuit may be a No. S_4 Burndept coil, the inductance, if wound on a tube, may consist of 100 turns of No. 26 gauge D.C.C. wire wound on a 3½in. tube and tapped at every ten turns. The inductance L_3 may be a Burndept No. 75 coil, or a tube 3in. in diameter, containing seventy turns of No. 26 gauge double cotton-covered wire.

The accumulator B_1 is of the six-volt type, while the high-tension battery B_2 has a value of between 50 and 100 volts. The latter voltage is recommended. The grid condenser C_4 is of the usual type and has a capacity of 0.0003 μF. The grid leak R_3 has a value of 2 megohms.

A battery B_3 is inserted where shown. The battery B_3 should preferably be tapped off at every 3 volts. Its actual maximum value will depend upon the type of valve used, but the battery should preferably be variable between 0 and 18 volts. In many cases the used portion of the battery will measure 9 volts, the grid of the first valve being therefore at a potential of −9 volts. An important feature of the adjustment of this circuit is the value of this battery B_3, but when the anode voltage is only about 50 volts the battery may be eliminated altogether without very much effect on signal strength.

Operation Notes

In operating this circuit the first thing to do is to see that the reaction coil L_3 is well away from the tuned anode coil L_2. The condensers C_1 and C_2 are now adjusted until signals are heard at their loudest strength, the condenser C_3 being adjusted to about half-way between minimum and maximum capacity. The reaction coil is now coupled to L_2, the condensers C_1 and C_2 being re-adjusted. Variation of the condenser C_3 may now be tried, and it will, in many cases, be found possible to strengthen the reaction by increasing the capacity of C_3, at the same time slightly reducing C_1. Every readjustment of the reaction coil will necessitate a re-adjustment of C_1. As a general principle, it is much better to keep the coupling between L_3 and L_2 as loose as possible, provided equal strength may be made up by correctly adjusting C_1 and C_3.

A Three-valve Modification

The ST76 circuit is a similar circuit with the addition of a low-frequency amplifying valve. The primary of an intervalve transformer is connected in place of the loud-speaker in Fig. 2, and the secondary is connected across the grid and filament of a third valve. Full details of this three-valve circuit will be given in the next issue of this journal.

Experimental Modifications

The circuit, as given, was found to give the best results in the actual form shown in Fig. 2, but, in view of the differences between loud-speakers, transformers, batteries, etc., readers may care to carry out experiments with different values of the components. A variable condenser, for example, might be tried connected across T_1, and also a variable condenser across the loud-speaker might also be tried. The high-tension battery, in all cases, is better for having a large capacity of not less than 1 μF shunted across it.

Results Obtainable

Loud-speaker results should easily be obtained up to 50 miles from a broadcasting station on this set using an average aerial. A large hall at Ilford was filled with music from 2LO, about 10 miles distant, using a low and poorly arranged single-wire aerial. In a house very loud results are obtainable at this distance. The signals are not as good as those obtainable with an ST100 using reaction, but the advantages of this circuit are that reaction may be used for the reception of British broadcasting, and also the troubles associated with crystal detectors are eliminated. The circuit would make an ideal one for commercial broadcast receivers.

THE CONSTRUCTION OF A 5-VALVE AMPLIFIER

By ALAN L. M. DOUGLAS, Staff Editor.

(Continued from No. 14, page 781.)

BEFORE proceeding any further with the construction of this instrument, it will be as well to examine the circuit diagram, Fig. 7. Although this appears a little complicated at first sight, if it is closely examined it will be seen that it represents an ordinary tuned anode two stage high-frequency amplifier with alternative H.F. transformer coupling, followed by a detector and two stages of note magnification. The introduction of the necessary terminals, plugs, and switches to effect the control of the various circuits can be clearly seen.

It will be noted that the high-tension supply terminals for the various points in the circuit are arranged round the edge of the panel in such a manner that if a common H.T. battery is used with the plug connection (which may be observed at the foot of the circuit diagram), these terminals are simply connected together by means of copper strips. If it is desired to work the amplifier from a common L.T. and H.T. battery, all the terminals round the edge of the panel are short-circuited, and the sole connections are effected by means of the four-pin plug described in the previous issue. When arranging the wiring of an instrument of this nature it is frequently convenient to re-draw the circuit in a pictorial manner and attach it to the back of the panel. For this purpose thin shellac varnish will be found suitable, although if handled much will not retain the template in position. It is, however, very much easier to remove than any other form of adhesive, and a rub with a cloth soaked in methylated spirits will remove all traces of the varnish.

The next most important consideration is the construction of the transformers used for effecting the high-frequency intervalve coupling, when desired. Reference to Fig. 8 will show the chief structural details of these devices, and it will be observed that they are arranged to have a standard four-pin fitting, so that for experimental purposes any type of coupling may be easily interchanged.

For short waves it has been found that the most satisfactory results were obtained from single layer transformers having the secondary wound directly over the primary. The dimensions of the tube should be adhered to, and for broadcasting purposes it will be found that a primary winding consisting of eighty turns of No. 24 s.w.g. single silk-covered wire, over which a secondary winding of ninety turns of No. 28 s.w.g.

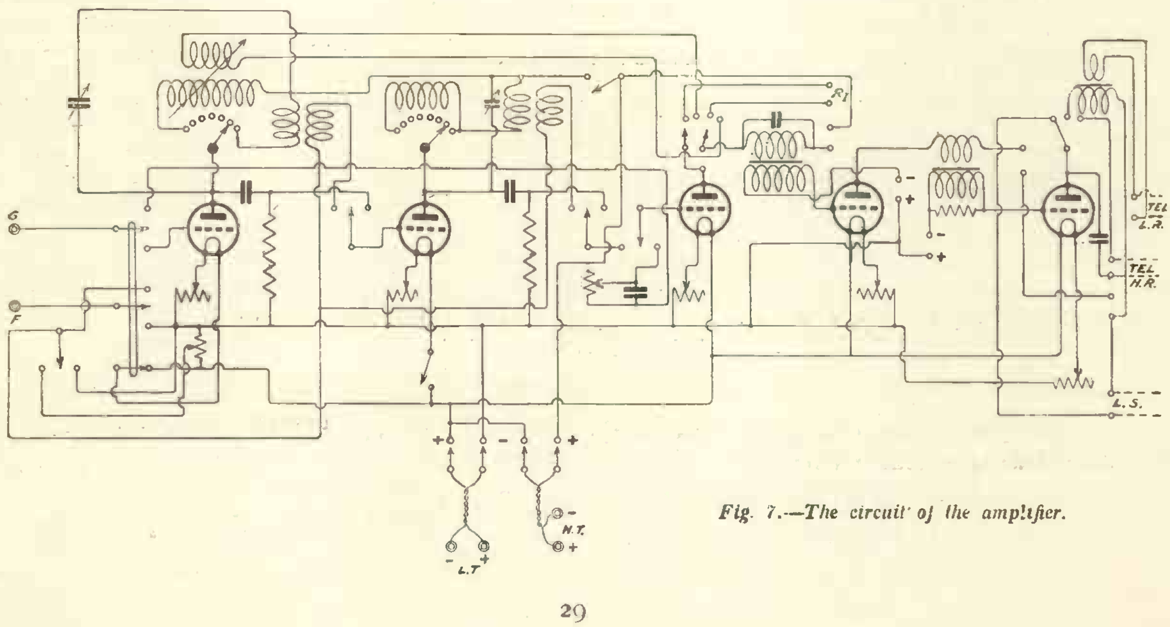


Fig. 7.—The circuit of the amplifier.

single silk-covered wire is placed, will give the maximum amplification. The two windings should be separated by either two or three layers of thin tissue paper well shellacked, or one layer of Empire cloth of good quality. It is essential, however, that there should be tight coupling between the windings. For other wavelengths, different windings will, of course, be required, but the following table may prove of use to those who wish to listen to the chief telephony stations now to be heard in this country.

Assuming the same diameter of tube, the following numbers of turns will require to be wound on for the various stations :—

rigid, thus ensuring constancy of operation of the transformers.

It will be necessary to make two of each of these transformers if two stages of high-frequency amplification are going to be used, but sometimes it is found that with different valves in use it is an advantage to arrange experimental windings so that slight differences exist between the inductance value of the coupling coils. This, however, is purely a matter of experiment, which can be readily carried out with this amplifier, as it is especially designed for the purpose.

The transformers having been dealt with, attention may now be turned to the method of constructing and mounting the small variable condensers used to tune the anode reactance coils, when this latter method of amplification is in use. These condensers have been kept separate in order that individual adjustment may be carried out, as it is generally found that it is an advantage to be able to tune the two high-frequency circuits separately. In some instances remarkably good results can be obtained by the use of two condensers mechanically interconnected, but in most cases it is desirable that they should be controlled individually.

Station.	Primary.	Secondary.
British Broadcasting up to 400 metres	Windings as above.	—
British Broadcasting and Telephony up to 500 metres.	10% more turns on each winding.	—
Aircraft telephony on 900 metres ..	100 turns 30 s.s.c. wire.	120 turns 32 s.s.c. wire.
PCGG and Telephony on 1,100 metres.	120 turns 30 s.s.c. wire.	150 turns 32 s.s.c. wire.
Radiola	180 turns 36 s.s.c. wire.	210 turns 36 s.s.c. wire.
Paris (Eiffel Tower transmissions) ..	250 turns 38 s.s.c. wire.	250 turns 38 s.s.c. wire.
LP (Berlin) and Rome Telephony ..	300 turns 40 s.s.c. wire.	300 turns 40 s.s.c. wire.

In all cases the above windings are separated by a single layer of Empire cloth, having a thickness of approximately 0.01in.

For convenience's sake, the transformers have been fitted with small handles, by means of which they may be easily placed in position without the risk of any damage to their windings. This is a useful feature, which does not in any way detract from the efficiency of the apparatus. It also tends to keep the tube on which the windings are placed more

Each condenser, which has a value of about 0.00025 μF, consists of thirteen plates, seven of which are fixed, and six of which

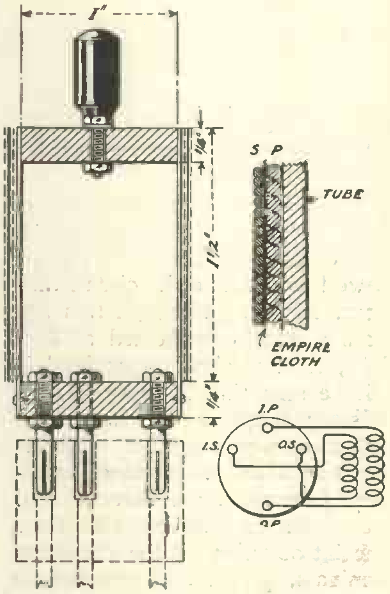


Fig. 8.—Details of the H.F. transformers.

are rotary. For the sake of rigidity, it is advisable to build these directly on to the panel, and if this is of sufficient thickness there is no possibility of distortion, and thus irregularities in tuning cannot arise.

To complete the construction of these condensers, fourteen fixed plates and twelve moving plates will be necessary, together with ten large spacing washers and forty-eight small washers. About 2ft. of No. 4B.A. screwed brass rod and eighteen 4B.A. nuts and appropriate washers will also be required. 2B.A. screwed brass rod makes an efficient spindle, although if squared spindles of the correct size are obtainable these might be used with advantage.

(*To be concluded.*)

AN ST100 FOR THE CAR

By PERCY W. HARRIS, Staff Editor.

A short description of a compact instrument for the holiday maker.

THE instrument illustrated in the accompanying photographs contains the well-known ST100 circuit in its original form, so arranged that the component parts fit into the minimum space, the tuning coils being enclosed in the box.

As will be seen from the illustrations, the top of the instrument carries three dials and knobs and the necessary terminals. In addition to these, the enclosed crystal detector is mounted on the top of the panel, all the remaining components being fixed beneath. The left-hand dial controls the aerial condenser (.0005 microfarad), which is permanently fixed in parallel with the aerial coil, the right-hand dial governs the anode tuning condenser (also .0005 microfarad), while the central dial controls the reaction between the anode and the aerial coils. The two intervalve transformers are separated as far as possible from one another, while the centre of the underside of the panel carries a vario-coupler (made by the Bowyer-Lowe Company), the outer winding of which forms the aerial coil, and the inner, or rotating winding the anode coil. By rotating the inner coil on the shaft which carries it the anode coil can be made to react on the aerial coil when necessary. The aerial coil (the outer winding) is made with two sets of tappings, one set at unit turns for eight tappings and the other at each subsequent eight turns, so that, by combining two switches, any number of turns, from one to the total number on the stator, are obtainable. As the aerial condenser is fixed permanently in parallel with this coil, and it is only desired to cover the broadcast band of wavelength with it, it is only necessary to use a portion of the windings, 32 turns being found to be just about right with the average aerial.

The size of the panel used in this case is, of course, dependent upon the actual component parts

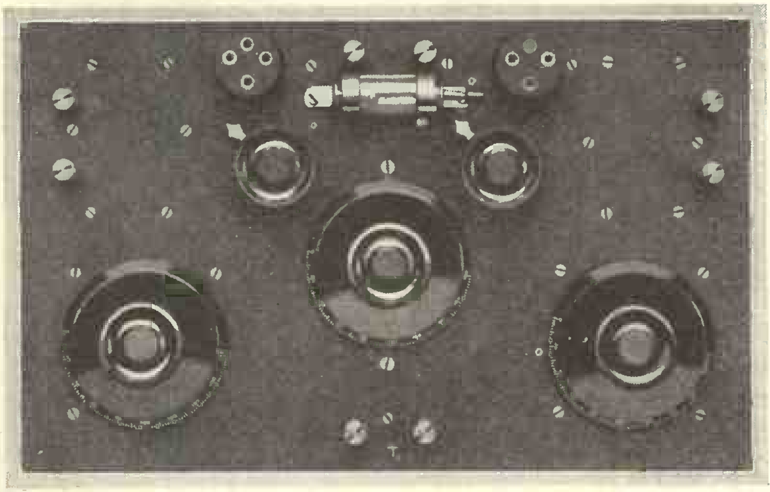


Fig. 1.—The arrangement of the parts on the panel.

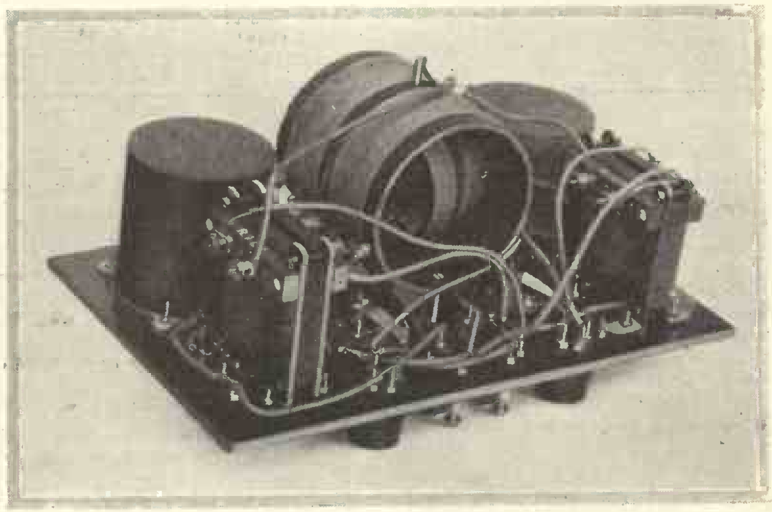


Fig. 2.—A view of the underside of the panel.

used. For example, the two condensers (each of .0005 microfarad) are of the "Mark III." type (ex-Army), and as these are not easily obtainable at the present time it may be necessary to use a larger panel, so that larger condensers may be fitted. The two intervalve transformers are "R. 1." make, and the gridleak is of the pattern used in the present writer's set described in the current issue of *Modern Wireless*. The two filament resistances are of the usual type, while the crystal detector is a hertzite crystal with cat-whisker, the whole being enclosed in a small glass cylinder supported between two uprights. This protects the crystal.

The two fixed condensers of Dubilier make are mounted immediately beneath the transformers, so as to save space. No shunting capacity across the high-tension terminals is used in this particular set, as it has not been found necessary.

Looking at the top of the instrument, the two left-hand terminals are for the aerial (upper) and earth (lower); the two middle terminals at the top of the instrument are for the positive and negative low-tension leads, while the two terminals on the right are for the positive and negative high-tension leads. The telephones or loud-speaker are attached to the two terminals in the front of the instrument. Where it has been necessary to support the component parts on the panel, clearance holes for 6B.A. screws have been drilled, the holes countersunk, and the screws pushed through and held at the other side by nuts. This method holds the component parts securely, and has been found superior to the method by which holes are drilled into the panel for a portion of the way and tapped to take the screws. This latter method is only safe when a very thick panel is used. No particular precautions are necessary when soldering up, save to see that all leads are as short as possible, and do not run at any length parallel with one another. It is not necessary to solder wires to all of the tappings on the vario-coupler, as if one wire is taken to one end and the other to, say, the 32nd turn, this ratio with the condenser in parallel will be amply sufficient for the broadcasting band and far beyond. Oiled silk tubing is used throughout the instruments to obviate any risk of one wire touching another. Every connection is soldered and good sound joints made everywhere.

The wiring diagram can be obtained as a full size blue-print by sending 1s. 6d. to the offices of this magazine.

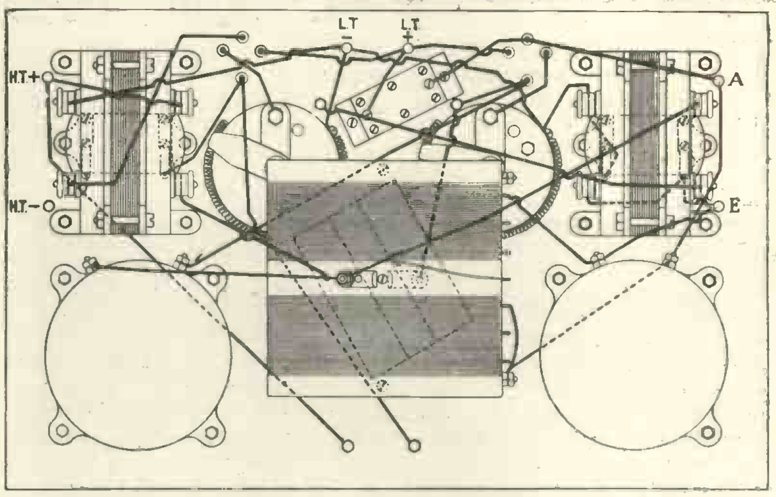


Fig. 3.—The wiring diagram.

A RESIGNATION

The following letter has been received by the Secretary of the Radio Society of Great Britain from Mr. John Scott-Taggart, Editor of "Wireless Weekly" and "Modern Wireless":

Dear Sir,

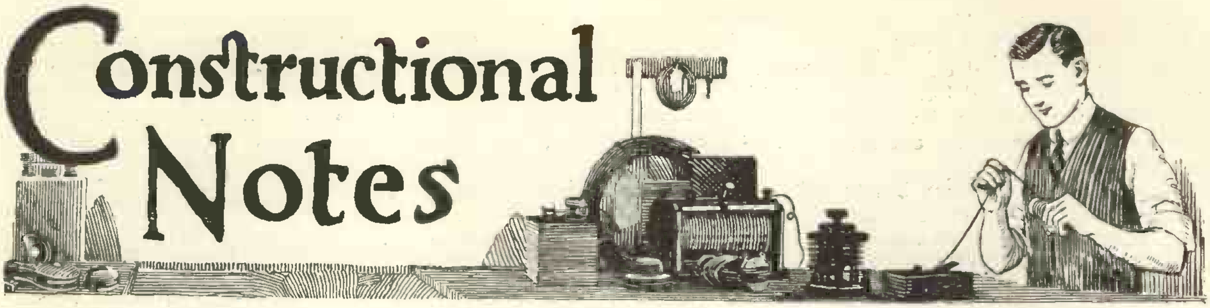
I have felt for a considerable time that my position on the Committee of the Radio Society of Great Britain is an embarrassing one, in view of the desirability of editorial independence, and the great difficulty I have in reconciling my editorial work with an active association with policies which may, at times, call for independent criticism.

My presence on the actual committee might give rise to misunderstandings, and I therefore trust that you will accept my resignation from it.

I am, of course, proposing to remain a member of the Society, and intend to further its real interests, both personally and through the medium of my journals.

Yours truly,
(Signed) JOHN SCOTT-TAGGART.

Constructional Notes



MAKING A TELEPHONE TRANSFORMER

THERE are certain very great advantages to be gained from using low-resistance telephones with a valve set; amongst others the risk of a burn-out is reduced to a minimum, cheaper receivers may be employed with quite good results, and any parasitic noises due to the set itself are rendered less obtrusive. To be able to use low-resistance telephones it is essential to provide a transformer to step down the voltage flowing in the anode circuit of the last valve. A very satisfactory instrument for this purpose can be made by anyone who does not mind tackling the rather tedious job of winding a large number of turns of fine wire.

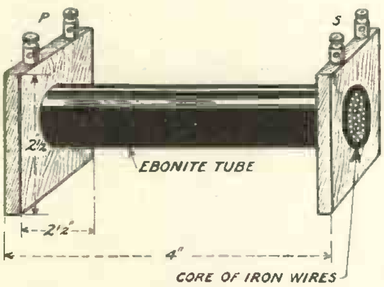


Fig. 1.—The bobbin and core of the transformer.

The drawing shows the foundation of the transformer. This is a kind of bobbin made by jamming a 4in. length of ebonite tube with an internal diameter of ½in. and an external diameter of ¾in. into two ebonite endpieces each ⅜in. thick and 2½in. square. If by any chance the holes in the endpieces are bored slightly too large so that the tube is not a tight driving fit it can be secured in place by drilling and tapping a 4B.A. hole in one edge of each endpiece and inserting a setscrew.

It will usually be found best not to insert the core until the winding has been done. If the tube is left empty it is not a difficult matter to fit a wooden mandrel which will allow the bobbin to be mounted in the lathe, or fixed up in an improvised winding machine made from the breast drill, or even from a combination of Meccano parts.

Two terminals are mounted on each endpiece, holes for their shanks being drilled and tapped in the ebonite. During the winding process their places may if necessary be taken simply by screws. The primary winding will consist of 4 ounces of No. 40 d.c.c. copper wire, which will cost about 5s. Attach the free end to one of the primary terminals, then take a turn round the tube and proceed to wind on evenly. Great care must be taken not to break the wire which is very thin and will not stand any jerks. Should a break occur the ends must be soldered together, the joint being well covered with a layer of thin insulating tape. When all the wire is on secure the far end to the second primary terminal.

Next lay on two layers of Empire cloth to form an efficient insulator between windings. The secondary, which consists of 1½ ounces of No. 34 d.c.c. wire, costing 1s. 3d., is now wound on as before, its ends being secured to the terminals of the opposite endpiece. A further layer of Empire cloth makes all secure.

The next job is to insert the core, which is made up of 4-inch lengths of No. 22 or 24 soft iron wire inserted one by one until the whole is packed as tightly as possible. If difficulty is found in forcing in a final wire so as to make all secure the core can be jammed in place by tapping one or two little wooden pegs in amongst the wires at either end. Nothing now remains but to mount the transformer on a baseboard of polished wood measuring 5in. by 3½in.

R. W. H.

THE USEFUL BREAST DRILL

THE bevel-geared hand or breast drill is one of the most useful tools to be found amongst the outfit of the wireless constructor's workshop. Apart from its legitimate function of making holes in ebonite, wood, or metal, it may be called in to help in emergencies in a variety of ways beyond the scope for which it was designed.

Mounted horizontally in the vice by means of its frame, it becomes at once a first-rate aid to coil winding. The former is mounted on a spindle of suitable size, which is inserted into the chuck. The reel of wire is provided with an axle so that it can turn freely, and is placed upon the bench on the worker's right. The right-hand then guides the wire on to the former and regulates the tension, whilst the left rotates the crank handle of the drill. Thanks to the multiplying action of the bevel gears, even coils such as those of transformers which contain a formidable number of turns can be made up easily and quickly. If the gear ratio is found by trial, one can put on a definite number of turns by counting the movements of the left hand.

The drill so fixed can also be used as an emergency lathe for making small parts. The work is mounted as before, and a tool rest is improvised from a block of wood or metal. A helper will have to be called in to turn the handle, since both hands are needed for controlling the cutting tool.

It happens often that one has to tap a large number of holes of the same size when making up a panel. To make a thoroughly sound job, terminals, valve-legs, and studs should be screwed in, and not merely slipped through, clearance holes. The process of tapping a score or more of 4B.A holes with the aid of the tap wrench is monotonous, besides being wearisome to the hand.

The solution is to use a taper tap mounted in the chuck of the drill. Its point should be dipped into turpentine before being inserted into the hole to be threaded. The work begins gently, the tap being worked backwards and forwards to allow it to clear itself properly whilst the thread is being started. As soon as it has obtained a proper grip it may be run quite fast. With the help of the hand drill, holes can be tapped in less than a quarter the time needed for doing the work with a tap wrench, and with so little labour that one does not mind tackling jobs that involve dealing with quite big numbers. R. W. H.

EMERGENCY DETECTOR

IT is often wanted to construct a crystal detector for purposes of experiment. Possibly the only crystal detector in one's possession is already engaged at the time, and one does not want either to have the bother of making an elaborate article to act as a substitute or to spend several shillings in buying one.

The illustration, Fig. 2, shows a simple type that can be made in a very short time. The foundation consists of a two-inch length of glass tubing with a diameter of not less than ½ inch. At either end is inserted a fairly tightly fitting ebonite plug.

In one of these a hole is drilled just large enough to allow a piece of fine insulated wire to be pulled through. The wire is fixed in place by making a couple of turns round a screw driven into the face of the plug. Its inner end is clipped off at about 1½ inches, and coiled round a knitting needle to form a cat's-whisker.

In the other plug is drilled a hole just large enough to take an empty revolver cartridge-case, anything from .300 to .45 is suitable for fairly large plugs, though if the glass tube is only ½in. or so in diameter a .22 rifle cartridge-case will have to be used. This is secured by a setscrew, whose head is entirely countersunk, driven in through the edge of the plug. A lead is soldered to the base of the cartridge-case, a crystal of whatever kind is preferred being fixed

Fig. 2.—The complete detector.

by means of Wood's metal into its hollow end.

If a crystal such as hertzite or permanite is used which contains many sensitive spots, adjustment of the detector is not at all a difficult matter. Once a good position has been found for the cat's-whisker the plugs may be sealed in position by applying a coating of shellac to the joint between them and the glass. The detector thus remains permanently set, and it will stand quite an amount of rough handling without getting out of adjustment.

When much experimental work with detectors is done it is not a bad idea to make up a number of these detectors, all of the same size, provided with different crystals. If a brass contact strip is fixed to the outer face of each plug they can be made to fit into spring clips similar to those used for supporting grid-leaks and anode resistances. The name of the crystal used should be written on a small gummed label stuck to the glass. R. W. H.

THE POTENTIOMETER

SOONER or later every wireless man decides to add a stage of radio-frequency amplification to his set. Note-magnifiers increase the volume of sound in the telephones, but they have practically no effect upon the range at which reception is possible, for they can amplify only those sounds that the rectifier, whether crystal or valve, already brings in. High-frequency valves, on the other hand, deal with oscillations just as they are collected by the aerial, increasing their amplitude and passing them on to the rectifier to undergo the necessary filtering process. The efficiency of the rectifier increases by leaps and bounds when it is called upon to deal with waves of respectable amplitude; hence if high-frequency stages are used, almost perfect rectification is obtained, with a consequent absence of the distortion and parasitic noises which are often due to incomplete filtering of the impulses that reach the set.

Many people are a little shy of high-frequency amplification, fearing that it will be too difficult for them to handle satisfactorily. There is no doubt that it requires more skill than the note-magnifier, which is, as a rule, perfectly straightforward; but there is no reason at all why it should not be used with perfect success by anyone if proper controls are provided.

If you look at the characteristic curve of any receiving valve you will find that it starts by making a concave bend; this is followed by a straight portion, then comes a convex bend at the top. You will see, too, that the form that any given portion of the curve takes depends upon the voltage applied to the grid of the valve. For high-frequency amplification it is essential to use the straight part of the curve; hence we must have some device that will enable us to make sure that the grid is receiving exactly the right voltage. If the potential is incorrect two things will happen: the valve will not function properly, and it will be liable to self-oscillation.

The pressure-regulating device used is the potentiometer, whose action may be readily understood if we think for a moment of what happens when water from a cistern is allowed to flow from taps fitted at different heights to a vertical pipe. If tap A in Fig. 3 is turned full on the pressure of the water coming from it will not be great, since the head is only 2ft. Tap B, with a head of 6ft., will deliver water at much higher pressure; and C's jet will be still more powerful. The three taps enable us to obtain water at three different pressures from the cistern; and if we provided taps at every inch or so we could regulate the pressure to a nicety. This is just what the potentiometer enables us to do with electricity.

It consists of a coil of eureka or manganin wire with a total resistance of from 200 to 400 ohms, which is shunted across the low-tension battery as shown diagram-

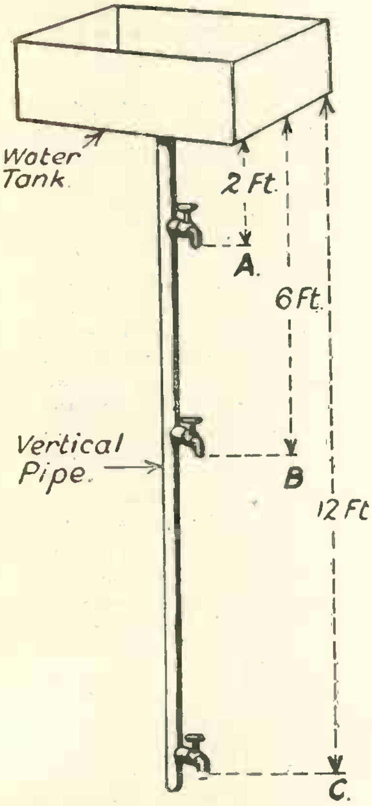


Fig. 3.—A water analogy.

matically in Fig. 4. Current flows through it continuously whilst it is connected to the battery, but owing to its high resistance the amount is very small. With the value of 300 ohms shown in the diagram, Ohm's law (current equals volts divided by resistance) shows us that it is $\frac{6}{300}$ amp., or 20 milli-amperes.

A sliding contact which can be moved from end to end of the coil makes contact with the turns of wire, and a lead from the slider is taken to the secondaries of the A.T.I. and the coupling transformers (Fig. 5).

Let us return for a moment to Fig. 4. If the slider is moved to the right-hand end of the coil the effect will be the same as if we connected the grid direct to the negative leg of the filament; that is, the grid will be at zero potential. Supposing that we move the slider to the other end, the grid is virtually joined to the positive leg of the filament, and the voltage applied will be +6 volts. If it is placed exactly in the middle of the coil the potential will be +3 volts. Thus by moving the slider we can "tap" any voltage between 6 volts positive and zero potential.

In this way we can make the valve work at any point in quite a large portion of its characteristic curve. By pushing the slider gradually towards the negative end of the potentiometer we make the working point lower and lower on the curve; if we reverse the process we raise it. The potentiometer becomes to the set what a bridle is to a horse or a throttle to an engine: it gives us control.

What we want to do when receiving telephony is to obtain the greatest amount of pure amplification without allowing the valves to oscillate; the potentiometer provides a ready means of accomplishing this. When tuning in for the first time we place the slider near the middle point of the coil. As soon as signals have been brought up to their best by adjustments of the inductances and the variable condensers we make use of the potentiometer, moving the slider very slowly towards the negative end. Signals will at once begin to increase in strength, and will continue to do so until a point is reached at which they become a little harsh or blurred, which is a sign that we must go back a little.

Now let us see whether the set can be relied upon not to cause

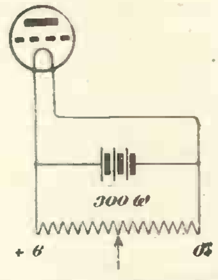


Fig. 4.—Potentiometer connections.

interference by re-radiation. To do this we turn the knobs of the condensers until we are right off the wavelength of the transmission that was being received. We then tune it in again in the ordinary way. If any squeaks or chirps occur as adjustments are made we may feel pretty certain that they are audible to all our wireless neighbours, who will not exactly bless us. We therefore introduce a slight "damping" effect by making the slider travel away from the negative end until adjustments can be made without producing in the receivers any sounds that should not occur. There will be a slight loss in signal strength, but we shall have the satisfaction of knowing that the set is properly under control, and that with careful handling it cannot possibly be the cause of annoyance to others.

This adjustment, once found,

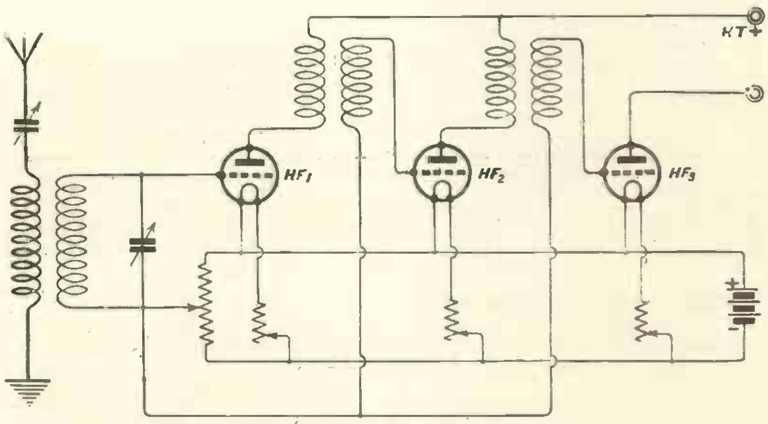


Fig. 5.—Arrangement of the potentiometer in circuit.

will remain fairly constant so long as filament current and plate voltage remain unaltered. It will probably vary slightly on different wavelengths, but once you have "got the hang of" using a potentiometer you will not find that it presents any great difficulty.

A further refinement is to fit a second potentiometer to the low-frequency side of the receiving set. Much of the distortion that so often occurs with note-magnifiers is due to their being worked on the wrong part of the valve curve. A potentiometer can be connected to the secondaries of low-frequency transformers with the addition of some small cells to permit a negative bias to be applied, but do not try to make the same potentiometer do for both. High-frequency and low-frequency amplifying valves are performing quite different duties, and the grid-potentials required will therefore not be the same.

AN EARTHING SWITCH

THOUGH there is probably little risk of an aerial being actually struck by lightning, it may become charged to a very high potential in stormy and changeable weather unless a connection direct to earth is provided. If the set is left connected up it may be seriously damaged in such circumstances.

To be on the safe side, it is as well to provide an efficient earthing switch. The word "efficient" is important, for one often sees arrangements that really afford no protection at all. One of these consists of a single-pole knife switch connected across the aerial and earth terminals of the set. Such an affair provides no more than a shunt, and would not prevent some of the unwanted charge from reaching the set.

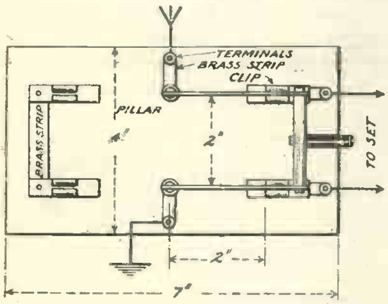


Fig. 6.—A double-pole earthing switch.

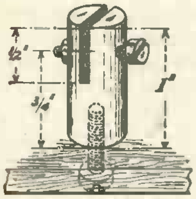


Fig. 7.

To be effective, a switch must disconnect the set altogether. For this purpose nothing is better than a large double-pole double-throw switch wired as shown in Fig. 6.

The switch is made up on an ebonite base measuring 7in. by 4in. The pillars for the arms (Fig. 7) are made from 1in. lengths of $\frac{3}{8}$in. round brass rod. A hacksaw cut $\frac{1}{2}$in. deep is made in each, a 4B.A. clearance hole being drilled through the rod from side to side to take the bolt which forms the pivot of the arm. A 4B.A. hole is drilled and tapped in the bottom of the pillar for the screw which secures it to the ebonite base.

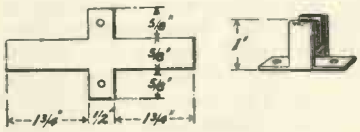


Fig. 8.—Dimensions of the clips.

The clips are of springy sheet brass. Fig. 8 shows the way in which they are cut out with the shears, and subsequently bent into their final shape.

The arms are also made of sheet brass, their dimensions being: length, 3in.; width, $\frac{1}{2}$in. They are secured by means of 4B.A. screws to the bridge, a strip of $\frac{1}{4}$in. ebonite 2in. long and $\frac{1}{2}$in. wide. The knob is a $1\frac{1}{2}$in. length of $\frac{1}{2}$in. round ebonite rod, secured to the bridge by a 4B.A. screw.

Fig. 6 shows the switch complete. The two clips on the left are connected in series by means of a brass strip. The pillars are connected to terminals for aerial and earth leads by other brass strips. The second pair of clips are secured in place by one screw and one terminal each. These terminals take the wires leading to the set.

The switch should be mounted on a hard wood shelf, and installed in a handy position outside the window of the room in which the set is kept.

A very desirable refinement consists in the provision of some sort of protection for the switch against rain. This may take the form of a small wooden "pent-house" roof placed immediately above it.

R. W. H.

AN ANTI-CAPACITY SWITCH

EXPERIMENTERS often wish to have a multi-contact switch of small appearance and size, yet possessing a very low self-capacity, in order to switch in and out of circuit high-frequency stages of amplification. The Dewar pattern of switch, whilst the neatest obtainable in this country, is not suited for this purpose. A novel type of multi-contact switch which presents a very neat appearance when fitted to a panel is illustrated here. It may be readily constructed from strips of $\frac{1}{4}$in. $\times \frac{1}{16}$in. springy brass or phosphor bronze, to the ends of which small blocks carrying short pieces of silver wire may be soldered so as to make good contact. Punch-holes could be made in the strip in lieu of the silver wires, if desired.

A. L. M. D.

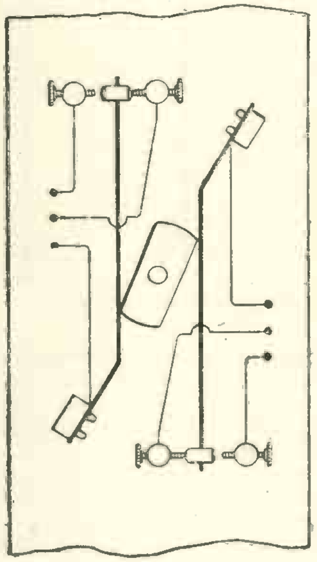


Fig. 9.—Details of the switch.

A CHEAP AND EFFICIENT VARIOMETER

A SIMPLE little variometer that will give good results on the broadcast wavelengths can be made without difficulty, its total cost not exceeding eighteen pence. One great advantage of the type to be described is that it has no brushing contacts. Many variometers have two of these, and they are almost bound to become, sooner or later, a source of trouble as the spindles and bushes wear.

The former for the stator consists of a 1½in. length of cardboard tubing with a diameter of 4in. Two 2B.A. clearance holes are bored exactly opposite each other to take the spindles. A pair of smaller holes are then made quite close to one edge, and thirteen turns of No. 26 d.c.c. wire, one end of which has been passed two or three times through the two small holes to form an anchorage, are wound tightly and evenly round the stator. The wire is now carried diagonally across so as to clear the spindle holes, after which a further thirteen turns are wound. The winding is finished off by being anchored as before, a short end 2in. or 3in. in length being left protruding.

The rotor, a 1½in. piece of tubing 3in. in diameter, is drilled and wound in the same way, the number of turns being just as before. Both rotor and stator windings should be shellacked to keep them in place.

Three ebonite washers, two ½in. in diameter and one 1in., all drilled with 2B.A. clearance holes, are now prepared. Two of these are glued to the windings of the rotor so that their holes coincide with those for the spindles drilled in it. Their purpose is to protect the insulation of the wire when lock nuts are tightened down. The third and largest washer is fixed by means of screws over the upper spindle hole of the stator. Besides protecting the windings, it forms a bearing for the spindle. To the lower part of the stator is fixed, by means of 4B.A. bolts, an ebonite plate which may be provided with terminals, a plug and socket, or a pair of valve legs, according to the type of mounting desired for the finished instrument. A 2B.A. clearance hole to coincide with that in the stator is drilled in the plate.

We are now ready to assemble the variometer. A 1½in. length of 2B.A. screwed rod is inserted through the holes in the ebonite plate and the stator. Over the end within the tube are placed a flat washer, a spring washer, a second flat washer, and a nut. The upper spindle, a 2in. length of the same rod, is also passed through its hole, a single nut being placed upon it. The rotor is now placed inside the stator, and the point of the bottom spindle inserted in the hole drilled for it. The rod is now turned to screw it through the nut already placed upon it until a quarter of an inch or so protrudes into the inside of the rotor. A second nut is then put on and clamped down.

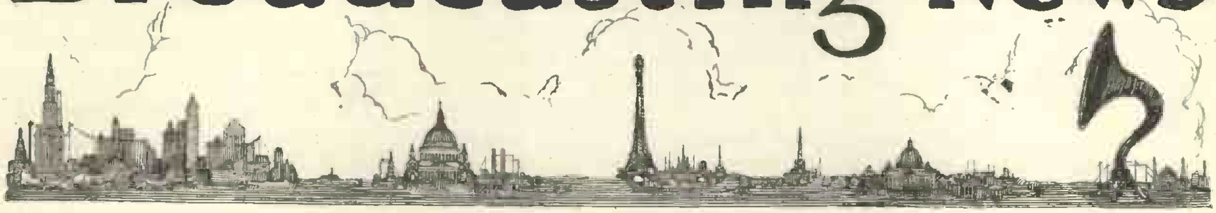
A nut is screwed on to the portion of the spindle which projects from the bottom of the mounting plate. This nut is adjusted until the rotor is drawn to an exactly central position within the stator; a second nut is then placed under it, and the pair are locked tightly. The upper spindle is then screwed in through an ebonite washer and through the rotor, to be fixed by a clamping nut on the inside. The beginning of the windings on the stator is now connected directly to one of the terminals on the plate. To the far end is soldered a short length of thin rubber-insulated flex, whose outer silk or cotton covering has been removed. This is taken to the "in" end of the rotor windings and soldered to it. Another piece of flex is taken from the "out" end of rotor winding to the second terminal, thus completing the circuit, and this quite efficient little tuning device. R. W. H.

A.C. FOR FILAMENTS

WHEN using a transformer for heating the filament of a valve, the alternating current produces a noise in the telephones which renders reception almost impossible: a method of overcoming this consists in shunting the secondary of the transformer by means of a potentiometer of 200 or 300 ohms resistance, to the sliding contact of which is connected one end of the secondary of the transformer (the end which would be connected to the positive terminal of the accumulator if such were used for heating the filament in the ordinary way). In moving the sliding contact slowly towards the centre, it is possible to find a point where the sound due to the alternating current is practically nil, and under these conditions reception is practically as good as with direct current.

The above information, given in a French contemporary by Moye in 1921 in an article on the employment of lighting-current for heating valve filaments, has resulted in the manufacture of the Ferrix transformer, which gives the heating currents and also the high-tension voltage. The primary is constructed for the voltage and frequency of the ordinary electric supply, that is, in France, 110 to 120 volts or 200 to 220 volts at about forty to fifty periods. There are three secondary coils. The first secondary coil is made of extremely fine wire and is solely for the production of the plate voltage; the following voltages may be obtained: 20, 40, 80, 100, 120, and 140. The second secondary coil, which is wound concentrically with the first, provides a current of about 1 ampere at four volts, suitable for the heating of the filament of the first valve. The third secondary coil provides for the heating of the filament of a second valve.

Broadcasting News



By OUR SPECIAL CORRESPONDENTS

LONDON.—At the time of writing, the wireless world is very interested in the effects of the great electric storm. Many people had been afraid that outdoor aerials would be dangerous to property, and possibly to life, in the event of any serious lightning. Some town councils and other bodies have been trying to enforce drastic regulations governing the erection of aerials: the argument being that aerials would be a peril in the event of atmospheric disturbances such as we have just experienced. What these people must now think upon this point I do not know, but it is a matter for satisfaction that the British Broadcasting Company has so far had no account of any damage to property as a result of outdoor aerials badly constructed or otherwise. It has been amply demonstrated that if the listener-in earths his aerial, it may act indeed as a lightning conductor and be an added protection to the house.

The last broadcasting performance of Shakespeare was witnessed by a small group of M.P.s who came specially from the House to Savoy Hill. The party consisted of Major Lloyd George, Captain Ernest Evans, Mr. Tom Shaw, Rev. Herbert Dunnico, Mr. Jack Hayes, Mr. H. C. Charleton, Mr. Chuter Ede. After the performance every member expressed surprise and pleasure at the manner in which the performance was given, and its results. Mr. Chuter Ede, a well-known educationist, stated how impressed he now is with the opportunity which broadcasting provides for bringing the gems of English poetry to millions of people throughout England. He added: "It would bring to adults and to children alike a realisation of the great beauty of the English language, a language used to express the greatest thought in the words of its greatest master." It is expected that the next Shakespeare play performed at Savoy Hill will be "Hamlet."

BROADCAST TRANSMISSIONS

	Call-Sign	*Wavelength*
CARDIFF	5WA	353 metres
*LONDON	2LO	369 ,,
MANCHESTER	2ZY	385 ,,
NEWCASTLE	5NO	400 ,,
GLASGOW	5SC	415 ,,
BIRMINGHAM	5IT	420 ,,

TIMES OF WORKING.

Weekdays ....3.30 to 4.30 p.m. and 5.30 to 11.0 p.m. B.S.T.

*London 11.30 a.m. to 12.30 instead of 3.30 to 4.30 p.m.

Sundays....8.30 to 10.30 p.m. B.S.T. 2LO 3.0 p.m. to 5.0 p.m. also.

SILENT PERIODS.

CARDIFF	8.0 to 8.30
LONDON	7.30 ,, 8.0
MANCHESTER	7.45 ,, 8.15
NEWCASTLE	9.0 ,, 9.30
GLASGOW	6.0 ,, 8.15
BIRMINGHAM	8.15 ,, 8.45

People who doubt the desire of the general public to hear instructive talks would be surprised could they see the definite evidence to the contrary in the possession of the Broadcasting Company. Instructive talks have a much wider appeal than is usually imagined, and many listeners-in will be pleased to learn that the British Broadcasting Company propose to reinstate the Natural History Museum Talks. We are interested to learn that there is a possibility of broadcasting a speech of the Prime Minister. On the 21st instant he is expected to address a meeting at the Crystal Palace on "The Primrose League," and there is every possibility that his audience will be far bigger than that which he will see.

The other day the versatile chief engineer of the B.B.C., Captain P. P. Eckersley, said that the recent simultaneous (land-line relayed) transmission was very successful, and such transmissions will be repeated from time to time when it is desired to broadcast some item of outstanding and general interest. This will be welcome news to the "crystal scratchers" and "single-valvers" all over the country, who will thus be able to receive such special items. It will, however, be a week or two before this can be done, as land-lines, etc., have to be arranged.

In reply to a query as to the possibility of relaying without the employment of land-lines, that is direct by wireless, Captain Eckersley replied that this was somewhat of a dream, and could not, he thought, be successfully done for a greater distance than, say, 50 miles, owing to X's, jamming, and general "mush," and that we could not hope to get the Continental transmissions relayed, unless, of course, it were found desirable at any time to employ a cable, say, from Dover to Calais, relaying the transmissions on our own concert wavebands.

The 2LO performance of "Romeo and Juliet" was an artistic success, and a welcome change in these days of slang and indifferent English. To the writer it seemed that the exponents at the broadcasting studio reached such a degree of artistry as to convey the atmosphere so essential to the full enjoyment of any play. Juliet was particularly excellent, but it seemed that Lady Capulet's grief, on learning of the death of her daughter, was just a little too well controlled at the outset to be quite natural. It is pretty certain that this feature of the programmes has come to stay, and were it not for the fact that certain of the "Uncles" at 2LO have to do double duty by appearing in these casts in addition to their already strenuous labours, one could heartily wish for "more and oftener."

Forthcoming Events

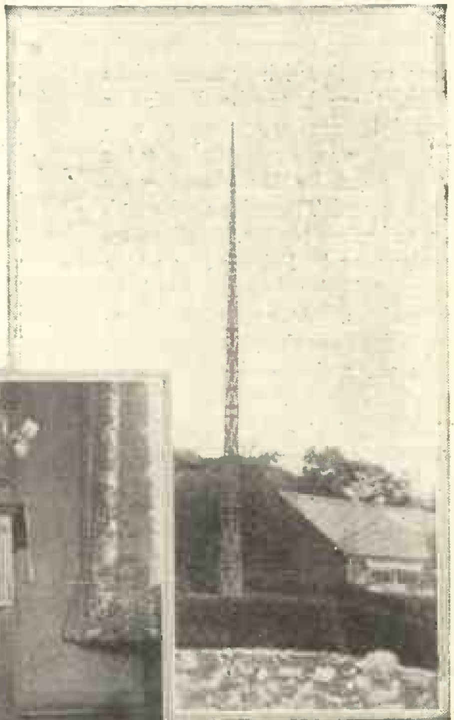
19th (THURS.).—Talk to Boy Scouts by General Sir Robert Baden-Powell.
"Musical Criticisms," by Mr. Percy Scholes.

20th (FRI.).—"Southwark Cathedral," by Mr. Alan F. Walker.

24th (TUES.).—"Impressions of Business in America," by Mr. W. S. Crawford.

GLASGOW. — There was laughter in many "wireless homes" this week, when listeners-in to the Glasgow station experienced a novel innovation connected with the broadcasting of a series of funny stories by the Editor of *Tit-Bits*. It was arranged that the Station Orchestra should laugh heartily after each joke. This no doubt made the story-teller's performance easier, for it gave him breathing intervals and cheered him up, and, in addition, a natural atmosphere was created for listeners-in throughout the country, many of whom laughed heartily through sheer infection. In this connection we may yet observe in the daily press a situation advertised "for persons of infectious laughter, references required." Hitherto listeners-in have had the serious look.

Preparations are being made for a number of specially attractive programmes to be given after the Glasgow Fair Holidays, and the Station Director hopes on many occasions to "set the heather afire."



A very high-class amateur station, showing the receiver fitted into an antique sideboard, and the 55 ft. lattice mast. Note the weight for keeping the aerial under constant tension.

MANCHESTER. — 2ZY's "Hello, Manchester" is a much better method of calling up than the time-honoured "Hello, Hello, Hello, Manchester calling you." But we do not like the so-called improvement of not giving the name of an item which has just been performed. It is very annoying when one over-estimates the length of a two-minute close-down to hear a piece that one knows but cannot name; and again, a name makes more of an impression after one has heard the item.

Language talks for business men are widely appreciated, but as the demand seems to be in favour of Spanish rather than Italian, these latter by Professor Valgimigli are temporarily discontinued, and the Spanish talks will be given by Mr. Bletcher on Mondays and Thursdays. French talks as before by Mr. Stafford on Tuesdays and Fridays, and a German talk by Mr. Stafford on Wednesdays. At 10.15 on Saturdays the week's competition results are announced.

Two classical evenings are held each week, (a) on Tuesdays (good orchestral music, operatic lectures and so on) and (b) Thursday (chamber music and special recitals). On Thursdays, also at 7.30, Mr. Scholes's weekly talk on music is given, and at 9.15 Astrophel's weekly review of literature and art.

Uncle Humpty Dumpty, who has for some time been distributing to his little listeners-in his autographed photograph, is anxious that no kiddies should be missed out, and invites all who have not yet sent in their names and addresses requesting his photograph to do so.

Forthcoming Events

18th (Wed.).—First Shakespeare Night. "Twelfth Night" will be given (as arranged for broadcasting by Miss Kathleen Nesbitt and Captain Cyril Lewis) and produced at 2ZY by Miss Amy Buxton Nowell and Mr. Kenneth A. Wright. Roger Quilter's charming settings of the Elizabethan lyrics occurring in the play will be used.
Incidental music selected from Purcell's work, played by the Leonard Hirsch String Quartette.

19th (Thurs.).—Madame Sophie Thomson de Konshen, soprano, late of Moscow Opera, will give a half-hour's recital of modern Russian songs by Gretchaninov, Dargomyszshsky, and other leading composers. Arnold Perry, whose recent piano recitals in Manchester and London have caused more than usual interest, will play a group of piano works, and will later in the evening collaborate with Mr. Leonard Hirsch in Lalos Symphonia Espagnole.

20th (Fri.).—This evening a new standard feature will be added to the 2ZY programmes in the form of a 12 minutes' medley of popular melodies, tastefully served up by a young and talented Northern composer and pianist, who desires in this work to be known by the nom-de-Radio of "Keyboard Kitty."

21st (Sat.).—Part of this evening's popular programme will be provided by the Melody Four, whose recent broadcasts were greatly appreciated by the 2ZY listeners-in.

22nd (Sun.).—A Sunday orchestral concert as a welcome variation on the more usual Sabbath fare.

23rd (Mon.).—The vocalist in this popular programme is Klinton Shepherd, who has already achieved distinction in radio as elsewhere.

24th (Tues.).—Concerto night. A talk on the history of the Concerto, followed by Mozart's A major concerto for piano, played by Miss Annie Lord with the Radio Orchestra, the Saint-Saëns 'cello concerto by Miss Beatrice Evelyn, the London 'cellist, and the Tchaikowsky violin concerto played by Leonard Hirsch, whose famous master, Dr. Brodsky, received the manuscript wet from the hands of the composer himself in Russia. This is a night that will attract all music lovers.

* * *

NEWCASTLE-ON-TYNE. — Transmission of selections played by the orchestra of the Newcastle New Pavilion Cinema, which was tried as an experiment, has not been as successful as was hoped. This feature has, therefore, been temporarily dropped from the programme pending the acquisition of a new amplifying panel in the theatre.

Considerable disappointment has been felt in Newcastle on account of the fact that a visit to the city does not figure in the tours of the premier opera companies. That this omission is unmerited is shown by the full houses obtained by those companies which do appear, many being turned away nightly even when the visit extends to three weeks. Now comes the welcome news that a visit from the British National Opera Co. is promised for December. It is hoped by all listeners-in that portions of the operas performed will be transmitted, as was the case on their visit to Glasgow.

Forthcoming Events

18th (Wed.).—Broadcasting of the "Lily of Killarney." All the talent is local, and the chorus, etc., is drawn from the best of our artists.

19th (Thurs.).—A night with "Musical Comedy—Dorothy." Madame May Grant's party are responsible for the production of this, and they as a party as well as individually specialise greatly in the musical comedy work for 5NO.

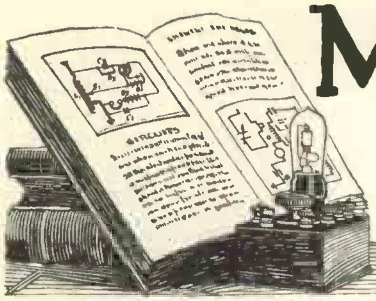
20th (Fri.).—A night with "Musical Comedy—The Arcadians." The above party are also taking this in hand.

21st (Sat.).—Saturday is a popular night, and Mr. W. A. Crosse's Jazz Orchestra supply all the orchestral work. Mr. W. A. Crosse is the station musical director, and his orchestra and military band are greatly appreciated by the listeners-in.

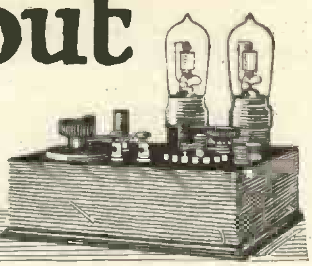
22nd (Sun.).—Mr. W. A. Crosse's military band takes up the whole evening.

23rd (Mon.).—A semi-classical evening.

24th (Tues.).—Band of Northumberland Fusiliers.
Madame Alec Thomson's party is responsible for the vocal items, and Mr. Yeaman Dodds will give a pianoforte recital.



Mainly about Valves



Our weekly causerie written by the Editor.

Variable Condensers

"WHAT size of variable condenser should I buy?" is a question which thousands of experimenters are asking themselves. Personally, I always recommend a 0.0005 μF or 0.001 μF variable condenser. The advantages of the 0.001 μF condenser lie in the fact that it is far more

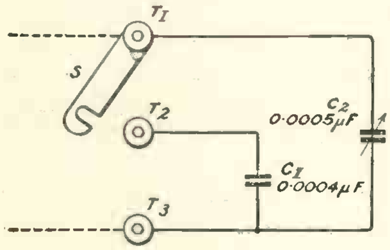


Fig. 1.

useful for receiving wavelengths of 600 metres and over. It also enables one to tune more rapidly to a given signal. With such a size of condenser, only one or two coils are needed, and it is possible to obtain the desired overlapping effect; that is to say, with one coil the signals may be heard at the extreme capacity of the condenser, and by using the next larger size of coil the signals may be heard lower down on the condenser.

It is, therefore, not so essential to have exactly the right amount of inductance before a station can be picked up. On the other hand, when working on short wavelengths, it is difficult to tune to a station exactly. The slightest movement of the condenser will result in putting the receiver out of tune. This is especially the case on British Broadcasting wavelengths, when a careful adjustment is absolutely essential, and with a large variable condenser of ordinary type a fine adjustment is not obtainable. One solution of the trouble is to connect a small vernier condenser in parallel with the large variable condenser. This vernier condenser will enable small variations of capacities to be obtained with a relatively large movement of the controlling knob.

Personally, I favour the arrangements shown in the accompanying illustrations. In Fig. 1, the condenser is provided with three terminals, T_1, T_2 and T_3. These terminals are preferably of the 4B.A. double army type, a brass strap is secured to the terminal T_1 so that it may be used for connecting T_1 and T_2 when necessary. Fig. 2 shows the strap in position between the terminals T_1 and T_2. Across the terminals T_2 and T_3 is permanently connected a fixed condenser C_1, having a capacity of about 0.0004 μF. The condenser C_2 is a variable one connected across the terminals T_1 and T_3. The leads to the condenser unit are taken to the terminals T_1 and T_2. With the strap "S" open, the condenser C_2 only is used, and a capacity ranging from almost zero to 0.0005 μF is obtainable. With the shorting switch "S" closed, the two condensers C_1 and C_2 are connected in parallel, and the range of capacity of the unit will now

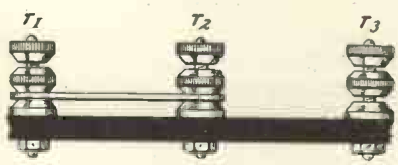


Fig. 2.

be from 0.0004 μF to 0.0009 μF, the sum of the two capacities C_1 and C_2. The principle, of course, may be extended. The reason for making C_1 a little smaller than C_2 is to enable a signal which requires about 0.0005 μF capacity to tune in to be received with either arrangement, this overlapping being most desirable.

It is curious that more manufacturers of variable condensers do not carry out this simple idea, because it is only a matter of, at the most, 2s. 6d. extra cost.

Another solution of the problem is to make a 0.001 μF variable condenser increase slowly in capacity at first, then more rapidly. This can be done by shaping the plates in a special manner. For example, a number of

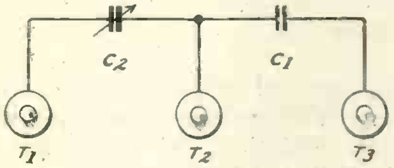


Fig. 3.

holes might be drilled in the movable set of plates at one end; a large movement would, therefore, be required to cause an appreciable increase of capacity, whereas, at the other end of the scale, the plates, not being drilled, would produce large changes of capacity for a small movement.

Changing a Large-capacity Variable Condenser into a Small One

When the variable condenser in use has a capacity of, say, 0.001 μF, and it is desired to use it as a vernier condenser, or as a 0.0005 μF variable condenser, it is necessary to connect in series with it a fixed condenser. The accompanying figure shows three terminals, T_1, T_2 and T_3. Across T_1 and T_2 is a variable condenser, C_2, having a capacity of 0.001 μF, while across T_2 and T_3 is a fixed condenser, C_1, having a capacity of 0.001 μF. If connections are taken from T_1 and T_2, the 0.001 μF condenser is used in the ordinary way. If, however, we take the leads to the terminals T_1 and T_3, the unit will be equivalent to a variable condenser, which may be varied between approximately zero and a maximum capacity of 0.0005 μF. It is a simple matter to change the variable condenser into one of a smaller capacity by connecting various sizes of fixed condensers in series with it. To change C_2 into a vernier condenser, the fixed condenser C_1 might, for example, be a 0.0003 μF fixed condenser.

This method of using fixed and variable condensers is rarely used by manufacturers of variable condensers, although it offers a wide scope for an enterprising firm. The addition of an extra terminal and a small fixed condenser should make practically no difference to the price of the condenser, while possible purchasers would immediately see the advantages of the arrangement. Four terminals and still another condenser might be added, if desired.

FORTHCOMING EVENTS

JULY.

18th (WED.).—The Radio Society of Great Britain. Members and Associate Members will pay a visit to the Transmitting Station of Northolt, and also to the Testing Laboratories of the General Electric Company, and special motors will leave Kingsway at 2 p.m.

19th (THURS.).—Hackney and District Radio Society. A chat on "Building and Working of Variometers."

20th (FRI.).—Leeds and District Amateur Wireless Society. Mr. S. Kniverton will lecture on "Wet High Tension" at 7 p.m., at Woodhouse Lane, U.M. Church Schools, Leeds.

Radio Society of Highgate. Analysis of results of the D.F. Competition, at 7.45 p.m., at the 1919 Club, South Grove, Highgate.

21st (SAT.).—Ipswich and District Radio Society. Visit to Pulham Aerodrome.

23rd (MON.).—Hornsey and District Wireless Society. Competition for the best answers to twelve questions.

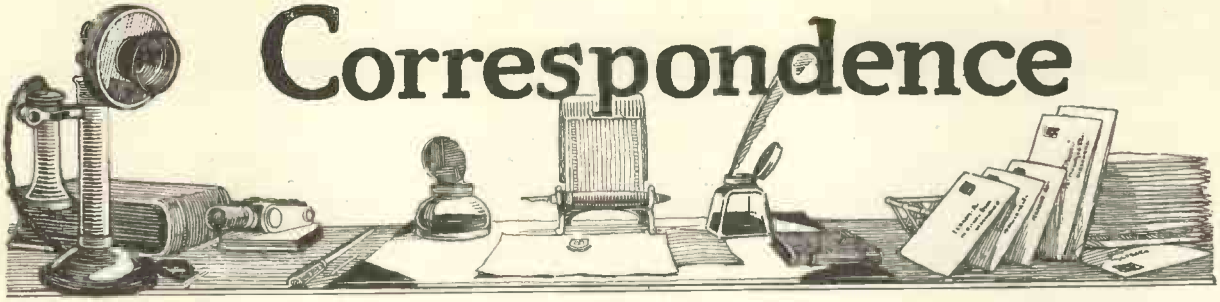
North London Wireless Association. At 8.30 p.m. Mr. J. A. Reading will lecture on "Experiences with a Regenerative Set."

Sydenham and Forest Hill Radio Society. Captain S. A. Huss will lecture at 8 p.m. on "The Flewelling Circuit."

24th (TUES.).—Plymouth Wireless and Scientific Society. At 7.30 p.m., Buzzer Practice, and at 8 p.m. a lecture will be given on "Winding Coils and Testing with Wavemeter" at Y.M.C.A. Building, Old Town Street, Plymouth.

25th (WED.).—General Meeting, Radio Society of Great Britain, at 6.0 p.m., at the Institution of Electrical Engineers. A paper contributed by Mr. Lionel J. Hughes and entitled "Resistance - Capacity Coupled Amplifiers" will be read by Mr. Philip R. Coursey. This will be followed by a short lecture by M. Marrec, of Paris, who will demonstrate reception on a frame aerial of American signals and explain his new arrangement for eliminating atmospherics and other interference.

Correspondence



ST100

To the Editor, *Wireless Weekly*.

Sir,—I did not have time to lay out ST100 till Tuesday last, and to my tremendous surprise, as soon as I touched the condenser I got 2LO marvellously loud and clear. I am delighted with the circuit, and it appears to give no trouble or to have any drawbacks. Its purity is wonderful, and I have never had such freedom from outside signals and oscillations! Please tell us the best way to box it up in a portable manner in an early issue.

You have the deepest gratitude of one who has been looking for a dual amplification circuit for a long time and was on the point of giving up in despair.

I am, etc.,

Shepperton. A. Wright.

CULLERCOATS

To the Editor, *Wireless Weekly*.

Sir,—I notice in your issue of June 27th, under "Broadcasting News," the old complaint in this district of interference caused by Cullercoats radio station during broadcasting hours, but I think the statement about that station operating for two hours without "ceasing" is a little far-fetched.

It must be remembered that Cullercoats is one of the busiest coast stations we have; its traffic is of commercial and sometimes life importance, and I think every credit is due to the way the staff handle their traffic during broadcasting hours (which, after all, is not a monopoly of the ether). As to those of us who can read morse, one cannot help but notice his speed-up and abbreviated procedure during those hours.

I trust that the above will not cause readers to think that I am a kill-joy—I am far from it, as I enjoy the B.B.C. concerts as much as anyone, but I like to see fair play.

It might be of interest to local amateurs to know that one can cut out GCC, perhaps not altogether, but sufficiently to prevent serious interference with 5NO. The circuit is nothing wonderful, being the ordinary two circuit loose-coupled receiver. I use a Mark III. tuner with Perikon detector and one note-magnifier for 'phone reception and two or three magnifiers for a small loud-speaker.

I am, etc.,

South Shields. D. Aird.

WIRELESS IN JO'BURG

To the Editor, *Wireless Weekly*.

Sir,—Having had *Wireless Weekly* from the first number I feel I must congratulate you on at last producing a periodical filling long-felt wants.

I have noticed that you are desirous of hearing of the different Radio Clubs, so thought it might interest you to know of the advancement of radio on this side of the globe, or possibly the enthusiasts on your side.

Wireless in Africa, I am sorry to say, is dead. We have only five small stations to listen to, and, of course, the high-powered Continental stations are received regularly on single-valve sets. We all out here envy our fellow brothers in England with broadcasting, and one or two of us, including myself, have been guilty of "listening-in" with the hopes of a freak occurring and our picking up 2LO or WJZ, but up to the present no such luck.

However, early in January the secretary and myself started to form a Radio Club, and a notice was put in a local paper calling for anyone interested in wireless to attend a meeting in the Y.M.C.A. That night it poured with rain, but 180 turned up and 62 joined; to-day the membership is 168. We now have meetings every second and fourth Friday in each month, which has always had an attendance of 100 to 140.

The club has been trying hard to do a little broadcasting, but up to the present the Government has not granted permission, but we still live in hopes.

Wishing your paper every success, I am, etc.,

L. G. Hughes.

Johannesburg.

SUCCESS

To the Editor, *Wireless Weekly*.

Sir,—I am one of perhaps a great number of readers who followed out your suggestions in an early issue of *Modern Wireless* regarding what you considered and what has proved to me to be the ideal unit receiver. Consequently the wiring of ST100 was only a matter of a few minutes.

The results on the local transmission using a Claritone loud-speaker are beyond praise. The tone, volume and freedom from parasitic noises is truly wonderful.

Prior to ST100 my best reception has been with tuned-anode coupling, which you have made so popular. I am, etc.,

Birmingham. M. D.

CRYSTAL RECEIVING SETS

To the Editor, *Wireless Weekly*.

Sir,—I have a home-made crystal receiving set with which I have experimented for some time past, and have now settled on a platinum cat's-whisker as being superior in results to the gold ones.

I have, however, on several occasions been able with this platinum cat's-whisker to pick up 2LO without having any crystal in the cup, merely making contact with the cup or securing screw. This is a matter of extremely careful adjustment and luck, but when the correct spot is found it is possible to get quite loud results; at other times, however, I have spent some time without getting more than faint snatches.

Out of many crystals which I have tried I have now settled down to the use of iron pyrites, as I have found that for clearness, purity of sound, and freedom from the scratching and banging produced by some crystals, it cannot be equalled—whilst I have always found it far and away the best for reception of operas and songs in general. I am, etc.,

S. Jessey.

Battersea, S.W.11.

VALVE COMBINATIONS

To the Editor, *Wireless Weekly*.

Sir,—Replying to your two questions at the end of Mr. H. E. Dixon Benwell's letter in the issue of June 27th:

D for dual is O.K.

I suggest a bar thus ⁀ be placed over the valve concerned with reaction, terminating between the valves to denote reaction on anode or transformer and beyond the high-frequency valve for reaction on aerial or secondary.

Thus 1—1̑—2

or 1̑—1—2

I am, etc.,

Bath. C. F. Fox.

ST100

To the Editor, *Wireless Weekly*.

Sir,—May I congratulate you on the new circuit, ST100, published in your excellent paper? I have just made up and tried this new circuit and am delighted with it; the purity of tone is a revelation.

With 4-volt L.T. I found 100,000 ohms resistance the best, but when using a 6-volt cells 50,000 ohms, otherwise there is a slight tendency to howl. With 90 to 100 volts on the plate I put a grid battery of 4½ volts in circuit, which increased the power considerably. I am using R.I. transformers, Mullard resistances, Ediswan and Osram valves, and home-made basket coils. I have not had time to try any other station except 2LO, but hope to be successful on other wavelengths.

I am, etc.,

Kent. W. K. Barker.

FADING

To the Editor, *Wireless Weekly*.

Sir,—I have recently carried out a number of experiments with regard to "fading," and have come to the conclusion that some fading is due to internal troubles of receiving sets.

On a set I have where reaction is used, I find that "fading" takes place which is not apparent on any of my other sets. I have found two ways of dealing with it, the first being to instantaneously reverse the reaction and return to normal when signals are quite clear again. The other method is to reduce the resistance of the grid-leak. I find this "fading" occurs when there is plenty of interference, and consequently assume it is due to "choking" in the set. I am, etc.,

J. Delibecque.

Clapham, S.W.4.

EXTENDED 'PHONE LEADS

To the Editor, *Wireless Weekly*.

Sir,—I have read with much interest the varied correspondence which has appeared in your columns *re* extended telephone leads. I have extended my leads from my wireless den in an outhouse to the house itself. The distance is about 30 yards in all, the wires crossing a yard at about 12 ft. high, and running under the house by way of the cellars, into the sitting room. The loud-speaker used is a "Music Master" type Amplion, and using four valves I find no reduction in signal strength or purity. As most correspondents seem to have observed, the purity is if anything improved.

It may interest your readers to know that I receive 2ZY (30 miles), using these extended leads as an aerial, with one stage of H.F. amplification. I am, etc.,

T. E. le Phone.

Cheltenham.

ST100 AND PARIS

To the Editor, *Wireless Weekly*.

Sir,—It may be of interest to state that the ST100 was quite successful last evening in bringing in the concert from FL, Paris, on a loud-speaker made up of a gramophone attachment with small gramophone horn. Every word was perfectly distinct, and the piano was particularly good. The coils used were Burndept 300 with a 0.001 μF condenser in parallel, pointer about 15°, and Burndept 400; the second condenser was a 0.0005 μF with the pointer at 30°—a certain amount of reaction was used.

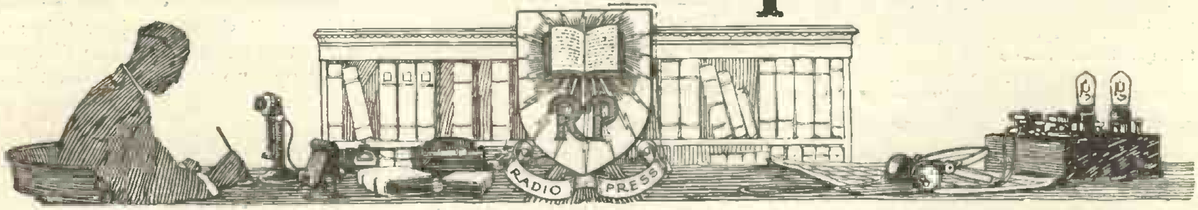
The aerial is approximately 30 ft. high at the house end—a poor arrangement, though only a temporary one. The receiver was in a top bedroom, practically on the same level as the higher end of the aerial, with a short lead in (3 or 4 ft.) and earth lead about 8 or 9 ft., to a water tap feeding the cistern.

This is the first time I have succeeded in obtaining the Paris concert so clearly, and the 50-mile limit of efficiency suggested in your article seems a distinct underestimate. Curiously enough, contrary to Mr. Percy Harris's experience, I find that for broadcasting, the aerial condenser in parallel is far the better arrangement, using Burndept S4 for both coils L_1 and L_2. The crystal used was zincite-bornite.

Yours faithfully and gratefully,

Beckenham. F. A. Beerk.

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.

F. E. C. (LEAMINGTON) asks the following questions: (1) What is the natural wavelength of his aerial (sketch submitted). (2) How he can eliminate a rushing noise heard in his telephones when the H.T. battery is switched on.

(1) The natural wavelength of the aerial you have sketched is in the neighbourhood of 80 metres. (2) In order to produce much of a rushing sound in your telephone, it is probable that your set is oscillating. If this is the case, the reaction coupling should be loosened and the H.T. voltage reduced to the minimum, which will give you the amplification you desire. Failing that, a step-down transformer with low-resistance telephones should be used, and the primary of this transformer should have a condenser of large capacity connected across it.

W. L. G. (SHIPLAKE-ON-THAMES) asks for a circuit diagram showing the necessary wiring for a high-frequency amplifier to add to his present valve set. He wishes to use Burndept coils which are already in his possession if possible.

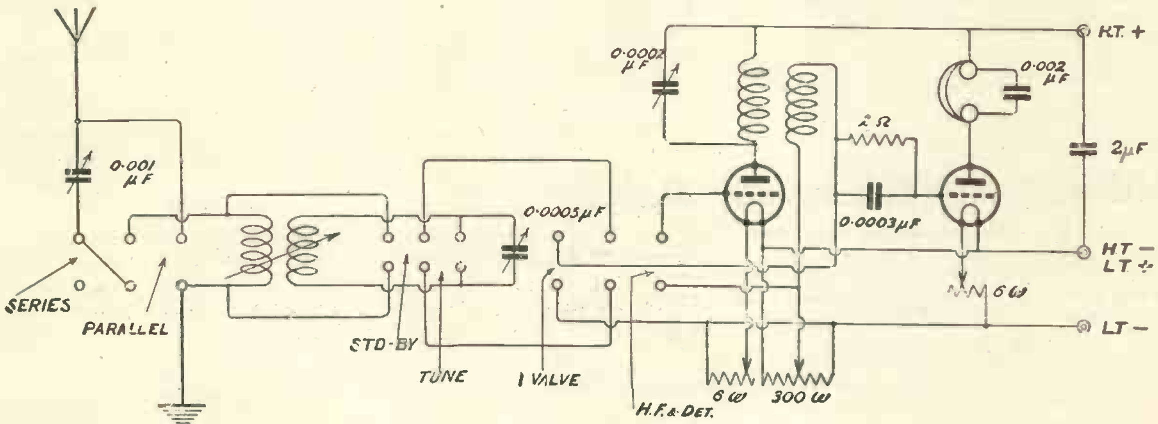
We give you herewith a suitable circuit diagram for your purpose. The variable condenser should have a value not greater than 0.0002 μF.

R. R. (WEST NORWOOD) has a 4-valve receiver employing tuned anode intervalve coupling and wishes to know how to construct suitable coils to amplify up to 10,000 metres.

If you propose to use the ebonite tubes you mention, they will be of rather an unmanageable size if wound as single layer solenoid coils. We suggest you use the plug-in type of honeycomb or basket coils, in which case you would require coils of 750 turns in both the aerial and anode circuits.

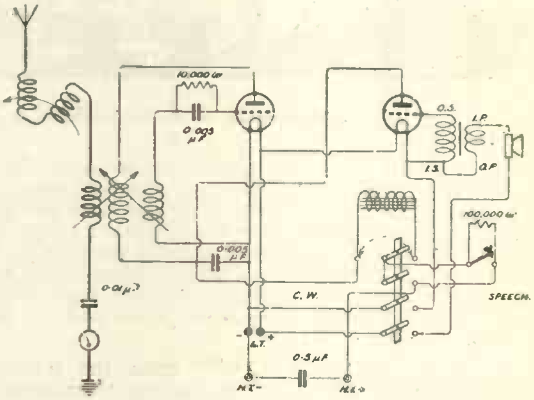
C. A. F. (WEYMOUTH) asks (1) for the size of a frame aerial for the reception of London Broadcasting. (2) Whether certain condensers will be required to tune this circuit. (3) The merits of two different types of valve.

(1) If your frame is 2½ft. in diameter, you will require 10 turns of Litzendraht cable. This frame should be tuned by means of a small variable condenser in parallel with it, having a capacity not greater than 0.00025 μF. (2) No aerial tuning inductance in the apparatus will, of course, be necessary when using the frame. (3) The first valve you mention is not quite so efficient as the second one, although it is slightly stronger mechanically.



W. C. (LEEDS) wishes to know how he may arrange his C.W. transmitter circuit so as to be able to use it for telephony at will; he wishes to use a choke-control system and to operate it by one switch.

The circuit given below will show you how this may be accomplished in a simple manner. The direction of windings of the microphone transformer should be noted.



J. F. A. L. (BOLTON) has a crystal set and wishes to extend the range. He asks what kind of loading coil should be used for this purpose, and whether it will be as efficient as if the set was designed to cover this range.

A satisfactory method of obtaining any desired increase in wavelength is to use plug-in honeycomb coils. There is no need for this coil to be tapped, but to extend the range from 600 to 900 metres will require a coil having about 75 turns. This should be connected directly in series between the aerial and your set.

T. W. F. (IPSWICH) is making the 2-valve Broadcast receiver described in "WIRELESS WEEKLY," No. 4, and wishes to know the maximum range over which he may expect results with this apparatus.

Under favourable circumstances a range of between 80 and 100 miles may be expected with this instrument. The fact that you have your window open makes no difference whatsoever to the working of an indoor aerial.

P. L. R. (HUDDERSFIELD) contemplates buying a 2-valve note magnifier, and asks whether there is anything to choose between four different makes, particulars of which he submits.

We think all the amplifiers mentioned are efficient, but if anything preference should be given to No. 4 in your list. Referring to a receiver for general purposes, we have to say that we cannot recommend any particular make of apparatus in these columns. The attention of those readers who send us in enquiries regarding commercial apparatus is directed to this answer, which must serve as a general reply to the numerous requests for our opinion that we have already received.

R. McD. (ROTHESAY) is building the four-valve set described on page 134 of No. 3 "MODERN WIRELESS," and asks for details of certain alterations he proposes to make.

This receiver is very satisfactory as it stands, and we do not advise any departure from the original specification.

R. R. (BRADFORD) is constructing certain apparatus which employs "Igranic" coils, but wishes to use in place of them basket coils wound upon a former having an internal diameter of 2in., with 17 pins. He asks how many turns of wire would be required on this former to correspond with the "Igranic" coils.

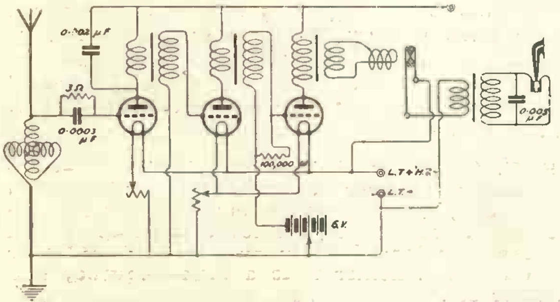
The same number of turns may be wound on your former as are indicated by the numbers stamped upon the "Igranic" coils, for which they are to be substituted. The manufacturers of these latter coils publish tables showing the wavelength ranges which are covered by each coil when used with different variable condensers.

L. F. S. (GRAVESEND) asks whether it is an advantage to use enamelled aerial wire instead of bare copper wire and whether a large galvanised iron bath which he has would make a satisfactory earth.

It is better practice to use enamelled wire than bare copper wire, as corrosion which occurs in cities forms various films of chemical substances on the surface of the wire which offer considerable resistance to high-frequency currents. The iron bath you mention would make a very satisfactory earth connection. Referring to the different types of coils you indicate, there is nothing whatever to choose between them where efficiency is concerned.

M. D. (BIRMINGHAM) refers to the circuit diagram of Mr. Ridley's, given in "WIRELESS WEEKLY" and asks the following questions :— (1) Whether it would be suitable for general use. (2) If the valves mentioned are necessary. (3) How many vanes should be used for the 0·00025 variable condensers.

(1) This circuit is very suitable for general work. (2) "R" valves may be used if desired. (3) 15 vanes having a radius of 1¼in. and separated by ⅛in. spacing washers will be satisfactory for this condenser.



J. B. R. (GLASGOW) asks for a diagram showing how he may add one L.F. stage and a microphone amplifier to his receiver, which is variometer-tuned and consists of one detector and one low-frequency valve.

We give herewith a circuit diagram showing how the apparatus you mention should be connected. Whilst a large volume of sound could be obtained from this arrangement, we think it would need careful adjustment to give pure reproduction.

H. E. H. (WALLWOOD ROAD, E.11) sends a sketch of a vario-coupler which he proposes to use for a crystal receiver, and asks what gauge of wire should be used to wind this with.

The rotor and stator should both be wound full of No. 24 s.w.g. single cotton-covered wire. A little shellac varnish on the rotor will help to hold the wire in place.

D. R. C. (WOOD GREEN) has made a crystal set, but finds he is unable to erect an outside aerial. He asks whether with a frame aerial he could expect any results from 2LO.

With careful adjustment you might just be able to hear the London Broadcasting Station, but the addition of a high-frequency valve would probably ensure satisfactory reception. In general, the use of a frame aerial with a crystal is confined to a radius of about two miles from a Broadcasting station.

H. W. R. (NEW SOUTHGATE, N.11) asks certain questions about an Armstrong super regenerative receiver.

The principle on which this receiver operates precludes the addition of valves in the manner suggested. We would recommend you to try a good valve receiver of a more ordinary type such as ST45, "Practical Wireless Valve Circuits," Radio Press, Limited.

M. T. (LINCOLN) sends us a diagram, and asks: (1) Whether it is correct, and (2) What the greatest distance is that has ever been covered by radio telephony.

(1) The diagram you submit is quite correct. (2) We believe the transmission of speech by the General Electric Company in 1915 from San Francisco to Paris is the greatest distance over which telephony has been effected. The San Francisco transmissions were also heard in Honolulu.

F. M. (PLUMSTEAD, S.E.18) submits a circuit diagram, and asks: (1) Suitable windings for certain coils. (2) Suitable windings for the associated high-frequency transformers. (3) The value of a condenser bridging the primary of an intervalve transformer.

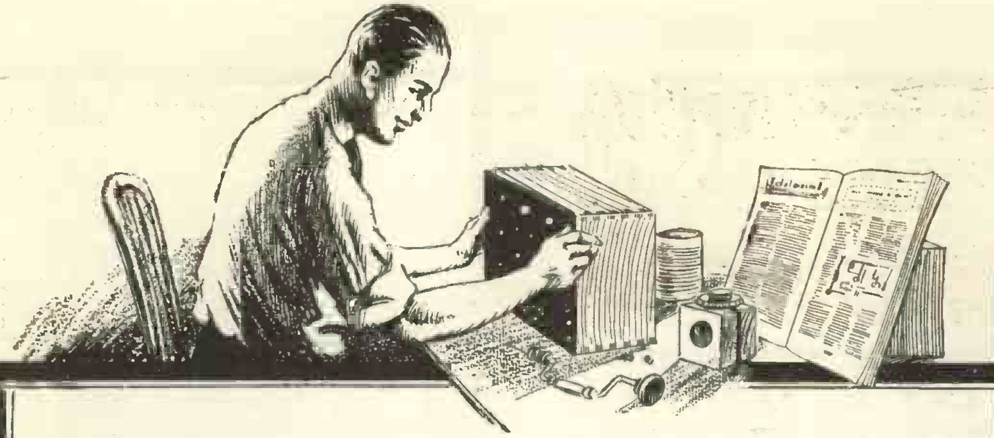
(1) To cover the range you mention coil L_1 might have 50 turns, coil L_2 75, and coil L_3 50 turns. (2) A suitable winding for your transformer would be 80 turns primary, 80 turns secondary, No. 32 s.w.g. single silk-covered wire on a former 2in. internal diameter. Both windings should be wound together in one slot and in the same direction. (3) A suitable value for C_4 is 0.002 μF.

E. C. (ROTHERHAM) has made the two-valve variometer receiver described in "MODERN WIRELESS," No. 1, and asks: (1) Whether the method of rectification employed is good. (2) If zinc is a suitable material to make the grid condenser out of. (3) Whether it is a high-frequency and detector set.

(1) The method of rectification employed is very efficient. (2) Zinc is quite a suitable material from which to construct this condenser. (3) This set embodies one high-frequency valve and a rectifier. A large number of these sets have now been made and are giving every satisfaction. You should therefore have no difficulty in obtaining good results from yours.

J. C. (HORNSEY) asks how to make a set of basket and slab coils, and also coils for use in a tuned anode circuit.

Without wishing to know the range of wavelength which you propose to cover, we cannot give you definite instructions. If you are using an aerial circuit and a secondary circuit, your tuned anode coils might be the same size as those used in the secondary or detector circuit.



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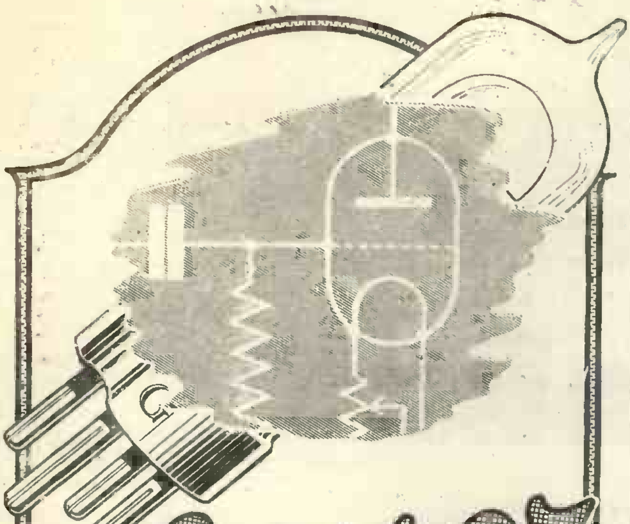

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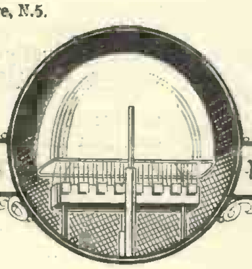

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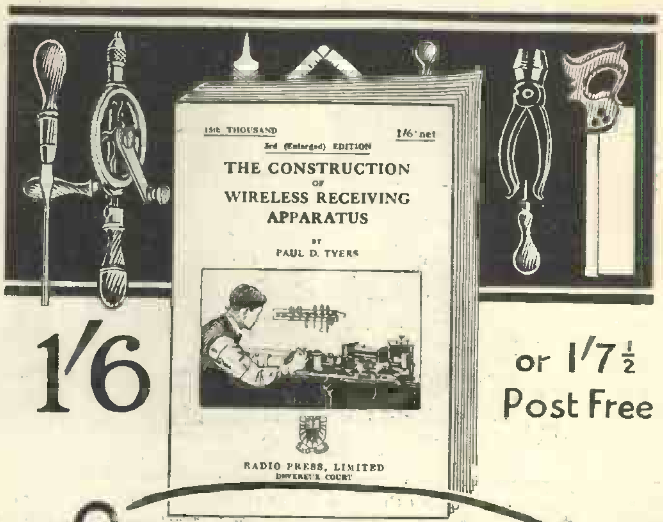

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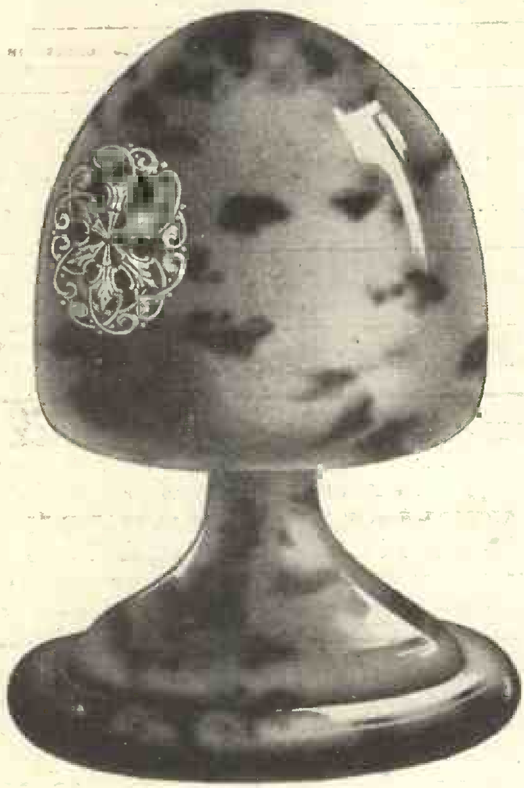

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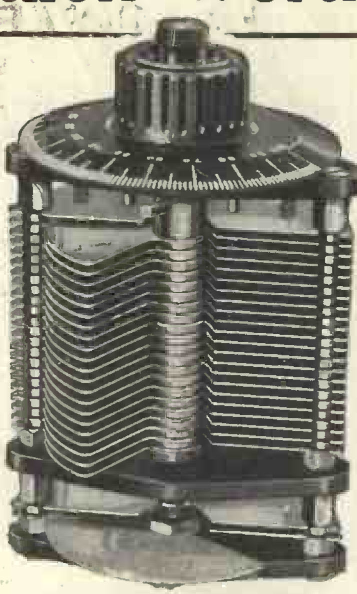

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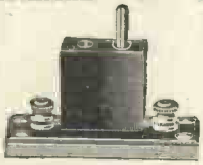

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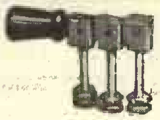

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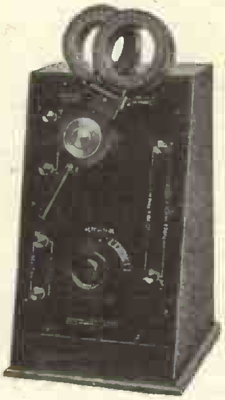

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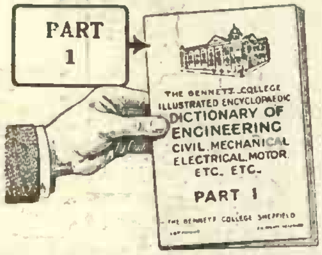

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Advertiser : How may I know that?

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"W.W." : You see what comes of overlooking important details.

Advertiser : I must certainly go further into this.

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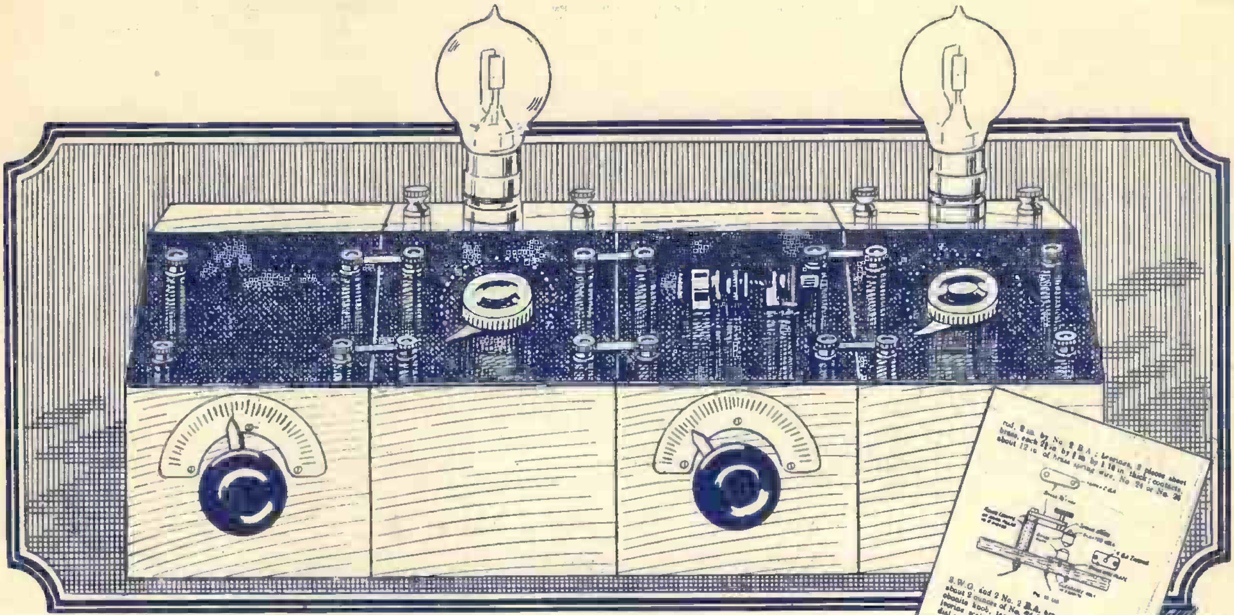

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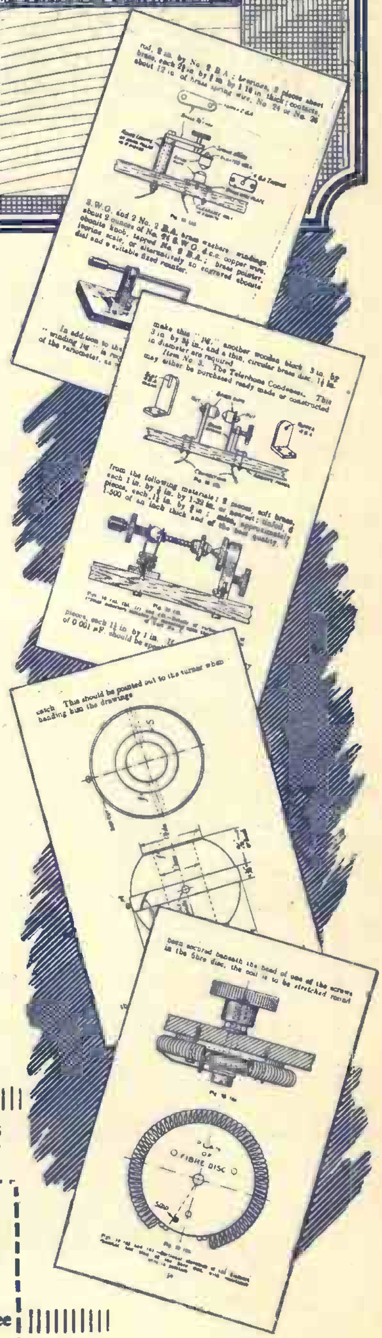

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by E. REDPATH (*Assistant Editor of "Wireless Weekly."*)

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Wireless Weekly

and The Wireless Constructor.

Vol. 2.
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A New Flewelling Receiving Circuit (Exclusive)

Wireless Weekly

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July 25, 1923

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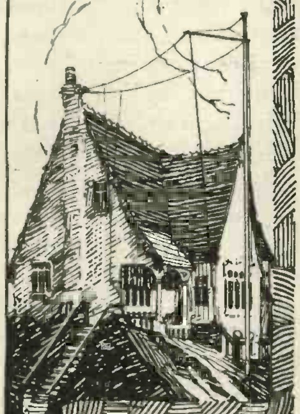

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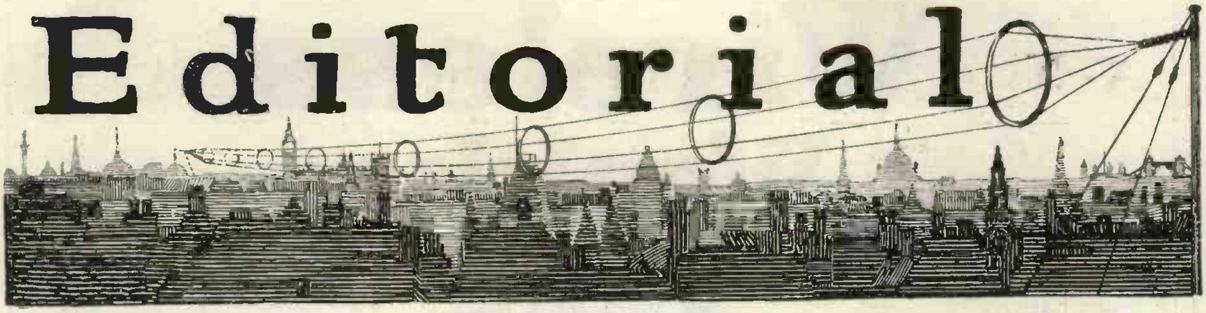
Editorial



AT long last we have a statement by the Broadcasting Committee, as published in full in our last issue, and before long —possibly even by the time these lines appear in print—we may have the anxiously awaited final report.

This report, it is confidently expected, will settle the important licensing question and other outstanding matters which affect the wireless industry, the public and the future of broadcasting generally.

There still remains, however, the unsatisfactory position between the British Broadcasting Company and the Concert Artistes' Association and Entertainment Managers. It is of the utmost importance that this matter should not be left in its present state of abeyance, as, if so, it is very likely to lead to further controversy at a time when the anticipated successful autumn and winter season should be in full swing.

Everyone who has the real interest of broadcasting at heart will agree that previous " stunt " publicity on the part of the daily Press did incalculable harm to a new industry, and there must be no possible opening afforded for another Press campaign in which scare headlines such as " Another Ban on Broadcasting " can be employed.

The British Broadcasting Company has already approached the entertainment providers with a view to arriving at a satisfactory working agreement, but so far its efforts have not been crowned with success. Nevertheless, their programmes are admittedly excellent and in fact are improving, the officials responsible both at the London and provincial stations sparing no efforts to provide entertainment to meet the tastes of all classes of listeners-in.

Perhaps the time has now arrived when the British Broadcasting Company can omit the various Associations from their reckoning altogether, and make their own arrangements for the necessary artistes, both concert and theatrical.

The Broadcasting Company will doubtless have all the necessary points down for consideration, and nothing is further from our intentions than to endeavour to teach the company how to run its own business. We have strong views, however, and consider it our duty to have strong views, with regard to the harmful effects upon the development of broadcasting and the prosperity of the wireless industry generally which might result from the present situation.

We feel that the controversy may suddenly break out afresh and interfere with the peaceful development of broadcasting in the autumn. We are all heartily sick of disputes and committees, and we hope that the B.B.C. will take every possible step to avoid an open dispute which will upset public confidence in broadcasting.

As the entertainment providers will not come to an arrangement, the B.B.C. will, we hope and believe, treat them with friendly expectation, but decline to invite further snubs, which are always given the fullest publicity. Their policy is to lie low.

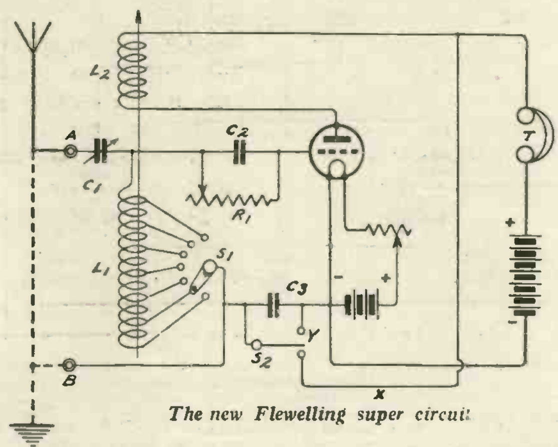
With the probability of an early report from the Broadcasting Committee, the prospect is certainly brighter than it has been for many months, and in a very short time broadcasting should attain the national popularity which it well deserves; but, we repeat, *all* outstanding hindrances to this development must be definitely and finally removed before September next. It will be a very serious error of judgment on somebody's part if public enthusiasm in the autumn is wrecked by unedifying and really unimportant disputes.

A NEW FLEWELLING SUPER CIRCUIT

The following article is based upon the contents of a letter sent exclusively to "Wireless Weekly" by the inventor of the circuit.

THE Editor has received an interesting letter from Mr. E. T. Flewelling, in which he encloses a circuit diagram of his latest super circuit.

This circuit is reproduced in the accompanying figure. It will be seen that the arrangement is very much simpler than it originally was. Any ordinary reaction circuit may be changed into a Flewelling circuit by the use of a 0.006 μF fixed condenser and an additional connecting wire. In the figure it will be seen that the variable condenser C_1 is included in series with the aerial, rough tuning being accomplished by the inductance L_1, which is tapped, the switch S_1 being connected to earth. In the grid circuit there is the usual grid condenser C_2, having a capacity of about 0.00025 μF. This condenser is shunted by a 0 to 5 megohms variable gridleak R_1; a Watmel variable gridleak, which has been submitted for test to this journal, will prove satisfactory for this purpose.



The new Flewelling super circuit

Between the earth and the negative terminal of the filament accumulator is a fixed condenser, C_3, having a capacity of 0.006 μF. A switch, S_2, is shown in the circuit. When the switch is on the top stud, Y, the whole circuit acts as an ordinary regenerative circuit, but if the switch is on the lower stud the circuit operates as a Flewelling receiver. The lower stud, it will be seen, is connected to the top side of the telephone receivers T, while between the telephones and the negative terminal of the accumulator is the high-tension battery.

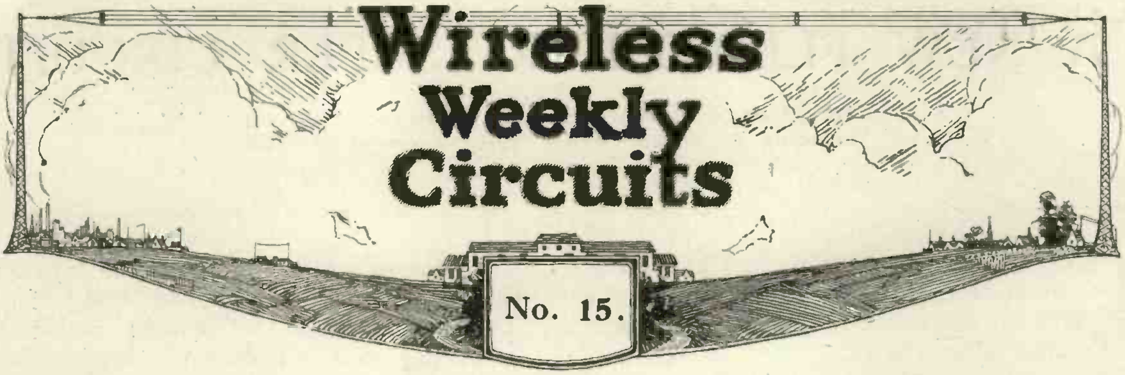
The reaction coil L_2 is tightly coupled to the inductance L_1, and when using the circuit as a Flewelling the only adjustments, apart from tuning, are the gridleak R_1 and the filament rheostat.

The dotted connection in the circuit, joining the aerial and earth terminals, is employed when no aerial is used; connection to the earth, however, remaining.

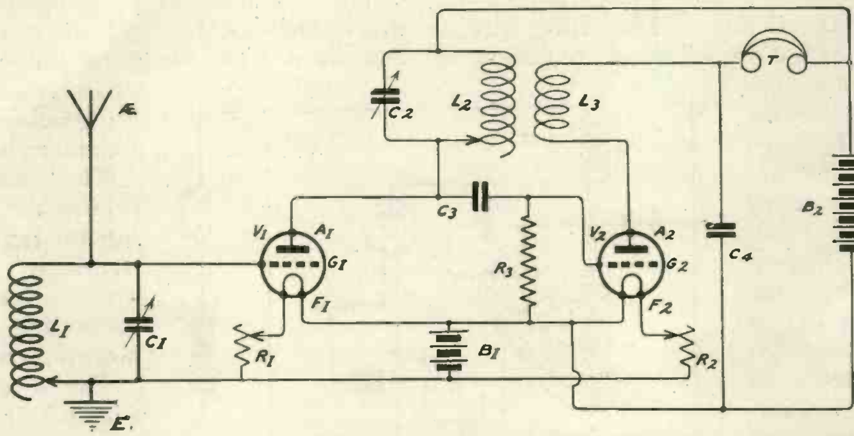
The circuit may be adapted to a frame aerial, excellent results being obtainable.

As is usual in the case of new circuits, we test them out before recommending them to our readers, and in the next issue of WIRELESS WEEKLY an article will appear by A. D. Cowper, M.Sc., a member of our editorial staff, and the winner of the recent Armstrong Super competition, organised by the Radio Society of Great Britain. Mr. Cowper introduced one or two slight modifications, but he finds that the circuit works exceedingly well and just as effectively as the original circuit described in WIRELESS WEEKLY.

We are advised by the Griffin Wireless Supplies Co. that the ST100 circuit may be seen and heard working with a frame aerial at their showrooms, 80, Newington Causeway, S.E.1. The firm claims that results are extremely good when used with their "Hedgehog" type of transformers.



A Tuned-anode with Reaction Receiver



COMPONENTS REQUIRED.

L_1 and
L_2 : Two variable inductances.
C_1 and
C_2 : Variable condensers having a maximum capacity of 0.001 μF.
R_3 : A gridleak having a resistance of about 2 megohms.
R_1 and
R_2 : Standard rotary filament rheostats.
T : High-resistance telephone receivers.
B_2 : 60-volt high-tension battery.
B_1 : 6-volt accumulator.
C_3 : A fixed condenser of 0.002 μF capacity.

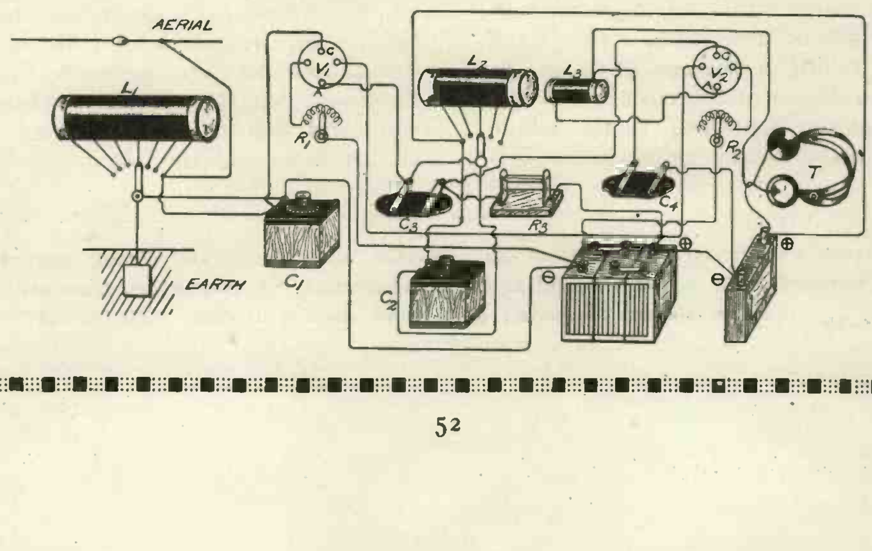
GENERAL NOTES.

This is the ST34 circuit in which tuned anode coupling is used, reaction being introduced from the anode circuit of the second valve.

The circuit may be used for the reception of British broadcasting.

VALUES OF COMPONENTS.

The inductance L_1 may be a cardboard tube 3in. diameter, wound with No. 26 double cotton covered wire, tappings being taken at the 10th, 15th, 20th, 30th and 40th turns. The tuned anode inductance is an inductance coil wound on a 3in. tube: 50 turns are provided, tappings being taken at the 20th, 25th, 30th, 35th, 40th, 45th and 50th turns. The reaction coil is wound with similar wire on a 3½in. tube, 60 turns being provided.



METHODS OF TELEPHONY CONTROL

By P. P. ECKERSLEY, Chief Engineer of the British Broadcasting Co.

In the following article this well-known wireless engineer deals with the practical problems of wireless telephony transmissions.

TELEPHONY control methods are legion. It is curious that one finds so few variations in amateur arrangements, and that experimenters do not try out more varied methods. It is the object of this article to suggest various types of telephony control and give diagrams showing the circuits.

In the first place, there are certain broad distinctions to make, and one may divide systems into:

(*a*) Trigger control.
(*b*) Power control.

By trigger control I mean methods which rely for their action upon the fact of the voice variations releasing energy in large quantities in some way or another, the action depending upon some instability in the circuit. In these types of control absence of distortion cannot be guaranteed. By power control is meant a method of control which actually and directly varies the input power to

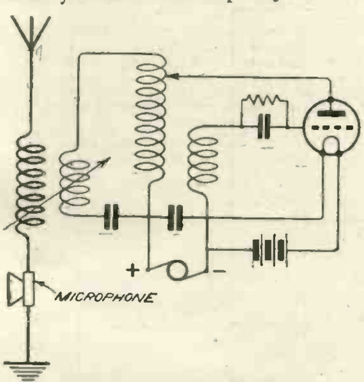


Fig. 1.—An early form of transmitter.

the oscillating valve. Let us first examine trigger control systems, as these are of interest to the amateur because of their economy.

Microphone in the Aerial

In Fig. 1 is illustrated one of the earliest known types of wireless telephone transmitters. The only important thing to notice is that a coupled circuit must be used. It may be asked at once why is this included as a "trigger control"? To my mind, the microphone in the aerial gives, to a certain extent, wavelength control as well as amplitude control. On talking into the microphone, the wavelength of the aerial system is, I think, minutely varied, and therefore it becomes different from that of the closed circuit, the net result being a bigger change of aerial amps. than would otherwise be the case. I must say I have no real experimental evidence to prove this one way or another; it is merely the result of quite casual investigation at one time and another.

The circuit of Fig. 1 is so simple that it may be asked why it is not more often used. The answer is also simple—it is just because about 0.2 to 0.3 ampere is the maximum aerial current that can be handled by a microphone of the ordinary type.

You know, of course, that methods of producing continuous waves were invented before the valve. Every wireless engineer started experimental wireless telephony, using the arc as the generator for the carrier wave. To get any distance they had to use several amps. in their aerial because no amplifying valve existed and crystal reception alone could be used at the receiving end. Thus inventors had a happy time inventing microphones that would deal with amps.

There were all sorts of ingenious arrangements actually made and used, young Niagaras that shivered into spray when one shouted, and other abominations. . . . I wonder if they were ever asked "to increase modulation, old man," and what they did, and whether their signals "were quite O.K.?" . . .

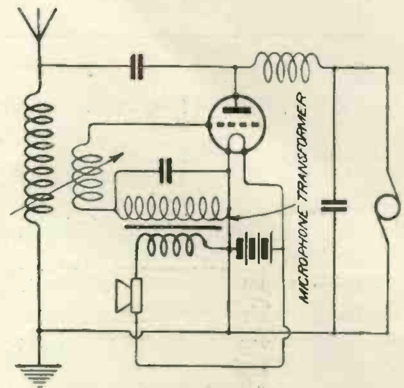


Fig. 2.—Illustrating grid control.

Truly, we owe a lot to the valve. Anyone, however, using 0.1 to 0.2 amps. (and 10 watts!) will find this method of control gives very good speech when correctly adjusted, but will find adjustment a little critical.

Grid Control

Fig. 2 gives a sketch of grid control—to my mind quite the nicest form of control for economy and efficiency. It involves only the one oscillating valve and a microphone transformer—in most cases nothing else.

Grid control is quite definitely a wavelength control as well as an amplitude control. It is efficient on waves below 800 metres; above this wavelength it is no good. This is rather an interesting fact, and the reason for it is not at all obvious.

With certain valves it is a good plan to connect a choke of the order of tens of henries in series with the supply, the reason again not being obvious.

I think, in the case of certain valves which are apt to be a little unstable, the choke has a stabilising effect and tends to stop "breaking," *i.e.*, too strong modulation causing the set to stop oscillating. The choke will be found useful if the user is experimenting with fine mesh valves working on high tensions of about 1,500 to 2,000 volts.

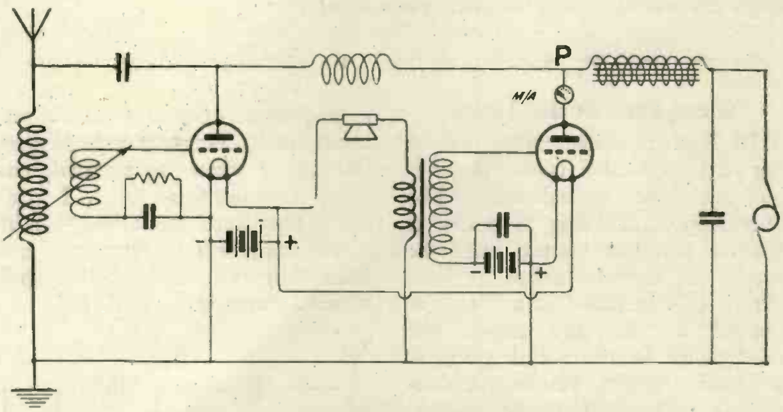


Fig. 3.—Showing arrangement of circuit for choke control.

The chief point to note with grid control is that the adjustment of the reaction coupling must be looked to, the best way being to set the reaction coupling so that it is just enough to maintain stable oscillation—no more.

Some seem to find virtue in connecting valves in the grid circuit, one way or another. Personally, I have designed and used sets up to ½ kw. (500 watts), using just the circuit of Fig. 2 without ever needing to complicate the apparatus by introducing valves. I have found no better speech or ease of handling by using this method, always provided plain reaction is in use.

Choke Control

Turning now to power control, the first and foremost of these is choke control. This is an American invention, but I think I am right in saying that it was used by Capt. Round and Major C. E. Prince in their experiments at Chelmsford in 1913. The circuits are very familiar, of course, but they are given again in Figs. 3 and 4.

The control is purely a power control, the choke working as an auto-transformer and varying the voltage of the applied E.M.F. to the oscillator in sympathy with the voice as applied through the microphone to the microphone transformer, and thence to the main control valve. Everything is beautifully straightforward and, if properly designed, there need be no distortion, no trigger action, and, with fullest control, the voltage of the point P may vary between O and +2E, where E is the applied E.M.F.* Thus the aerial power may be made to fall to zero or rise to double its steady value with the voice variations. Of course, this can never been seen on the aerial ammeter because the changes are so rapid and the ammeter so sluggish in action.

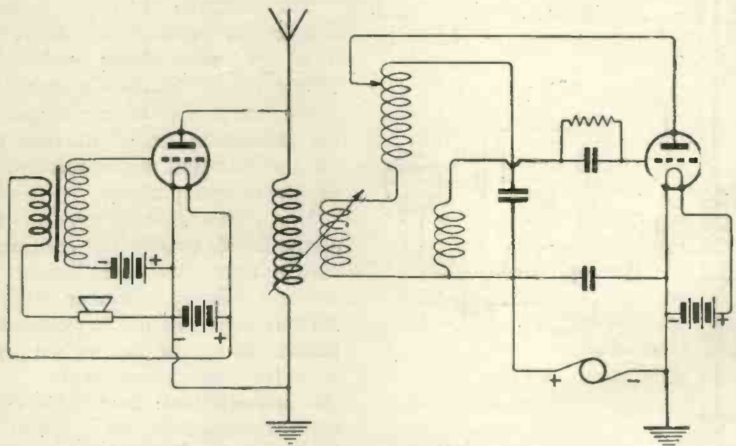


Fig. 4.—Another method of power control.

Many experimenters may think they will get greater ranges by forcing up their aerial current to the neglect of their control system, but it is obvious that 0.5 of an amp., which is varied between 0.1 to 0.9 with the voice, will give far louder telephony signals than a current of 0.9 which is varied between 0.8 and 1.1—in the latter case the voice vibrations are a mere ripple on top of a strong "carrier." In the first case a variation of 0.8 is obtained, and *variation* is what really counts.

In every case I have seen, the control has been neglected and the aerial amps. have been worshipped. What is the good of "radiating 1.1" (always, of course, with 10 watts) if you are not controlling it? *To get proper control the feed to the oscillator should equal the feed to the control valve.*

This means that the control valve will get very hot because it will have to stand the full loss, whereas the oscillating valve only has to stand the deficiency losses. Put 150 watts (100 milliamps., say, at 1,500 volts) into an oscillating valve, and if the efficiency of the system is 50%, 75 watts

* This is a theoretically possible maximum.

will go into the oscillating circuit and set up oscillations therein; 75 watts will be dissipated in heat at the anode of the valve. (At 100% efficiency an R valve would keep quite cool with 1,000 kilowatt input and 1,000 amps. in the aerial. *Note:* It would be amusing to see what happened if the aerial ceased to oscillate! Finish 1 R valve!!)

But if 150 watts are put direct on to a control valve, the plate must stand 150 watts, twice as much as the oscillating valve, and therefore the control valve must be able to stand at least twice as much loss at its anode as the oscillator.

Thus, take our 150 watt set, and write down the genealogical table:—

Main Power 150 watts = 1,500 volts 100 ma.

Oscillating System 75 watts 50 ma. at 1,500 volts.	Control System 75 watts 50 ma. at 1,500 volts.
.... valve capable of dissipating 37·5 watts.	.... valve capable of dissipating 75 watts.

Now the aerial current will be $\frac{1}{\sqrt{2}}$ of its value when all, or nearly all, the power went into the oscillating system, but no fear need be felt; the power is going to the right of our genealogical table, and is working to *control* the aerial current. You have no ocular proof of this, but ask your friends if they have not aural proof. If you are designing this 100 watt transmitter, meaning by the P.M.G.'s regulations that you may not put more than 100 watts into your oscillator, remember that for choke control you will require a 200 watt generator, 100 watts for your oscillator, and 100 watts for your control. Don't worship the amp.; it's the control of the amp. that counts.

Now there are further considerations in the control system, and the first and foremost, if freedom from distortion is required, is to realise that the control valve must have negative potential on the grid so that the transformer is not loaded on its positive voltage excursions. The way to test things is to get a milliammeter in series with the valve, see Fig. 4, and to note when you talk into the microphone whether this wobbles. Remember it must *not* wobble appreciably, otherwise the control valve must be rectifying and the speech must be becoming distorted. You will need to obtain a very open mesh grid valve and adjust the negative potential to suit conditions.

If you do this, and if you can get hold of a really good microphone, there is no reason why your speech and music should not be just as good as that from 2LO —your problems, as a matter of fact, will be less in some respects, inasmuch as you are dealing with far less power. Of course, I know a microphone that gives faithful reproduction is hard to come by.

Absorption Control

Leaving choke control at last, we now come to so-called absorption control—a type of control sometimes used with a good deal of success by radio engineers, and incidentally the type used by Capt. Round and Mr. Ditcham in their original broadcasts from Chelmsford in 1919, when a power of 15 kw. was used on a highish wavelength, using aerials 400ft. high. (Would that such powers and aerials were allowed to-day for broadcasting, but perhaps all my readers don't agree.)

The system is just the same as that used in Fig. 1; it is, in fact, a way of putting the microphone in the aerial, only a microphone which is able to stand the full current. Again, for the same reason, a coupled circuit must be used, because it is absolutely impossible to keep the system stable otherwise.

The above gives basically the main systems of telephony control that have been used commercially at one time and another. In my next article I propose to go further into the question of telephony control systems, and discuss the future development and the possibility of no carrier wave transmission, and so on. In fact, I shall leave the well-known behind, and talk about what development may lead to in the future.

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 XIII

(Continued from Vol. 1, No. 14, page 788.)

Draw a Circuit showing a Crystal Detector followed by two stages of Low-frequency Amplification.

Fig. 1 shows such a circuit. The theory of its action is very simple; the rectified pulses passing through the primary T_1 produce low-frequency current variations in the secondary T_2, and these are amplified by the first valve.

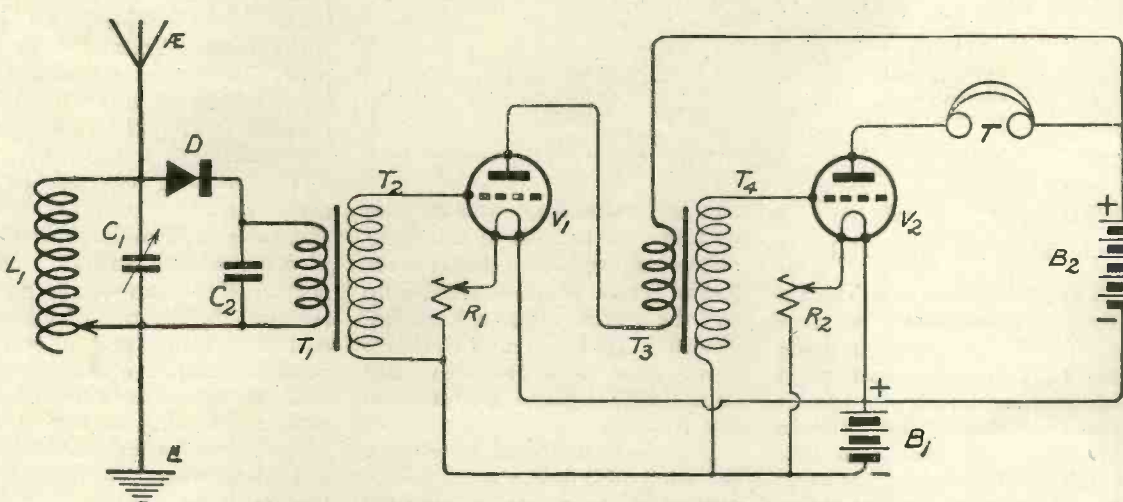


Fig. 1.—A crystal detector followed by two stages of L.F amplification.

The amplified currents then have their voltage stepped-up by the inter-valve transformer T_3, T_4, and are then applied to the second valve, which amplifies them still further.

When is this sort of Circuit a desirable one to use?

This circuit may be recommended when the receiving station is within ten miles of a broadcasting station, and it is desired to work a loud-speaker. Good loud-speaker results could not be obtained, usually, above five miles on such a circuit, but loud signals in telephone receivers may be obtained up to considerable distances.

Draw a Three-valve Circuit in which the first Valve acts as a Detector and the other two Valves as Low-frequency Amplifiers.

Fig. 2 shows the circuit. The first valve acts as a detector on the leaky grid condenser principle, while the second and third valves act as low-frequency amplifiers.

What are the advantages of a Circuit of the Fig. 2 type?

This circuit will give louder signals than a circuit in which the rectification is accomplished by a crystal detector. Moreover, it is more reliable, as there is no crystal to get out of adjustment. The circuit cannot be regarded as the most effective way of using three valves, but it is certainly the simplest, as the only

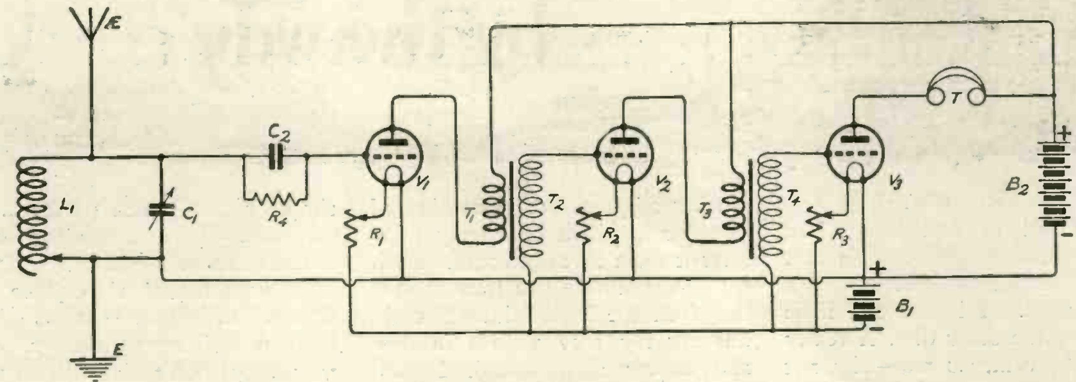


Fig 2.—A valve detector followed by two stages of L.F. amplification.

adjustment to be made is the tuning of the aerial circuit.

In a previously given circuit, a crystal detector and telephones were connected across the tuned anode oscillatory circuit of a high-frequency amplifying valve. Could the Crystal Detector be replaced by a Valve Detector?

Yes. Fig. 3 shows a theoretical arrangement of the circuit. It will be seen that the oscillations in the aerial circuit are impressed on the grid of the first valve V_1, the amplified oscillations flowing in the circuit L_2, C_2. Across this circuit L_2, C_2, are connected the grid and filament of the second valve V_2, which acts as a detector. In the grid circuit of this valve we have the grid condenser C_3 shunted by the

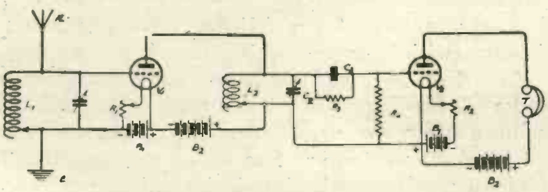


Fig. 3.—Showing how a crystal detector may be replaced by a valve when the crystal is preceded by a H.F. valve.

resistance R_3. In the anode circuit of the second valve we have the telephones T. The amplified oscillations in the circuit L_2, C_2, are detected by the valve V_2 in the usual way, just as if the circuit L_2, C_2, were part of an aerial circuit. The fact that this circuit is in the anode circuit of the first valve makes little difference.

Redraw the Fig. 3 Circuit in practical form, using a Single Accumulator and a Single High-tension Battery.

Fig. 4 shows the practical circuit redrawn.

In Fig. 4 what is the value of the Grid Condenser C_3 and the Gridleak R_3?

The grid condenser C_3 has the usual value of about 0.0003 μF (microfarad), while R_3 has a value of 2 megohms; this latter resistance may be a variable gridleak, if desired.

Why is it that the Gridleak R_3 is connected directly across the Grid and positive side of the Accumulator B_1, instead of across the Grid Condenser C_3?

The gridleak is connected across grid and filament because, if it were connected across the condenser C_3, the grid would receive a positive potential from the high-tension battery B_2. This potential would be communicated to the grid through the gridleak; but, since the leak is connected in the position shown, the condenser C_3 effectively prevents the positive potential of the high-tension battery affecting the grid of the second valve.

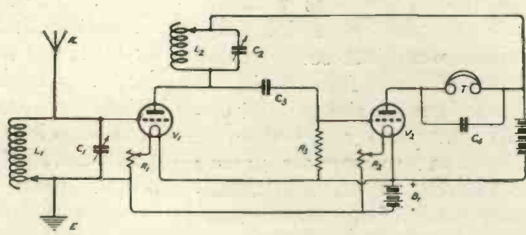
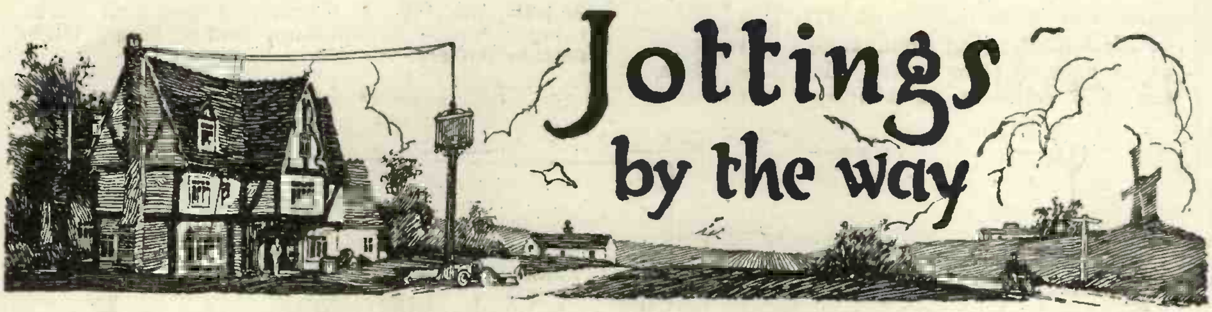


Fig. 4.—The circuit shown in Fig. 3, but using single L.T. and H.T. batteries.



Jottings by the way

A Sad Affair.

IT is sad to find how often one's fondest hopes, one's best ideas, somehow fail to work out properly. I had a sad little experience the other day. A really great idea came to me—why not use lines of aluminium paint for making connections beneath the surface of the panels? You see the possibilities! Gone would be the need for soldering joints or for tightening down inaccessible nuts. As the connecting links would present towards one another edges no more than a thousandth of an inch or so thick capacity between them would be of negligible dimensions. If you wanted to make a condenser, what could be easier? You would merely take a piece of mica and dab a patch of aluminium paint on either side of it; then you would connect up, and, whilst the set was working, you would continue to dab until the results were just so.

But when with feverish hands I had traced out a simple trial circuit upon a piece of ebonite, it refused, alas! to function in any way whatever. Tests with a milliammeter and a high-tension battery were instructive. Even when the E.M.F. was raised to 100 volts a thick line of the paint would not pass current enough to produce the slightest flicker of the instrument's pointer.

Instead of a new conductor I had in fact discovered a very excellent insulator! This is surprising at first, for the paint consists of tiny particles of aluminium suspended in solution. Apparently the medium is not very volatile, and when the paint dries, each particle of metal is left with a thin coating of grease or something of that kind, which effectively insulates it from its neighbours. Still, even though fate has thus smitten me upon the head with her club, burying my rosy visions in dust and ashes; and, though I shall not be able to write a wondrous article beneath the fine headline, "Really Wireless Wireless," yet I think that there is something in the idea. If some cunning maker of pigments can devise a metallic paint that will conduct well when dry, he should reap a fortune, and all of us will shower blessings upon his head.

Ten Years Too Late.

I suppose that every one of us has thought for a moment at some time or other that he was on the eve of giving birth to some epoch-making invention. An inspiration comes. The theory is undoubtedly all that it should be, and when a model is put together it works perfectly. Then we hasten with trembling steps to one of the Great Men of Wireless, to whom we display diffidently yet with a very proper pride the child of our brains and hands. "Quite a good idea," he says, after a brief examination. "Let me see, I first used it ten years ago. I think it was invented by ———." He names one of the pioneers of wireless, and, thanking him, we glide from his presence. This habit that people have of forestalling one's inventions is really most reprehensible.

Another Nasty One.

But quite another kind of experience even more soul-shaking may come your way as it once did mine. You make up some very simple device which performs excellently. There is nothing extraordinary about it—in fact, it seems so obvious that you feel sure that dozens of people must have thought of it for themselves. You use it, but don't give it a thought as a possible aid to fame and fortune. Then one day you see the thing announced in a vast advertisement as the most marvellous of discoveries for the wireless man's ease and comfort. Everyone rushes to buy it; no set is complete without it. The man who puts it on the market buys a Rolls-Royce, and you retire into your shell to brood upon the grossly unjust conduct of Fate. These little things will happen in this vale of tears. For a lady, Fate has a most muscular arm, and when she hands you one for yourself she usually does it pretty well.

The Case of Snorkings.

Some fellows, however, seem to go on asking for it for a pretty long time before she loses her temper and lands them a really saucy one. Take, for example, that fellow Snorkins, who spent his whole time in inventing every conceivable thing from excuses to tall stories, from complicated corkscrews to self-adjusting rheostats. Most of his brain-waves worked out pretty well. Mrs. Snorkins was trusting enough to swallow without demur the nine hundred and seventy-two ingenious and varied excuses which he gave in the space of five years for arriving home on the stroke of midnight. The tall stories won him a reputation in certain circles as a genius; in others they sufficed to place him upon a pedestal as the world's most able liar. With his corkscrews and other gadgets he had a measure of success. His prosperity made him boastful, patronising, and a general nuisance. So far, Fate had withheld the spanking of which he was so badly in need. She let the man go on just to see what he would do.

Eventually he turned out his single-control, self-tuning, no-aerial wireless receiver, presenting the model proudly to Mrs. Snorkins. It was a beautiful thing. The ebonite panel contained nothing but two knobs standing side by side in its midst. There were no terminals, no visible wires. The first knob had a pointer which travelled round a scale marked Eiffel Tower, Radiola, Brussels, London, Birmingham, and so on. The second bore the words "louder" and "softer" with beautiful curly arrows pointing in opposite directions. To use the thing you set the pointer of the first knob against the station desired, then you moved the second so ⟶, or so ⟵, until the sounds were suited to your ear.

The Bludgeon Falls.

Mrs. Snorkins became a wireless enthusiast on the spot. As she is more than a little deaf, the second knob remained permanently at its maximum setting, which caused the loud-speaker hidden within the cabinet to emit a blare of noise that could be heard from cellar to attic. The first knob's pointer was seldom on the zero mark. Mrs. Snorkins would wake up at three in the morning and switch on WJZ. Throughout the day she had Königswusterhausem, Rome, Paris, and Lyons pouring forth melody for her delectation to fill in the gaps between the broadcasting hours of our home stations.

Snorkins, like Frankenstein, had created a monster that was beyond him. For him life became one long horror of mingled Jazz, Wagner, weather reports, and talks on feeding babies, from which there was no escape at home. For a time he wandered sadly about the streets growing daily more wan-looking. Eventually he was run in for assaulting a perfectly harmless man engaged in giving an open-air wireless demonstration. His conduct at the police station was so remarkable that he was kept under observation. Finally, he was removed to Colney Hatch, where, I learn, he is now engaged in perfecting an apparatus for delivering parcels by wireless.

Bumble Takes a Hand.

It is proposed, I see, that in future the erection of aerials shall be controlled in some measure by local authorities. This seems very right and proper. You cannot nowadays erect a garage or even a toolshed in some places without submitting the most detailed plans to the Panjandrums of your town or village and obtaining their august consent. But as things are you may splice together with old bits of rope a clothes-prop, a broom handle and an old umbrella and erect with their aid an aerial that, besides being an eyesore, is also a menace to the lives and property of your neighbours. If you do not wish to make the thing secure, no power on earth can compel you to do so, though, should it crash through the next-door greenhouse during a gale, or fall upon your fellow-man's devoted head, he can sue you for pretty heavy damages.

In theory, the idea of control of some kind is beautiful, we are agreed; but how would it work out in practice? I foresee breakers ahead. You may have a council, or whatever the body is that does these things, which, knowing nothing of wireless, will make the most absurd regulations. At Little Puddleton, where we are all for solidity, I think that telegraph-poles stayed with stout wire will become *de rigueur* for aerial masts, anything slighter being looked upon as too flimsy to be safe.

A friend who lives in a near-by townlet tells me that there they expect that the artistic touch would rule. Poles would have to be tall, slim, and of graceful proportions, whilst the truck would be replaced by a finial of some emblematic design. Each place will evolve its own particular aerial. Probably in half a century collectors will go in hordes to Christie's to bid madly against one another for a typical Wigglesby Magna mast, or for a pair of the quaint insulators that decked the back gardens of Great Gubblesthorpe, 1923.

A Good Idea.

Seriously, though, I think that the suggestion that aerials should be inspected and passed fit is thoroughly sound. To judge from those that one sees, many people have derived most of their knowledge of spars and cordage from the pictures of Mr. Heath Robinson. Aerials of the most precarious type have sprung up during the summer on every side. Many of them, though suspended from quite thin poles, have no sort of staying, and the slightest breath of wind sets the crazy masts swaying. What will happen when the autumn gales burst upon us and do their worst goodness only knows. I venture to prophesy that there will be some pretty pieces of recrimination between landlord and tenant over damaged roofs and chimneys, and between neighbours over gardens laid waste, party walls razed and chicken runs decimated by falling aerials. It would be to everyone's advantage to have definite rules and regulations for the erection of aerials and a proper system of inspection.

WIRELESS WAYFARER.

A THREE-VALVE BROADCAST RECEIVER

By E. REDPATH, Assistant Editor.

The following article deals with the completion and assembly of this self-contained receiving set.

(Concluded from Vol. 2, No. 1, page 10.)

The Intervalve Coupling Coils

DETAILS of the intervalve coupling coils are given in Fig. 7. The primary coil, which is ultimately to be connected in series with the first anode variometer, consists of a wooden

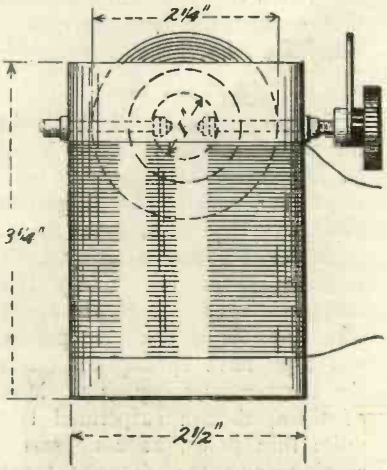


Fig. 7.—Details of the coupling coil.

ball mounted upon brass spindles in a similar manner to a variometer rotor, and fitted inside a cardboard tube (preferably impregnated with paraffin wax) carrying the secondary windings.

The primary coils consist of 26 turns of No. 22 s.w.g. d.c.c. and the secondary coil of 100 turns of No. 36 s.w.g. d.c.c. copper wire, no "tappings" being provided. When ultimately connected up in the set, the effect of reversing the connections of this secondary coil should be tried.

The Secondary Condenser

This condenser may either be purchased complete, in which case a capacity of 0.0003 μF should be specified, or may be built up from standard parts as mentioned in the specification of materials required. For a preliminary trial the condenser may be omitted and the secondary coil (L_2 in Fig. 4) used as an aperiodic coil, in which case the effect produced by the later addition of the condenser can be observed.

The Small Fixed Condensers

Details of one of these condensers are given in Fig. 8. Three are required, each consisting of four copper foils separated by thin mica (about 1-500in. thick), the area of overlap of the plates or foils being ¾in. square. These condensers will form C_1, C_3 and C_4 of Fig. 4. For the condenser C_5 twice as many foils should be employed, whilst for the condenser C_6, if it is decided to fit one, 8 foils with an overlap of 1¼in. by ¾in. will be found satisfactory.

The Crystal Detector

So many designs for crystal detectors have appeared in these pages that none will be given in this present article. As already mentioned, the type of detector which gives a fairly firm contact, such as zincite-bornite, is to be preferred, provided that really good crystals are used, the only reason for the use of the "cat-whisker" type of detector in the writer's set being that no really good crystals of zincite or bornite were available. When actually fitted to the set, or rather in the preliminary assembly to be described presently, the effect of reversing the connections to the detector should be tried.

The L.F. Transformers

On account of the close proximity of the various components in a set of this description, it is desirable that the low-frequency transformers used should be screened, and it is found that the ironclad type, as fitted to the writer's set, are very satisfactory.

Those experimenters who make a special point of constructing as much of their own apparatus as possible will find full particulars of a serviceable L.F. transformer in *Modern Wireless*, No. 3, or in the author's handbook "How to Make a Unit Wireless Receiver."

The Preliminary Assembly

Fig. 9 shows pictorially the method which is strongly recommended in the case of any receiving set which is at all complex. Although three standard valve panels, with the usual four terminals and filament rheostat, are shown, it is to be understood, of course, that if these are not

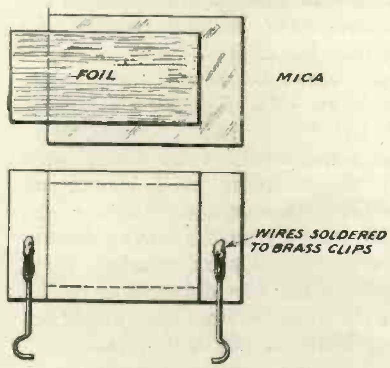


Fig. 8.—One of the small fixed condensers.

available the three valve holders already specified for this set may be secured to the wooden board and wired up to the terminals and a single filament rheostat.

This preliminary assembly not only enables various small adjustments, such as the capacities of the fixed condensers and changes in the direction of coil connections, to be effected very readily, but, in addition, it affords to the inexperienced constructor a clearer insight into the details of the arrangement and the functions of the various component parts. It is also a comparatively easy matter to test the individual circuits and components separately by suitably altering the connections. If any difficulty is experienced with the variometers, it is also a simple matter to connect a crystal and a pair of phones across each variometer and connect up to the aerial and earth, in which case the arrangement forms a simple "variometer-tuned" crystal receiver, and will enable a good estimate to be formed of the wavelength range of the variometer.

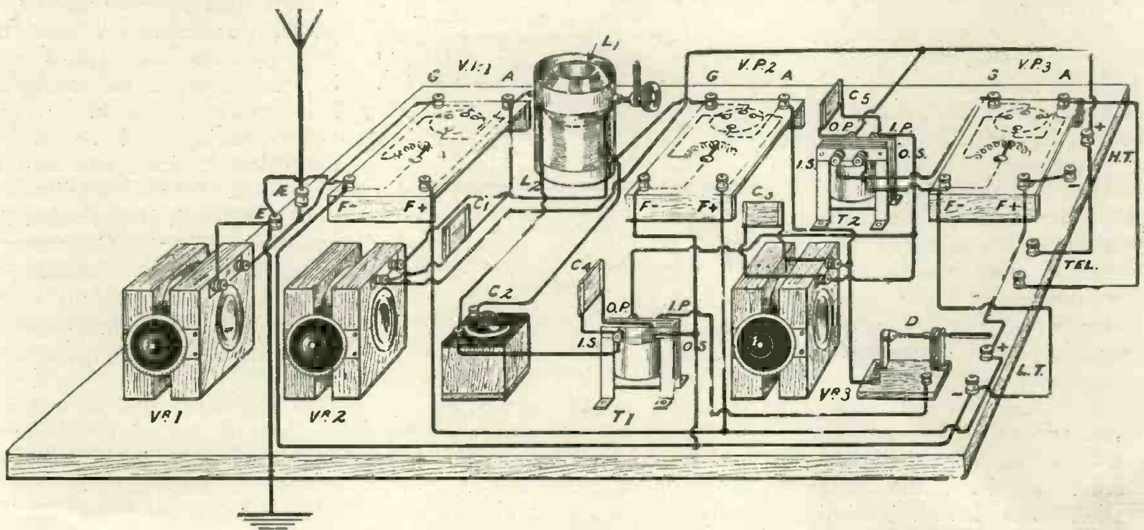


Fig. 9.—The arrangement and connections for the preliminary assembly.

The capacity values of the two condensers C_1 and C_3 (Fig. 4) should then be adjusted experimentally until each is approximately equal to that of the aerial.

When all the components have been completed and carefully tested in the preliminary assembly, it remains to assemble them finally upon the back of the ebonite panel and fit all complete into the containing box.

The photograph, Fig. 10, is a front view of the completed panel, and shows the disposition of the various controls, valve-holders, crystal detector and terminals. As the overall dimensions of some of the components to be used by readers will vary, it is not considered necessary to give a "drilling plan" of the ebonite panel itself.

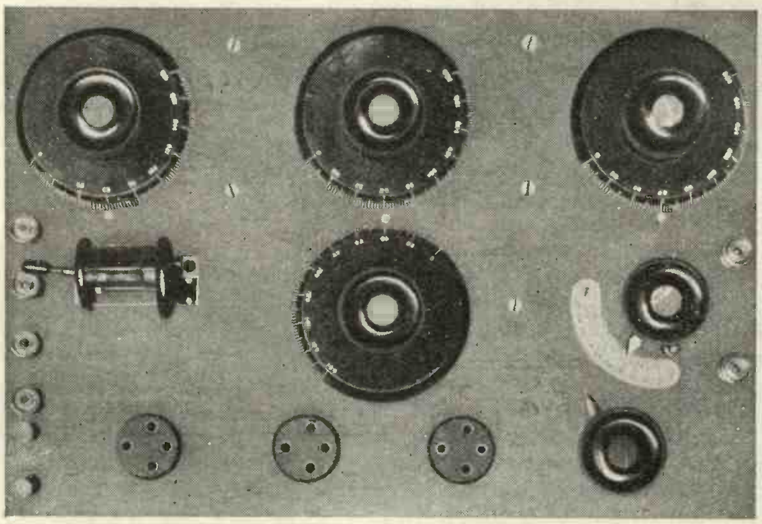


Fig. 10.—Front view of the completed panel.

The Containing Box

Full details of the containing box are given in Fig. 11, reference to which will show that provision has been made for including the 60-volt high-tension battery and either a small accumulator for use with the ordinary type of valves or dry cells for lighting the filaments of dull-emitter valves.

The overall dimensions of the box are such that a standard Violina loud-speaker can be fitted as shown in a previous photograph (Fig. 1); but if this is not desired, and if the batteries are to be external to the set, the containing box need only measure 13in. by 9in. inside, by about 4in. deep. In any case the details of jointing and the choice of material are left to the skill and taste of the individual reader.

Wiring Up

It is in the final assembly and connecting up of a set that a great many readers experience difficulty and frequently go wrong. In the present set there are three different types of circuit; firstly, the filament lighting circuits; secondly, all the grid circuits; and, thirdly, all the anode circuits.

Reference to Fig. 12, which is a complete back-of-panel wiring diagram, will show that these respective circuits are indicated by different types of lines, and if the various circuits are wired up in the order named and the connecting wires covered with insulating sleeving of different and distinctive colours, the probability of any error will be considerably reduced, whilst the completed arrangement is very easily checked over.

Black sleeving is recommended for the filament lighting circuit, re-

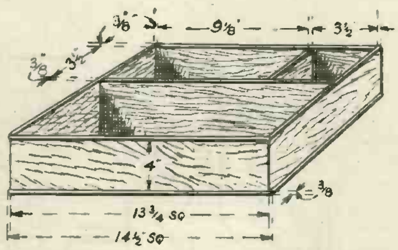


Fig. 11.—Details of the containing box.

presented by heavy black lines in the wiring diagram, Fig. 12; green for the grid circuit; and red for the anode circuit. Any readers who experience difficulty in wiring up their set from the necessarily small diagrams appearing in these pages may, in this instance, obtain a full-size blue print wiring diagram by forwarding a postal order for 1s. 6d. to the Editor of this journal.

Operating the Set

When trying to receive actual signals with the components temporarily assembled, as shown in Fig. 9, some little difficulty may be found owing to the arrangement being so very selective.

The tuning will be rendered much less critical, and therefore easier, until the correct adjustments are ascertained, if the small fixed condensers (C_1 and C_3) across the second and third variometers, are omitted; whilst for all preliminary testing the coupling between the two coils L_1 and L_2 should be tight.

In the absence of a wavemeter or tuning-tester of some description, by means of which the various circuits may be calibrated, no hard and fast rules can be given. The aerial tuning variometer, when used in conjunction with an average experimental aerial, will tune

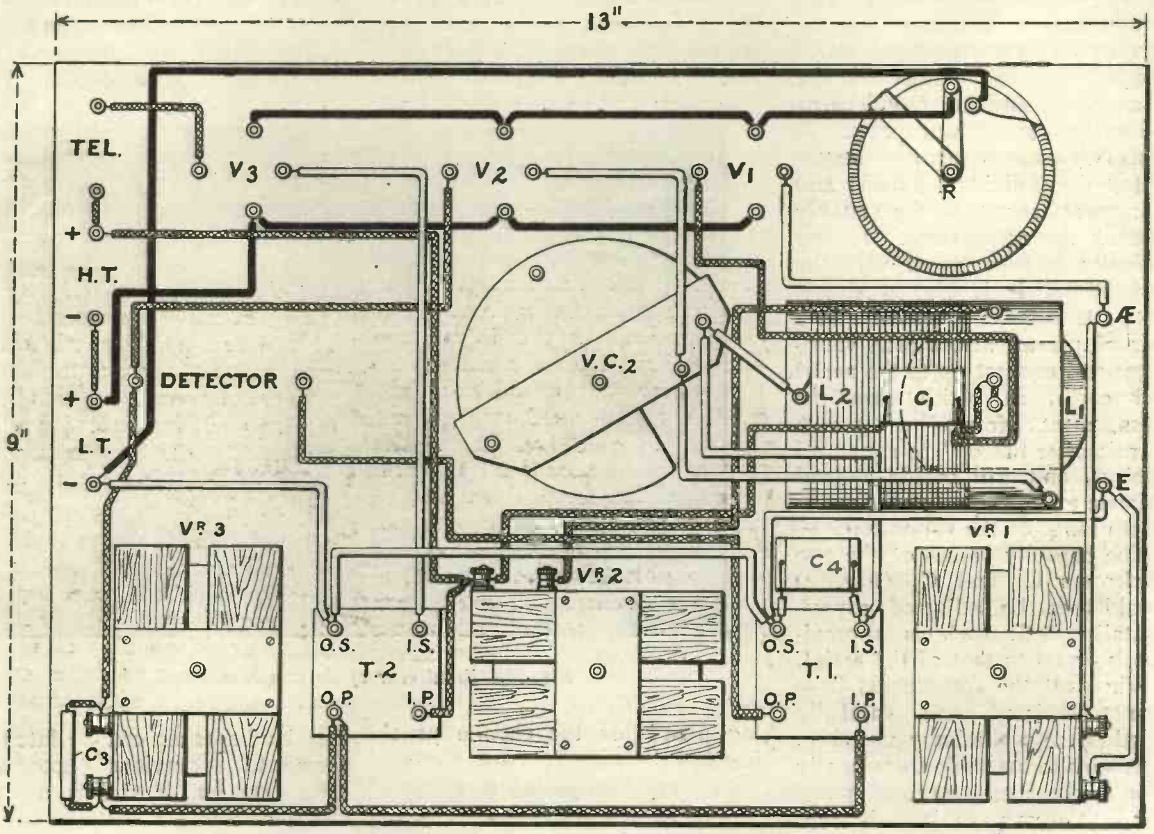


Fig. 12.—A complete back-of-panel wiring diagram.

in waves from about 300 to about 450 metres.

An Alternative Circuit

For those readers who care to experiment with a view to simplifying the arrangement, and incidentally noting which gives the best results, an alternative circuit arrangement is shown in Fig. 13. In this arrangement it will be noted that the coupling coils between the first and second valve are dispensed with, and electrostatic coupling employed. The variable condenser already on hand may be used for this purpose, and is to be connected as shown at C_4 in Fig. 13.

It will be observed that the grid of the second valve V_2 is connected to the negative side of the filament battery *via* the secondary of the "reflex" transformer T_1, this winding being shunted by a small fixed condenser C_3, as before. The effect of omitting this condenser, also of introducing into the grid circuit at the point marked X a high-frequency choke coil consisting of about 100 turns of No. 36 s.w.g. d.c.c. copper wire wound upon a cardboard tube 2½in. in diameter, should be tried. The secondary coupling coil may, of course, be used for this purpose instead of winding a new coil.

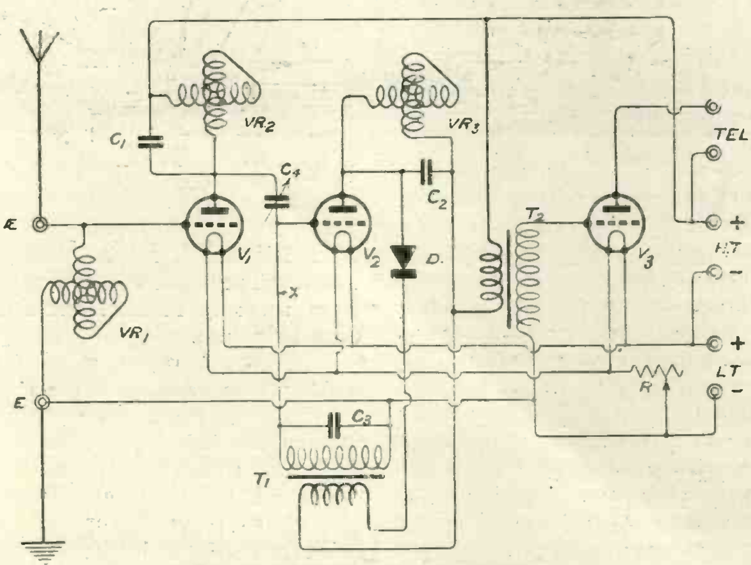
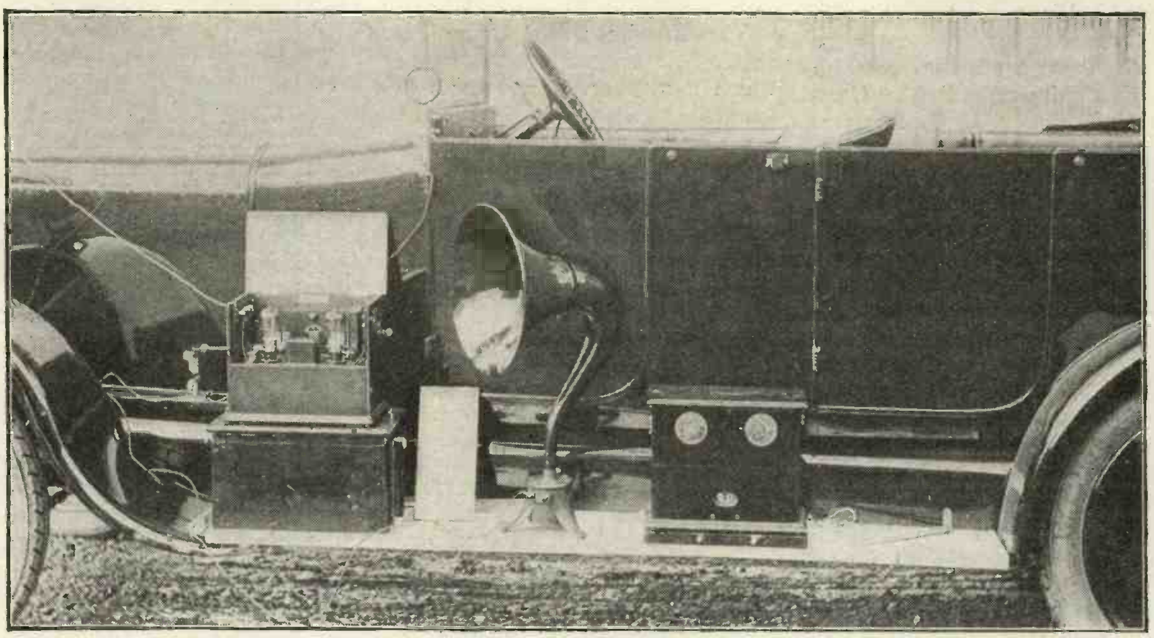


Fig. 13.—An alternative circuit diagram

WIRELESS RECEPTION ON SMALL CARS



The popular interest in broadcasting has become so great that large numbers of people are taking apparatus with them in the open-air. Our photograph shows a B.S.A. car equipped with a Marconiphone V2 and power amplifier.

News of the Week

WE learn with interest that a School Radio Society has been started under the auspices of The Radio Society of Great Britain. An inaugural meeting was held on Saturday, July 14th. Mr. Hibberd, of the Grayswood School, Haslemere, who has for a long time been interested in the introduction of wireless in the school is to be the Honorary Secretary.

Mr. Hibberd, it will be remembered, contributed an article entitled "Wireless in Schools" in our issue dated July 11th. All schools having their own society should communicate with a view to joining, and it is suggested that a complete syllabus of work and lectures should be sent to all schools. We understand that at the time of going to press some 50 schools have already promised to join. Members of the Committee will be Mr. L. F. Fogarty, Mr. R. Carpenter, Mr. Pocock, Mr. Hannaford Brown, Mr. Galvin, Dr. Ritchie, and Mr. L. McMichael. It is further suggested that the subscription fee for Public Schools should be 3 guineas per annum and for Secondary Schools 1 guinea.

It is announced that a provisional wireless receiving station has been opened at Tulear, Madagascar, which will receive messages from passing ships within a radius of 250 miles between 9 and 11 a.m. and within a radius of 600 miles between 7.30 and 9.30 p.m. local Madagascar time. The call-sign of this station is FTL.

The Board of Trade has learned from the British Vice-Consul at Punta Arenas that direct wireless telegraphic communication between Punta Arenas and Stanley, Falkland Islands, has been re-established. The hours of working are from 10.30 to 11 a.m. and from 6.30 to 7 p.m.

At present messages are only received at Punta Arenas for Stanley, but it is hoped eventually to handle traffic for all parts of the world.

We are informed that there is no truth in the rumour that the venue of the new South Coast broadcasting station is to be altered. It has been definitely decided to erect the station at Bournemouth.

The Empire Press Union recently held an annual meeting, at which a number of references to wireless matters were made by Lord Burnham and other speakers. Lord Burnham remarked that the question of telegraphic communication was a crucial one for the Empire. He was a member of the Business Council of the Post Office, and had been present at many of the discussions upon the subject which had occurred at the meetings of that body. It seemed that one of the greatest difficulties in the way of a satisfactory settlement of the difficulties of wireless communication was the fact that the Postmaster-General changed once a fortnight. The fourteenth annual report of the Council made a reference to wireless telegraphy in which it was hoped that the decision of the Government to admit private enterprise to Empire wireless would lead to speedy utilisation of this means of communication upon a commercial basis. Wireless telegraphy had during the past year been employed but little for press purposes in the United Kingdom, owing to lack of high-power stations, whereas it had been employed largely by American newspapers for transmission of news from Paris and Hanover to New York, Philadelphia and Chicago.

At a luncheon given by the B.B.C. in London on July 20th prizes were distributed to the winners of the Wireless Man Hunt Competition. The names of the successful gentlemen are: Mr. A. Trill, of Croydon; Mr. C. Fleming Williams, of Letchworth; and Mr. C. Outler, of Forest Gate.

We are given to understand that the anticipated report of the Broadcasting Committee must not be regarded as being in any way final, in that the report will be made to the P.M.G., who will then negotiate with the parties concerned. To say the least this is very disappointing.

A case of some interest to listeners-in was heard at Southend County Court recently. An electrician had been sold a wireless set for broadcast reception, which he later discovered was not stamped and had been made by an amateur. He found that he could not obtain an experimental licence and accordingly brought an action for the value of the set, in which he was successful.

At the conference of the Urban District Councils' Association of England and Wales at Llandudno, it was unanimously decided that the executive council should be instructed to consider the question of the control by local authorities of the erection of wireless aerials. It was stated that the matter had become of vital importance owing to the enthusiasm of wireless experimenters, who were not as competent as telegraph linesmen to fix overhead wires and apparatus with that regard to safety which was imperative, especially in the case of wires erected over public thoroughfares. Among the risks were damage by fire, insecurity, masts in dangerous proximity to public roads, and chimneys becoming dangerous through attachment of aerial apparatus.

The Austrian Marconi Co., Ltd., has recently been formed, with a capital of £133,000. Marconi's Wireless Telegraph Co., London, subscribed £93,000, and the Austrian Government the remaining £40,000. The company has the exclusive right to conduct wireless traffic between Austria and all other countries for a minimum period of 30 years. We understand that several new stations will be erected, and it is anticipated that traffic will be opened before the end of the year.

We notice that provision is being made for tuition in wireless at the London University, Gower Street. A syllabus of lectures and demonstrations for July 7th included subjects dealing with wireless, and an exhibition of wireless telephony apparatus by Prof. J. A. Fleming, F.R.S., took place in the Electrical Lecture Room.

The Black Bros. Orchestra which has frequently contributed to the B.B.C. programmes.

During the last voyage of the *Saxon Prince* from Newport News to Rio de Janeiro, one of the seamen was taken seriously ill, and instructions were given by the captain to the wireless operator to ascertain if there was a ship in the vicinity carrying a doctor.

A reply to the wireless call was received from a Spanish steamship *Manuel Arnus*, bound from Teneriffe to San Juan (Porto Rico), and the vessels altered their course in order to meet. As they were approaching each other instructions as to treatment were wirelessed from the Spanish ship.

In view of the fact that the *Manuel Arnus* is equipped with wireless direction finding apparatus the result of bearings taken caused the vessels to meet with minimum delay. The Spanish surgeon boarded the *Saxon Prince*, and on examining the patient found that the case was serious enough to warrant his removing the seaman to his own vessel. The transfer was accomplished without delay and the vessels renewed their interrupted voyages.

AMMETERS AND VOLTMETERS FOR WIRELESS USE

By Dr. J. H. T. ROBERTS, Staff Editor.

The following article deals with the principles underlying the construction of these well-known instruments, together with their use in testing.

IN almost every branch of electrical science the ammeter and the voltmeter may be said to be fundamental measuring instruments, the former for measuring the strength of electric current, the latter for measuring the voltage, or electrical pressure, which determines the flow. There is a considerable variety both of ammeters and voltmeters, and as the wireless experimenter frequently requires to know the suitability of an instrument for his particular purpose, it will be useful to give a short account of the general principles underlying the construction and use of these instruments.

The Ammeter

It was explained in the series on "Electricity and Magnetism"

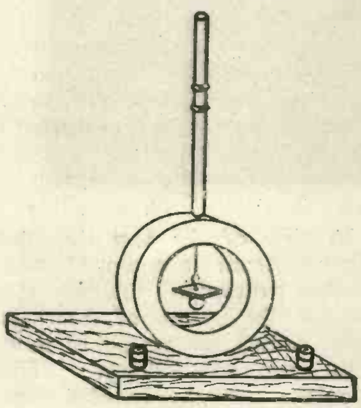


Fig. 1.—Illustrating principle of electromagnetic ammeters and voltmeters.

that an electric current produces several characteristic effects, which include the thermal, electro-magnetic, and the electro-chemical effects. Any of these may be employed as the basic principle in an electrical measuring instrument, but the one which is most useful for general purposes, and which is commonly used, is the electro-magnetic effect.

If a magnetic needle be suspended at the centre of a vertical

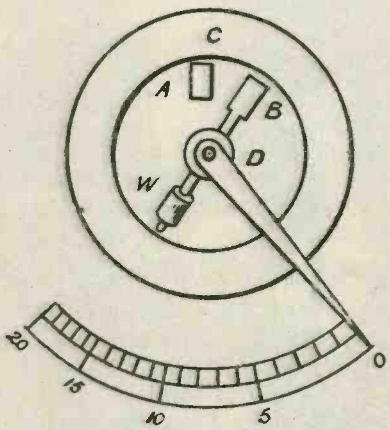


Fig. 2.—Principle of "moving-iron" instrument, "gravity control."

coil of wire, the electro-magnetic field set up in the region of the coil when an electric current passes through the wire causes a deflection of the needle, and the amount of this deflection is an indication of the strength of the current which is flowing in the coil. This is the action which is made use of in the construction of the most common form of ammeter. In practice, however, since an ammeter usually requires to be portable, it is necessary to introduce various modifications from the simple arrangement which has just been mentioned.

Before dealing with the various types of instrument, it will be well to fix our ideas by considering an actual specimen in the shape of a

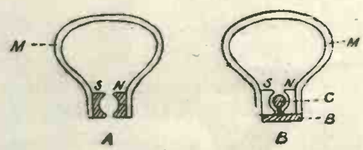


Fig. 3.—(a) Permanent magnet of moving-coil direct current Weston ammeter. (b) Showing fixed soft-iron cylinder for producing uniform magnetic field.

"moving-iron" instrument with what is called "gravity control." Such an instrument is indicated in Fig. 2. C is a cylindrical coil of wire through which the current flows. A is the end view of a short bar of soft iron placed with its length parallel to the axis of the coil. B is a similar bar of soft iron which is mounted on a pivot and balanced by a weight W of non-magnetic material. A pointer is attached to the movable system BW, and, by means of a scale, the angular displacement of the pivoted system may be read off. When a current passes through the coil, the two soft iron bars A and B are magnetised, both with the same polarity, and they repel one another to an extent which depends upon the strength of the current.

Classification of Instruments

Ammeters and voltmeters may be classified in various ways.

(1) According to whether they are intended to be used with

(*a*) Direct current.

(*b*) Alternating current.

In some cases instruments designed for use with alternating current may be employed for direct current, but direct current instruments are not available for use with alternating current.

(2) According to the principle upon which they are based,

(*a*) Hot-wire.

(*b*) Moving iron.

(*c*) Moving coil.

(*d*) Induction.

(3) According to the controlling force which acts against the force created by the current,

(*a*) Gravity control.

(*b*) Spring control.

(*c*) Magnetic control.

Further classification may also be made according to whether the instrument is intended to be portable or for switchboard use, and also as to whether the dial is to be in the form of a flat disc, like the face of a clock, or in the form of a horizontal or vertical scale.

The instrument which has been briefly described above is *not* of the portable type, since it requires accurate adjustment in order that the pointer shall be on the zero of the scale when no current is flowing through the instrument.

Weston Moving Coil Instrument

The construction of the Weston moving-coil instrument may be taken as typical of that of the moving-coil class of ammeters. In Fig. 3 (A) is shown a permanent horse-shoe magnet with pole-pieces S, N, attached so as to leave a cylindrical space in which a small rectangular coil of wire may rotate about an axis co-axial with the cylindrical tunnel. The intensity of the magnetic field in S, N in Fig. 3 (A) will be greatest at the parts where the pole pieces come close together and will be less at the intermediate parts. In order to provide a uniform field in which the coil may rotate, a soft-iron cylinder C is introduced, as shown in Fig. 3 (B). This has the effect of making a practically uniform air gap across which the magnetic flux must travel, with the result that in the central parts the lines of magnetic force due to the permanent magnet are very uniformly spaced. A small rectangular coil of very fine wire is wound upon an aluminium frame and is pivoted, in watch-jewels, so as to be capable of rotation about an axis coincident with that of the soft-iron cylinder. To this coil is attached a very light aluminium arm, which moves across the scale and indicates the angle of deflection of the coil when a current flows through it.

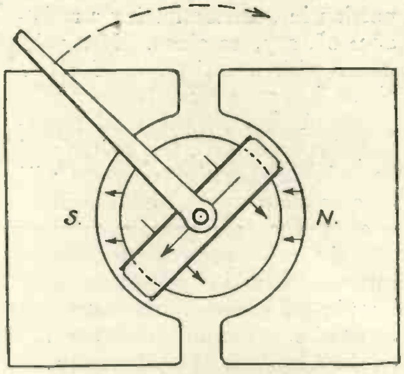


Fig. 4.—Showing the moving coil.

In Fig. 4 the magnet is supposed to be lying in a horizontal plane, the axis of rotation of the coil being vertical. Above and below the coil is a hair-spring, similar to that used in a watch, the upper and lower hair-springs being opposed and being slightly unequal in strength. The controlling or restoring force, tending to bring the coil and the needle back to zero position, is thus equal to the difference between the forces exerted by the upper and lower springs. These springs also act as leads, the current passing into the coil through one spring and out through the other. When a current passes through the coil, the latter behaves as a magnet, and rotates in the magnetic field between the poles S, N, taking up a final position in which the deflecting forces due to the electro-magnetism are balanced by the restoring forces due to the hair-springs. After the scale of the instrument has been calibrated by means of currents of known strengths, it may be used for determining strengths of other currents.

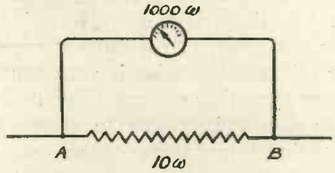


Fig. 5.—The voltmeter circuit must not take sufficient current to upset the circuit conditions.

Employment of Ammeter

One of the primary requirements in any measuring instrument, whether electrical or otherwise, is that its employment shall not upset the conditions which it is designed to record. Thus an ammeter which is designed for measuring current in a circuit must not, by its introduction, materially alter the current in the circuit. This means that the internal resistance of the ammeter must be very small.

It will be evident from the description which has just been given that the resistance of the small coil of fine wire may be considerable, but this difficulty is readily overcome by connecting across the terminals of the ammeter a low resistance, known as a "shunt." If the relation between the resistance of the shunt and the internal resistance of the ammeter is known, the proportion of the current which will take the path through the ammeter is known, and the scale may be calibrated accordingly.

For example, suppose the resistance of the ammeter coil is 9 ohms and the resistance of the shunt is 1 ohm, then one-tenth of the current will flow through the ammeter, and if the position of the needle when 1 ampere is flowing through the coil be marked "10 amperes" and so on, the scale will indicate the total current flowing through the ammeter and the shunt combined.

In some instruments the shunt is incorporated in the instrument itself, and is called a self-contained shunt. Sometimes, however, particularly where it is desired to use an ammeter for a large range of current-strengths, a set of shunts is supplied with the instrument, each shunt giving to the scale reading of the instrument a different set of values. For example, if in the case mentioned above the 1-ohm shunt were removed and a shunt of $\frac{1}{10}$ of an ohm were substituted (the relation between the internal resistance and the shunt

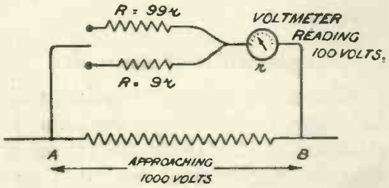


Fig. 6.—Increasing the range of voltmeter by means of series resistances.

resistance being now 99 to 1) a total current of 100 amperes would only result in 1 ampere passing through the ammeter, and hence the readings would need to be multiplied by ten, or, in other words, the range of values indicated within the scale would now be increased ten times.

An ammeter must always be included *in series* in a circuit in which it is desired to measure the current, and, as we have said, its net resistance must always be very low so that its introduction into the circuit does not materially increase the resistance of the circuit, as otherwise the current indicated by the ammeter would be less than the current which was flowing before the ammeter was introduced.

The hot-wire ammeter and induction instruments will be dealt with on another occasion.

The Voltmeter

Voltmeters which are employed in ordinary practice are almost invariably of the electro-magnetic type and usually are neither more nor less than *ammeters* of high resistance. It may be said, in other words, that the principle of the common voltmeter is identical with that of the ammeter. Just as the ammeter must have a *low* resistance, so as not to upset the *current* conditions of the circuit, so the voltmeter must have a *high* resistance so as not to upset the *voltage* conditions of the circuit.

In Fig. 5 is represented a portion of a circuit, the particular portion in question having a resistance of, say, 10 ohms. If a voltmeter with a resistance of 1,000 ohms be connected between the points A and B, the total resistance between these two points will be reduced, but the reduction will be extremely small, and for practical purposes we may consider that the small current which flows through the side circuit represented by the voltmeter circuit does not upset the potential difference between A and B. Consequently, if the voltmeter has previously been suitably calibrated, it will indicate the required voltage between the two points A, B.

Testing H.T. Batteries

A voltmeter is frequently employed for testing the condition of high-tension batteries. It is well known that the current-capacity of small dry cells, such as are commonly employed in the construction of H.T. batteries, is very small. If, therefore, the internal resistance of the voltmeter is too low, the current which flows through the instrument may be sufficiently great to cause partial polarisation of the batteries, with the result that the voltage drops and the indication of the voltmeter is incorrect. If a voltmeter of this type be employed for testing secondary batteries ("accumulators"), the difficulty referred to does not arise, as the current capacity of such batteries is very much larger than that of small dry cells. Care should be taken to ascertain that the internal resistance of a voltmeter intended for the testing of H.T. batteries (or in any other case where the current capacity of the system is limited) is sufficiently high, otherwise perfectly good cells may fall under suspicion or be actually condemned. If there is any reason to doubt the indications of the voltmeter, and the internal resistance is not known, it is a good plan to test the cells on a second voltmeter, and note whether there is any considerable discrepancy between the indications of the two instruments.

Another way in which the unsuitability of a voltmeter may sometimes be noticed is the gradual dropping of the indicated voltage as the cells are left connected to the instrument. When

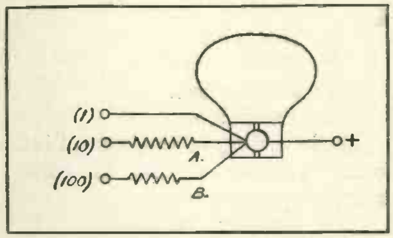


Fig. 7.—The principle of Fig. 6 incorporated in voltmeter instrument.

the voltmeter is connected to the battery the reading should remain absolutely steady; if it gradually falls, this probably indicates that the internal resistance of the instrument is too low, and that polarisation of the cells is taking place, but, of course, it may also indicate the presence of faulty cells in the battery.

The range of a voltmeter may be increased in a manner somewhat similar to that described above for an ammeter. Instead, however, of placing a *shunt* across the terminals of the instrument, *resistance* is included *in series* with it. The reason for this can best be understood by reference to Fig. 6. Suppose the voltage between the points A and B is to be determined and the range of the instrument is between 0 and 100 volts, whilst the potential difference between A and B is approaching 1,000 volts. If a resistance R be included in series with the instrument, R having a value nine times as great as that of the internal resistance of the voltmeter, then the combined resistance in the voltmeter circuit is ten times what it was originally, and the potential difference between the terminals of the instrument will be one-tenth of the potential difference between the

(*Continued on p.* 70.)

RANDOM TECHNICALITIES

By PERCY W. HARRIS, Staff Editor.

In these notes are discussed many points of interest to the radio experimenter and listener-in.

IN America practically the only form of commercial radio - frequency coupling utilises transformers, which are sold in a form similar to that of audio-frequency transformers. Many of them have iron cores, the laminations being extremely fine so as to cut down to a minimum the losses due to eddy currents. Practically all such transformers have an optimum magnification on 360 metres (the standard broadcasting wavelength in America). The fact that nearly all broadcasting is done on one wavelength makes it a simple proposition to design a transformer which is efficient on such receptions. In this country, where we have different wavelengths for different stations, the problem is not so easy of solution.

American radio-frequency transformers appear to be very inefficient compared with our own methods of coupling, and for this reason have not achieved such a wide popularity. The tuned anode method seems practically unknown in America, and in fact one rarely finds any reference to a tuned high-frequency stage, whether tuned anode or tuned transformer.

American audio-frequency transformers follow the general lines of those here, but are generally wound with finer wire, and will not stand such high plate voltages. There is a simple reason for this, as it is rarely that a higher voltage than sixty is used on the plates of any of the American valves, save where they are used with power amplifiers. These American transformers do not always act efficiently with our own valves, as their impedances are often too low.

* * * *

Most British amateurs are acquainted with the fact that if the I.S. side of the low-frequency transformer is connected to the battery side of the filament resistance in the negative lead, a negative potential will be impressed upon the grid, depending upon the voltage drop across the resistance. Thus, if we have a 6-volt accumulator and the resistance is such that the voltage across the filament terminals of the valve is adjusted to exactly four, there will be a drop of two volts across the resistance, and the grid will be two volts negative compared with the filament. While the advantage of this form of connection is fully realised by the American manufacturers, many of them cannot so wire up their instruments, as this method is covered by a patent held by one of the larger corporations. Of course it is quite possible to use one or two dry cells in the grid circuit to give the necessary grid potential. The filament battery in America is called the "A" battery, and the plate battery is called the "B" battery, thus the grid cells are quite logically called the "C" battery.

* * * *

While on the subject of grid potentials it is well to point out that the advantage of placing this negative potential on the grid is only obtainable when the voltage of the filament battery is higher than the voltage drop across the filament. Thus, if we have a four-volt valve and light it with a four-volt battery, the resistance must all be cut out, and there will therefore be no voltage drop. This point should be borne in mind by those who are about to buy accumulators, and who are under the impression that they will get all they need by buying a four-volt accumulator.

* * * *

Some very interesting experiments have recently been conducted by one of the big American broadcasting stations in an attempt to overcome the difficulty due to "dead-spots." The City of Cleveland is well known to be such a dead-spot, and an attempt to obtain satisfactory reception of broadcasting on 360 metres proved thoroughly unsatisfactory. An attempt was then made to broadcast on wavelengths not only of 360 metres but also of 100 metres, the 100-metre reception being picked up in Cleveland on a frame aerial. It was found that the 100-metre transmission was satisfactorily received, and by means of re-transmissions the distant programme was made available to all those people in the City of Cleveland who wished to hear it. Several interesting points came out during the test, one being that daylight absorption of the 100-metre transmission was far less than that of the 360, and, in fact, that the 100-metre transmission (although on much lower power) came in decidedly better. American amateurs with transmitting licences have long since demonstrated that transmissions on wavelengths of 200 metres and below are remarkably efficient. Possibly in this country it may be found that broadcasting on 100 metres, or perhaps on still shorter wavelengths, together with re-transmissions on the standard broadcast band, may effectively solve the problem of our own dead-spots.

* * * *

Reaction on to the aerial ("criminal reaction," as I heard it termed recently) is under no ban in the United States. In fact, the larger wireless corporations, in their endeavour to popularise radio, have manufactured and sold very large numbers of sets in which reaction on to the aerial is the rule. Such sets can be fairly efficient when properly and skilfully handled, but of course are the reverse of selective, and are capable of causing just the same interference in America as we experience here. Discriminating amateurs use what are known as "three-circuit tuners," a secondary circuit being very loosely coupled to the aerial, and the plate circuit tuned and coupled back to the grid circuit, either electro-magnetically or electrostatically. Such tuners when handled with a reasonable amount of care cause no trouble whatever from radiation, and give a signal strength in excess of that available with the best single circuit tuners, while their selectivity is extremely high. In skilled hands it is quite possible to separate stations the wavelengths of which are within a few metres of one another.

Perhaps the most popular of American circuits is that in which the aerial is tuned by means of tappings on the stator of a vario-coupler, the turns being tapped in units and eights or units and tens, so that by combinations of two single-pole switches running over studs, it is possible to use any number of turns up to the maximum. The secondary, which rotates within the primary, is so arranged that with a variable condenser across it, it will tune well over the broadcast band. The plate circuit of the valve is tuned, and if the wavelengths are fairly short the inter-electrode capacity in the valve is quite sufficient to hand back energy from the plate circuit to the grid, thus giving all the reaction needed.

AMMETERS AND VOLTMETERS FOR WIRELESS USE

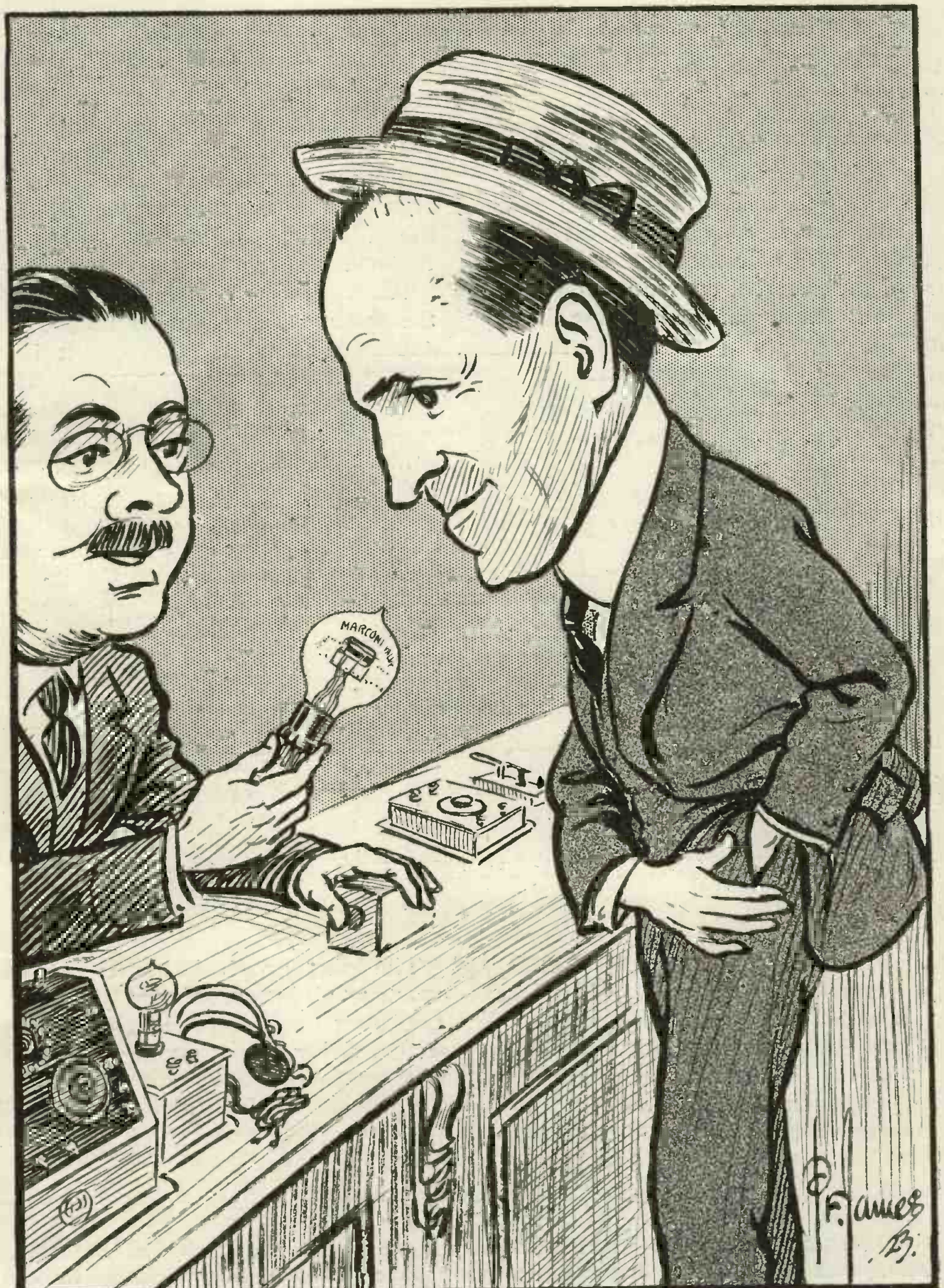
(Continued from page 68.)

points A and B. Correct readings will be obtained by multiplying the actual readings of the instrument by ten.

In practice, coils of different resistance are frequently incorporated in the instrument itself, and switching arrangements are provided so that the different ranges of the instrument may be readily obtained. This is indicated in Fig. 7, where two such coils A and B are shown. One positive terminal is provided and three negative terminals. Suppose the scale is divided for 1 volt, that is to say, the application of a potential difference of 1 volt between the terminals + and (1) will make the needle move right across the scale. Now if the resistance of the coil A is nine times the resistance of the moving coil, it will require 10 volts, applied between the terminals + and (10) to make the needle move right across the scale. The terminal (10) is so marked because when that terminal is used the whole range of the scale is 10 volts. Similarly, if the coil B has a resistance equal to ninety-nine times that of the moving coil, it will require 100 volts applied to the terminals + and (100) to produce the full-scale deflection. Suppose the whole scale is divided into one thousand divisions. When using the terminals + and (1), each division reads 1/1,000 of a volt; when using terminals + and (10), each division reads 1/100 volt, and when using terminals + and (100), each division reads 1/10 volt, which arrangement is very convenient for experimental work.

EVENTS WE NEVER EXPECT TO WITNESS

No. 3.



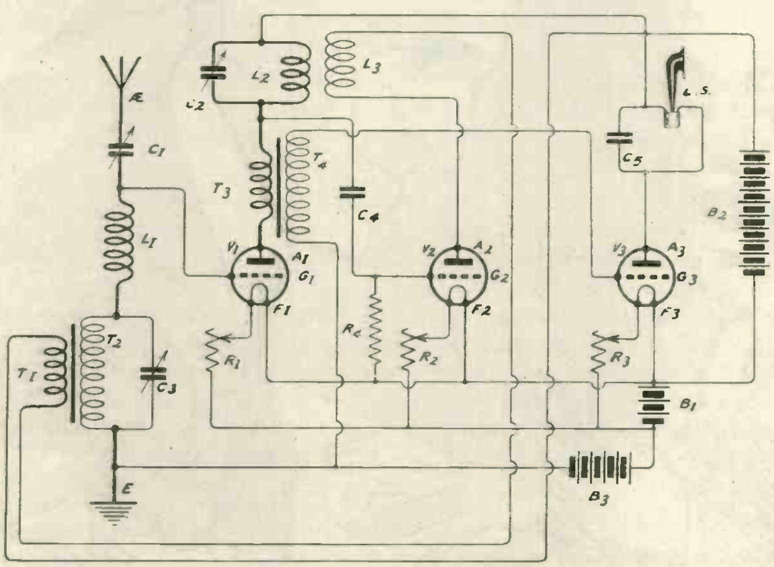
Mr. Mullard buys a Marconi valve for his broadcast receiver.

A THREE-VALVE ST76 CIRCUIT

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

This article is a continuation of the one appearing in the preceding issue of this journal.

IN the last issue of *Wireless Weekly* the writer gave details of a new two-valve reflex circuit, and it is proposed here to show how this circuit may be extended to make an exceedingly efficient three-valve set. The values of the different components are as before, but an additional valve has been added, and an extra intervalve transformer is necessary. In the accompanying figure the primary of a step-up intervalve transformer T_3 T_4 is included in the anode circuit of the first valve. The secondary winding T_4 is connected to the grid G_3 of the third valve V_3 and to the negative terminal of the battery B_3, which provides the grids of the amplifying valves with a negative potential of about −9 volts when the high-tension battery B_2 has a value of about 100 volts.



Circuit diagram of the ST76 arrangement.

The operation of this circuit is the same as that of the ST75 circuit described in the preceding issue. Care should be taken to see that the transformer T_3 T_4 is well insulated and not close to any wires going to earth. It should not, for example, be placed near the filament accumulator or high-tension battery.

As the different coils and condensers have the same values as those used in the ST75, it is only proposed to point out that a fixed condenser C_5 of not less than 0.002 μF capacity is connected across the loud-speaker. This, of course, is not essential, but will usually improve the tone.

By the use of plugs and jacks it is possible to use two or three valves in this circuit.

The photograph last week showed a set constructed in accordance with this circuit. The plug enables the loud-speaker to be inserted, either in the anode circuit of the first valve or the anode circuit of the third.

Full constructional details of the ST75 will appear in the next issue of *Modern Wireless*.

THE SHEFFIELD RELAY STATION

An account of the progress made and the difficulties encountered in connection with the above station.

THE difficulties which have hindered the progress of Sheffield's relay station were fully explained to the wireless public of Sheffield by Capt. P. P. Eckersley, chief engineer of the B.B.C., on Monday evening, July 9th. Those who had organised the meeting were gratified to find the large and stately Firth hall of the University crowded to the doors some time before the meeting was opened, and it was a fine testimony to the lively interest in wireless existing in Sheffield.

In his racy and captivating style, Captain Eckersley assumed the rôle of apologist for the B.B.C. towards the impatient amateur who wished to listen in on a crystal set, but did so, as he said, without his hand on his heart, for the difficulties were such as had to be surmounted by research or experiment. He impressed the company with the assurance, however, that the B.B.C. were anxious to do everything possible to push on the relay station so that wireless should be within the reach of everyone, and not a section only.

He explained what led them to the idea of a relay station. One of the great troubles was jamming, or interference generally. They decided that they must either receive wireless waves in Sheffield and re-transmit them, or have them sent up by telephone for retransmission at a greater power, sufficient to shout down the jamming. It was the first time in England that they had tried to do this experiment. It was a new thing. He did not believe they had done it even in America. With regard to the position of those wishing to receive distant stations direct, the solution of the difficulty was to get different wavelengths. But they were difficult to get hold of. If they put a relay station on between 350 and 425 metres there was no doubt it was going to jam the rest of the services to some extent. That problem was to be got over and the first thing the Company were asking for was a wavelength over or below the present broadcasting length. They were experimenting at present on how to do that.

They felt that the best thing to do was to set apart a wire from the parent station on the ordinary trunk routes to the transmitter, and transmit on a certain maximum length at which they could receive. But, of course, they were waiting for some money. (Laughter.) They only got five shillings per person—sometimes. If they go to the Postmaster-General and say they want a wire from London to Sheffield he would reply, "Yes, that will be £15 a night."

Captain Eckersley referred to the technical problem they were up against in the land wire method, namely distortion. Briefly their problems were: What is the wavelength going to be so as to allow of not jamming with direct reception of broadcast matter, and to enable them to receive by wireless and pass on by relay? What is the cut-off, or distortion of high and low notes going to be on the land line? And another problem was: If they are going to establish a relay station in Sheffield, what would Sheffield hear? If reception in Sheffield by relay was as he had heard it direct, they would be reminded of the "insurrection in hell" phrase recently used.

Sheffield had at that moment a station. It was not a relay station because they had not a land line or a wireless receiving station. They would send out on the station now erected regular transmissions, and hoped to do so twice a week, though if it was necessary to close down for a week at any time they must not be disappointed. The wavelength would be somewhere about the 400's.

After the speechmaking the new transmitting station was put into action, and by means of an ordinary crystal set with loudspeaker very clear speech and music was received from the Applied Science Department where the relay station is first to be fixed. The power used was 100 watts, and Sheffield generally within a radius of four miles was able to listen-in to the first broadcasting performance of the new station.

The Junior Magnavox loud-speaker.

NOW that summer has come in earnest many of our readers will be turning their thoughts to ways and means whereby broadcasting can be enjoyed in the open air with the same ideals of comfort applicable to the home.

Picnics hold a greater charm when the joys of the party are enlivened with music, and the possibility of dancing to follow also holds some attraction. Further, tennis and cricket pavilions may enjoy this new amusement, as may also garden parties, river trippers and motorists.

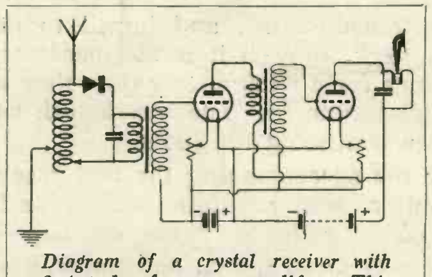


Diagram of a crystal receiver with 2-stage low-frequency amplifier. This circuit is suitable for receiving in the open up to distances of five miles, using a loud-speaker.

Those experimenters who contemplate open air reception should bear in mind the fact that loud-speakers have a considerably bigger accomplishment to perform in the open air than is the case when the instrument is used in a room.

In *Wireless Weekly*, Volume 2, No. 1, many suggestions for outdoor aerials were given, and, by means of these, experimenters will find that for reception up to 5 miles from a Broadcasting Station quite suitable apparatus is a crystal receiver coupled to a two-valve low-frequency amplifier and loud-speaker. For distances greater than this and up to approximately 18 miles, a three-valve receiver is recommended.

Should the purpose of the reception be to conduct an open-air dance, then, in order to give the required amount of volume throughout the area over which the dancers will perform, a system of sound distribution should be introduced. Loud-speakers should be installed at equal distances round the area in which the dancing is being conducted; these should be turned towards the dancers and connected in parallel with the receiver. By this means the amount of volume produced is evenly distributed among the performers without any individual loud-speaker being unduly loud. The effect will then be that, though everyone will see the instruments and hear them, no one will be able to say positively which one they are listening to.

When the programme to be received is dance music, or even opera, this method of distribution is particularly effective, for the music is "brought" right amongst the audience rather than being concentrated about the horn of any one particular loud-speaker. Again, this method reduces the number of valves required, for nothing like the same volume of sound is needed.

For conducting an open-air dance within a radius of, say, 15 miles of

LOUD-SPEAKIN[...] DOO[...]

By STANLEY G. RA[...]

The following article contain[...] on how broadcasting can be[...]

The above photograph by Mr. A. Haskell [...] wireless concert[...]

a Broadcasting Station, it is suggested that the best apparatus would be a single-valve receiver coupled to a two- or three-valve power-amplifier and six loud-speakers. The method of connecting these is as follows:—

From the output terminals of the

[...]NG OUT OF [...]RS

[...]EE, Staff Editor.

[...] a few brief suggestions [...]joyed in the open air.

[...]shows an audience listening to an open-air [...] at Newcastle.

[...] receiver connection is made to the primary of an intervalve transformer; the secondary is connected to the input of the power-amplifier, to the output terminals of which are connected the six loud-speakers in parallel. The most suitable valves for the power-amplifier are L.S.2 valves with 200-300 volts applied to the plates. The loud-speakers should be of a large size, whilst all battery leads should be as short as possible and of a fairly large gauge wire.

On the river, at all times attractive while the warm summer lasts, wireless offers considerable amusement, and, further, makes the evenings more enjoyable with the pleasantness of music.

Whereas in the past the gramophone has supplied this want, times have changed, and with a little ingenuity on the part of the experimenter wireless can be made to give this amusement with even better results.

In the case of small boats not possessing masts, the aerial may be either a frame or else a cage type aerial swung between a short staff fitted at either the stern or the bow of the boat.

The earth connection is made by means of a bare copper wire, to the end of which is attached a weight, thrown over the side of the boat.

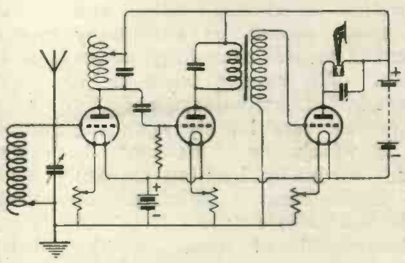
With this arrangement it may be taken that any three- or four-valve receiver will give perfectly good results, using a loud-speaker, and will produce a volume sufficiently loud to enable those on the banks of the river to hear with distinction.

Using a four-valve set with a loud-speaker, distances up to approximately 30 miles from a Broadcasting Station should be obtained.

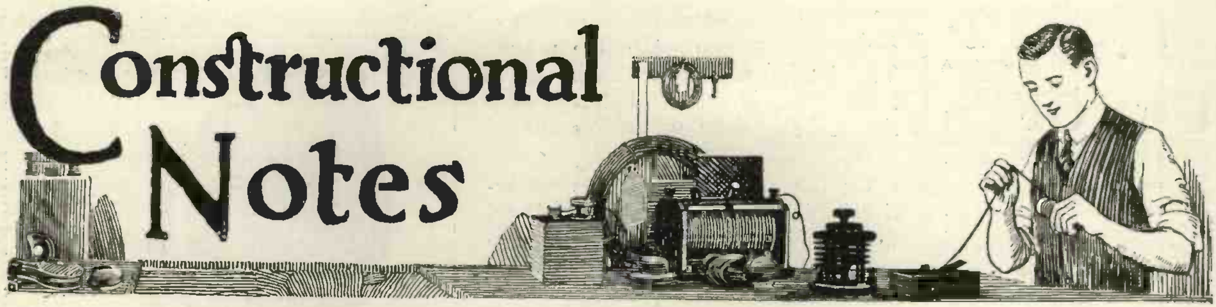
Those readers who are anticipating a holiday on the river could do no better than take a wireless receiver with them, for on wet evenings when the river offers no attraction, nothing is more consoling than the fact that, though confined under canvas, one may yet listen to the music and news emanating from the nearest Station of the B.B.C.

In conclusion, it is as well to carry at least one spare valve, and, should you not be using a loud-speaker, see that there are sufficient telephones for each member of the party. Another word of advice is that, since wireless apparatus is so sensitive to the effects of damp, it is as well to insulate it from the ground or deck by means of a box or mackintosh. If the set is to be used to any extent for outdoor work, it is well worth the trouble of assembling the apparatus to be used in a leather suit case, not only for purposes of portability, but also as a means of protection.

The True-music loud-speaker.



A three-valve circuit, comprising one H.F. valve, detector, and one L.F. valve, suitable for operating a loud-speaker in the open up to distances of 18 miles.



MAKING A L.F. TRANSFORMER

THE making of a low-frequency transformer is not a task that every amateur wireless constructor would care to tackle, involving as it does the winding of very large quantities of wire so fine that the slightest jerk will cause a break. There are, however, people who take pride in making every possible part of their set themselves, and they will find useful the constructional details given below.

There are two points of great importance in the design of a low-frequency intervalve transformer. The first is that its primary should have a large impedance; the second,

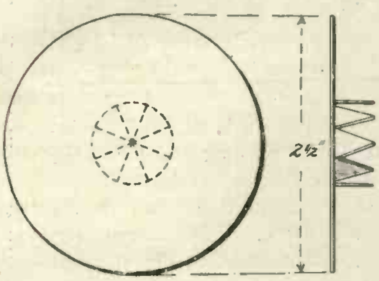


Fig. 1.—The end flanges of the transformer.

that the core should be built up of laminations or of small wires, and that these should be sufficiently numerous to provide a large cross-section. We cannot work to a definite impedance value, since this will depend very largely upon the way in which the transformer is wound and assembled; but we can aim at providing a direct-current ohmic resistance somewhere in the neighbourhood of that of the 'phones which would replace the transformer in the plate circuit of the detector valve if a note-magnifier were not in use.

As it is essential to silent working that the insulation between windings and core shall be as good as possible, we will make the bobbin of a piece of ebonite tube 3in. long, with an internal diameter of ½in. The end flanges, made of stout cardboard, are 2½in. in diameter. In the middle of each is drawn a ¾in. circle, as seen in Fig. 1, which is marked out as shown. The flaps are then cut with a sharp-pointed knife and bent up as depicted in Fig. 1. After a thorough dressing with shellac the flanges are slipped on to the tube with the flaps pointing inwards. These are shellacked again and then bound tightly with silk whilst still wet.

The windings of the primary will consist of 2oz. of No. 42 single silk-covered wire. The end is soldered carefully to a piece of stout insulated wire which is anchored in the usual way to one of the flanges quite close to the ebonite tube. The end of the stout wire is allowed to project outwards from the flange, and the letters I.P. are marked on the cardboard beside it. We are now ready to begin winding.

To do this by hand is an almost impossible feat, since there will be about 10,000 turns in the primary alone, and the secondary will contain nearly two and a half times as many. If a lathe is available matters are very much simplified, for we can mount the bobbin on a mandrel. If not, some kind of winding machine must be improvised; Meccano parts can be made to serve quite well.

The fine wire is now wound on as tightly and as evenly as possible; the reel should be mounted on a spindle, the right hand feeding the wire on. When this winding is complete, solder the end to another length of stout insulated wire and anchor as before, marking the wire O.P. Cover the primary winding with a double layer of insulating tape wound like a puttee so that the edges overlap.

The secondary is put on in the same way, its ends being marked I.S. and O.S. respectively. Should a break occur during the putting on of either winding, the ends must be bared and neatly soldered together. The joint should then be wrapped carefully with silk and given a good coat of shellac. About 4oz. of wire will be required for the secondary.

The core consists of a bundle of 7in. lengths of the best soft iron

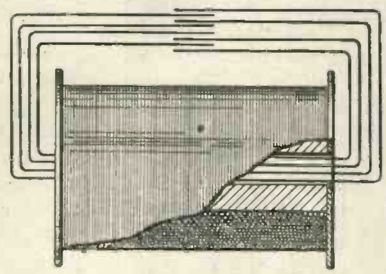


Fig. 2.—Showing the core and bobbin of the transformer.

wire of small gauge. Each length should be shellacked. The wires are made into a bundle that will just pass tightly into the ebonite tube, being firmly bound for the middle 3in. with stout thread. If the bundle is a loose fit, it should be wedged in with little wooden pegs.

The wires are now bent upwards and turned back over the bobbin to meet and overlap in the middle (Fig. 2). To reduce the reluctance of the magnetic path it is best to scrape the shellac off the ends and to bind each pair together with a few turns of very fine wire.

The whole transformer is next wound with tape and fine string to serve as a protection. The best way of mounting the finished instrument is to place it in a small box, packing it tightly in place with oily cotton waste, which will not collect moisture. Or if an old H.T. battery is lying about the workshop, its wax may be melted down and run into the box to make all secure. The four leads from the transformer are taken to terminals mounted on an ebonite lid made from the box.

The cost of making this transformer will be about 12s., but it will perform better and stand harder work than almost any ready-made type sold at nearly double its cost, since it contains far more wire and is vastly better insulated.

R. W. H.

AN EFFICIENT LEAD-IN TUBE

THE importance of having a good lead-in tube is not always realised; yet it may make all the difference to the quality and strength of one's receptions. If the lead-in is not well insulated on its way to the set a considerable part of the impulses brought in by the aerial may escape to earth before they reach the tuning inductance, and so do no useful work.

The tube to be described is simplicity itself, yet it is reasonably efficient. It costs very little to make, and it looks neat when mounted in the window frame, for nothing is visible either inside or outside the window but a wing nut or terminal screw and an ebonite washer beneath it.

The first requirement is a piece of stout ebonite tube with an internal diameter of ¼in. Its length must be exactly the same as the thickness of the window frame. A hole through which the tube will just pass is drilled with brace and bit in the window frame and the tube is inserted. A piece of 2B.A. screwed rod 2in. longer than the tube is now passed through it and an ebonite washer ¾in. or 1in. in diameter is placed over each end, the rod being clamped in position by nuts screwed tightly down both outside and inside the window.

The lead-in and the aerial wire of the set are fixed to the rod either by milled terminal screws or by wing nuts. The latter will be found the more convenient, since they are easy to tighten down and

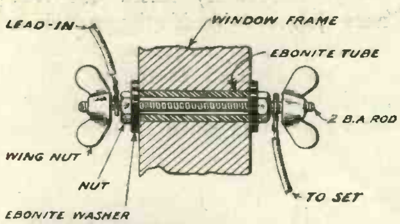


Fig. 3.—Sectional view of the leading-in tube.

unscrew. One can thus be sure of obtaining tight connections, and when the set is to be disconnected there is no need to use the pliers, no matter how hard the nuts may have been turned down.

R. W. H.

MOUNTING TUBULAR VALVES

THE V24 or "test tube" type of valve, though excellent on account of its low capacity, since the leads from filament, grid, and plate have not all to pass through one narrow pinch, has yet one great drawback.

It fits into clips which may be mounted either upon an adaptor for a four-pin holder, or may be fixed direct to the ebonite panel of the set. In either case the clips for grid and plate caps are apt to make rather a bad contact when the holder has been in use for some time.

The importance of having good connections in the grid circuit in particular is well known. In the anode circuit a poor or varying contact will lead to noises being produced in the receivers by the slightest jarring of the set, and it may even be the cause of a mysterious silence on the part of the set even when it is tuned to a wavelength upon which strong signals are known to be in existence.

There are two tips that are well worth attention. In the first place the little caps of these valves are apt to become covered in time with a layer of dirt, grease, or oxide, or a combination of the three. Their contact surfaces should be given an occasional polish with an old piece of the finest emery cloth. If your valves have been in use for some time, and if the caps are dull-looking, you will probably find that this treatment reresults in a marked increase in signal strength.

The second tip concerns the provision of a steadying device for the valve when it is mounted in the clips. Take a fairly stout rubber band and place it round the glass of the valve. Loop it over two or three times until it is quite a tight fit. Now run it down almost to the plate and grid caps.

Place the valve in its clips, then pull out a loop from the band and slip it over the one which makes contact with the grid cap. Take a second loop and place it over the plate clip. The valve is now held very tightly, the clips being forced against the contacts by the added tension of the rubber. No matter how the set is jarred within reason, it will not move in its setting. If each valve is fitted with a rubber band of its own, it is a matter of only a second or two to remove one from the holder and to replace it by another.

R. W. H.

SLOPING-FRONT CABINETS

THERE can be no doubt that the sloping-front cabinet is one of the best mountings for the ebonite panels of the receiving set. Besides looking very neat, these cabinets take up little space, since their extreme depth need not exceed six inches. They are most convenient, too, for one can operate the set whilst sitting at the wireless table without having to stoop over it. Lastly, they are things that anyone who has a little skill in using ordinary wood-working tools can make quite easily for himself.

Any hard wood will do for them, though oak, which is easier to work than mahogany or teak, is perhaps the most satisfactory. The wood used should be well seasoned and half an inch in thickness.

The size of the cabinets will depend, of course, upon that of the panels used. If a standard height for the panels of, say, nine inches is adopted, all pieces of apparatus can be mounted in cabinets of uniform height, the width being varied to suit the requirements of individual units. Nine inches is a convenient height, since a panel measuring 9in. by 6in. will take a complete single-valve receiver and the reaction tuning condenser, or a high-frequency amplifying valve with its inductance and condenser. A 9in. by 9in. panel will do for two H.F. or L.F. valves, and one measuring 9in. by 12in. will serve to mount a complete three-valve set with valves, rheostats, transformers, and three variable condensers for aerial circuit, secondary and reaction.

Fig. 4 (top right) shows a finished cabinet of the largest size mentioned. The dimensions of end pieces that will suit all sizes are given in Fig. 4. These should be cut out carefully and trimmed up with the plane until all are of exactly the same size and shape. The bottom of the cabinet is 6in. wide, the front 3in., the back 11½in., and the top 3in. The length in each case will depend naturally on the size of the cabinet under construction.

The corners of cabinets made by professionals are usually dovetailed together. This, however, is a process to be undertaken only by those who are pretty good carpenters. The halved joint shown in Fig. 4 is much easier to make, and, as it looks just as well if neatly done, is strongly to be recommended. In order to provide a bed for the panel a beading of half-inch deal is fixed right round the opening of the cabinet. It should be so arranged that the panel, whatever its thickness, lies exactly flush. A very neat job results if the panel is mounted upon hinges at its lower end and secured at the top by a catch or a single screw. It can then be swung open in a moment

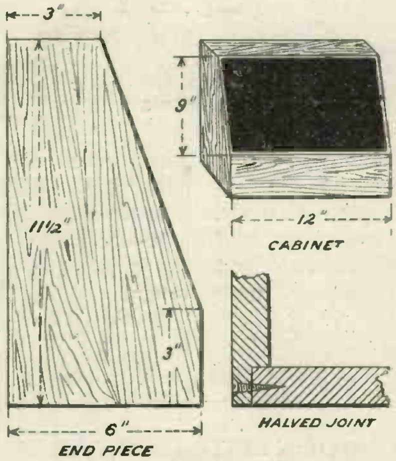


Fig. 4.—Illustrating the different sections of the cabinet.

if the need arises to inspect its underside or to make changes in the wiring.

To obtain a good finish on the wood is not at all a difficult matter. First rub it down as smooth as you can get it with the finest glass cloth, then dress well with linseed oil. When the oil has sunk in and become dry, it will be found that the grain has risen a little. Smooth down again with sand-paper and oil once more. When the second dressing is dry, the cabinet should be polished with beeswax and turpentine. The panel may be mounted when the first dressing has been given, the remaining processes being carried out on subsequent days.

Several of these cabinets can be used to form an experimental or "unit" set and when placed side by side have an excellent appearance. R. W. H.

A FINELY ADJUSTABLE DETECTOR

WHETHER it is intended to be used by itself or to act as the rectifier on a multi-valve set, a finely adjustable crystal detector is one of the most useful pieces of apparatus that can find a place on the experimenter's bench. Most of those that one buys have defects in their design that make them unsatisfactory for delicate work. Sometimes the adjusting screw is too coarse, sometimes the supports are so flimsy that the slightest jar upsets the contact after laborious adjustments, sometimes again no movement is provided for the cups themselves, so that one cannot properly search the crystals held by them for their most sensitive spots.

The design now to be described, besides being both easy and cheap to make, has none of these drawbacks. Whilst adjustments are being made it is perfectly flexible, but once it has been set it can be counted upon to withstand any reasonable treatment, in the way of slight jars that must occur when one is working at the wireless table.

The base is a piece of ¼in. ebonite 3½in. long by 1½in. wide. Only four holes are drilled in it; these, which are 4B.A. clearance, take the shanks of the terminals and the bolts (Fig. 5) which secure the supports in their places.

The supporting arms are made of stout angle brass, which is obtainable from most ironmongers. That which supports the fixed crystal is 2in. in height; the other is ½in. less. A 4B.A. clearance hole is drilled ¼in. from the top of the longer one, and a slot is filed down to meet it (Fig. 6). The purpose of this is to enable cups provided with various crystals to be removed or inserted with the minimum of trouble. The arm for the movable crystal is of the same dimensions and shape; it is made of sheet brass.

The adjusting screw should have a very fine thread. If possible, one such as those used for the fine adjustment gear of microscopes should be obtained, but if one of these is not available an 8B.A. screw 1in. in length may be used. It should be passed through a disc of $\frac{1}{8}$in. ebonite $\frac{1}{2}$in. in diameter and held in place by a nut at either side.

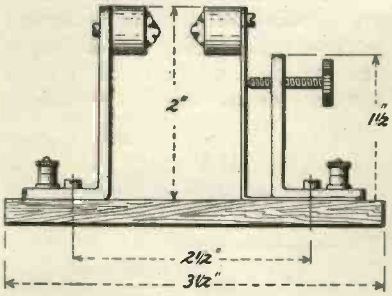


Fig. 5.—The detector assembled for use.

Tap a hole for it $\frac{1}{4}$in. from the top of the shorter support and make a hacksaw cut (Fig. 6) down to it. Drill a 6B.A. clearance hole through the support from edge to edge, and insert a bolt as shown in the drawing. This bolt serves to take up any backlash or wobble in the adjusting screw due to wear.

The parts may now be assembled on the base as shown in the first drawing. The base itself should be mounted on a piece of hard wood, recesses being made with a $\frac{3}{8}$in. bit for the nuts of the terminals and screws.

The cups are made from short pieces of $\frac{1}{2}$in. round brass rod in which are deep hollows made with a $\frac{1}{4}$in. or $\frac{5}{16}$in. drill. The holes for the 4B.A. retaining screws are made not in the centre but at a little distance from it (Fig. 6). The cups are thus capable of an eccentric movement which allows the surfaces of the crystals to be properly searched. If a number of different crystals are mounted in cups, one can test out any couple very easily, for it is a matter of seconds to change the cups in the supporting arms.

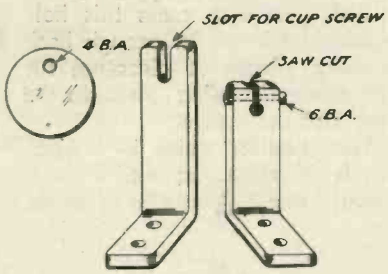


Fig. 6.—The parts of the detector ready for mounting.

R. W. H.

IMPROVING CHEAP TELEPHONES

TELEPHONES may be cheap for several reasons, but it is likely that little time has been spent over final adjustments. The closer the magnets are to the diaphragm the louder will be the signals, and this is what we require, especially in crystal receivers.

Unscrew the ebonite cap and slide the diaphragm off sideways; do not pull it upwards. A small piece of iron might be laid across the pole pieces if left for any time, as the magnetism is preserved thereby. Do not drag this off either, as magnets should not be jerked. Now lay a steel rule across the case and see if the pole pieces have been finished off square both ways and that there is no more space under the rule than four thicknesses of the *Wireless Weekly* paper (0.012in.). If more than this, unscrew the terminal nuts and lift the whole circular magnet out of the case and pack it up with fibre or paper washers, so that when replaced and bolted up, the lowest point on the pole faces comes about right. The windings will be found wound upon bobbins which are a friction fit on the poles. Push these gently down out of the way of the file, which might cut the wire running from one bobbin to the next. File up the pole faces square and leave the above-named space or a little less. The filings will be attached all round the pole pieces and can be wiped off, making sure that none is left sticking up.

As the space has now been made so very small, the diaphragm will be pulled down on the pole faces and will not come free *when the cap is screwed on tight.* To prevent this happening, cut a disc of very thin, smooth tissue paper the same size as the diaphragm and place between it and the magnets. Lay the paper disc over the magnets and lower the diaphragm centrally into position. Screw on the cap, and, when tight, the pressure should pull the diaphragm free. This can be tested by letting a match fall endways on to the diaphragm and listening to the sound, which will be hollow. If touching, the sound will be dead. Do not press the diaphragm with the finger; this may only damage it. If it is not free, cut some paper washers with a central hole to clear the magnets, and put in sufficient between the case and the paper disc until the diaphragm just comes free when screwed up. This equivalent amount can be further filed off the pole pieces, or the washers left in place.

When this adjustment is finally satisfactory the bobbins are gently raised again nearly to the top, and the washers, paper disc, diaphragm, and cap replaced and screwed up. One earpiece can be done first, and it can then be compared with the other to see how much change has been made. In the pair I adjusted, a cheap pre-war American make, the change was very marked, and they were then as good as Sullivan 'phones.

It is said that thin diaphragms are the best, but such difference as I found was in favour of a medium thickness The thickness of the diaphragm will affect its stiffness, however, and consequently the clearance space to be allowed above the magnets.

H. E. A.

A SIMPLE STAND FOR HONEYCOMB COILS

THE coil-holder to be described is a handy little affair, very easy to make, and costing no more than about 3s. 6d. in all. It is most useful for taking the A.T.I. and the secondary, or for a tuned anode

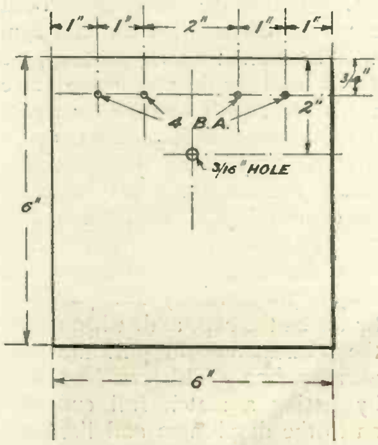


Fig. 7.—The layout of the panel.

inductance and the reaction coil coupled to it. It may also be used with great advantage as a high-frequency transformer, the variable coupling between the coils conferring great selectivity.

The apparatus is designed to take two coils, the lower fixed, the upper moving; but if it is desired to make it up as a three-coil stand, the design is very easily adapted to the purpose. In this case the fixed holder becomes the middle one, and a second moving holder, mounted in exactly the same way as the upper one, is added below it, a longer spindle being used.

Fig. 7 shows the layout of the panel, which is a piece of ebonite 6in. by 6in. by $\frac{1}{4}$in., and is not a very complicated business.

The coil-holders can be made at home from $\frac{1}{2}$in. ebonite. But, as they can be bought complete from advertisers in this journal for 10d. apiece, it is hardly worth while to do so. Fig. 8 shows how that intended for the moving coil is treated. A $\frac{3}{16}$in. hole is bored for the spindle, and two 4B.A. holes are drilled and tapped for the screws which fix the extension handle in position. In the fixed holder only the $\frac{3}{16}$in. hole is drilled. In both cases this hole should be placed far enough back to allow plenty of clearance for the screws running through the plug and the socket.

The spindle, which is a $4\frac{3}{4}$in. length of 2B.A. screwed rod, is mounted in the $\frac{3}{16}$in. hole by means

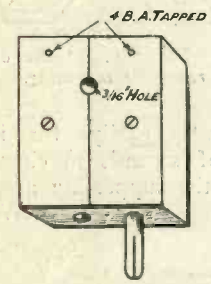


Fig. 8.—The moving coil-holder.

of two nuts placed one above and one below the panel (Fig. 9). A second nut is added below to lock everything securely in position. Above the nut on the upper side of the panel comes a $\frac{1}{2}$in. length of brass tube $\frac{3}{16}$in. in diameter. This is followed by another nut. Then comes the fixed coil-holder, which is locked in place by having another nut turned hard down upon it.

A flat washer is next placed on the spindle followed by a second piece of brass tubing 1in. in length and another washer. A nut is screwed down until the holder

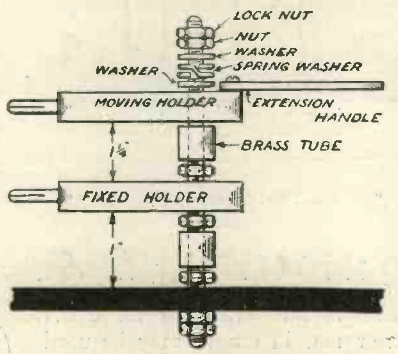


Fig. 9.—The arrangement of spindle.

moves easily but without wobbling. Then a lock-nut is put on to prevent the adjustment from altering when the stand is in use. The extension handle is simply a piece of ebonite $\frac{1}{4}$in. thick and 3in. long by $\frac{3}{4}$in. wide. It is fixed by means of two round-headed 4B.A. screws driven into the holes made for them in the holder.

Into the four 4B.A. holes at the top of the panel are inserted small terminals, one pair being connected to the plug and socket of the fixed holder, whilst the others are wired to the moving holder by means of flex leads long enough to allow of sufficient swing in either direction. The panel may be mounted on a piece of hard wood $\frac{3}{4}$in. thick, recesses being made with brace and bit for the lower end of the spindle and for the shanks of the terminals with their nuts. R. W. H.

BINDING CASES FOR VOL. I.

We are making arrangements for the binding of readers' back numbers in two attractive styles, one a blue cloth and the other a half-leather binding, and also for the supply of the separate cases.

An index is being prepared, and a further announcement will be made in due course.

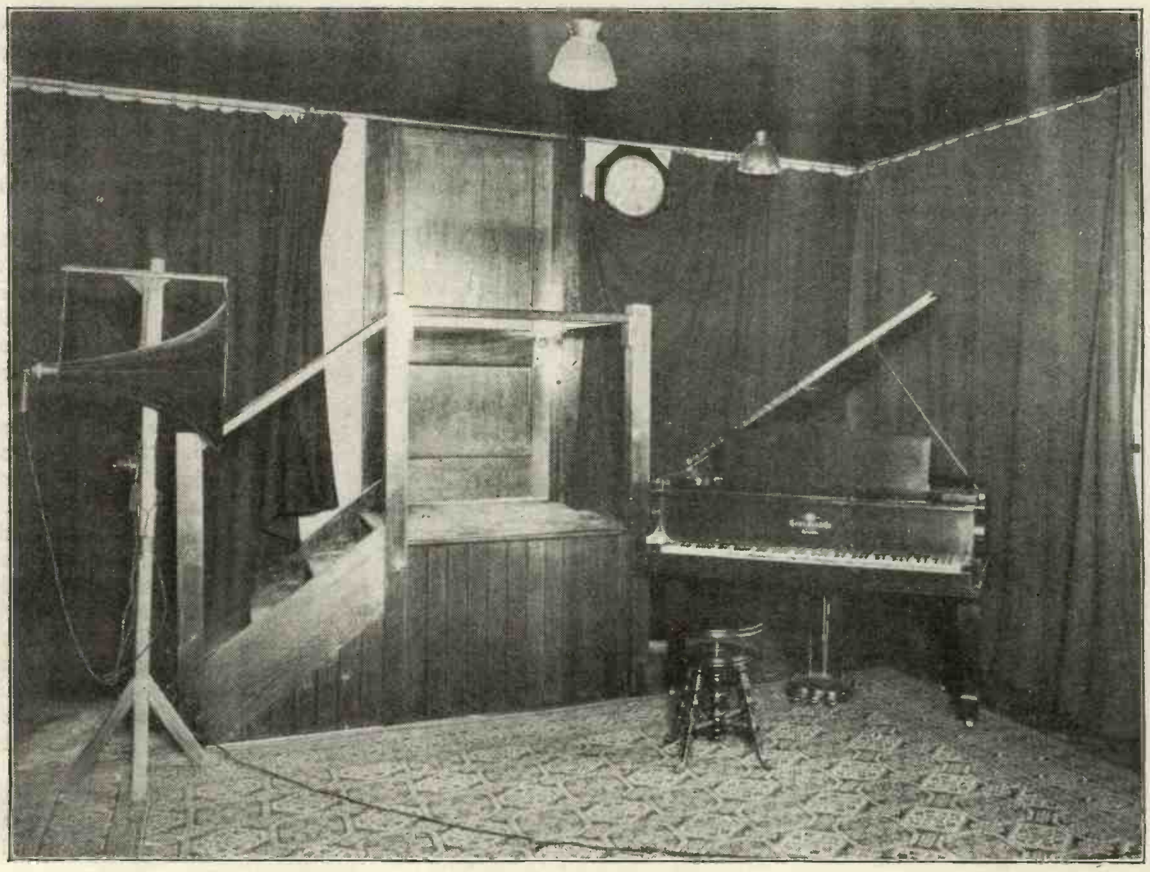
A DOMINION BROADCASTING STATION

The following article gives a brief description of one of the stations in the first of our Dominions to adopt broadcasting.

SHORTLY after the commencement of broadcasting in the United States of America and before this country seriously thought of adopting such a scheme, Canada commenced operations, and can therefore claim to be the first British Dominion to introduce broadcasting as a regular procedure.

When thinking of broadcasting on the other side of the Atlantic, one is apt to regard the United States as holding the monopoly of such a service; on the contrary, however, Canada has done much to make broadcasting popular and useful. Those of our readers who know the country will appreciate the advantages offered to dwellers in the wheat and forestry districts by its means.

Many families denied the everyday social intercourse that we in England are used to—by virtue of their calling taking them far from the cities and towns—are afforded the pleasures of a news service which otherwise would not be possible, and, further, the monotonous hours of darkness are relieved by musical programmes.



The studio at the "Calgary Herald" broadcasting station.

The method by which broadcasting is carried on in Canada is much the same as that obtaining in the United States, and a fair general understanding of the stations used may be gathered from the following description of that belonging to the *Calgary Herald*, call-sign CFAC.

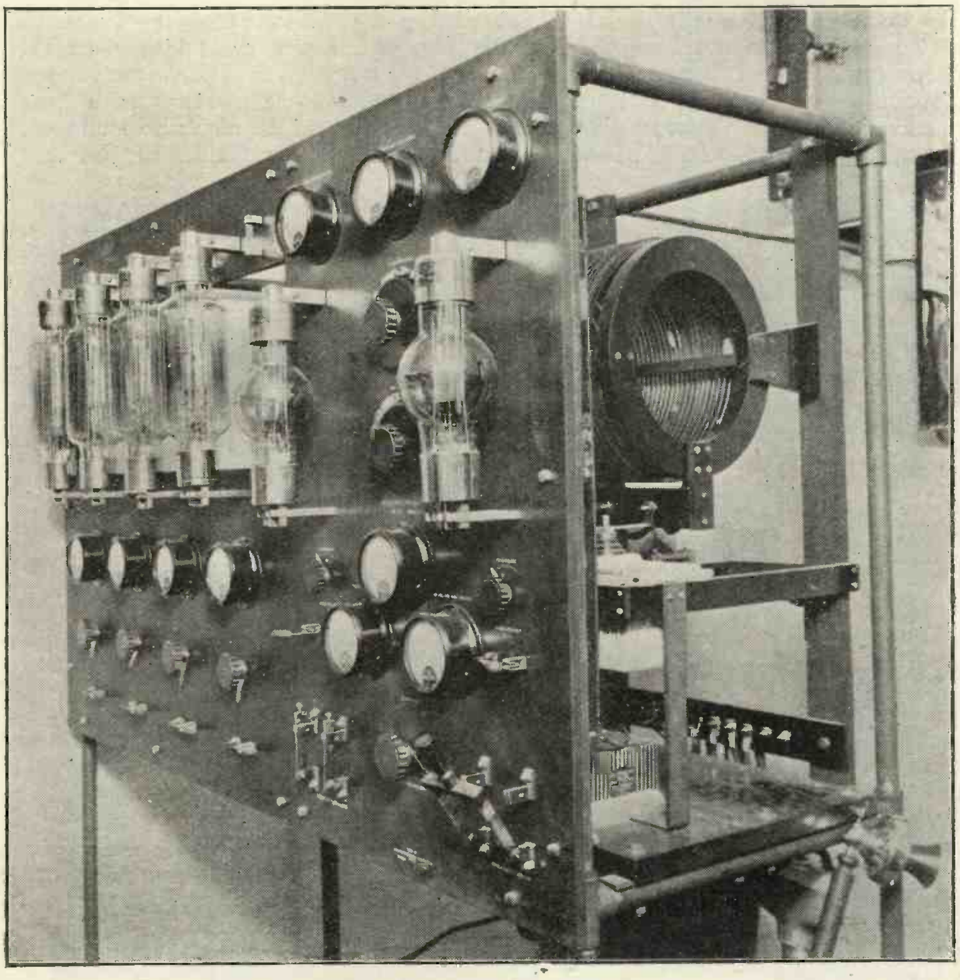
Situated on the top of the *Herald* building at Calgary, this station has been in regular operation since its installation on May 1st, 1922.

Its having been heard consistently through the West, Southern States, the Atlantic seaboard, Canada, Mexico, and Alaska.

In addition to the usual transmissions of concerts, news, weather reports, etc., lectures by prominent speakers are delivered every Wednesday and Saturday afternoons on various subjects. On Thursday evenings, before regular concert time, interesting addresses are given on abstract subjects. Every Saturday evening, commencing at 7.15, this station broadcasts, for the benefit of the youthful listeners-in, Old World Stories, the series now running being King Arthur and his Knights of the Round Table.

The Calgary Station employs one of the largest sets used in Canada, and has been heard as far away as Panama, a distance of 3,500 miles.

The set, neatly put together in panel fashion, is rated as a 2,000-watt machine; it consists of four 500-watt oscillators and two 250-watt modulators, and works on 430 metres wavelength. The plate current is supplied at 2,000 volts pressure, and the filaments are lighted by a 20-volt generator. The motor generator set is composed of a 2,000-watt 2,000-volt D.C. generator on the one end of a 5 h.p. motor and a 1,000-watt D.C. generator on the other end.



The two kw. broadcasting set. The four 500 watt oscillators may be seen on the left and the two 250 watt modulators on the right.

The manufacturers of this 2-kilowatt broadcasting set are the Canadian Independent Telephone Company of Toronto.

In order to keep interference from local noises as low as circumstances will allow, the motor generator set is situated in a different part of the building to that occupied by the general apparatus, and is controlled from the instrument room.

In addition to the transmitting plant the station is also furnished with a multi-valve receiving set coupled to a power-amplifier and large Magnavox loud-speaker.

The aerial is slung between two steel masts 75ft. in height, erected on the top of the *Herald* building, which is itself some 175ft. high.

Situated directly between the masts on the top of the building

Continued on p. 92.

Apart from being the first of its kind in Western Canada, it has the credit of holding the second place in the whole of the Dominion for broadcasting a full programme from a theatre, and third place for a full church service.

The efficiency of the apparatus and its ability to cover a wide range is indicated by reports of

THE CONSTRUCTION OF A 5-VALVE AMPLIFIER

By ALAN L. M. DOUGLAS, Staff Editor.

(Concluded from Vol. 2, No. 1, page 30.)

DETAILS for the assembly of suitable condensers have appeared from time to time in *Modern Wireless* and *Wireless Weekly*, and the reader's attention is particularly drawn to the article in *Modern Wireless*, No. 4, dealing with the assembly of variable condensers from bought parts. The essential points are rigidity

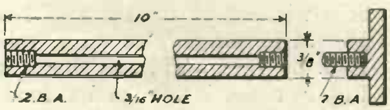


Fig. 9.—Details of the extension handles.

and evenness of spacing. For this purpose the vanes should be carefully examined in order that no irregularities may be present at the edges. This is a fruitful source of trouble in amateur-assembled condensers.

The method by means of which the spindle is extended so as to enable remote control to be effected will be clear from Figs. 9 and 10, which show the details of the extension handles. These might be of any pattern desired, but the particular type described in this article can hardly be bettered.

It should be noted at this point that to enable delicate control of the very high frequencies involved at short wavelengths, the size of these condensers should be kept as small as is consistent with the necessary tuning range. Finer adjustment and sharper amplification is thereby possible, although for long waves, *i.e.*, over 10,000 metres, the capacity of this condenser might be increased to 0.0005 μF or even more.

It should be noted that, although the connections of the high-frequency transformers themselves have been indicated in Fig. 8, the arrangement of the pins can be readily adjusted so that the fittings may be made to agree with the scheme of connections in any transformer already in the reader's possession. A careful note should be made of the exact location of the windings, so that various types of transformer, resistance, and reactance capacity coupling may be employed. A method of coupling which might appeal to the experimenter for certain purposes is one in which valves themselves are used as adjustable anode resistances.

The reader is advised to purchase ready-made low-frequency intervalve transformers, but the following specification of an excellent transformer may prove of value to those who wish to construct their own. It might be said at this point that the results obtainable from the following transformer are quite comparable with any instrument now on the market :—

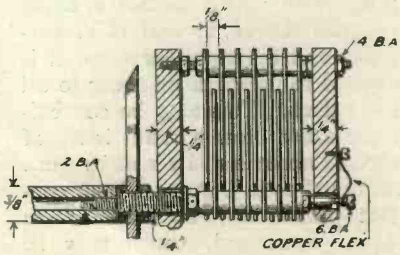


Fig. 10.—Fitting of the extension handles.

attach them that an opposing effect is produced by current flowing through their windings. 2B.A. screwed brass rod is very handy for the actual fitting to the panel of any of the more weighty parts of the apparatus, and as the ebonite is ¼in. thick this may be drilled and tapped in such a manner as to allow a secure hold to be effected.

It will be as well for the reader to purchase the leaks and condensers already made up, and for the complete instrument the necessary leaks are detailed in the first

Core.	Primary Winding.	Secondary Winding.	D.C. Resistance.	Inductance Value.	Gauge of Wire.	Quantity of Wire Required.
26 s.w.g. soft iron stampings, cross-section ½" × ½", each lamination insulated from its neighbour.	4,500 turns.	11,000 turns.	Primary 1,100 ohms. Secondary 3,600 ohms.	Primary 8 henries. Secondary 50 henries.	44 S.S.C.	Primary ½ oz. Secondary 1½ ozs.

The method of mounting these transformers will be clear from an examination of the photograph, Fig. 2, showing the rear of the instrument, and it is as well to so part of this article. Constancy in operation is essential when using devices of this nature, and whilst it is a comparatively easy matter to make grid condensers which will remain reliable, the question of home-made leaks is always rather a dubious one. Small condensers may be made if desired from strips of tinfoil ½in. in width and having an effective overlap of 1in., separated by mica having a thickness of about 0.006in. Two foils of these dimensions per condenser will give a capacity of about 0.0003 μF.

The final item is the four-pin plug, with which contact is made between the H.T. and L.T. batteries and the amplifier when it is desired to use common feeds to all the valves. This may be conveniently made from a small block of ebonite about 2in. by 1in. by ½in., arranged as in Fig. 11. Four contact points may be made from ⅛in. brass rod, which may be tapped for a small screw as shown in the diagram. The ends of these contact pins, which fit into the socket member, might be rounded off with a file so as to ensure an easy entry, and if desired small rings may be turned round them at the points where the silver rivets bear upon them when the plug is pushed home, in order that a spring contact may be effected

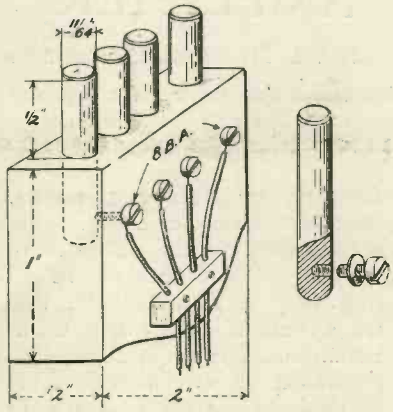


Fig. 11.—Details of the 4-pin plug.

thereby. The arrangement of the pins is such that the plug cannot be inserted the wrong way, and this makes speedy attachment and detachment of the leads possible.

The construction and assembly of such an amplifier as is here described will provide much useful information for the keen experimenter, and whilst single-valve reception might be indulged in if desired, it affords interesting opportunities of testing out various methods of high-frequency amplification and noting the results obtained. The actual instrument described in this article has received broadcasting from a station 400 miles away on a loud-speaker, using only a small indoor aerial consisting of a single wire 12ft. long. An earth connection was of course used.

It should be noted that the size of the reaction coil is just sufficient to produce reaction effects in the oscillatory circuit of the second valve, and should consist of a winding of 120 turns of No. 38 s.w.g. s.s.c. wire on a tube 1½in. by 1½in. This, as shown in Fig. 4, slides inside the first tuned anode coil to effect coupling.

FORTHCOMING EVENTS

JULY.

25th (Wed.).—General Meeting, Radio Society of Great Britain, at 6.0 p.m., at the Institution of Electrical Engineers. A paper contributed by Mr. Lionel J. Hughes and entitled "Resistance-Capacity Coupled Amplifiers" will be read by Mr. Philip R. Coursey. This will be followed by a short lecture by M. Marrec, of Paris, who will demonstrate reception on a frame aerial of American signals and explain his new arrangement for eliminating atmospherics and other interference.

Wolverhampton and District Wireless Society. Visit to the Wolverhampton Corporation Generating Station.

26th (Thurs.).—Cardiff and South Wales Wireless Society. Mr. E. Ogden will conduct experimental work.

Hackney and District Radio Society. Mr. Bell will lecture on the "Flewelling Circuit."

Finchley and District Wireless Society. Mr. Puckle will lecture on "Wireless Receivers" at the last meeting of the session.

Lewisham and Catford Radio Society. Mr. H. M. Stanley will lecture at 136, Bromley Road, Catford, S.E.6, on "How Ether Waves may be Detected."

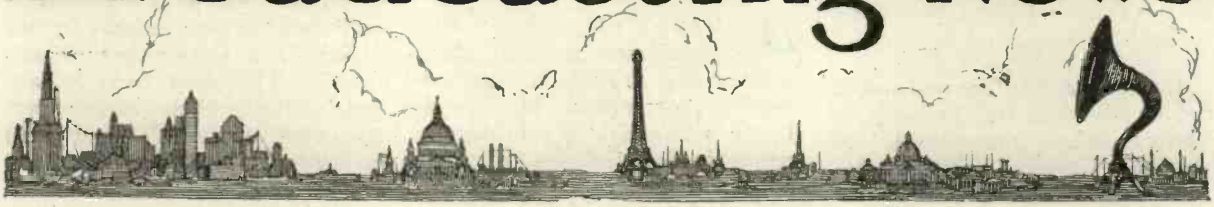
Liverpool Wireless Society. At 7.30 p.m. Messrs. S. G. Brown, Ltd., will give a "Demonstration of a New Type of Loud-speaker" at the Liverpool Royal Institution, Colquitt Street, Liverpool. Non-members should write for invitation cards and persons interested in wireless are invited to become members.

27th (Fri.).—Radio Society of Highgate. At 7.45 p.m., Mr. F. L. Hogg will lecture at the 1919 Club, South Grove, Highgate.

Brockley and District Branch of the Radio Association. Mr. G. A. Saunders will give a lecture at 8 p.m., entitled "A few considerations of Ether, Electrics and Material Phenomena" at the Headquarters, Gladstone Hall, New Cross Road.

30th (Mon.).—Hornsey and District Wireless Society. Auction of members' surplus apparatus.

Broadcasting News



By OUR SPECIAL CORRESPONDENTS

LONDON.—When Mr. Lowther was Speaker of the House of Commons he was continually being bothered by pressmen and others as to when he was going to resign. He had one unvarying good-humoured answer: "Every day brings my resignation nearer."

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That is about the utmost one can say about the House of Commons Enquiry Committee's Report. Every day brings its publication nearer. Indeed, by the time this appears it should be public property, and then we shall know where we are.

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There have been several changes in the personnel of the B.B.C. staff of late which should make for even greater efficiency. Mr. Reith, the General Manager, is to have the assistance of an efficient Deputy General Manager in the person of Mr. Carpendale, C.B. The engineering staff has also been strengthened, and the director of each station has two assistant directors to support him. These increases of staff have been made necessary by the overwhelming pressure of work in every department of the B.B.C. They have also been made with a view to assuming additional responsibilities which will be thrust upon the B.B.C. when the long days are over.

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The wireless man-hunt was amusing, and a considerable number seem to have taken part in the chase. It was perhaps not a fair test from the point of view of the possibilities of broadcasting in the detection of crime, as the various uncles who were acting the part of the criminals were rather too light-hearted about it, and took risks which no man escaping from justice could dream of taking.

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It was astonishing how quickly they were recognised, however, and there is no doubt that if the services of broadcasting were scientifically utilised, they would form a valuable adjunct to the existing resources at the command of the police.

BROADCAST TRANSMISSIONS

	Call-Sign	Wavelength
CARDIFF	5WA	353 metres
*LONDON	2LO	363 "
MANCHESTER	2ZY	385 "
NEWCASTLE	5NO	400 "
GLASGOW	5SC	415 "
BIRMINGHAM	5IT	420 "

TIMES OF WORKING.

Weekdays ....3.30 to 4.30 p.m. and 5.30 to 11.0 p.m. B.S.T.

*London 11.30 a.m. to 12.30 instead of 3.30 to 4.30 p.m.

Sundays....8.30 to 10.30 p.m. B.S.T. 2LO 3.0 p.m. to 5.0 p.m. also.

SILENT PERIODS.

CARDIFF	8.0 to	8.30
LONDON	7.30 "	6.0
MANCHESTER	7.45 "	8.15
NEWCASTLE	9.0 "	9.30
GLASGOW	6.0 "	8.15
BIRMINGHAM	8.15 "	8.45

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The Sunday afternoon concert (July 15th) was far and away the best yet transmitted by the B.B.C. from London. Whether it was due to the acoustics of the Æolian Hall, or system of transmission, the writer cannot say, but one thing which struck him very forcibly was the excellent quality of song and music.

The rendering of the Wagnerian music on the organ (all the stops and effects came in equally good) transported one for the nonce to a large, spacious, cool hall, where one sat and heard without distortion or suppression the masterly rendering of that great composer. The singing, too, came through, liquid, flowing, and mellow, whilst both the violin and 'cello solos have never been heard to equal advantage on the wireless wave hitherto.

The piano seemed just a little metallic on several notes, and it seemed that the announcer might have spoken just a little more softly and thus avoid any semblance of an echo.

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A desire has been expressed by many experimenters that each station should close down completely for one evening weekly. The particular night might be varied from week to week, and be so arranged that only one station should be closed on any one evening. Not only would this give those living close in an opportunity of going for more distant stations, but it would prove a great relief to the greatly overworked station authorities.

Forthcoming Events

JULY.

25th (WED.).—"Seen on the Screen," by W. G. Atkinson. J. Grant Ramsay on "What to Wear."

26th (THURS.).—Sir R. Baden-Powell. Percy Scholes: Musical Criticism. Mr. C. Tate Regan on Zoology.

27th (FRI.).—W. A. Haddon: Dramatic Criticism. Ronald Baynall, Entertainer. Captain Ainslie: Astronomy.

28th (SAT.).—Mr. Philip Snowden, M.P.: "No More Wars."
30th (MON.).—W. A. Croxton Smith: "Dogs."
31st (TUES.).—Royal Air Force Band.

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ABERDEEN.—The new station for Aberdeen will probably be opened about the middle of August. Captain Eckersley has been to the granite city of the North, and has been successful in putting through the negotiations for sites very quickly. The new studio will be in Belmont Street. The Aberdeen station will not only serve the North of Scotland, but will be available for listeners-in on the East Coast, especially in Dundee.

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BELFAST.—Despite the hold-up in the establishment of a Northern Ireland broadcasting station, due to the delay in the Post Office and B.B.C. dispute, wireless continues to make great strides in Ulster. Almost nightly wireless concerts are featured entertainments in Belfast vicinity. As a matter of fact, at the reception given by the Lord Mayor in the City Hall, Belfast, to the Congress of the Gas Institution, dancing was enjoyed by 300 couples at one time to music broadcast from Glasgow.

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BIRMINGHAM.—The Birmingham station has taken another step towards an improvement in programmes. Mr. Joseph Lewis, a musician of considerable repute in the Midlands, has been appointed director of music, and will take up his duties shortly. Mr. Percy Edgar will, of course, remain in sole charge of the station, but Mr. Lewis will have a free hand in arranging the musical part of the programmes, and his intimate association with the musical world should be productive of some good programmes.

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One interesting suggestion which Mr. Lewis has put forward is the engagement of a permanent staff of artistes, who will perform at regular intervals, giving oratorios, selections from opera, etc.

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One of the programmes from 5IT recently was marred by the action of a Government department. The choir from a local girls' school, whose earlier performances from 5IT had been greatly enjoyed, had arranged for another visit.

At almost the last moment, however, it was announced that the Board of Education had forbidden the performance, in accordance with the Act governing the appearance of children in music halls!

A new portrait of Uncle Rex at 2LO.

CARDIFF.—The director of the Cardiff Broadcasting Station has received a letter from an official of the Royal Automobile Club at Aix-les-Bains stating that he is a regular listener-in to Cardiff. Another communication from Jersey says that the writer, with a six-valve set and a Brown's loud-speaker, derives the utmost pleasure from the programmes broadcast from the Welsh station.

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Complaints are made at Cardiff that a few owners of wireless receivers are making themselves a general nuisance every evening during the interval from nine to nine-thirty and after the close of the programme of the Cardiff Broadcasting Station by oscillating their valves and producing such interference that other experimenters are prevented from carrying out tests or picking up other stations. As the nuisance is said to be caused purposely, several owners are co-operating in an endeavour to locate the offenders with a view to presenting a complaint to the authorities in the hope that the licences may be withdrawn, the installations confiscated and the offenders punished.

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DUBLIN.—It would seem that the Free State is going to score over Northern Ireland in having its broadcasting station almost immediately. The *Irish Independent*, usually authoritative, stated the other day that the arrangements are now complete for submission to the Free State Parliament. The plan includes one broadcasting station near Dublin for the whole of the territory, *i.e.*, the 26 counties, and awaits the approval of the military authorities. Certainly it will be a mistake if the new station is erected far from the centre of Dublin, which is so convenient for well-known artists who visit the city, as well as for the Civic Guard and other bands.

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GLASGOW.—Glasgow wireless users have betaken themselves with their sets to the silvery sea or the Highland glen for the Fair Week. Hundreds have packed their wireless apparata and rigged these up at their holiday resort. Now, whether they be by lovely Glengarry or in the midst of the revels of Rothesay, Dunoon or St. Andrews, they are in touch with the Glasgow Broadcasting Station and an admirable programme of music.

By moor and loch, too, campers' tents have sprung up, and there are few without an aerial mast. Wireless is a tremendous boon to campers, for, though they may never see a newspaper from the beginning to the end of their holiday, the Glasgow station gives them all that they want to know in the news bulletin.

Forthcoming Events

JULY.

25th (WED.).—C. A. Malcolm, M.A., Ph.D., will give a short address.

26th (THURS.). — Miss Beatrice Eveline, 'cellist.

28th (SAT.).—Wm. McDonald, humorous items.

29th (SUN.).—Prof. James Moffat, D.D., D.Litt., will give a short address.

30th (MON.). — The Grenadier Guards' Band.

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MANCHESTER. — Mr. Dan Godfrey has been appointed Director of the Manchester Station. Mr. Godfrey is the son of Sir Dan Godfrey, and he has lived, moved, and had his being in musical circles all his life. When he was in Bonn with the Army of Occupation he conducted a series of three symphony concerts, which were greatly appreciated by friends and our erstwhile foes alike.

There is no doubt that Mr. Godfrey knows the job of entertaining the public perfectly, and he will have plenty of scope for his activities and abilities in Manchester. He will find his way quickly to the hearts of the Manchester listeners-in.

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Mr. Wright, who has borne the burden of the heat of the day at Manchester, and who is responsible for bringing the programmes to their present state of excellence, will receive an important appointment at 2LO, where he will have ample scope for his wide experience.

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All listeners-in, and music lovers especially, must have enjoyed the evening which was devoted to Mozart's compositions. The two outstanding features of the programme were the piano quartet and the duet for two pianos, the latter being an especially good transmission.

The heat wave brought in its train the inevitable adjunct for summer wireless, namely, atmospherics. In Manchester these never amounted to very much, although they rendered long-distance telephony almost impossible.

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A future feature of interest to farmers is the weather forecast, which will be read at 6 p.m. for their special benefit.

Forthcoming Events

JULY.

26th (THURS.).—Classical Night. A second modern Song Recital by Helena Taylor; Chamber Music for two clarinets and piano, by Patrick Ryan, of the Radio Orchestra, and his brother, recently returned from the United States; and 40 minutes' programme by Edward Isaacs, the famous Manchester pianist, and Florence Holding, another of 2ZY's best sopranos.

27th (FRI.).—Dance programme by the Shorrocks Syncopated Dance Orchestra, with "Keyboard Kitty" in her second appearance, which will be welcome after her last week's broadcast.

28th (SAT.).—The Radio Military Band will make a welcome return with a jolly popular evening's programme.

29th (SUN.).—A Mendelssohn orchestral evening, with Frank Taylor, that admirable broadcasting Manchester tenor, singing a number of Mendelssohnian excerpts.

30th (MON.).—At 7.30 Herbert Ellingford, the well-known organist to the Liverpool Corporation, will give a chat on "The Necessity for a Broader Outlook upon Music in Cathedrals and Churches." The public who clamoured for re-engagement of Jas. Worsley, the Lancashire dialect entertainer, will be gratified to know that he appears this evening in the general programme. Nell Davies will be the vocalist.

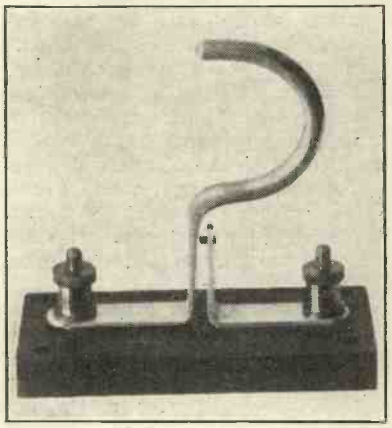
31st (TUES.).—Fredk. Garnett, whose caricatures are a feature of the English press, will give a talk on "Caricature"; and in the subsequent programme Mr. McCafferty, Irish baritone, who visited 2ZY some time ago, and Madge Taylor, the operatic soprano, will perform with the Radio Orchestra.

Apparatus we have tested

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

A Combined Lightning Arrester and 'Phone Hook

MOST of us have experienced at some time or other that guilty feeling when, waking up in the middle of the night to hear a thunderstorm approaching, we recollect that we have omitted to earth the aerial. Messrs. George Palmer (Universal Cinema Supplies), Ltd., have sent for trial a fitting



The safety 'phone hook.

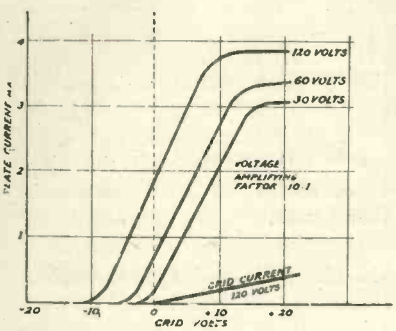
which will effectively prevent this anxiety, by making it impossible to forget the earthing of the aerial, in the form of a large aluminium hook mounted on an ebonite base fitted with two terminals, intended to be so connected that when the 'phones are hung on this hook, after the manner of the ordinary land-line 'phone, a contact is made that connects the aerial directly to earth.

The fitting is nicely finished, and has good insulation, as shown by test. We might suggest that the hook be made a little stronger.

The New Xtraudion Valve

The Economic Electric Co., Ltd., have placed on the market a new edition of their Xtraudion valve, a sample of which we have been able to test. The characteristic curves obtained for 30, 60, and 120 volts respectively show a long, straight portion, with sharp bends at both extremes, that at 30 volts bending very sharply at just about zero grid volts.

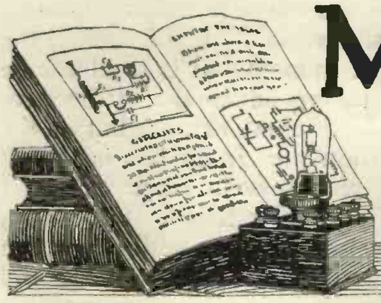
At 4 volts L.T. the filament current was a shade under ½ ampere, and no blue glow was observable at 150 volts on the plate, so that the valve belongs to the hard category. As a rectifier the new Xtraudion gave an excellent performance: best with a 2 megohm gridleak to the L.T. plus; or, alternatively, with a 4 megohm to the H.T. plus. With the former, local broadcasting was comfortably clear (at 13 miles) with no H.T. battery at all; every 4-volt cell of H.T. added gave some increase in signal-strength, up to 70 volts, the highest tried, though the increase was slower above 30 volts H.T. With 30 volts, no sort of reaction, a low-resistance variometer tuner, and middling good aerial, signals were very strong. As a low-frequency amplifier, the valve practically replaced an ordinary R in the first stage; in simple, simultaneous amplification circuits there was little to choose between a French R and this valve, though the R valve took a much larger current. On the ST100 it gave a fine roar with 2LO's dance music, audible at the end of a large suburban garden, the first (simultaneous action) valve having 80 volts on the plate, and an ordinary R valve as power-amplifier beyond. For high-frequency alone, or in more complex dual circuits, the smaller filament emission appeared to militate against it: we understand that the makers make no special claims for use in this manner. In the single-valve



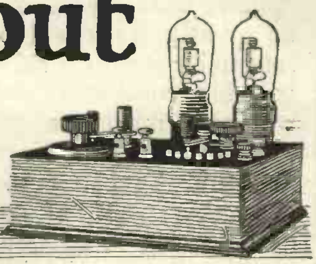
Xtraudion characteristic curve.

Armstrong it functioned quite well on moderate plate voltage; best, of course, on short waves.

With the voltage-amplification factor of about 10, and the moderate demands both in filament current and high-tension, it will prove a useful and economical general-purposes valve. It is too early to speak of the life of the filament in ordinary usage; we understand that the filament fitted is rather more sturdy than that in preceding patterns, and no trouble should be experienced on this score.



Mainly about Valves



Our weekly causerie written by the Editor.

L.T. and H.T. Switches

WHEN switching off a valve set many experimenters simply switch off the filament current without taking the high-tension plug out. I have always regarded this as an unwise proceeding. If the high-tension battery is left in the circuit, the chances are that it will gradually discharge itself across the leakage path, which, while making little difference when actual reception is going on, is sufficient to allow the passing of current from the high-tension battery. Even if this leakage passes through only a matter of one megohm resistance, it will not take long for a high-tension battery to become useless. It is, therefore, desirable to take the plug out of, say, the positive terminal of a high-tension battery when not receiving.

Reaction into Untuned Circuits

I do not believe in introducing reaction into an untuned or aperiodic circuit. Fig. 1 shows a receiver in which transformer coupling is used between the valves. Reaction is introduced from the anode circuit of the second valve to the grid circuit of that valve. In such a case, where neither transformer winding is tuned, it is quite likely that the application of reaction will weaken the signals. One of the principal effects of reaction is the reduction of the damping of the circuit, thereby making it very much more selective to the wavelength to which it is tuned. By coupling the anode coil to the grid coil, the selectivity of this grid circuit is greatly increased.

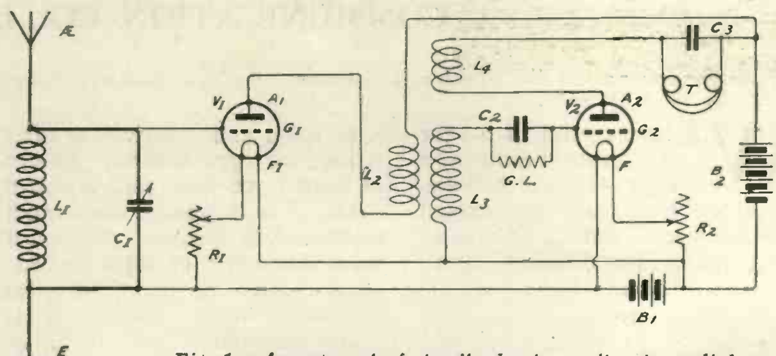


Fig. 1.—Arrangement of circuit wherein reaction is applied to the secondary of an untuned H.F. transformer.

Without the effect of reaction, the transformer coupling would serve for a comparatively wide range of wavelengths; for example, two or three of the Broadcasting Stations might be heard quite clearly. The windings are to a certain extent aperiodic, but this is not altogether true; the coil in the grid circuit of the second valve has some capacity, and there is also the grid-filament capacity in parallel with the grid coil. The grid circuit, therefore, has a certain natural wavelength, which, we will assume, is 380 metres. The grid coil, however, is not very particular within limits as regards the wavelength of the signals to be received. If the waves were of a length of 380 metres, the grid circuit would be happiest, but it would be quite content to pass on high-frequency currents having different frequencies.

When, however, reaction is introduced from the anode circuit of the valve, the selectivity of the grid circuit is greatly increased, and it will no longer allow the currents to be passed on through it, other than those corresponding to a wavelength of 380 metres. The more reaction is introduced into this grid circuit the more stubborn does it become, and if, for example, the signals from 2LO (369 metres) were trying to come in, they would be greatly weakened owing to the greater selectivity of the grid circuit. If we had a variable condenser across the grid circuit, we could make the grid circuit particularly selective for 2LO, but in the example given it would be better to do without reaction altogether. If, of course, the transformer does happen to be wound to the right wavelength, the introduction of reaction may increase the signal strength, but, in any case, the transformer will not be suitable for covering a range of wavelengths.

Frame Aerials and Their Use

Very frequently the wonderful results that are obtained on a frame aerial with a special circuit are treated as something to be emulated. Personally, reading that circuits will give signals on a two-foot frame from all the broadcasting stations, leaves me cold. Who wants to use a frame, anyway? By the use of a frame and a particularly sensitive circuit, distortion in many cases is liable to result, and in any case, who wants to use a frame when he can use an effective indoor aerial or a standard outside aerial? If, of course, the object of using a frame aerial is to eliminate interference by taking advantage of directive effects, this is a different matter, but if the only commendation the circuit has is that it will give good results on a frame aerial, I fail to see any particular merit. Of course, there are cases where a frame aerial only can be used. Such cases are moving vehicles and where the police, or other moving persons, desire to keep in touch with headquarters. To get really good signals on a short indoor aerial, or on a standard P.M.G. aerial, should be the aim of designers of apparatus. To carry the argument *ad absurdum*, who would waste their energy in developing an apparatus which would receive signals on a two-inch frame aerial?

As for those circuits which *only* give good results on a frame aerial, they really benefit the average listener-in very little. In special cases, they may be extremely effective, but the average man desires circuits which will give loud and selective results on the aerial he uses, not the aerial which he might have to use under very special circumstances.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION CO., LTD.

WE have received from the above-named company a copy of their balance-sheet and profit and loss account for the year ending December 31st, 1922. The directors' report reads as follows:—

The gross revenue for the year amounted to £1,103,970 15s. 5d., as compared with £1,084,460 6s. 8d. for the preceding year.

The net profit for the year amounts to £171,848 4s. 2d.

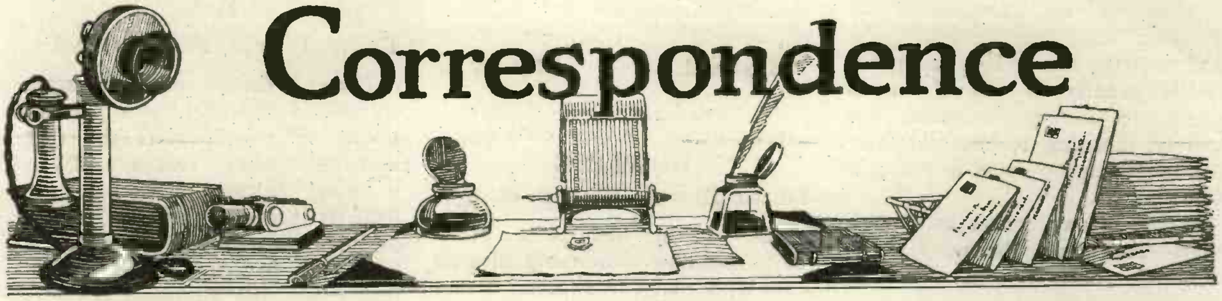
This is an increase as compared with 1921, and is arrived at after writing off approximately £8,000 in respect of bad and doubtful debts. The increase is due in part to additional business consequent upon the return of ships to commission after the period of great depression in the shipping trade which necessitated the laying up of a large number of ships in 1921, and also to economies which have been effected throughout the organisation in the methods of working and control.

Your directors recommend the payment of a final dividend at the rate of 7½ per cent., which, together with the interim dividend declared in December last, will make a total of 12½ per cent.

During the year under review 63 debentures of a par value of £1,260 were redeemed.

The directors retiring by rotation are Senatore G. Marconi, Mr. Alfanso Marconi, and Captain H. Riall Sankey, who, being eligible, offer themselves for re-election.

Correspondence



ST100

To the Editor, *Wireless Weekly*.

Sir,—Please permit me to express my appreciation of your two fine magazines, also the remarkable ST100 circuit. I have held an experimental licence since the close of the war, and during that time have tried out all the usual and unusual circuits, but the results I obtained with ST100 startled me. The nearest broadcasting station is Newcastle, perhaps sixty miles away, and I can truthfully say that ST100 gives 100 per cent. better results on the loud-speaker than the usual four-valve set (one H.F., rectifier, and two L.F.). I find the circuit easy to operate, stable, and the speech, etc., very pure. I find ordinary Galena—with a short length of graphite from a lead pencil as a contact—gives the best results.

In conlusion, I would strongly advise any beginner who desires maximum results at minimum cost to get busy and hook up this arrangement. I am, etc.,

Yorkshire. T. Hight.

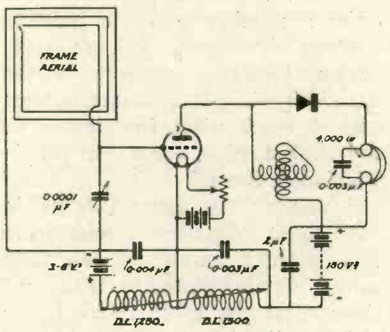
A LONG-DISTANCE SUPER-REGENERATIVE RECEIVER

To the Editor, *Wireless Weekly*.

Sir,—I have found a variation of the single-valve super-regenerative circuit which, though not suitable for handling extremely loud signals, gives remarkably good results with very weak signals and with any that are not strong enough to burn out the crystal employed.

With ordinary single-valve super-regenerative circuits, the valve has to perform three separate functions, *i.e.*, oscillate at the signal frequency, oscillate at the quenching frequency, and rectify as well. It would seem that when receiving weak signals better results are obtained if one can lighten the work of the valve, so to speak, by using other means to produce rectification.

The simplest way of doing this is shown in the accompanying diagram. It is to be noted that there is no coupling between the grid and anode circuits apart from the inherent electrostatic coupling existing between the grid and plate. The variometer is of a type that consists of coils supported by an aluminium cage; this cage is connected to the positive end of the high-tension battery,. thus entirely doing away with hand-capacity effects.



The circuit referred to by Mr. Beddington.

With a frame aerial 2ft. 1in. square, consisting of seventeen turns of wire space 1 cm. apart, a condenser with a maximum value of 0.0001 µF just covers the whole of the broadcasting band of wavelengths.

With the circuit and frame aerial described, using an R valve with 180 volts on the anode operating on the ground floor of a house in Bournemouth, the transmissions of L'Ecole Superieure des Postes et Telegraphes can be heard with the telephones laid on the table. Cardiff and London come in well, and with careful tuning Birmingham and Manchester can be received quite satisfactorily.

This circuit also seems to filter out to a considerable extent the annoying high-pitched whistle which is characteristic of super-regenerative circuits.

I am, etc.,

Guy C. Beddington.

A PIRATE REPLIES

To the Editor, *Wireless Weekly*.

Sir,—I notice in your issue No. 11 that a problem which has been puzzling the brains of every expert and others in the United Kingdom, viz., "Pirates, and how to exterminate them," has been solved by someone in the person of A. B. Brown, S.E.16.

It is a very big boast to claim having solved a problem which has baffled all others; but let us congratulate the worthy gentleman before we proceed further, at any rate I raised my hat as soon as I read the article.

Now as regards the exterminating of "Pirates."

I shamefully have to confess that I am one of them, and I have serious doubts as to whether "pirates" like the idea of being exterminated: answering for myself, I do not.

To exterminate a person (I suppose we are persons) is to finally dispose of him, and it is not considered just to lay aside persons in such a final manner. I think the expression should be modified.

Most of us have heard of Peeping Tom, and the penalty he had to pay, but it is a somewhat severe penalty to pay if one is going to be exterminated for merely listening to an entertainment (although we may be doing it for nix).

A. B. Brown writes as though every unlicensed listener-in is a criminal, and this is entirely ignorance on his part.

Does not A. B. Brown know that there are thousands of listeners-in who possess sets constructed by themselves, and that those listeners-in are unable to obtain licences; had he fully absorbed the press reports he would have realised the position better than he appears to now.

The majority of us so-called pirates who enjoy the broadcasting would be willing to pay the paltry sum necessary to purchase a licence were we able, but can this ultra-wise gentleman inform the pirates where licences can be obtained? I submit that the fault does not lie with the pirates.

Apparently A. B. Brown's grievance is that, having acquired a set bearing the stamp of the B.B.C., he begrudges the purchasing of his licence, and were he able, he would probably now be a pirate too; but why vent his spite on the innocent listener-in?

Possibly "A. B." is the possessor of an expensive valve set for which he was able to pay a fair sum, in which case let him think more sympathetically of those less fortunate people who owing to force of circumstances have to purchase sets a part at a time out of poor pay and rig them up when circumstances permit, and these enthusiasts are much more likely to appreciate the broadcasting than he.

As regards "A. B.'s" suggestion about showing licences every time one desires to purchase a twopenny insulator, etc., well, it is too silly to comment upon.

In conclusion please allow me to request "A. B." to concentrate his inventive energies in some other direction where they may be appreciated.

Every success to your valuable publication. I am, etc.,

Eynsford. PIRATE.

HOWLING

To THE EDITOR, *Wireless Weekly*.

SIR,—In the first place, allow me to say how thoroughly pleased I am with your two papers. I find them both descriptive in a very interesting and fascinating manner.

There has been some considerable attention devoted to "howlers" and "condenser swishers," and although this matter is becoming somewhat stale it is, nevertheless, a big item. I should, therefore, like to point out one or two facts to present, or would-be, "howlers."

I suppose there are some thousands of people who use the "tuned anode" method of reception, but I also suppose there are quite a number who use reaction without the anode coil, *i.e.*, reaction directly applied to the aerial circuit. It is so much easier and so much nicer for those who use it, but what about the people who don't use it?

I wonder how many listeners-in wish these "howlers" somewhere in a slightly warmer climate than ours? It is probably many of these listeners-in to "condenser swishers" who cause some of the trouble unconsciously.

Very often one can hear CW with a crystal set. Why? Not because a crystal set should receive CW on its own accord, but because it is being heterodyned by either a local oscillator or a neighbouring reactioner.

To those using single-valve sets, or multi-valve sets (not including tuned anode circuits), next time you are worried with those whistles, try separating your coils as far as possible. The effect is wonderful—to others, even if it does decrease signal strength slightly, do not be so selfish as to think of yourself only, think of your neighbours! I am, etc.,

C. L. SOLOMON.

Brondesbury, N.W.6.

2WS

To THE EDITOR, *Wireless Weekly*.

SIR,—I should be very much obliged if you could bring to the notice of your readers the fact that this Society's call-sign, 2WS, is being illegally used. I have recently received several reports on the transmissions from 2WS, but 2WS has not been transmitting at all, and somebody is therefore making use of the call-sign without authority. I should welcome reports from anybody hearing this call-sign, as we may thereby be able to find the locality of the offender. I am, etc.,

J. F. STANLEY.

The Radio Society of Highgate.
Highgate, N.6.

A DOMINION BROADCASTING STATION

(Continued from page 82.)

is the station in which the concerts radiated have their origin. The broadcasting studio is a room 21ft. long and 15ft. wide, and, in a manner similar to our own familiar stations, is especially constructed and furnished so as to reduce echo and reflection of sound to a minimum.

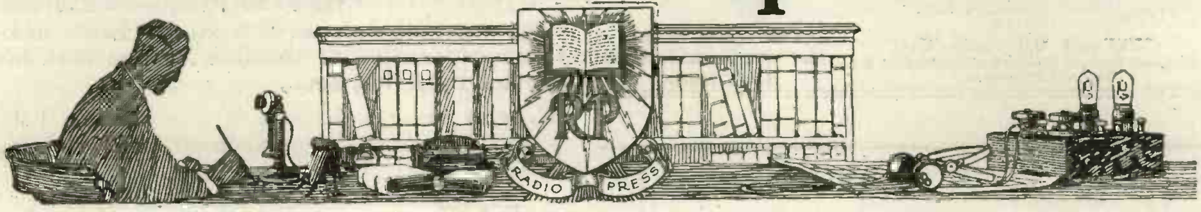
The walls and ceiling are completely covered with heavy green curtains, which may be drawn aside, disclosing doors and windows.

The floor is covered with thick rugs, thus making the room entirely free from echo, eliminating all undesirable noises and allowing a true reproduction of the performance.

The items of the transmissions are somewhat similar to those broadcast from the American stations, and, apart from the usual evening concerts, there are transmitted at noon of each day market and weather reports of particular interest to farmers.

S. G. R.

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.

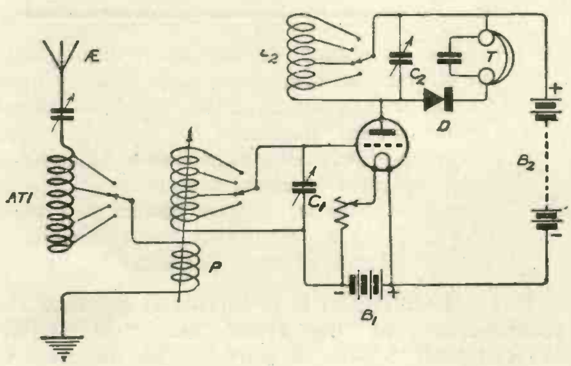
1. A Postal Order to the value of 1s. for each question must be enclosed, together with the Coupon from the current issue, and a stamped addressed envelope.

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

B. P. (NEWCASTLE) requests a circuit diagram of a set to comprise an inductively coupled tuner, high-frequency valve with tuned anode circuit and crystal detector.

The diagram herewith shows a very suitable arrangement. The aerial circuit comprises the aerial tuning inductance ATI, which may be either a tapped coil or a slider inductance, and the coupling coil P, which may be wound upon a wooden ball and pivoted inside the secondary coil. The closed oscillatory circuit comprises the inductance and

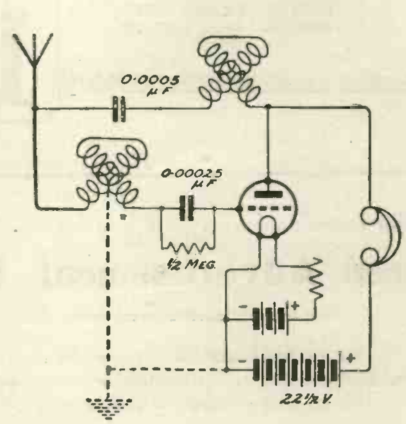


the variable condenser C_1, the opposite plate of the latter being connected to the grid and negative side of the filament of the valve. The tuned anode circuit comprises the tapped inductance L_2 and variable condenser C_2, the crystal detector and high resistance telephones being shunted across the condenser. B_1 is a filament lighting battery, 6 volts, and B_2 the high tension battery of 50 to 100 volts. The values of the inductances and variable condensers will, of course, depend upon the wave-length to be received, and particulars of suitable coils are given in previous issues.

D. A. (WORCESTER) requests particulars of suitable windings for a step-down telephone transformer.

The output windings, to be connected to the low resistance telephones, should consist of 1,000 turns of No. 30 s.w.g. d.s.c. copper wire wound upon a soft iron core ⅜in. in diameter. The primary or input winding should consist of about 12,000 turns of No. 40 s.w.g. d.s.c. wire. Full constructional details of a suitable transformer are given on page 33 of our last issue.

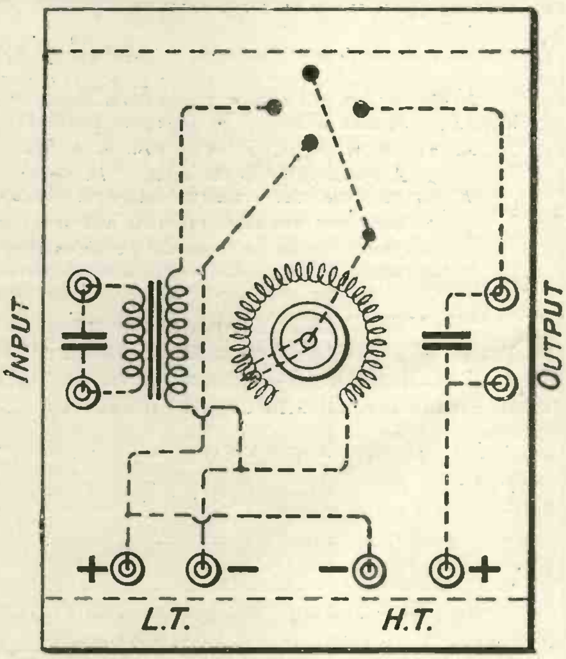
A. Y. (BIRMINGHAM) requests a diagram of a new circuit which he might test.



We give above a novel circuit for which good results are claimed in America. If an earth connection is used with the aerial it should be connected as indicated by the dotted lines. We suggest you try with the McClelland variometer, which should enable you to obtain good results on the broadcast band of wavelengths.

I. H. P. (MANCHESTER) requests a circuit diagram and details of a single valve low-frequency amplifier suitable for use with his crystal receiving set.

We give below a diagram of a serviceable L.F. amplifying panel, the components required being as follows :—



1 panel of ebonite or dry wood impregnated with paraffin wax, about 4½in. wide by 6½in. long, with cross piece at each end shown dotted in the diagram.
1 iron-core intervalve transformer, having a step-up ratio of about 1 to 4.
1 filament rheostat, 1 valve holder or 4 valve legs, 2 small fixed condensers, capacity 0·002 μF, and 8 brass terminals.

P. L. (LONDON, E.1) writes regarding the four-valve set described in "MODERN WIRELESS" Nos. 3 and 4. He desires to arrange the components in one cabinet.

Provided that care is taken to fit the variometers some distance apart and to avoid connecting wires running parallel and close together, a very servicable cabinet set could be made. In reply to a further question we fear you will not be able to entirely eliminate 2LO, only two miles distant. If you desire to experiment in this direction, make use of an inductively coupled tuner.

J. F. T. (CALLANDER) submits a diagram of a proposed valve-crystal circuit and enquires with regard to the use of a condenser in parallel with the anode coil.

The condenser is necessary in order to obtain accurate tuning of the anode circuit. Quite good results are obtained by the use of one of the tapped anode reactance coils now on the market, which, of course, are claimed to function without any condenser, although one of small capacity (say, 0.0001 μF) will probably be found an advantage. With a good aerial and careful operation of the set, you may receive 2LO, and should certainly get excellent results from 5SC.

G. H. T. (GOLDERS GREEN) enquires regarding the use of the microphone amplifier described in "WIRELESS WEEKLY."

We do not think your proposed arrangement will give satisfactory results, but a few experiments will determine this. Sac Leclanche cells may be used in conjunction with the microphone, but the amount of current required imposes rather a heavy load, and it may be necessary to employ two sets of batteries with a change-over switch, so that as one is exhausted the other can be brought into use.

M. T. S. (GLASTONBURY) asks one or two questions regarding crystal detectors. The nature of the questions will be gathered from the following reply.

The majority of crystals now on the market are very reliable. Many dealers supply crystals which have actually been tested. Instability is one of the unfortunate drawbacks to the use of almost all crystal detectors, but especially those of the "cat whisker" variety, and it is usually necessary to reset the detector prior to using the apparatus.

J. L. B. (GLASGOW) refers to the two-valve broadcast receiver described in "WIRELESS WEEKLY" No. 4, and enquires regarding the probable receiving range of the set when used with a really good aerial.

Many readers are obtaining excellent results with the apparatus in question. An experimenter at Shrewsbury informs us that he receives Birmingham, Manchester, and in the late evening London, Newcastle, and Glasgow. When trying to receive distant stations, the tuning adjustment must be very carefully carried out. We shall be pleased to learn of your success in due course.

A. E. M. (SIDCUP) proposes to employ a relay for recording purposes and enquires regarding the possibility of operating it from a crystal receiver.

You will not be able to operate any type of mechanical relay direct from a crystal, unless the transmitting station is very close to you indeed. The actual output from the crystal set is so small that it is a difficult matter to measure it. We would strongly advise you to couple a valve amplifier, such as the two-valve amplifier described in WIRELESS WEEKLY No. 3, to your crystal set and connect the relay to the output terminals of the amplifier.

BRIEF REPLIES

R. K. (PENZANCE).—We fear you will always experience some interference from the near-by Coast Station. Your receiver is not at all selective. Try an inductively coupled tuner and report results in due course.

A. H. H. (LEICESTER).—In the absence of a circuit diagram of your apparatus we are unable to assist you.

A. W. G. T. (——).—Your circuit appears quite correct, but results would probably be improved by the addition of a small fixed condenser (0.001 μF) across the telephones and a large one (up to 0.5 μF) across the H.T. battery.

H. H. (ROCHDALE).—We have no knowledge of the apparatus and advise you to write to the manufacturers.

E. F. A. (FOREST GATE).—Full details of the regulations regarding the issue of licences are given in "Wireless Licences and How to Obtain Them," Radio Press, Limited, price 1s.

J. W. F. (ILFORD).—It is scarcely economical to attempt to construct such large capacity condensers. Purchase one or two Mansbridge telephone condensers. These are obtainable from dealers in ex-Government apparatus.

W. T. M. (SOUTHAMPTON).—With a good aerial and careful adjustment of your apparatus you should be able to hear 2LO. We understand, however, that Southampton is considered somewhat of a blind spot.

D. P. (CORNWALL).—For the inductively coupled receiver, as described in *Modern Wireless* No. 3, you will require a little over 1 lb. of wire for the primary and about ¾ lb. for the secondary.

L. B. (WORTHING).—The condenser C_2, as fitted in the detector unit shown on page 126 of *Modern Wireless* No. 2, should have a capacity of 0.002 μF.

C. R. (DUNDEE).—An arrow drawn through a coil indicates that the inductance of the coil is variable. Drawn through two adjacent coils, it indicates that the coupling between the coils is variable, and drawn through a condenser that the capacity of the condenser is variable.

W. P. R. (WEST ACTON).—By all means try the arrangement, but, in general, the effective receiving range of a crystal set with an indoor aerial is about three or four miles. A great deal depends upon the situation of the indoor aerial, whether under the roof or on an intermediate floor.

M. W. F. (PADIHAM).—Although a crystal detector may be connected directly to the grid of a low-frequency amplifying valve, considerable improvement is effected by the introduction of a step-up iron core transformer.

M. D. M. (CRICKLEWOOD).—The connections of the L.F. transformer are important. Try the effect of reversing them. Reflex circuits have very strange characteristics, and it is important to well insulate and carefully space the various components.

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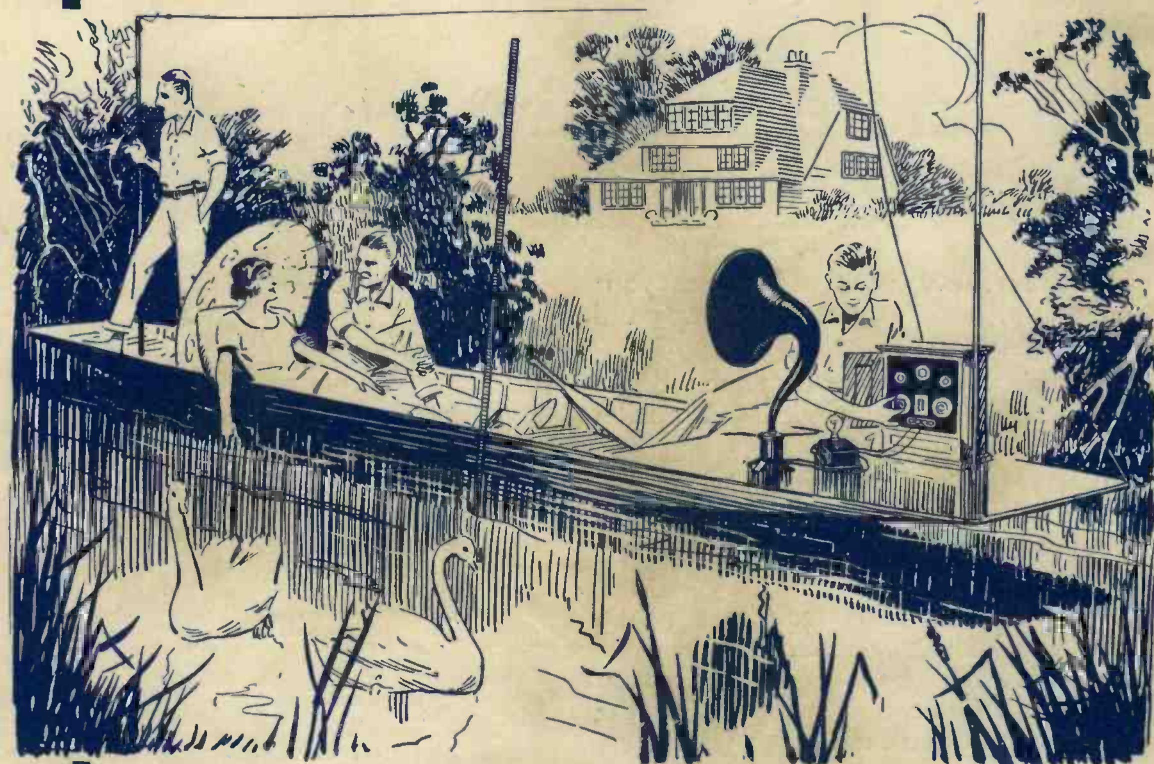

Write for Publication No. 361, "Radio in Summertime."

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