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Wireless Weekly

and The Wireless Constructor

No. 13

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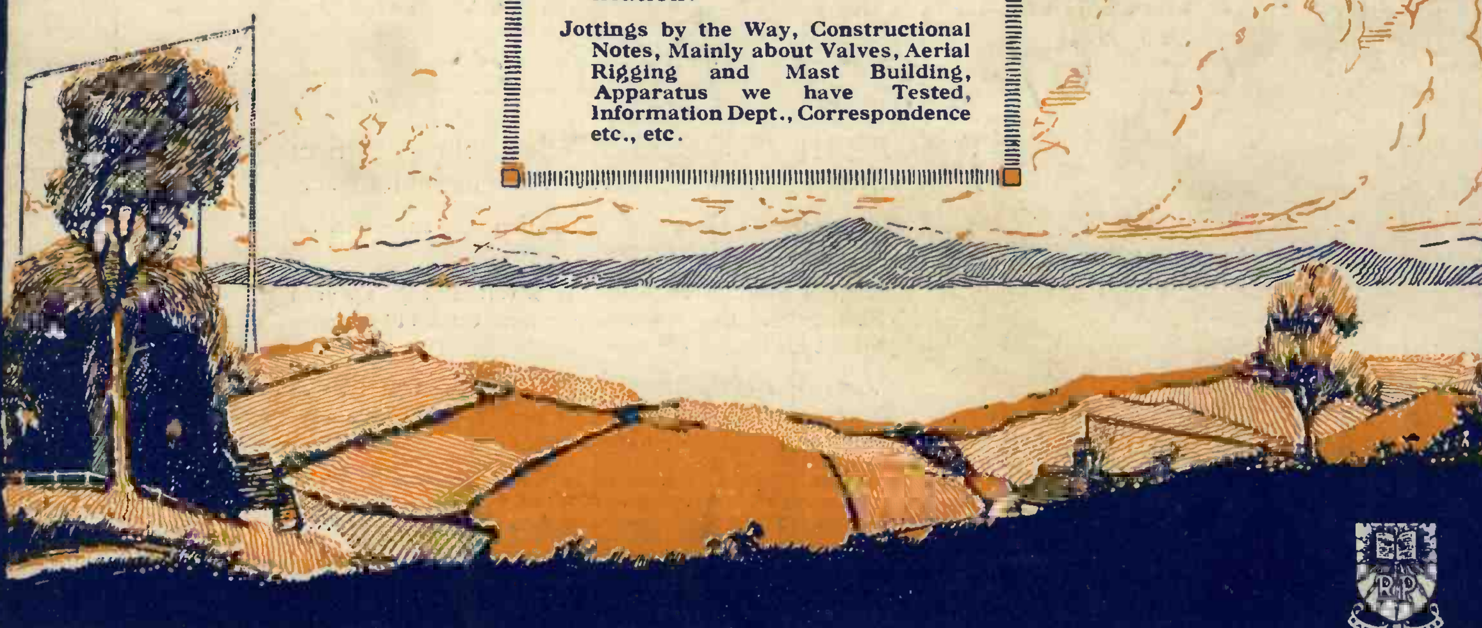

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MODERN WIRELESS

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Wireless Weekly

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July 4, 1923

CONTENTS

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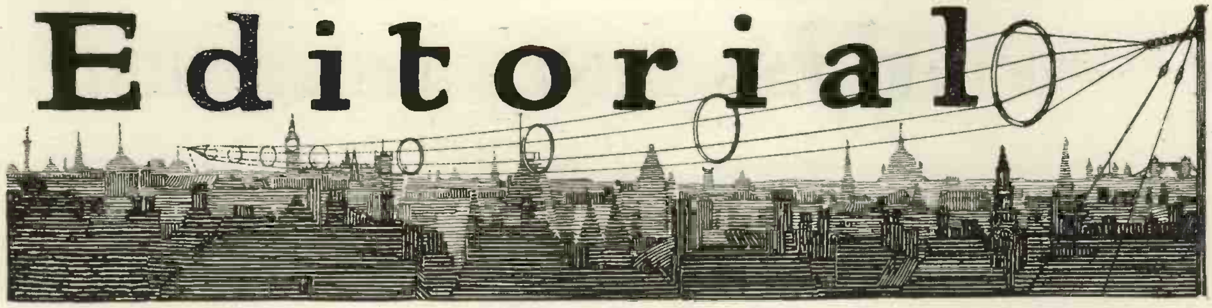


The Possibilities of Summer Radio

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.

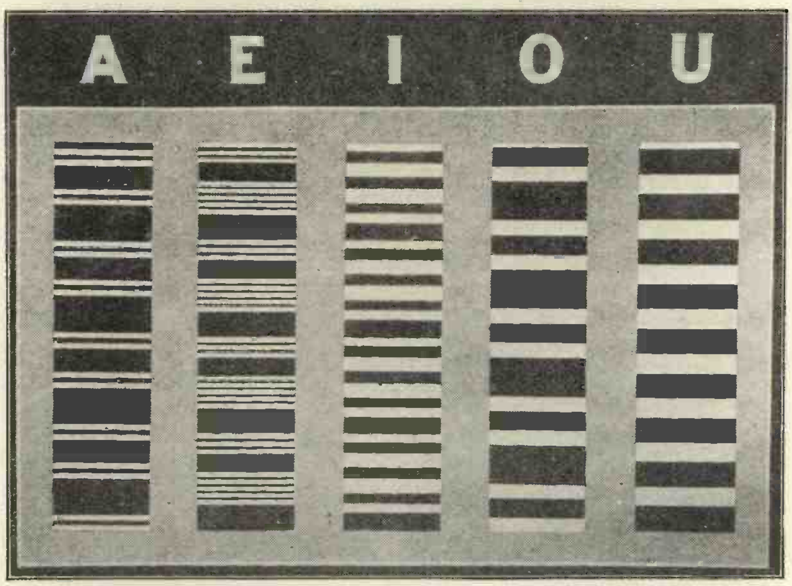
Now the light in the Photion tube is generated by the electric current which is passing through the gas enclosed therein. The intensity of the light depends on the intensity of the electric current. Therefore, if a powerful telephonic current is passed through the Photion, light emitted varies exactly 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.



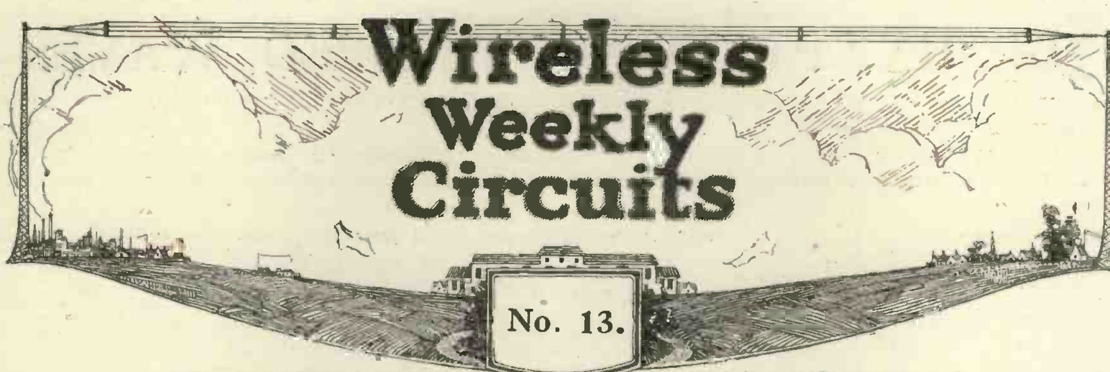
A micro-photo of portions of a speech record of vowel sounds.

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.

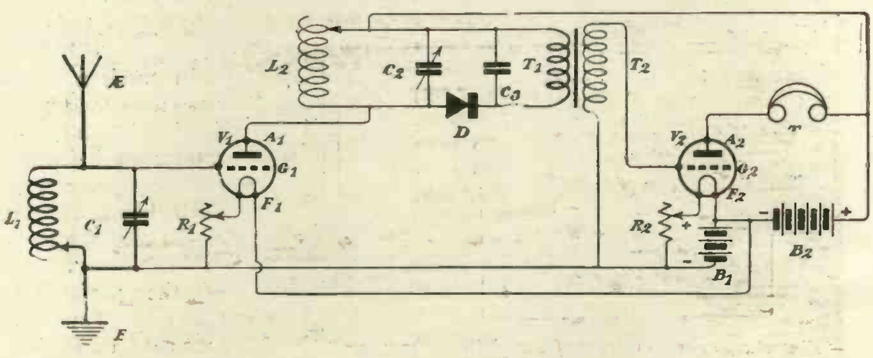
Connected to this photo-electric cell is a small battery for supplying current, which is controlled by the light falling upon the cell, and thereby made to exactly reproduce the original telephonic current from the transmitter when the sound picture was first recorded. This new telephonic current, however, 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.

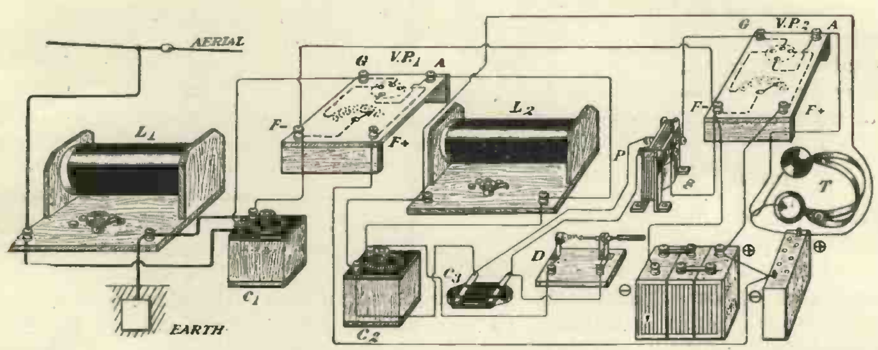
In this circuit the first valve acts as a high-frequency amplifier, the magnified oscillations being detected by the crystal detector D and the low-frequency currents then amplified by the second valve. It is important to tune the circuit L_2 C_2 to the same wavelength as the incoming signals.

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.

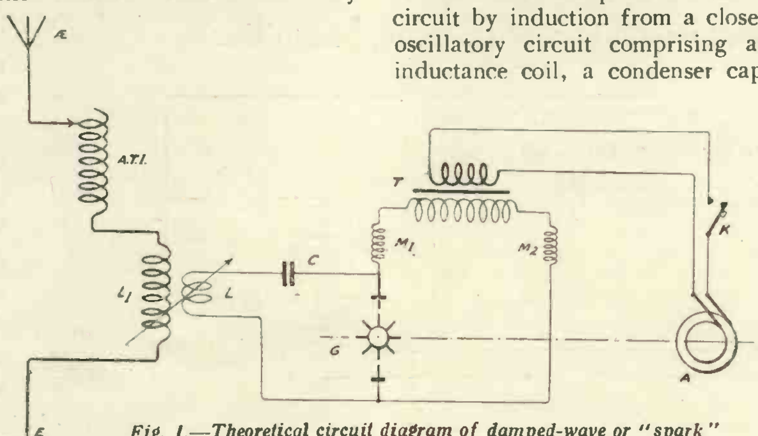


Fig. 1.—Theoretical circuit diagram of damped-wave or "spark" transmitter.

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

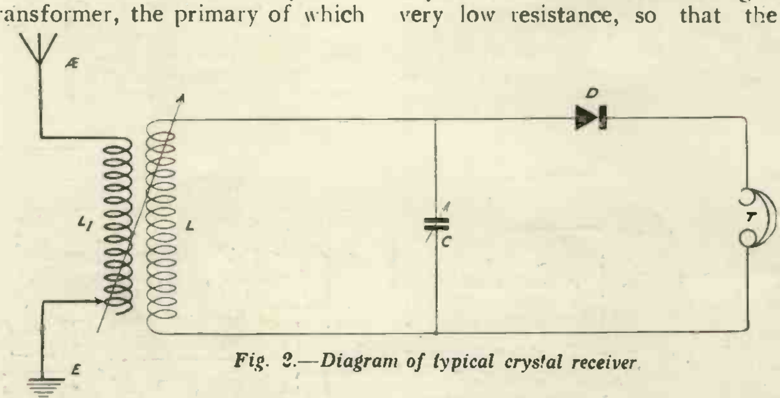


Fig. 2.—Diagram of typical crystal receiver

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.

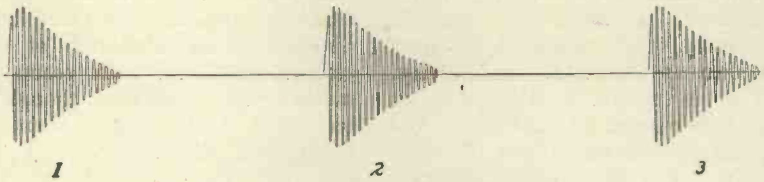


Fig. 3.—Groups of damped oscillations.

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.

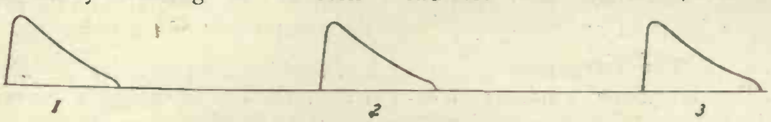


Fig. 5.—The resultant telephone currents.

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."

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.

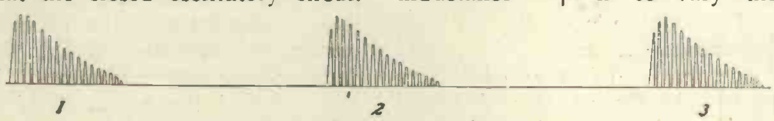


Fig. 4.—The same groups after rectification.

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 electromagnetic 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

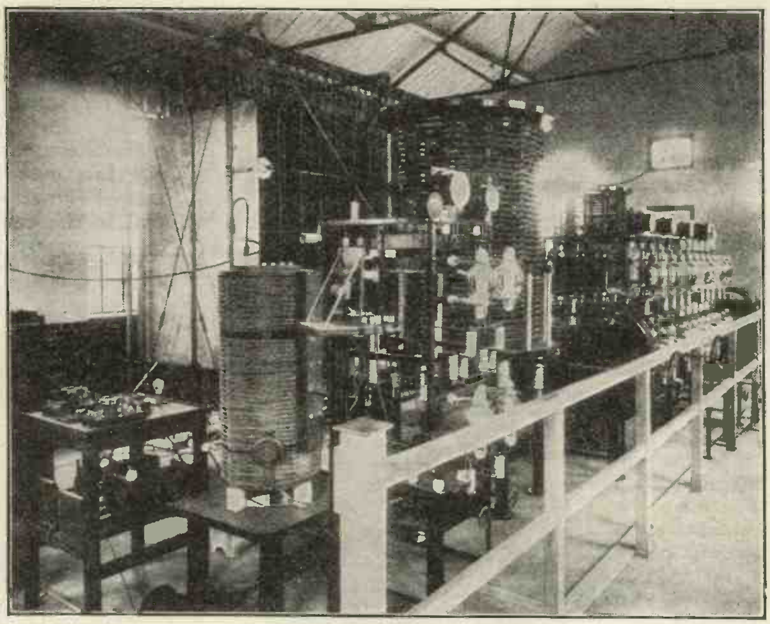
An interesting description of the Marconi high-speed commercial station at Ongar and the central control organisation at Radio House.

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.

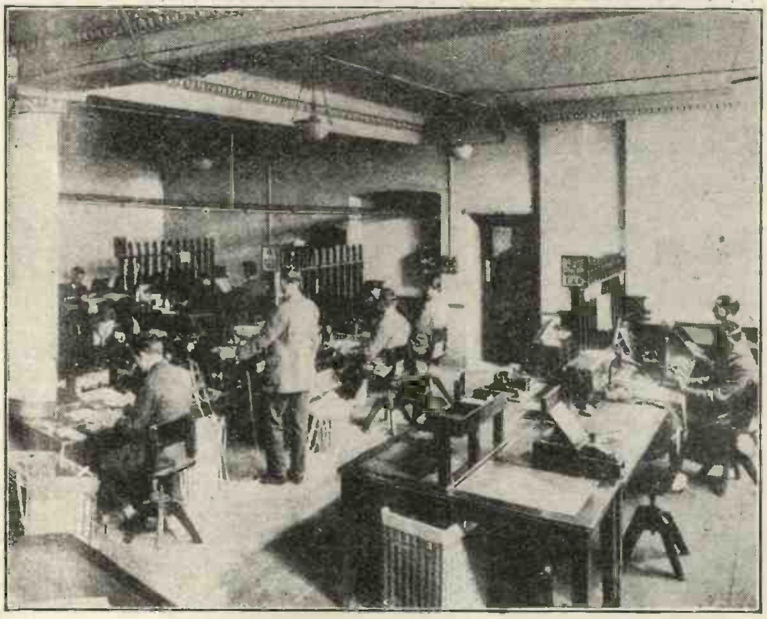
Radio House is the nerve centre of the Marconi high-speed commercial services.

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.

Many of the delivery envelopes bear addresses already printed, and means are provided for locating any envelope instantly, and without



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.

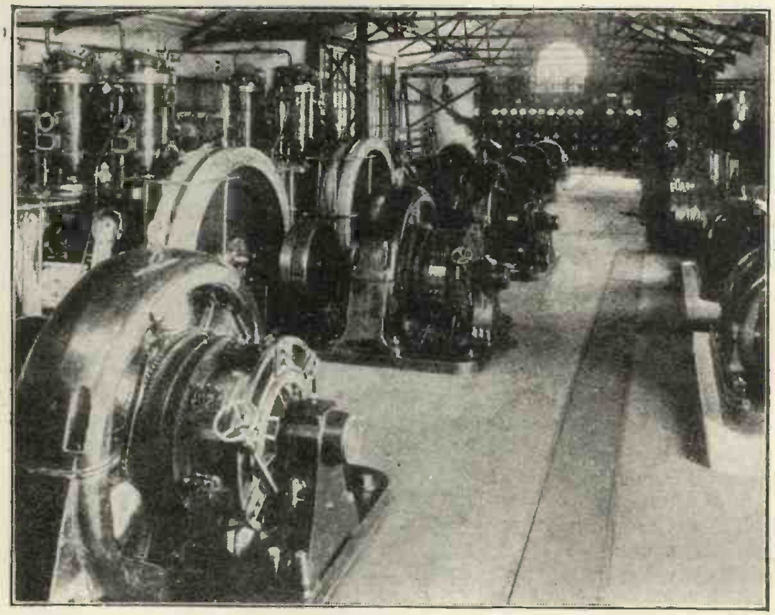
The message is then sent to the telephone room, or one of the private wire circuits, for immediate transmission to the addressee, or to the messenger department for delivery by hand. Before passing to the messenger department the message is conveyed automatically to the "unpacking" room, where, by means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

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.

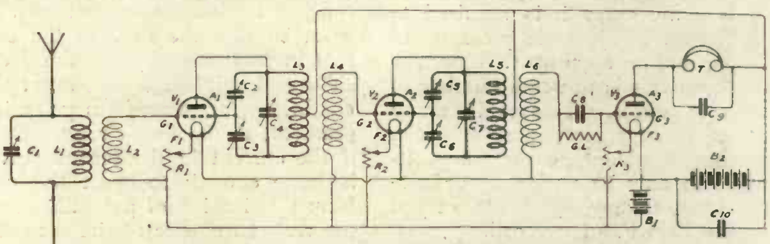


Fig. 10.—The bridge method applied to two H.F. valves with a third, acting as a detector.

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.

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.

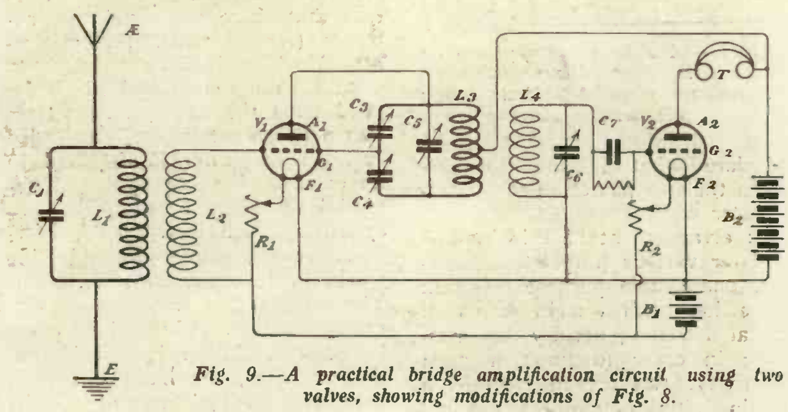
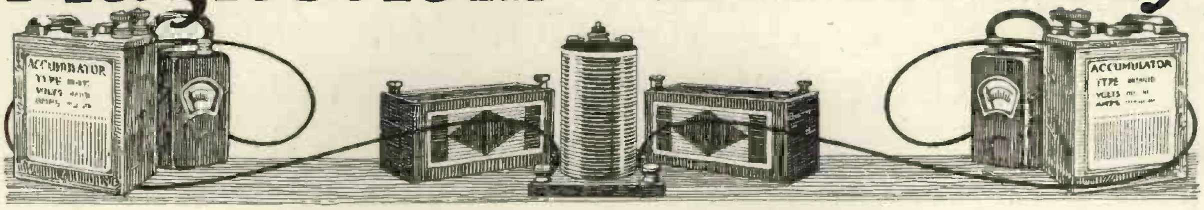


Fig. 9.—A practical bridge amplification circuit using two valves, showing modifications of Fig. 8.

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 potent al 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.

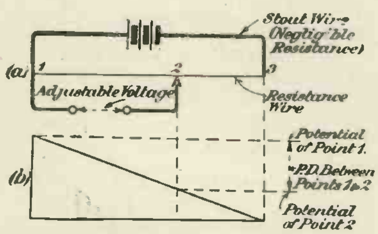


Fig. 1.—(A) Arrangement of potentiometer. (B) Graphical representation of uniform potential-gradient along potentiometer wire.

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

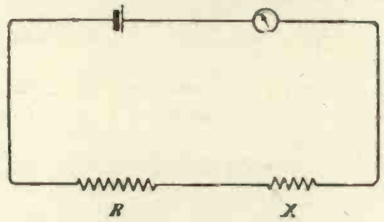


Fig. 2.—Rough method of measuring a resistance.

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

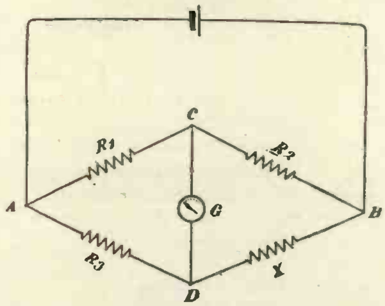


Fig. 3.—Wheatstone's bridge for accurate determination of resistance.

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 3½ 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 "½-watt" lamps. This means that they consume ½ a watt of power per candle-power of light emitted. A ½-watt lamp of 100 c.p. will thus consume 50 watts, and if it is operated on a 200-volt circuit, it will draw ¼ 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 ½ 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 = 1⅓ 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. "½-watt" lamp on a 250-volt circuit?

500 c.p. ½-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 "½-watt" usually consumes rather more than ½-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 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.

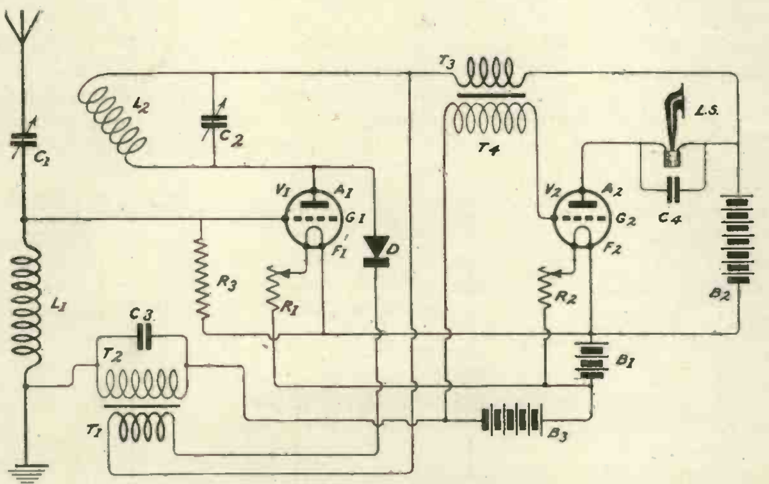


Fig. 1.—The original ST100 circuit with grid cells added at B_3.

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

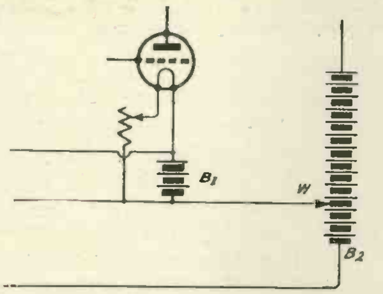


Fig. 2.—Method showing how the H.T. battery may be used for providing negative potential to the grid.

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 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

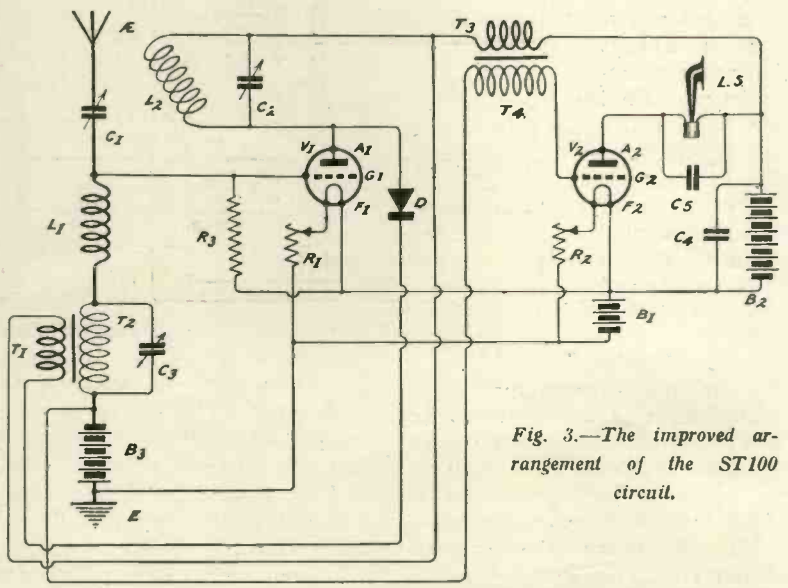
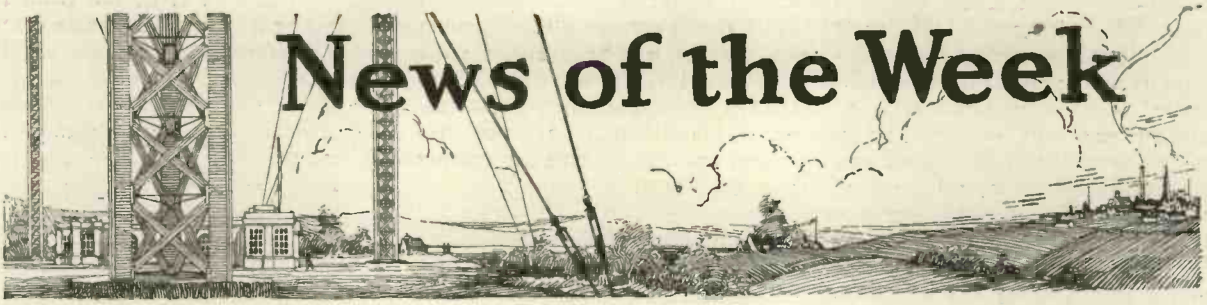


Fig. 3.—The improved arrangement of the ST100 circuit.

(*Continued on page* 772.)



News of the Week

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.

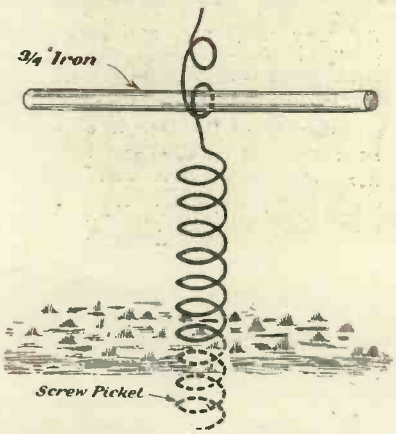


Fig. 11.—Showing the method of using a screw picket

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.

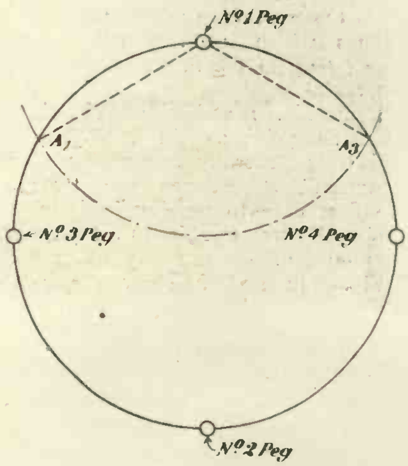


Fig. 12.—Ground plan of the pegs.

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.

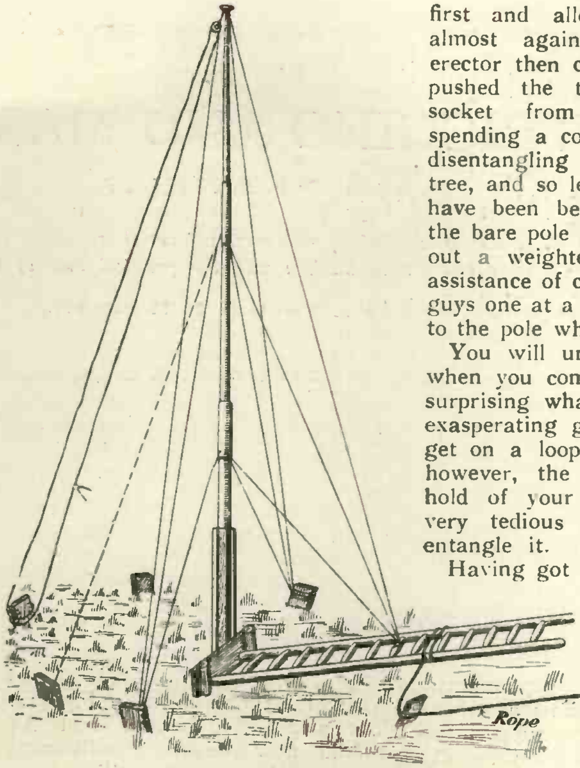


Fig. 13.—Raising the mast.

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

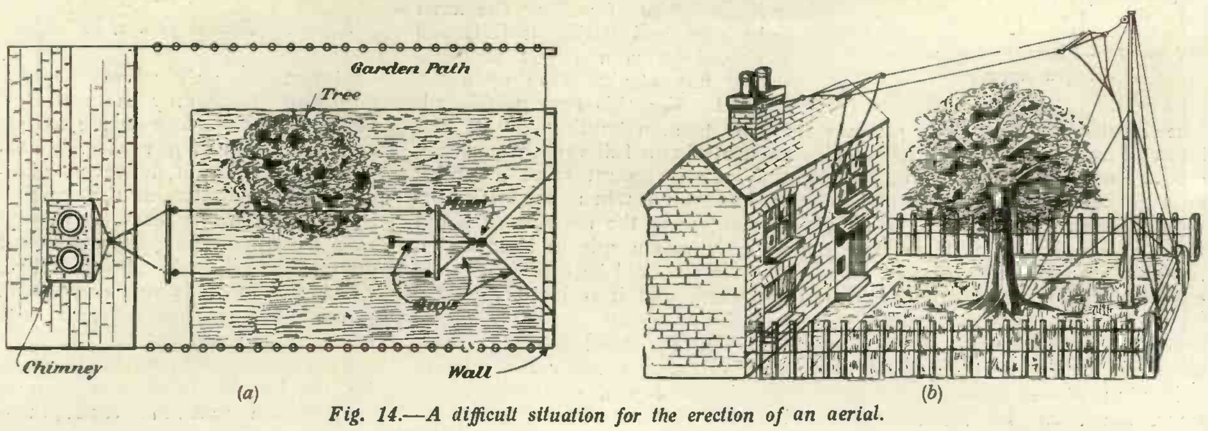


Fig. 14.—A difficult situation for the erection of an aerial.

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

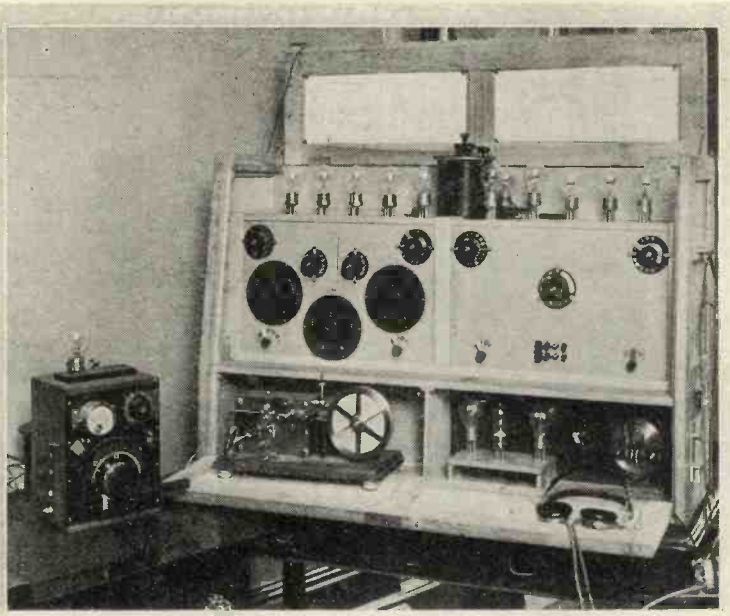
Particulars of a new and interesting invention designed to eliminate the undesirable interference experienced in commercial radio-telegraphic working.

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.

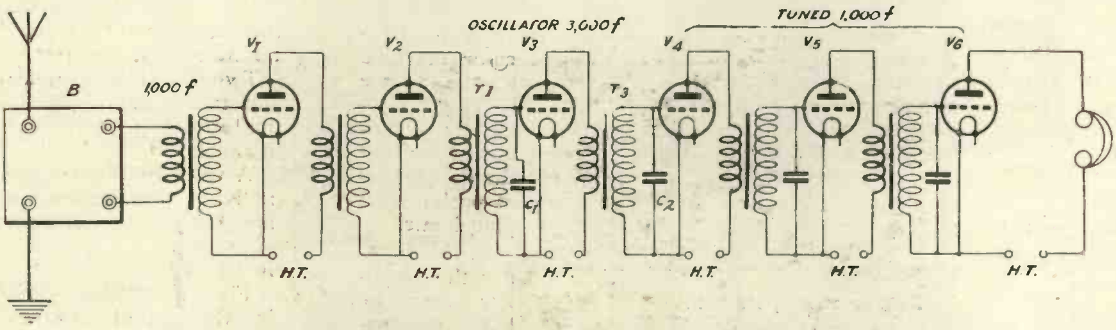
The demonstration, from a practical point of view, was distinctly successful, and continuous wave stations were received with a minimum of interference. Tuckerton was also received quite clearly with an absence of atmospherics. The result was certainly striking, but the Morse which came through seemed 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.

A NOVEL LOW-FR

By ALAN L. M

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

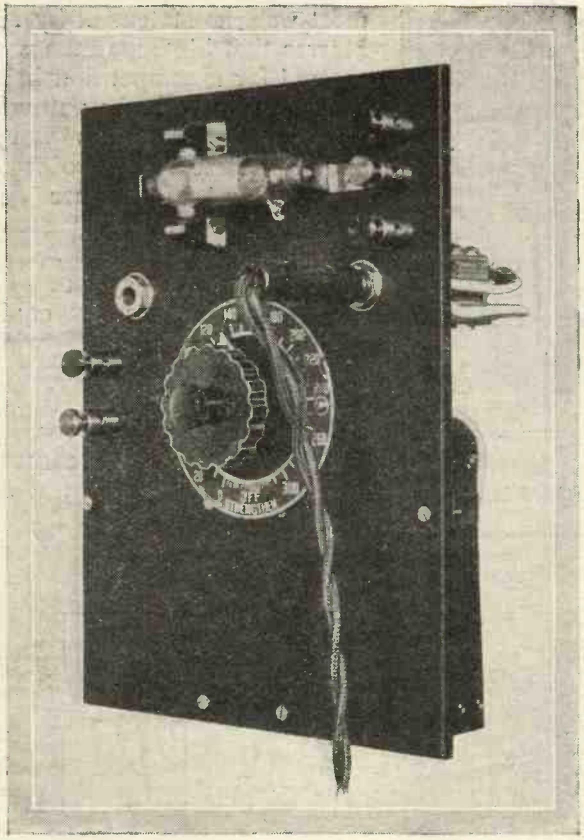


Fig. 1.—Exterior view of the unit.

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:—

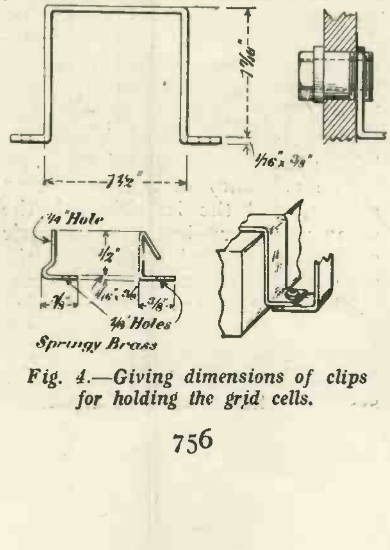


Fig. 4.—Giving dimensions of clips for holding the grid cells.

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.

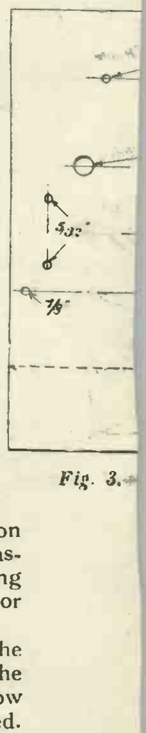


Fig. 3.

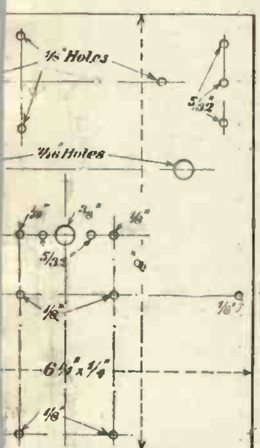
The first procedure is to mark out and drill the ebonite panel (Fig. 3) in such a manner that the components may be conveniently attached. It is not important in what position on the panel the apparatus is assembled, so that the final placing of the parts is purely a matter for convenience.

Fig. 3 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 etector unit described in "Wireless Weekly," No. 8.



The panel markings.

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.

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.

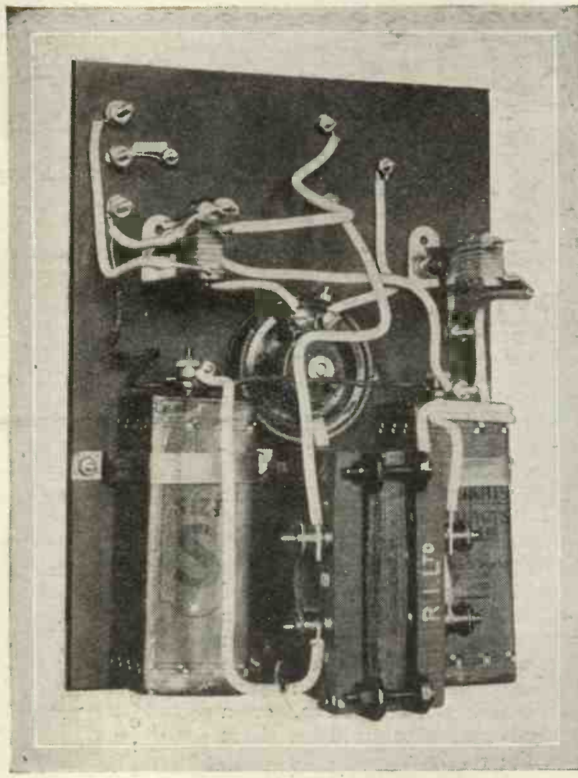


Fig. 2.—The back of the panel.

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.

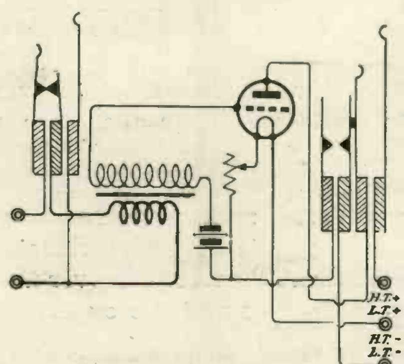


Fig. 5.—Wiring diagram.

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.

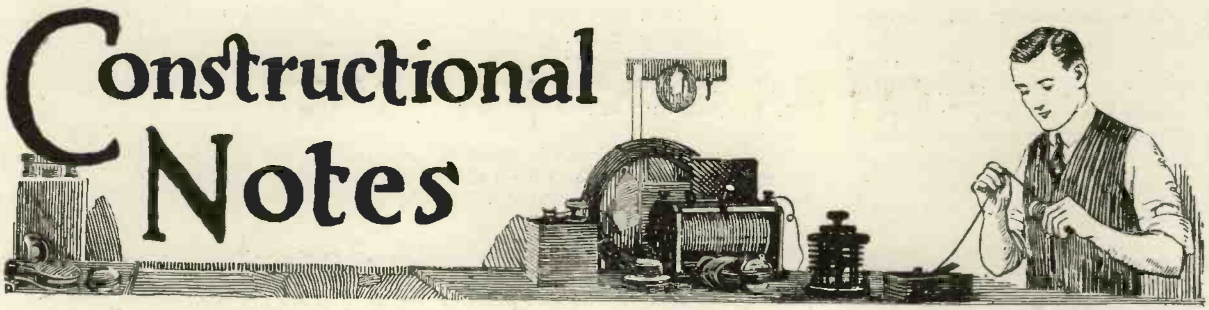
The Hague often affords a case of fictitious fading in that the wavelength wanders as much as five metres, otherwise these transmissions are fairly constant.

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

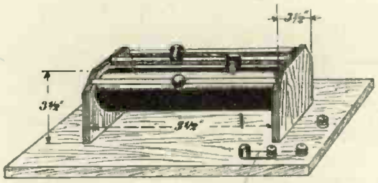


Fig. 1.—The three-slider potentiometer.

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.

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

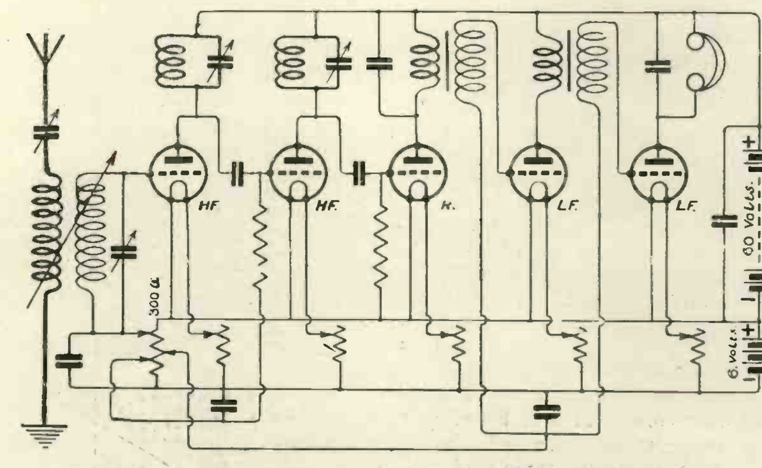


Fig. 2.—One method of using the three-slider potentiometer.

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

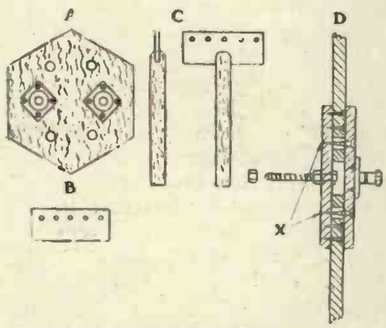


Fig. 3.—Parts required for constructing frame aerial.

to construct the frame are shown in Fig. 3. Two hexagonal hubs are cut out from a piece of ½in. board, the diameter across the points being 8in. One of these is drilled through the centre to take a fairly long ⅜in. 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 ½in. square section wood, slotted at one end to accommodate the spreaders B, which are cut from ⅛in. 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 1¼in. 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 1½in. 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

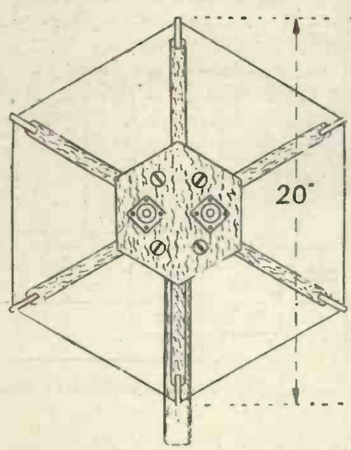


Fig. 4.—Illustrating the position of the arms.

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

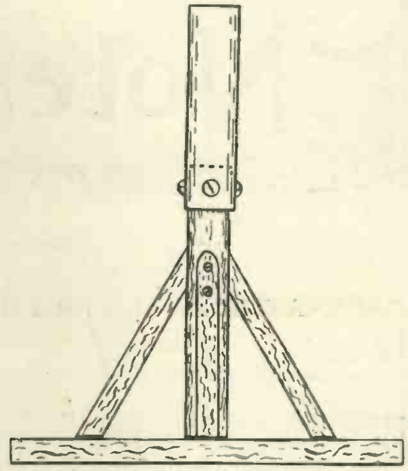


Fig. 5.—The supporting base.

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

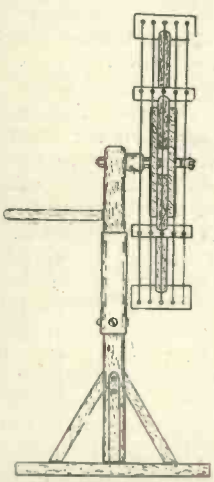


Fig. 6.—The complete frame aerial.

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.

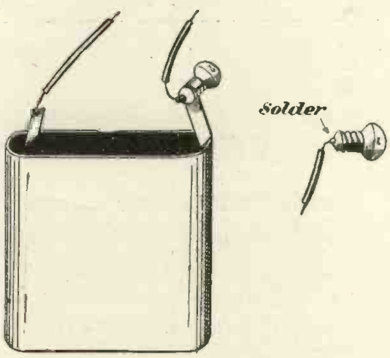


Fig. 7.—The completed tester.

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 $\frac{1}{4}$in. ebonite shaped as shown in the drawing. In this are drilled two 4B.A. tapping holes spaced $\frac{7}{8}$in. 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

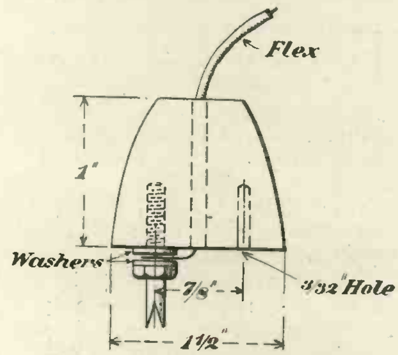


Fig. 8.—Details for contact pin.

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.

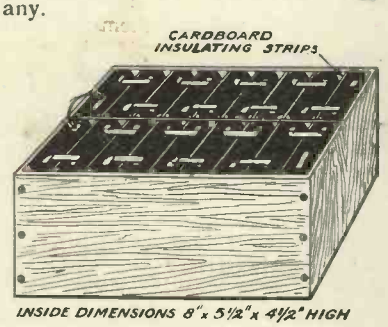


Fig. 9.—The H.T. battery in box with lid removed.

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 under-

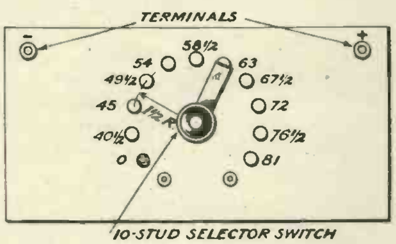


Fig. 10.—The top of the box.

side of the panels, and connected across the terminals.

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 $3\frac{3}{4}$

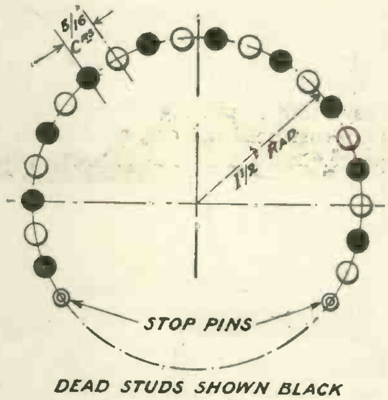


Fig. 11.—Suggested method for fitting studs.

volts it should be removed and replaced. The fact that this can be done with ease is one of the chief

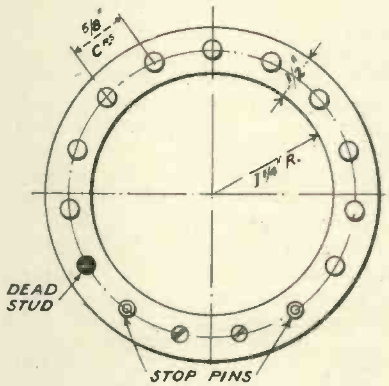


Fig. 12.—An alternative method.

advantages of a H.T. unit made up and housed in this way.

R. W. H.

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.

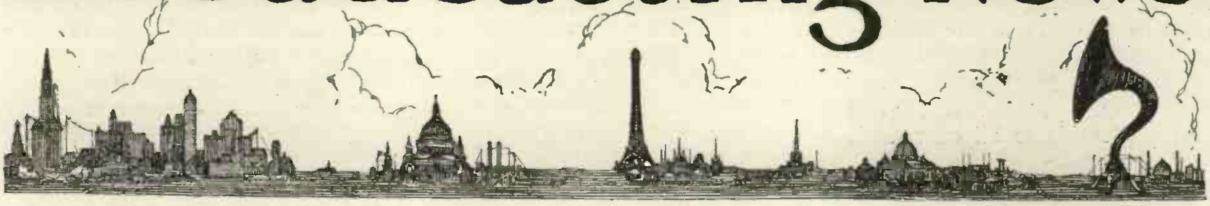
A simple and effective connection of this type can easily be made by attaching a spring under the heads of two wander plugs. The spring is made of any desired length from bare copper wire of about No. 20 S.W.G. The easiest way of forming this latter is to wind the wire round a pencil. The plugs are inserted 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.

* * *

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.

* * *

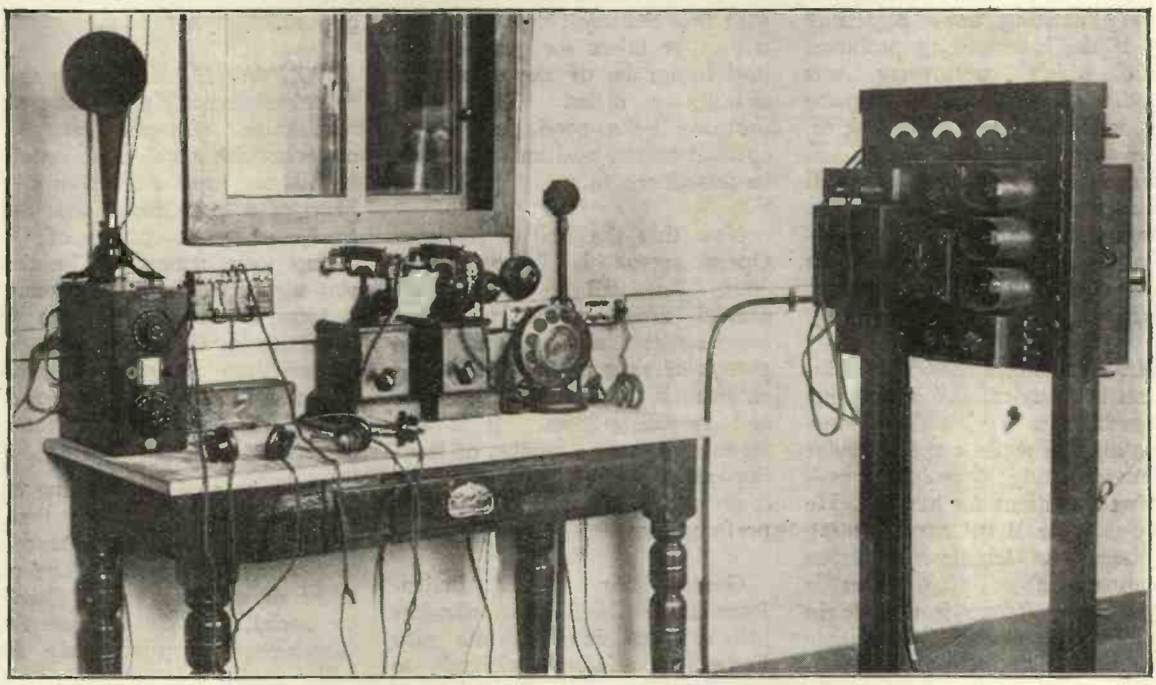
During the Golf Open Championship meeting at Troon a wireless demonstration was given in a large marquee on the course, with an inside aerial running along the tent poles about 10ft. high. An Ethophone V., with powerful amplifier, was used to operate five loud-speakers, and the results attained were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



The control room at the Glasgow Station.

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.

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.

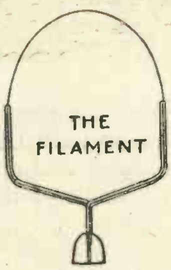


Fig. 1.

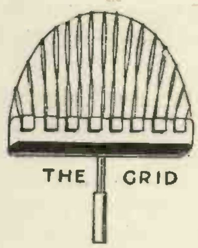


Fig. 2.

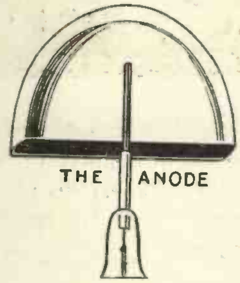


Fig. 3.

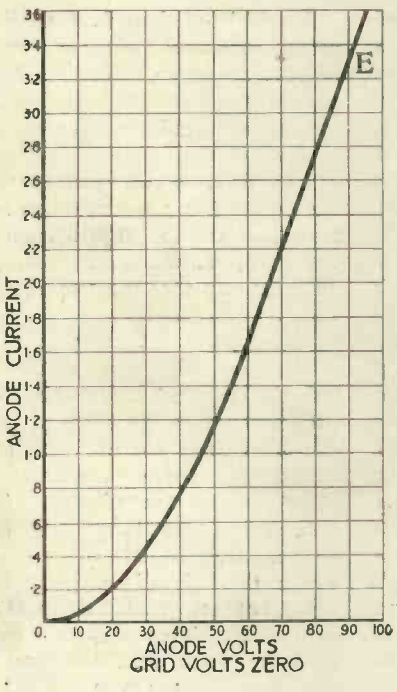


Fig. 5.—Showing the characteristic curve for a P.1 valve.

Fig. 4.—The Cossor P.1 valve.

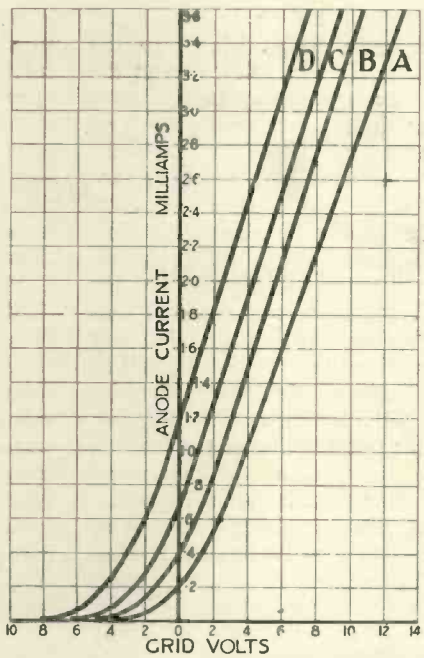
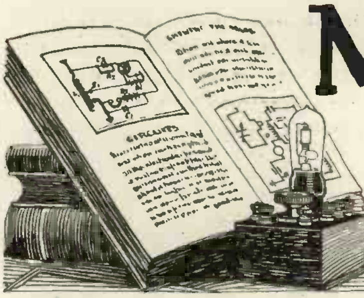
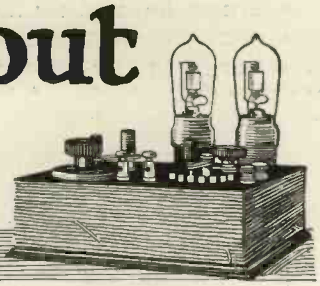


Fig. 6.—Curves illustrating the effects of various anode voltages with 4 volts on the filament. A, 20 volts; B, 30 volts; C, 40 volts; D, 50 volts.



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

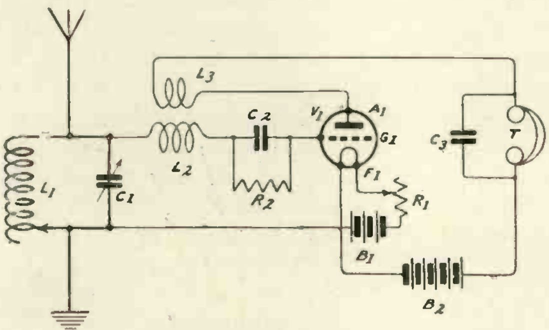


Fig. 1.—An uncommon method of reaction.

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. 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

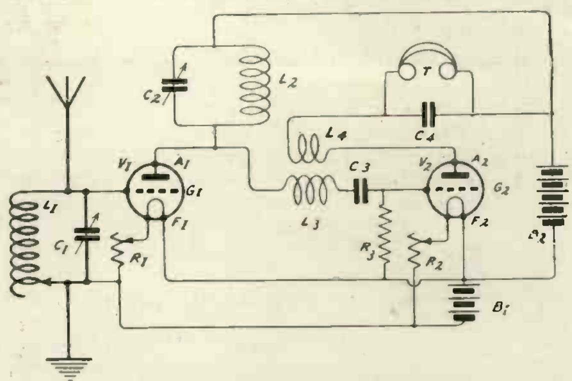


Fig. 2.—The same method of reaction applied to a high-frequency valve.

and 50, are not sufficient to cover the broadcasting wavelength.

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

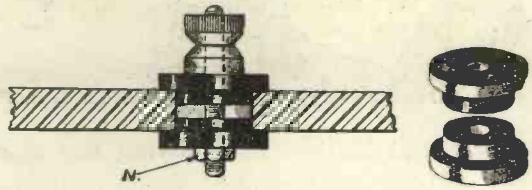


Fig. 3.—Ebonite bushes for insulating terminals fitted to wood panels.

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.

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.

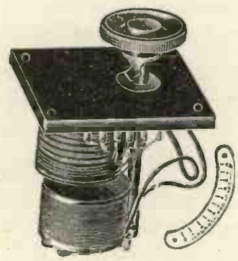
Tested upon a good suburban aerial, two valves being used with this H.F. unit between the first (amplifying) and the detector valve, ship-stations came in very noisily. Amateurs were also heard with good intensity, and one well-known London amateur at moderate loud-speaker strength.

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.)

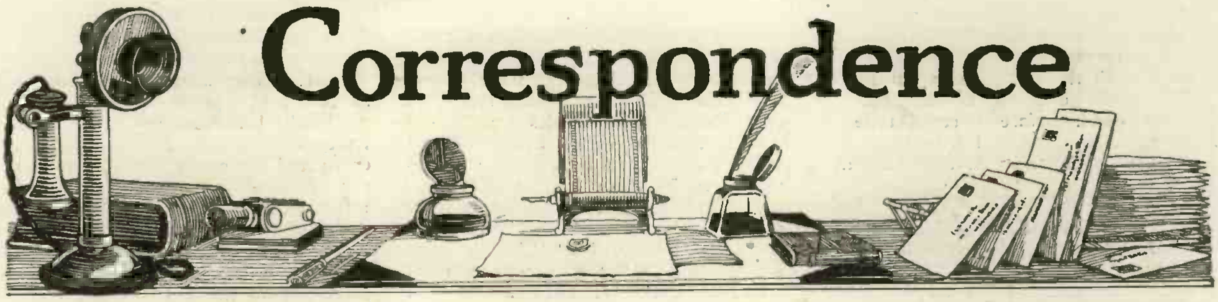
The author is very well known in the wireless world and is a past President of the Wireless Society of London, as well as author of numerous wireless textbooks. The present volume is an excellent little treatise on acoustics, the conversion of sound energy into electrical energy, wireless transmission, 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.

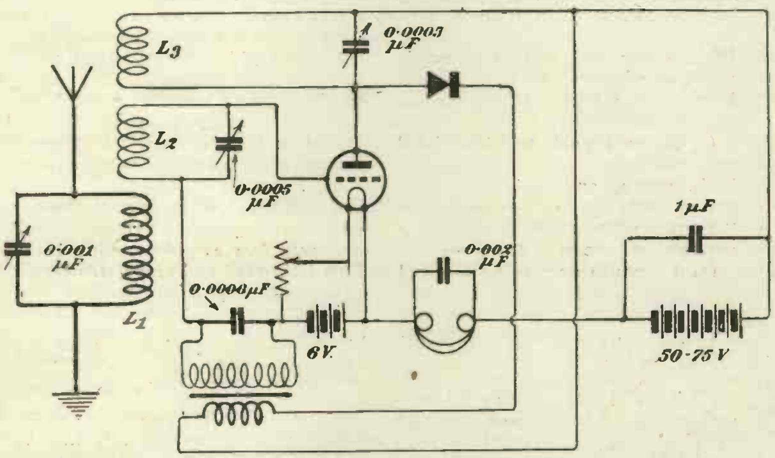
DUAL AMPLIFICATION

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.)

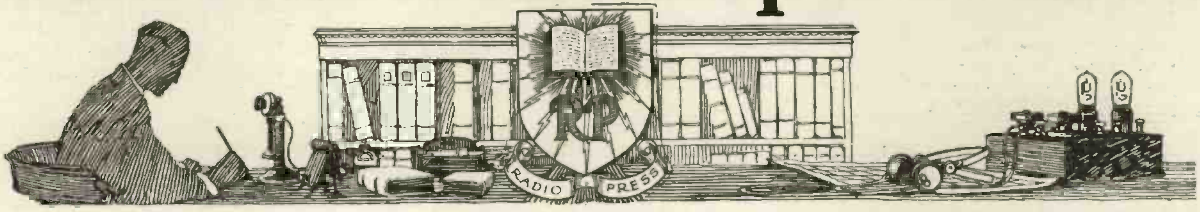
tube $3\frac{1}{2}$in. in diameter and tapped at every ten turns. The inductance L_2 may be a tube 3in. in diameter wound with 100 turns of No. 26 gauge D.C.C. wire and tapped at 50, 60, 70, 80, 90 and 100 turns.

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.

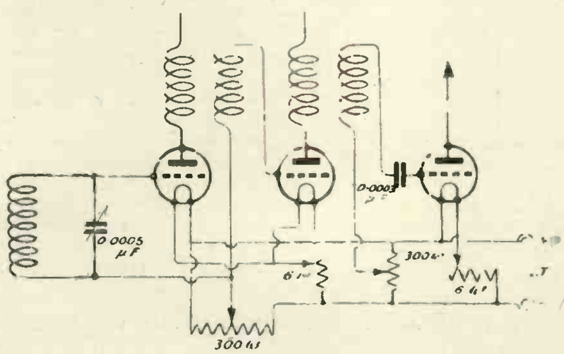
1. A Postal Order to the value of 1s. for each question must be enclosed, together with the Coupon from the current issue, and a stamped addressed envelope.

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 have 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.

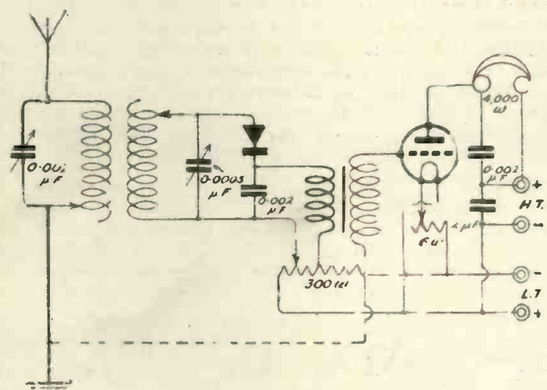
W. T. E. (LISTOWEL) refers to the telephone transformer shown on page 69 of "MODERN WIRELESS," No. 1, and asks how much wire is necessary to wind this.

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.

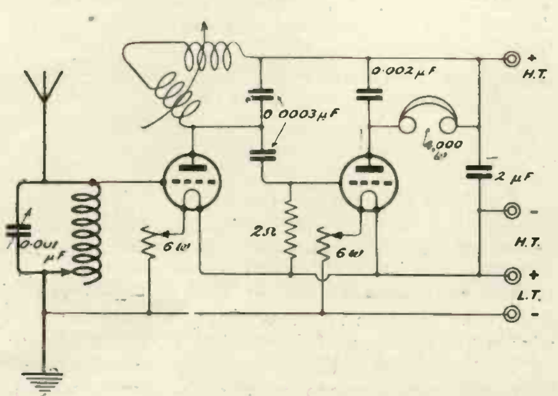
H. L. P. (WIMBLEDON) asks particulars for a choke for regulating alternating current supply for a transformer in his possession.

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.

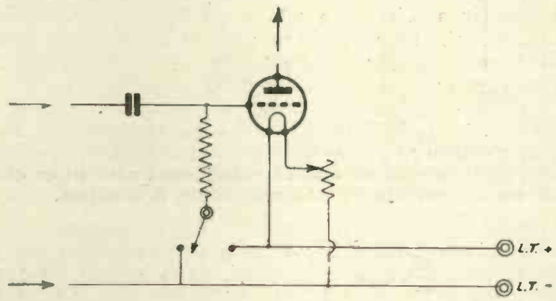
L. W. (LEVEN) is constructing the progressive unit system described in "WIRELESS WEEKLY," and wishes to know if with this apparatus he would succeed in hearing 5SC, from which he is 54 miles distant.

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 conditior

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