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The New Volume.

With this issue we introduce to our readers the XIIth Volume of *The Wireless World and Radio Review*, and we do so in the earnest hope that we are including within its pages subject matter of still greater interest than has been found between the covers of earlier volumes. We believe that at the present time the majority of readers are interested particularly in the practical side of wireless, and we are therefore including special articles of a practical nature in greater proportion than in the past. Mr. Philip R. Coursey will describe, in a series of articles, how to make up standard apparatus for measurements in wireless, and he will explain the practical application of the instruments. Mr. F. H. Haynes, who in the past has contributed articles under the title of Experimental Station Design, will write on the equipment of the home workshop, describing the tools required in making up apparatus and their use. Mr. W. James, also of the technical staff of the Journal, is contributing a series of articles illustrated throughout with practical references describing the principles of wireless telegraphy. Many new ideas will be included in early issues, whilst Mr. Maurice Child will shortly commence to describe a series of experiments in wireless, the purpose of which will be to build up for the amateur a thorough understanding of the purpose and function of all components in wireless apparatus.

We believe that readers will appreciate the reduction in price of the Journal from 6d. to 4d. per copy. This reduction has been made possible owing to the large increase in circulation, and it is fitting that our readers should share in the prosperity of the Journal.

A New Transatlantic Achievement.

For many weeks past the Editorial post has been overflowing with reports of reception both of American broadcasting and amateur stations. The recent Transatlantic Tests, too, have shown what is possible in the way of amateur achievement in short-wave transmission.

However, the honour of being the first British amateur to report an exchange of messages with an American falls to Mr. Frederick L. Hogg, of Highgate. From about 4 o'clock on the morning of the 17th March, until nearly 5.30, Mr. Hogg of **2 SH** was maintaining touch with the American station **1 ZZB**, and whilst there was naturally considerable interference, more especially in reception on the other side, it was nevertheless possible to exchange information and arrange an appointment for further experiments.

We hope to say more of this success in a later issue.

Experiments with the Neon Tube—I.

HOW A NEON LAMP CAN BE MADE TO PRODUCE OSCILLATING CURRENTS.

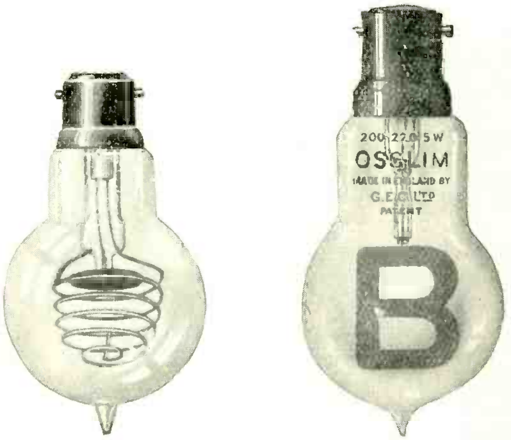
By S. O. Pearson, B.Sc.

DURING the past two or three years a considerable amount of attention has been focussed on the Neon Tube. A great deal of research has been carried out in England and on the Continent, but unfortunately very little has been published up to the present time. However, one outcome of these researches has been the perfecting of the Neon Lamp as supplied in this country by the General Electric Company, Ltd., under the trade name of " Osglim " and these can be purchased quite cheaply for purposes of experiment.

A Neon Tube consists essentially of a glass bulb enclosing two metal electrodes and filled with neon gas at reduced pressure, neon being one of the rarer gases. When a suitable difference of potential is applied to the electrodes, a discharge takes place through the gas and a luminous glow is formed over the entire surface of the negative electrode or cathode. This glow has a soft velvety appearance, its colour being a yellowish red or orange. No glow is formed on the anode when it is arranged in the bulb in close proximity to the cathode. In the commercial type of discharge lamp neon is used on account of the fact that the voltage necessary to start the discharge is less for neon than for any other gas. One of the greatest difficulties which had to be overcome was the tendency of the glass bulb to become blackened on the inside, this blackening being due to minute particles of the cathode which are shot off and deposited on the glass. This difficulty has been overcome by including certain impurities in the gas, and the electrodes are made of the purest iron. These lamps are now supplied for voltages ranging from 200 to 250, and are primarily intended for purposes of advertisement or decoration, the negative electrodes taking the form of letters of the alphabet, numerals, etc. Two forms are shown in Fig. 1.

However, the radio experimenter will be interested more from the point of view of the possibility of application to radio work, and it is intended here to describe one or two discoveries which, it is hoped, may form a basis for further experiment and lead to further applications.

In order to carry out such experiments as these, it is almost essential to have a knowledge of the chief characteristics of the neon lamp. It will be seen later that the effective resistance between the electrodes when the lamp is glowing, decreases with increase of current; hence a steadying or ballasting resistance is connected in series and mounted inside the cap of the commercial type of neon lamp. This resistance should be removed for purposes of experiment in order that a voltmeter, condenser or other apparatus may be connected directly across the electrodes.



By Courtesy of The General Electric Co., Ltd.

Fig. 1. Forms of Neon Lamps.

The Volt-Ampere Characteristic.

If the voltage applied to the electrodes of a neon lamp is gradually increased from zero, it is found that no current flows and the lamp does not commence to glow until a voltage of over 160 is reached. In a particular lamp tested the discharge commenced when the pressure had reached 171 volts and the current suddenly increased from zero to nearly 30 milliamperes; but although the voltage was kept constant at 171 when once the discharge had commenced, the current did not remain at 30 milliamps, but began to fall, rapidly at first, and then more gradually until after five minutes or so it became constant at

14·7 milliamps. This falling off of current is partly, if not wholly, accounted for by the rising temperature and pressure of the gas in the bulb. It has been shown* that the temperature of the medium surrounding the bulb has a decided effect on the final steady value of the current, this becoming less as the temperature is raised. The critical starting voltage seems to be quite definite for a given temperature.

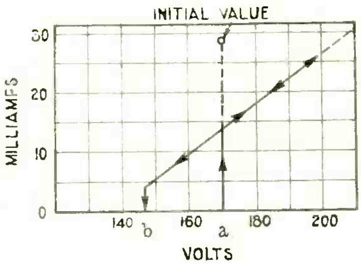


Fig. 2.

In obtaining the characteristic curve shown in Fig. 2, the final steady values of the current were found for increasing values of the voltage, which was measured by means of an electrostatic voltmeter connected directly across the electrodes. It will be seen that the curve follows a linear law. On reducing the voltage gradually it was observed that the current did not cease to flow when the critical starting value of 171 volts was reached and passed, but continued until the potential difference had fallen below 150 volts, the same straight line law being obeyed throughout. At about 147 volts the current suddenly ceased and the potential difference had to be raised above 170 volts again before the glow could be re-established.

This characteristic curve indicates two properties of outstanding interest. Firstly, the characteristic for increas ng voltage is different from that for decreasing voltage, the current starting at a much higher voltage than that at which it ceases. Secondly, although the current increases with voltage according to a straight line law, this straight line, when produced, does not pass through the origin, but cuts the V-axis a long way to the right of it. The significance of this is that the resistance of the lamp is not constant, but decreases very rapidly with increase of current. By making use of the former of these two properties the lamp may be made to take an intermittent current, and the second makes the neon tube eminently suitable for use in conjunction with valves for the automatic recording of wireless signals. These two devices, which are both due to Mr. H. St. G. Anson, are considered in turn below.

*Proc.,Phys. Society, Vol. XXXIV., 15th Aug., 1922

The Production of Intermittent Currents.

Before describing the actual arrangement it will be necessary to consider very briefly what happens when a condenser of capacity C farads is connected in series with a high resistance R, and a voltage V is suddenly applied to the ends of the circuit. At the instant the voltage is switched on, a current commences to flow through the resistance, and the condenser begins to acquire a charge. The current has its greatest value at the start when the potential difference across the condenser is zero, and dies away as the voltage across the condenser builds up, until eventually when the condenser voltage becomes equal to V, the current ceases altogether, assuming of course that the condenser has perfect insulation. If v is the voltage across the condenser at any instant, then the voltage across R is equal to $(V - v)$, and therefore charging current equals $(V - v)/R$; that is, the current is proportional to the difference between the supply voltage and the condenser voltage. The current is plotted against time after first switching on, and is shown by the dotted curve of Fig. 3. The rate at which the condenser voltage builds up is directly proportional to the charging current and the variation of this voltage with time is given by the full line curve of Fig. 3. It is this curve that we are most concerned with. The building up of the voltage is most rapid at the start

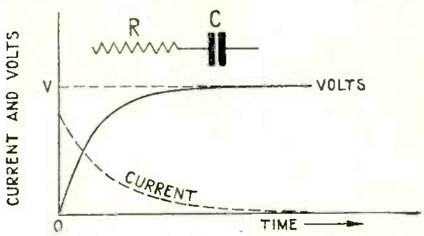


Fig. 3.

when the current is large, but becomes more gradual as time goes on. When the constants C, V and R are known it is quite easy to calculate the condenser voltage v after any given interval of time.

We have seen that in the neon lamp no current flows until the potential difference between the electrodes reaches a certain definite value; that is, to all intents and purposes, its resistance is infinitely great for all values of voltage up to that at which the discharge through the gas commences. If then a neon lamp is connected in shunt with the condenser of the circuit considered above,

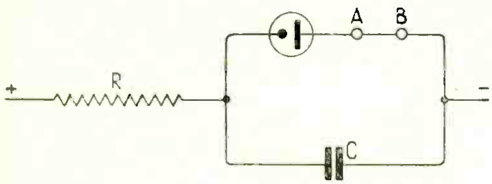


Fig. 4.

as shown in Fig. 4, and if a voltage higher than the critical starting voltage is applied to the ends of the circuit, the lamp will obviously flash on as soon as the potential difference across the condenser builds up to the critical starting voltage of the lamp. Immediately this occurs the condenser becomes shunted by a comparatively low resistance—that of the lamp—and consequently begins to discharge itself through the lamp, which will continue to glow until the voltage across it and the condenser falls to the lower critical value at which the discharge through the gas in the lamp ceases. Of course R must be sufficiently large or the condenser voltage will not fall sufficiently to reach the lower critical value at all, and the lamp would keep on glowing indefinitely. As soon as the neon lamp goes out the condenser begins to charge up again to the starting voltage, and so the process is repeated indefinitely. Thus an intermittent current is produced by the arrangement and may possibly be put to a number of uses in connection with radio work.

Let a and b represent the upper and lower critical voltages respectively of the neon lamp; then the glow lasts whilst the condenser voltage is falling from a to b and the dark period whilst the voltage is rising from b to a. The action is indicated by the curves of Fig. 5. The upper curve represents the voltage across the condenser and lamp, being plotted against time after first switching on and the lower curve shows the nature of the intermittent current.

Since the rate at which a condenser charges up for a given supply voltage is inversely proportional to the capacity of the condenser and to the resistance in series, it can be seen at once that the frequency of flashing of the lamp can be varied at will over a very wide range by suitably adjusting the values of R and C. Frequencies as low as one flash in several minutes, and so high as to be above the audible range have been obtained, and it is these higher frequencies that will be of special interest to the experimenter. If the series resistance R is made large in comparison with the resistance of the lamp when in the glowing condition, the rate at which the condenser charges during the dark period will be much slower than the rate of discharge during the light period, and since this arrangement seems to give best results in practice, very little error will be introduced by taking the time of one complete cycle as being equal to the time of one dark period. If T = time of one dark period, then

$$T = CR.\log_\epsilon \frac{V-b}{V-a} \text{ seconds,}$$

where V = supply voltage, and the frequency $f = 1/T$ cycles per second approximately. This expression shows that the higher the supply voltage, the shorter will be the periodic time T and the higher the frequency.

For the benefit of those who are disposed to carry out experiments on these lines some practical data and figures are given. The device operates most easily when the series resistance R is fairly large and good results are given over the audible range of frequencies using a resistance of from 0·5 to 1 megohm,

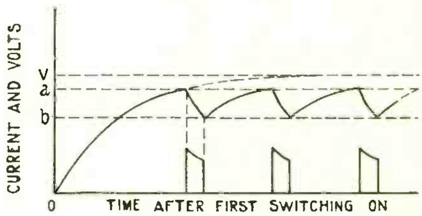


Fig. 5.

and condensers ranging in capacity from 0·001 to 0·05 microfarad with a supply voltage from 200 upwards. Of course a variable condenser will enable a continuous adjustment of the frequency to be obtained. The type of variable condenser in the old Marconi ship's wavemeter is particularly suitable. Series resistances as low as 80,000 ohms have been used with success on particular lamps, but for these lower values the arrangement seems to become unstable and a certain amount of difficulty is experienced in starting and maintaining the " oscillations."

Frequencies within the audible range are best detected by means of a fairly low resistance telephone connected preferably in the lamp circuit at AB (Fig. 4), or a transformer may be used to convey the oscillations to any other desired apparatus. The telephone or transformer should not be included in the external circuit as this has a very high resistance, and the current pulsations in it are very weak compared to those in the loop circuit. The power represented by the intermittent current is roughly inversely proportional to the series resistance, and therefore for high values of resistance the pulsations will be quite feeble for moderate and high frequencies, and the lamp will not be illuminated over the whole of the cathode, but only a small patch of light will be seen on the cathode where it is in close proximity to the anode.

An instrument could be made up giving a whole range of note frequencies, either in steps or continuous, according to the condensers used, and such an instrument should prove most useful in all note frequency or telephonic measurements. As an instance could be given the testing of low frequency amplifiers over the whole band of speech frequencies, and it should be an easy matter to detect undesirable resonant frequencies in the amplifier.

It should be mentioned here that practically the same intermittent conditions can be obtained by connecting the neon lamp *in series* with the condenser and shunting the condenser by the high resistance. In this case the process of charge and discharge is reversed, the lamp glowing whilst the condenser is charging *through the lamp* and remaining dark when the condenser is discharging through the resistance.

On one or two occasions radio frequencies corresponding to wavelengths of the order of twenty thousand metres have been obtained by the methods described above, such frequencies being detected by means of a heterodyne wavemeter. Possibly by the inclusion of tuned circuits the production of these high frequencies may be assisted and the wave shape of the pulsating currents improved. In order to excite a tuned oscillatory circuit effectively the duration of the light period should be made as nearly equal to that of the dark period as possible by reducing the value of R.

In the second instalment of this article will be given the application of the neon lamp to the recording of wireless signals.

(*To be continued.*)

The Pending Reorganisation of Wireless Licences.

THE situation with regard to the issuing of licences by the Post Office, both experimental and broadcasting, has now reached a stage when some new organisation must be adopted with as little delay as possible.

At the present moment it is not easy to forecast exactly what the result of the negotiations in progress at the time of writing will be, but of one thing we may rest assured, and that is that those who desire to experiment in wireless will not have the necessary facilities withheld from them.

In the past it has been exceedingly difficult for many who desire to construct their own apparatus to obtain the necessary licence ; in some cases this has even driven them to ignore the law and construct apparatus either without a licence at all, or simply satisfying their consciences to an extent by purchasing a B.B.C. licence.

An active part in the arrangements which are now under discussion is being taken by the Radio Society of Great Britain, supported by the numerous affiliated Societies in London and the Provinces.

The points of view which have been brought to the notice of the Postmaster-General are those of the Manufacturers of wireless apparatus, the British Broadcasting Company, and the wireless Amateurs and Experimenters represented by the Radio Society of Great Britain and affiliated Societies.

The Broadcasting Company is of course responsible to its members for producing the most efficient broadcasting possible, and in order to do so, the matter which it has most at heart is how to obtain the necessary funds. It is generally admitted that under the present organisation an enormous leakage occurs of dues which the Broadcasting Company had anticipated receiving. The amateur and experimenter, whilst not wishing to discourage or interfere with the broadcasting service, realises the importance of the utmost freedom being given to anyone who desires to take more than a superficial interest in the scientific side, and who desires to experiment and construct his own apparatus.

As the Journal of the experimenter, *The Wireless World and Radio Review* is naturally in full accord with the desirability of such freedom being given, and welcomes the strong attitude adopted by The Radio Society of Great Britain in pushing for the achievement of this purpose.

Complete Receiving Station

HOW TO ERECT THE AERIAL AND BUILD LOOSE COUPLER.

The Necessary Components.

SIMPLE apparatus of satisfactory performance is the aim in the design of this receiving outfit. The essential components are the aerial, complete with all its fittings and leading-in wire, earth lead and connections, loose-coupled tuning inductance, variable condenser, crystal detector, and telephone receivers. The fitting up of each of these components will now be dealt with individually.

The Aerial, Etc.

No definite instructions can be laid down

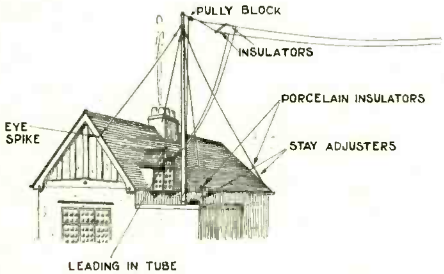


Fig. 1. Staying a small mast on the house top.

as circumstances vary, but the following points must be observed.

1. Make the aerial as high as possible, and in particular endeavour to make it higher than surrounding objects, such as chimney-stacks and trees. It is not always essential, however, to erect elaborate or heavy masts as it is frequently possible to get quite good results with comparatively low aerials, especially if the distance from the transmitting station does not exceed say, ten miles. Bear in mind that the higher the aerial the stronger will be the received signals.

2. Post Office Regulations specify that the total distance from the point of leading in to the far end of the aerial shall not exceed 100 feet.

3. Two wires will always give better results than a single wire providing they are spaced at least six feet apart. A single wire of 100 feet is satisfactory, but if the space available does not permit of an aerial of this length, the adoption of two wires is strongly recommended.

4. If the leading-in wire is not continuous with the aerial wire, be sure that connection is made right at the end, and not a few feet from it. If more convenient the leading-in wire may be attached precisely in the middle, though when this is done an excessive sagging in the centre of the aerial may be the result.

5. The leading-in wire should fall straight away from the aerial and on no account should be brought back under it.

6. Endeavour to make the remote end of the aerial the higher.

Fig. 1 illustrates a mast stayed to a house-top and supporting a twin wire aerial and some typical aerials are shown in Fig. 2. Single No. 18. S.W.G. copper wire, preferably enamelled to protect it from the weather, may be used for the aerial. Heavier wire consisting of many strands may be made use of if greater mechanical strength is required, but it must be remembered that a heavy aerial is much more difficult to support and

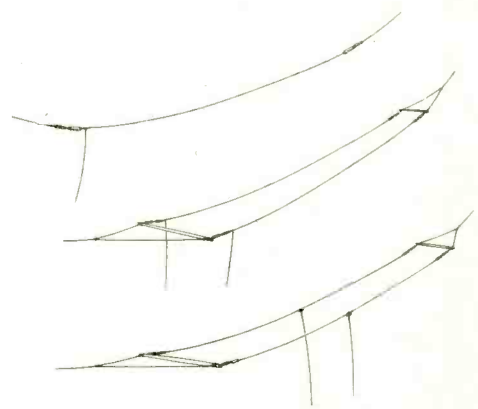


Fig. 2. Typical aerials.

pull up taut. Care should be taken to avoid kinks as the wire is paid out. No. 10 to No. 16 S.W.G. galvanised iron wire may be used for guying if necessary. Spreaders, if used, should consist of stiff cane or bamboo. The aerial insulators should be small so that the weight is not appreciably increased.

Suggestions for making an earth connection are given in Fig 3. Similar wire to that used for the aerial should be arranged for connecting to the instruments and the distance to the point of earthing should be as short as possible. It is worth experimenting with several earth connections to determine that which gives the best results.

Loose Coupled Tuning Inductance.

This component is shown in Fig. 4, and the turns. Holes are pierced in the cardboard at the points where the tappings are to be made, and the wire is looped in for the purpose of connecting to the switch. The end of the tube at which winding is completed must be tightly plugged with a piece of wood of $\frac{3}{8}$ in. to $\frac{1}{2}$ in. in thickness. This can easily be cut to shape by means of a saw, chisel, or sharp pen-knife. The reader is reminded that cardboard tube has the property of absorbing moisture and slightly changing in diameter. To obviate this, it is advisable to leave it in a warm oven for an hour or two and then to give it a coat of shellac varnish inside

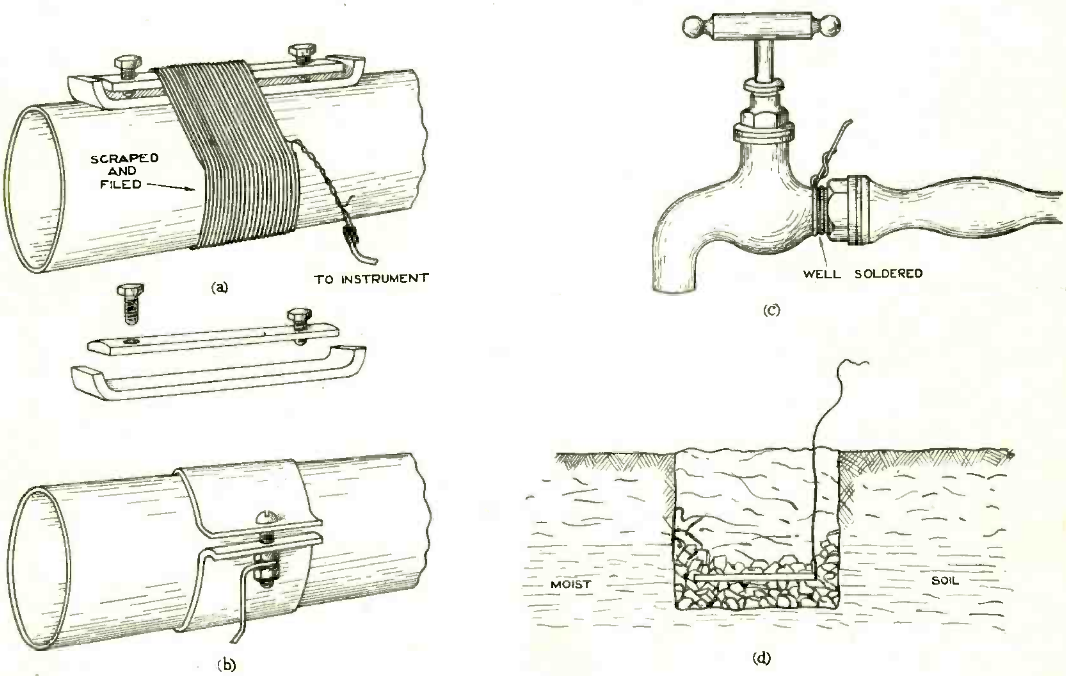


Fig. 3. Methods of making the earth connection.

drawing is almost self explanatory. The inside coil is wound on a piece of cardboard tubing about $3\frac{1}{2}$ ins. in diameter and 4 ins. long. A suitable cardboard tube can be found in the containers of several household commodities, whilst many electrical and wireless stores stock special tubes for the purpose. By piercing two holes at about $\frac{1}{2}$ in. from each end of the tube for the purpose of holding the wire, the winding can be carried out with No. 22 S.W.G. double cotton covered copper wire, tappings being taken out at the 10th, 15th, 20th, 25th, 32nd, 42nd, 57th and 77th and out, or alternatively, to soak it in melted paraffin wax, before winding. The wooden disc is secured flush into the end of the coil by means of four small brass screws, after which the plugging piece is screwed from the inside on to an upright support. An eight-stud switch is arranged on the supporting piece of wood and the switch studs may consist of ordinary brass screws passing right through the wood or the special switch studs which are now on the market. The actual fitting up of the switch, including the arm and knob, is left to the reader according to the parts he has available and the style of finish desired. The tapping points from the coil are in turn soldered to the projecting points of the screws or, alternatively, taken through holes made in the wood and held down under the screw heads.

The cardboard former for the stationary coil may be from 4 ins. to 4½ ins. in external diameter and about 4 ins. in length. This tube is also wound with No. 22 D.C.C. and has 70 turns, the first seven of which are tapped out to a switch in the manner just described, turn by turn, after which tappings are brought out at every seventh turn to a second switch. These switches may be mounted one above the other on a piece of wood arranged vertically alongside the coil.

The telephone receivers employed with a crystal receiving outfit should be of the highest quality and have a resistance of about 4,000 ohms.

The method of connecting up is shown in Fig. 4.

Instructions for Operating.

The crystal must be adjusted to what is considered, after a little experience, to be the most sensitive setting. A buzzer wavemeter is particularly useful for this purpose, as was described fully in a recent issue.* Slide the moving winding fully into the fixed winding and with the condenser almost at its zero position adjust the switch which taps off turns of the aerial circuit in sevens simultaneously with that on the moving winding. When a signal is heard it can be more sharply tuned in by adjusting the switch which taps off single turns and the variable condenser, and moving the sliding coil, little by little, away from the stationary one. If the condenser is nearly at maximum value to bring in a signal, then the switch on the sliding inductance should be advanced one stud and the condenser adjusted to a lower value. This will give greater signal strength.

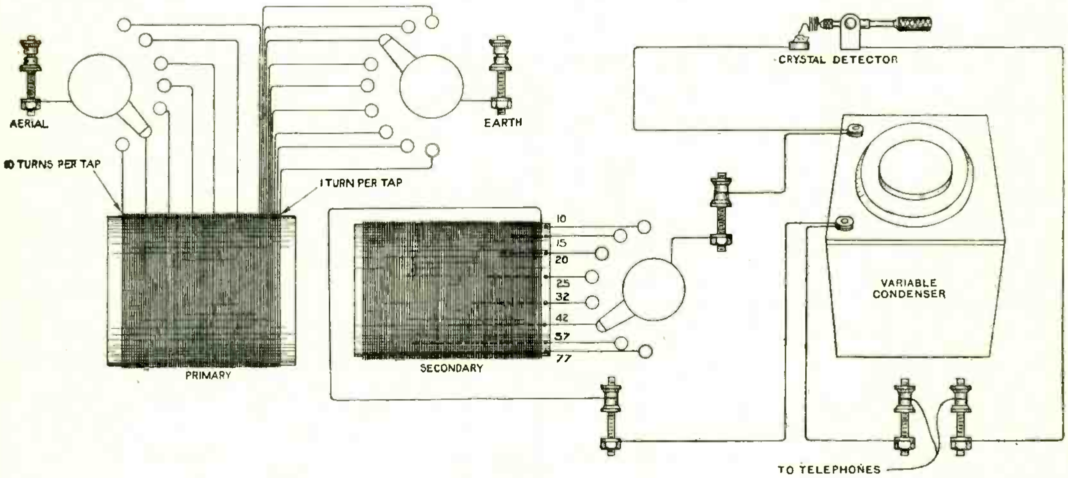


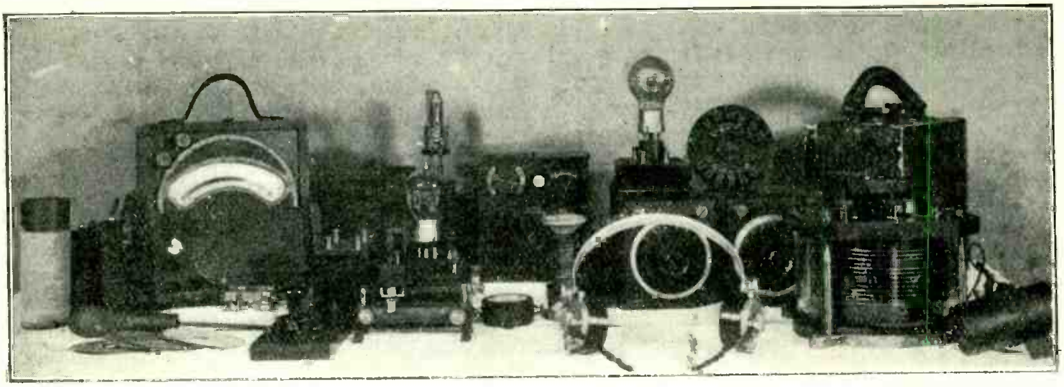
Fig. 4. Schematic diagram of connections, showing arrangement of tappings on fixed and sliding coils.

Variable Condenser, Crystal Detector and Telephone Receivers.

A variable condenser of the air dielectric type, having a maximum value of 0.0004 microfarads, is required for tuning the sliding inductance. This can easily be purchased complete or assembled from parts.

The crystal detector must comprise an arrangement by which a piece of crystal, such as prepared galena or silicon, is held firmly and a light contact made upon it by a piece of fine copper, brass or iron wire.

* *Wireless World and Radio Review,* p. 792. March 17th, 1923.



The Amateur's Experimental Laboratory.

1. Notes on Apparatus and Methods.

By Philip R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E.

It is often thought that anything in the nature of accurate scientific investigation or quantitative measurement is beyond the scope of the average radio experimenter. The use of complex mathematical formulæ is terrifying to many, while others feel that they cannot afford the necessary equipment of expensive measuring instruments and apparatus. It is the main object of this series of articles to point out that this attitude is by no means a correct one, and to show how anyone possessing quite simple radio apparatus and components can carry out a number of useful and at the same time interesting experiments and measurements.

The apparatus required need not in most cases be elaborate or expensive, although naturally for some purposes more equipment is required than for others. The tests that can be conducted in this way may also be made the means of developing a better understanding of the functioning of the existing apparatus, and thus lead to means for improving its effectiveness.

As examples of these types of measurements may be mentioned the experimental determination of the values of coils and condensers, of the effective resistances of high frequency circuits, and of the parts of such circuits, measurements on aerials and on valves, and experiments with amplifiers, intervalve transformers, and numerous other components, etc., all of which tend to the improvement of the working of the experimenter's apparatus. It is proposed in this series of articles to deal with as many of these measurements and experimental determinations as possible, bearing always in mind the limitations of the average experimenter's purse and the need for effecting the tests with the simplest possible apparatus. It is not intended to describe primarily experiments with complete receiving sets, although some of those to be detailed may find application in that direction.

It will be assumed in the first place that the experimenter already possesses some form of valve receiver, preferably one containing at least two valves—say a detector and one stage of low frequency amplification. More complex receivers are of course no serious disadvantage, although two valves arranged in this way serve most of the purposes for which its use will be required. It is not intended to interfere with the arrangement of this receiving set, but to arrange the tests independently of it in the main. For some purposes, however, it is convenient to be able to make use of such a receiving set in conjunction with some of the tests to be described. For such uses it will merely be necessary to disconnect the aerial and earth leads from the receiver, leaving the remainder of the circuits quite normal. The set should be one of a type that is provided with some form of reaction, so that oscillations can be set up when required. It is also assumed that spare L.T. and H.T. batteries, valves, and other similar components are available from which the various circuits can be arranged.

While it will not be possible to set out an extended list at this stage of all the parts that will be required, since these will be detailed as necessary in each article, there are a few "essentials" which can well be mentioned here. These will be required on many occasions, and if not available should be purchased, if it is intended to carry out the tests which are to be described.

These are :—

- A 6-volt accumulator battery.
- Two H.T. batteries, each of adjustable voltage, in steps of $1\frac{1}{2}$, 2, or 3 volts according to type. A maximum of 20 to 30 volts will suffice for one, while the other should have a maximum of at least 60 volts, and preferably 90 volts.
- Two valve-holders.
- Two filament resistances (adjustable).
- One milliammeter (moving-coil type), reading from 0 to 5 milliamps. with shunts for higher ranges.
- One moving-coil voltmeter, reading from 0 to 100 volts.
- One or two variable air condensers, having maximum values of about 0.001 microfarad.
- One coil holder to take 2 or 3 plug-in coils.
- One single socket for plug-in coils.
- Sundry small fixed condensers of various values.
- Sundry spare valves.
- Sundry wire, terminals, etc.
- A grid condenser of 0.0002 microfarad, with a grid leak of 2 megohms.

The above listed parts should all be additional to whatever apparatus is installed as a permanent receiving set, so that they can be joined up independently of it, and when necessary, used in conjunction with it. With the aid of these parts it is possible to join up radio-frequency oscillation circuits, which can be utilised for many forms of radio-frequency tests employing either the heterodyne beat method or the double-click method of indicating resonance.

Owing to the importance of these methods and the frequency of their use later, it may be desirable to give a brief outline of them here.

When a three-electrode valve is connected up in the usual manner, with an appropriate battery to render the filament incandescent, and a pair of telephones is included in the plate circuit in series with the H.T. battery, the arrangement becomes a simple detector valve circuit, the efficiency of which can be much improved by connecting a grid condenser and leak in series with the wire leading to the grid of the valve. Such an arrangement will of course, detect radio signals in the usual manner if the grid circuit is connected to a receiving aerial. For our purposes, however, some reaction must be provided between the plate and grid circuits in order that in addition to functioning as a detector the valve also sets up continuous radio-frequency oscillations. For this purpose the use of a coil-holder in conjunction with some plug-in coils is very convenient as it enables a large choice to be made in the range of wavelengths which can be worked with. One coil should be included in the plate circuit of the valve, and another in the grid circuit, so that by coupling them together oscillations can be produced.

If another source of oscillations is available from a second oscillating valve or from some other oscillator, it becomes possible to induce into the grid circuit of the oscillating detector valve just described, an oscillatory current which may have, within reasonable limits, any desired frequency in relation to the oscillations generated by the detector valve. When these oscillations have nearly the same wavelength an interaction takes place between them which results in the production of "beats," just as in acoustics two sounds of nearly the same pitch produce a pulsation of sound or "beats." The beat or pulsation frequency is numerically equal to the difference between the two main frequencies—and this is true in the electrical as well as in the acoustic case.

When we are dealing with two sounds the frequency of the beats cannot be very large since neither of the sounds will as a rule have a frequency in excess of about 5,000 per second, and hence the difference between their frequencies cannot exceed this figure, and will generally not be more than a few hundred per second. Hence the beat frequency in the acoustic case will be only a low pulsation or at the most a low tone. In the case of two radio frequencies, however, the beat frequency, being the difference between them, can be quite high—several thousands per second, and even above audible frequencies. In the radio case the initial frequencies are usually so high that very little detuning is required to produce a beat note of several thousand per second, which represents an acoustic note of fairly high pitch. The higher the frequencies of the radio frequency oscillations, *i.e.*, the shorter the wavelengths, the less will be the percentage detuning necessary to produce a beat note of given pitch. Thus: consider two oscillations of wavelength approximately equal to 6,000 metres. The frequency corresponding to 6,000 metres is 50,000 per second; hence if one circuit is oscillating at this frequency and the second has a frequency of 51,000, the beat note will be 51,000—50,000=1,000 per second, which is a nice comfortable tone to hear in the telephones. The percentage detuning between the circuits is, in this case,

$$\frac{1{,}000}{50{,}000} \times 100 = 2 \text{ per cent.}$$

Suppose now the oscillation wavelength is reduced to 200 metres, the corresponding frequency is 1,500,000 per second. In this case, for a beat note of 1,000, the second circuit needs to be given a frequency of 1,501,000 per second, the percentage detuning in this case being only

$$\frac{1{,}000}{1{,}500{,}000} \times 100 = 0{\cdot}06 \text{ per cent.}$$

Since however it is possible easily to hear the beat note when it has a frequency of 100 per second, it is easily possible to detect an amount of detuning between the circuits represented by 0.006 per cent., while usually still closer limits can be worked to if a little extra care is taken.

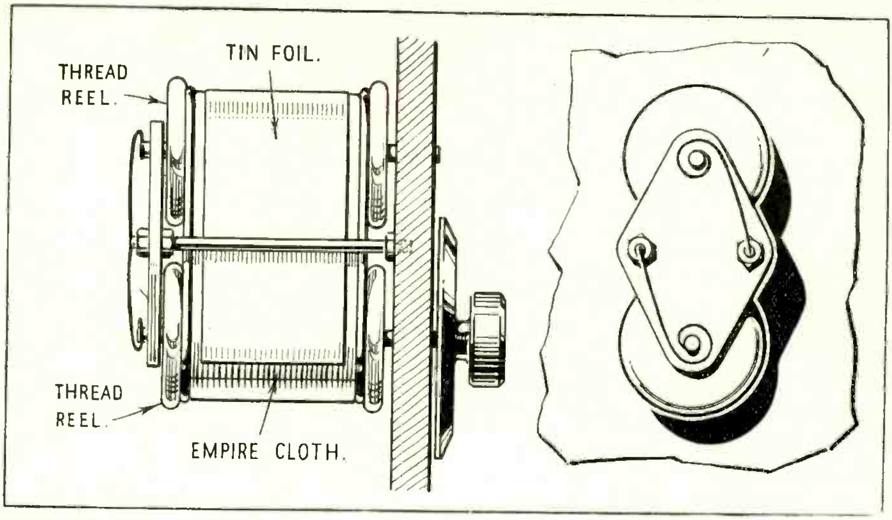
Hence the heterodyne method forms a very convenient and accurate means of determining the resonance point of two circuits—a method far more exact than is possible by other means.

The "double-click" method to which reference was made above is also a means of indicating resonance between two circuits but one that does not give such a high order of accuracy as the heterodyne beat method, although it is accurate enough for most purposes. To carry it into effect it is necessary to use an oscillating detector valve such as has already been outlined, and to set up the second circuit close to oscillating circuit. Then as the tuning of the second circuit is altered, while listening in the telephones of the oscillating detector valve, it will be found that at the resonance point the second circuit absorbs energy from the oscillating circuit and stops the oscillations—the cessation being indicated by a click in the telephones. As the tuning condenser of the second circuit is moved through the resonance point a click will be heard in the phones, and as it is moved back again another click as it passes through resonance. These two clicks will be nearly at the same setting of the tuning condenser—the mean of the two settings being taken as the resonance point. The reason for the two clicks, and how this method may be used will be discussed in another article.

Both these methods of indicating resonance between two circuits provide simple means of determining the constants of the oscillation circuits in a manner which will be discussed more fully at a later stage.

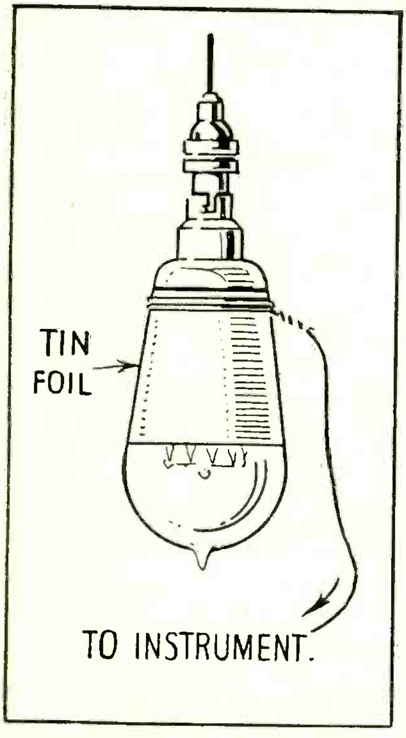
Members of the Lytham Saint Annes Wireless Society with their handsome display of apparatus. The Society held a special public demonstration, attended by nearly 600 persons, on March 10th.

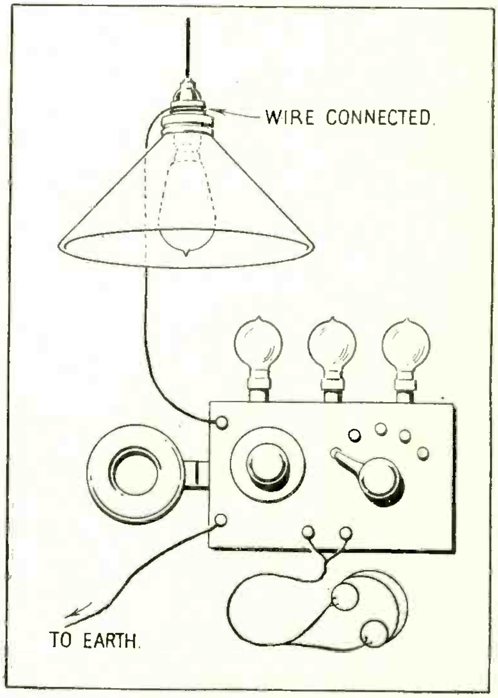
A New Variable Condenser.



Of a simple design, it can be built at home. The tin foil is attached to the empire cloth, and makes contact with the spindle of the upper reel. The lower reel is covered with tin foil, which makes contact with its spindle. Cords must be tightly fixed round the ends of the reels so that they both move together.

Electric Lighting Circuits as Aerials.





Two effective methods of utilising electric lighting leads as aerials. The capacity of the tin foil wrapping, or even of the fitting itself to the conductors, is sufficient to pass the H.F. currents induced into the lighting system.

Wireless Theory for the Listener-in and Experimenter.

By W. James.

Introduction.

It is the purpose of the writer to provide information which will satisfy the intelligence of those people who have but recently become wireless enthusiasts, and, who besides wishing to merely operate their receiver for the best enjoyment of broadcast programmes, feel a desire to understand in a general way the principles underlying the reception and transmission of speech. There is always a great satisfaction felt when one is able to predict the result of certain tuning operations.

Others may wish to modify or add to their receiver. There is no doubt a large number have purchased small power receivers, and after a while have felt a desire to increase the range or the strength and quality of the signals. To those these articles will be of especial help.

It is proposed to plunge straight into the principles of reception. It is thought those who require further information concerning *electricity* will refer to books specifically designed for that purpose.

1.—The Simplicity of Wireless Circuits.

A simple examination of a wireless receiver will suffice to show how simple are the components which together form the receiver. There are the tuning circuits, which comprise inductance coils and condensers; the crystal or valves; the transformers; and the head receivers or loud speaker. A few other parts such as switches, resistances and batteries are used. The whole, suitably wired together, and we have a wireless receiver capable, when connected with an aerial, of receiving signals from all parts of the earth. Each item, individually considered, is as simple as one could wish; the whole receiver, with its wiring connecting this component with that, rather bewildering and mysterious to those who have not examined each portion in detail. To those who read these articles it is hoped the bewilderment will disappear, though the sense of mystery will probably always remain.

2.—Wavelength.

It is stated the wireless programme of the London station of the British Broadcasting Company will be transmitted with a wavelength of 369 metres. Everyone is familiar with wave motion. A stone is thrown into a pond and waves are produced. The waves have amplitude, depending upon the disturbance, and they have velocity. The distance travelled by the disturbance in one second is its velocity. The number of crests which appear during the second is the frequency; therefore the wavelength, or distance between two successive wave crests, is equal to the velocity divided by the frequency. Waves are shown in Figs. 1 and 2.

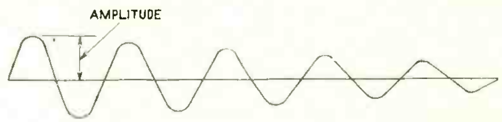


Fig. 1. A damped wave. The wave is damped because the amplitude of the wave diminishes. The wavelength is the distance between successive crests or troughs. It will be noticed the wavelength is the same whether measured between the first and second crest, or say, the fourth and fifth trough.

The velocity of electricity is equal to the velocity of light—300 million metres per second. The electrical energy which is being transmitted by the broadcast station in the form of wireless waves is therefore travelling in all directions with a velocity of 300 million metres per second. The distance between successive crests of the waves is 369 metres.

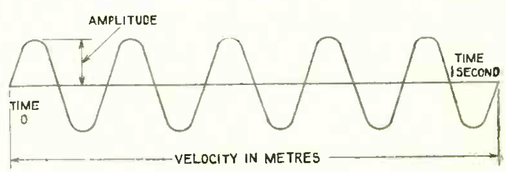


Fig. 2. A continuous wave. The wave is continuous because the amplitude of the crests of the wave is constant. The velocity is given by the distance through which the energy of the wave travels in one second, and is equal to the wavelength multiplied by the frequency.

As in the case of waves upon water, the amplitude of the waves is less, the greater the distance from the source of energy.

The waves have a definite shape. When the transmitter is connected to the aerial, continuous waves are generated, but as soon as the control circuits are switched in, and someone speaks so that the microphone is affected, the continuous waves are modulated and take the general form of the sound waves. The aerials, to which are connected our receivers, therefore absorb electrical energy which, besides varying with enormous frequency—equal to 300 millions divided by the wavelength—are varying also at a slower rate according to the nature of the signal which is being transmitted. The frequency of the human voice varies from 200 to 3,000 cycles or complete alternations per second. The waves which are received are therefore complex, but their nature is easily understood. As a simple analogy one can think of the "flying boats" which are to be found at exhibitions and shows. While the boats go round and round, they move up and down. Here we have one slow motion, while superimposed is the quicker motion. As a more exact analogy, perhaps, one may think of a boat which is travelling over the waves of the sea. To the boat is fastened one end of a flat spring, the other being weighted and free to vibrate. When the boat is moving over calm water, by bending and releasing the spring, the end of the spring will vibrate rapidly as shown in Fig. 2. If now the boat travels along the surface of the waves we have two motions, one slow motion due to the ship, and the rapid motion due to the spring. The waveform will then be as given in Fig. 3, a large number of small variations due to the spring

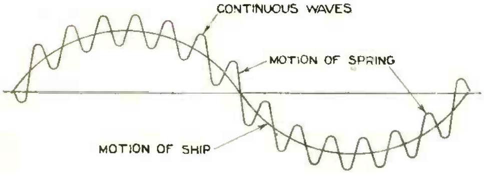


Fig. 3. A continuous wave superimposed upon a lower frequency.

taking place at the same time as the slower variations due to the waves of the sea. We have, therefore, a *modulated* wave. The wireless transmitter is designed so that a continuous stream of waves as shown in Fig. 2 is sent out until, when the microphone is affected by speech, the wave shapes given in Fig. 4 are produced. In Fig. 4 it will be noticed the continuous waves have different amplitudes from point to point, according to the magnitude of the slower frequency speech signal.

3.—The Object of Tuning.

It is well known that mechanical objects possess a natural frequency, or natural period of vibration. Thus when soldiers on the march reach a bridge the order to "break step" is given. The natural period of vibration of the bridge is low—it may be 90 a minute. If the soldiers marched over the bridge taking 90 steps a minute, the frequency of the blows of the soldiers feet upon the bridge would coincide with the natural frequency of the bridge which would vibrate. The amplitude

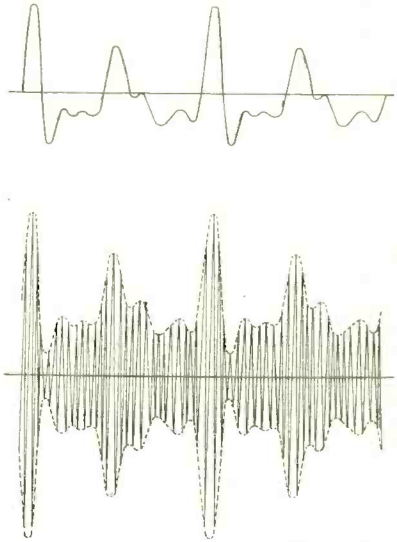


Fig. 4. The upper diagram shows the wave shape produced when the letter A is spoken. The transmitter generates continuous waves, but when the speech and continuous waves combine the continuous waves are varied in amplitude according to the speech wave. As shown in the lower portion of the figure we have a modulated wave, the shape of the dotted line joining the peaks of the wave being similar in contour to the upper diagram.

of the vibrations would depend upon the force with which the soldiers feet struck the bridge, and would build up until there was a danger of the vibration of the bridge resulting in its destruction. The point to notice is the magnitude of the vibrations set up depend upon the force of the blows, and the frequency. When the soldiers break step, the force of the blows remains the same, but the frequency of the blows is totally different. The bridge will not swing. In wireless circuits we desire the amplitude of the electrical vibrations to be as great as possible. The force or magnitude of the energy which is collected by the aerial (corresponding to the force of the blows due to the soldiers marching) we have no control over; but we can alter the natural frequency of the aerial and so cause the energy to swing with the maximum amplitude. The act of changing the natural frequency of the circuits in the receiver is called tuning. From a little consideration it must be obvious that if we tune the receiver so that it responds to one frequency only, the energy in the circuits will reach a far greater maximum value than if the circuits respond equally to a number of frequencies close to the fundamental or main frequency. The circuits should, therefore, be designed so that they respond to as near as possible one frequency only. Carrying the analogy a little further, it will be noted the amplitude of the swings of the bridge will depend upon its construction, that is whether it is fairly rigid or flexible. In the same way the amplitude of the oscillating energy in the receiver will depend upon the resistance offered by the material of the circuits. To obtain a maximum amplitude, the resistance should be reduced to as low a value as possible.

4.—Tuning Circuits.

An electrical circuit which contains capacity and inductance may be tuned to any frequency desired by the correct choice of values. In a wireless receiver the condenser and the inductance connected in the tuning circuits are variable.

5.—Electrons.

Befo-e one is able to visualise the action of inductance coils and condensers, and in particular the thermionic valve, it will be necessary to obtain some idea of the effects produced by electricity. The subject will only be touched upon here, the aim being to present sufficient information for the reader to have some of the mystery, at all events, of the action of the apparatus mentioned above removed. The subject is fascinating and well worth pursuing.

The construction of matter is generally well understood. Matter is anything which occupies space. It is well-known matter is divisible into molecules, which are made up of atoms. The atom is the smallest particle of matter which is able to take part in chemical action; thus, one molecule of water (H_2O) consists of two atoms of hydrogen (H_2) combined with one atom of oxygen (O).

The modern view of electricity is that the atom is charged with a large number of electrons. The electron is considered as the natural unit of electricity. Closely associated with the electrons is a smaller number of positive charges. The positive charges form a central nucleus, and it is believed these positive charges are fixed, and remain always connected with the atom. On the other hand, the electrons are *free*. The number of electrons present in an atom which has not been disturbed varies with the material of which the atom is composed. Some atoms have just a few electrons associated with them, while others have a much larger number. To form a mental picture, the positive charges may be considered as forming the central shaded portion of Fig. 5, while the electrons are represented by the large number of smaller circles. The electrons are in constant movement, and fly round and round the positive

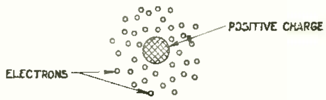


Fig. 5. The figure gives an idea of the construction of an atom. The central positive charge is fixed. The electrons or negative charges are grouped around the positive charge, and are in constant motion. Probably atoms of substances differ only in the number and arrangement of electrons which are normally associated with them.

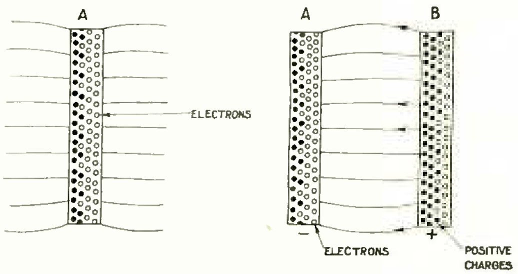


Fig. 6. In the left-hand portion of the figure the body A is negatively charged because it has an excess of electrons. When body B is brought near A, the electrons present in B will leave the side nearest A with the result that the left-hand side of B is positively charged. Lines of force are set up between the two bodies.

charges, their path not necessarily being circular, but due to collisions may be zigzag. Their velocity is very great. Under the influence of certain forces, the velocity of the electrons may be increased to such an extent that they fly off into space. This will be more fully dealt with when we come to consider the action of the thermionic valve.

Now it is well-known that bodies with unlike electric or magnetic charges attract, while on the other hand bodies with similar charges repel. As an illustration, a north and a south magnetic pole attract each other ; in a similar manner two bodies, one charged with positive electricity and the other with negative electricity, attract. A body is considered charged positively when it has a deficiency of electrons, that is, the number of electrons present is less than that normally associated with the body. The body is charged negatively when it has an excess of electrons. If one considers a charged body A, Fig. 6, lines of force will leave the body as represented. If now another body, B, which is not charged, is brought within the field of A, a redistribution of electricity will take place in the body B : thus, if A is negatively charged, the side of B nearest to A will become positively charged, because the electrons which are free will be repelled to the side of B remote from A. It is to be expected, therefore, that due to the presence of both positive charges and electrons in a piece of any substance, there will be no passing to and fro from one point to another of electrons under normal conditions. The atoms are therefore electrically *neutral* until disturbed.

6.—CONDUCTORS AND INSULATORS.

A conductor of electricity is characterised by having a large number of electrons which are free to move when stimulated, while an insulator, on the other hand, contains few free electrons, or is a substance in which the electrons are difficult to move. An atom which is not electrically neutral, that is, which is either charged positively or negatively through having too few or rather more than the normal number of electrons, is called an ion.

A current of electricity is considered as a drift of electrons along a conductor. The movement of electrons (or in other words, the current of electricity), may be obtained in a number of different ways ; thus, if a dry cell is connected to the ends of the conductor, although the electrons continue to fly around the positive charges, there is a gradual electron drift along the conductor as represented in Fig. 7. In this case, due to the chemical action which is taking place between the elements of the cell, one end of the conductor

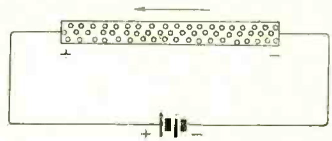


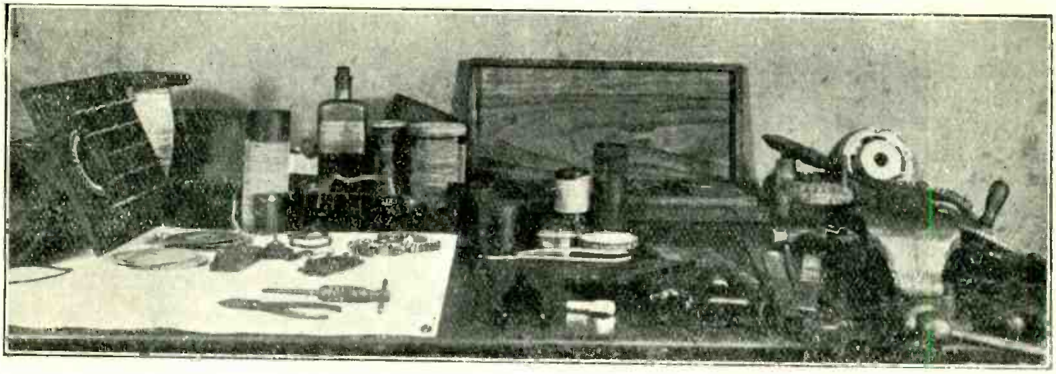
Fig. 7. When a potential difference is applied to the ends of a conductor there is a drift of electrons, the electrons moving away from the end which has an excess towards the end which has less than the normal number. In the figure the movement of electrons is shown through the action of the cells which are joined to the conductor. It will be noticed the electron flow is from negative to positive. In ordinary circuits it is customary to assume the current flow is from positive to negative.

is made positive, while the other end is made negative. We say the cell is generating an electrical pressure, and when connected in the manner shown, we are applying a potential difference to the ends of the conductor. The electron drift takes place from the negative end of the conductor to the positive, the tendency being for the electrons to flow in an endeavour to restore the number of electrons at the positive end of the conductor. In a similar manner, when a bar of iron or other conductor of heat is heated at one end, the heat will travel down the bar from the end with the higher temperature to that with the lower temperature, in an endeavour to equalise the temperature of the bar at all points.

(To be continued.)

Why not use the Lower Wavelengths when Transmitting?

ALTHOUGH a number of experimenters make use of the lower wavelengths when conducting transmission experiments there appears to be quite a number who work near 440 metres. Now it is a fairly simple matter to build a transmitter which will operate quite well when tuned to the higher wavelength, but difficulties are experienced when one tries to operate on the lower band. The difficulty is largely due to the readiness with which the tuning is varied with but slight changes in the capacity. Remote controls may be arranged by mounting wooden pulleys to the spindles of the variometers, the handles also having pulleys. A string may be passed round the pulley grooves.



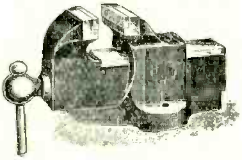
The Wireless Workshop.

By F. H. Haynes.

Articles under this heading will appear in alternate issues and will give elementary practical advice on the working of materials employed in wireless constructional work as may be helpful to the amateur worker. The construction of the components of a complete four-valve receiver will be given to explain home workshop methods.

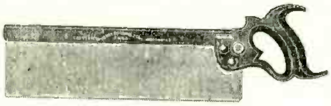
I.—Initial Considerations and Equipment.

The scope of the wireless experimenter is very much limited if he lacks facilities for making up components and complete outfits embodying both ideas gleaned from

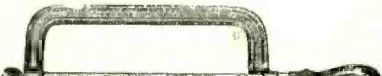


his own tests and those put forward by research workers.

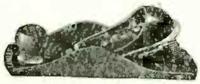
It is not the aim of this article to create despair in the heart of the reader who is forced to execute his instrument making on the kitchen table or whose means prevent him



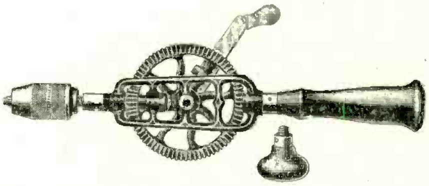
from procuring a complete array of tools. The recent Transatlantic Tests have evidenced how much highly successful work can be accomplished when only some small corner of the household is devoted to the making and installing of the apparatus.



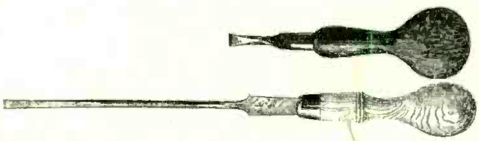
The advantages gained by having a strong and heavy bench permanently allocated for one's use cannot be too strongly emphasised. It may be fitted with a rack to carry all the hand tools and affording an allotted place for each tool so that all are readily accessible, easily put away and the absence of any one immediately detected. Their display in this manner permits of them being kept in a good



and clean condition and those requiring it may be kept slightly greased to prevent rust. It must be realised from the start that cleanliness and the tidy arrangement of the tools in the workshop is vital to precise and speedy



work, beside producing a condition of mind conducive to good workmanship. A drawer in the bench is useful for accommodating the



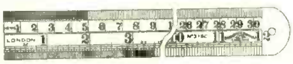
smaller and more delicate tools, such as the square, micrometer, calipers, drills, taps and dies, etc. Another drawer can perhaps be arranged to hold a stock of screws, nuts, washers, terminals and other small parts, whilst two or three boxes standing on runners

beneath the bench will serve as receptacles for spare and scrap stocks of ebonite, brass, wood, etc. The less fortunate worker who cannot possess himself of such a bench should at least provide a large box with a number of

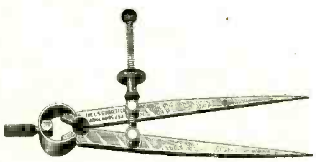
wooden trays for accommodating various tools and materials.

The tools to be procured for a start, and representing the minimum with which good work can be carried out, are scheduled below:—

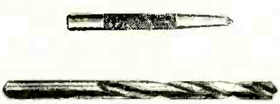
An iron vice having jaws measuring 2 ins.



to 3 ins. across, or larger, and opening in a parallel fashion to a distance of 3 ins. or more. This will require bolting permanently to the bench or other firm structure at a height of about 2 ft. 6 ins. from the floor. A



small stiff-backed tenon saw 6 ins. to 8 ins. in length and fairly fine set, so that it can be used on hard woods and ebonite. A hacksaw for metal, having a solid cast-iron back and

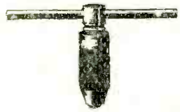


arranged, preferably, to take 8 in. blades. A dozen of the best quality fine set blades should be procured with the saw.

A small iron plane about 5 ins. in length and having a blade about $1\frac{1}{2}$ ins. across.

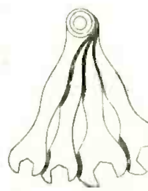
A hand brace with adjustable chuck arranged

to take drills up to $\frac{1}{4}$ in. There are many of these tools on the market which only take drills up to about 5/32 in. which somewhat limits their utility.



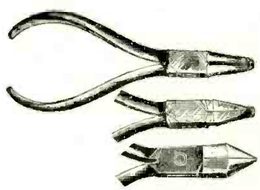
An electrician's screwdriver about 9 ins. long having a boxwood handle and edge about $\frac{1}{4}$ in. to 5/16 in. across.

A smaller instrument screwdriver with an edge of about $\frac{1}{8}$ in.



Four 8-in. files about 1 in. wide and of the following grades, dreadnought, rasp, bastard cut and smooth cut, with two cutting faces,

one cutting edge and a safety edge. Two of these files may with advantage be half round. Three smaller files, about 5 ins. in length,



one flat, one triangular and the other round and having medium cut faces.

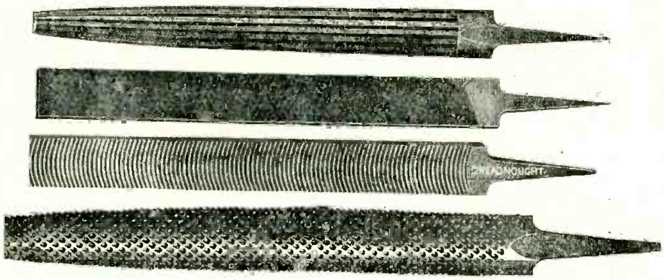
4 in. or 5 in. steel square.

6 in. steel rule.

A pair of spring dividers.

$3\frac{1}{2}$ in. centre-punch.

A set of Morse twist drills, sizes 1 to 45, or in sixty-fourths of an inch, from $\frac{3}{64}$ in. to $\frac{1}{4}$ in. Drills of the following sizes may also be needed, $\frac{9}{32}$ in., $\frac{5}{16}$ in., $\frac{11}{32}$ in., $\frac{3}{8}$ in., $\frac{7}{16}$ in. and $\frac{1}{2}$ in.



Taps and dies, sizes 0, 2, 4, 6 and 8 B.A. with holders. Two taps being taper and plug should be obtained in each size.

Three small pairs of pliers, having rounded, square, and cutting jaws.

A larger pair of cutting pliers.

A soldering bit of medium size.

Among the consumable materials will be required, coarse and fine emery and glass paper, "Seccotine," "Fluxite," resin, solder, shellac varnish, paraffin wax, adhesive insulating tape and pale gold lacquer.

A set of small spanners for B.A. nuts.

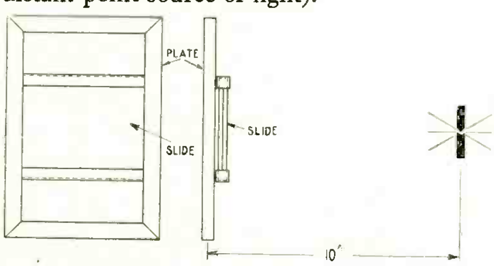
A medium sized hammer will be needed.

Screws, ebonite and brass will be detailed as required.

A Simple Method of Copying Lantern Slides.

By G. G. BLAKE, M.I.E.E., A.Inst.P.

SOME time ago, when preparing a lecture, I was lent a large number of lantern slides, on condition that I made copies and returned them as soon as possible. As so many had to be copied and so little time was available, I sought a quicker method than the use of an enlarging lantern, and finally I evolved the following, in which the same principle is employed as when radiographs are taken by X-rays (*i.e.*, sharply defined shadows cast by an object illuminated by a distant point source of light).



Method of printing direct from slide.

The whole process is carried out in a dark room illuminated only by the usual ruby light, and the procedure is as follows —

The lantern slide to be copied (Fig. 1), mounted with its usual cover glass, is placed in contact with a "special rapid" plate in a $\frac{1}{4}$-plate printing frame with the film side of the lantern slide facing the film side of the plate (the cover glass being between). The frame is placed at a distance of 10 feet from a small automatically fed electric arc, having a current consumption of only 5 amps. at 110 volts D.C., and it will be found that a perfectly sharp reproduction can be made from a slide of average density, by an exposure of less than one second's duration, the arc being switched on and off as quickly as possible—just a flash.

The negatives of the slides thus obtained are in every way as sharp and full of detail as the usual photographic reproductions made by an enlarger or with a camera. A dozen slides can be copied in less than half-an-hour and the negatives developed and fixed. Having rinsed the negatives after fixing, a bath containing a very weak solution of permanganate of potash, in about four minutes destroys all traces of hypo. They were then placed in a 10 per cent. solution of formaldehyde to harden the films so that they can be carefully wiped with a dry cloth and placed before a fire, which dried them in about seven minutes. Contact prints can then be made on "slow contact" plates in the usual manner.

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

The Wireless and Experimental Association.*

At the meeting on March 14th a long discussion took place on the relative merits of carborundum and hertzite. The diagram of a single valve super-regenerative circuit also came under review. The Chairman stated that he was conducting experiments on wireless reception with some deaf people with most promising results.

Hon. Asst. Secretary, G. H. Horwood, 557, Lordship Lane, S.E.22.

Walthamstow Amateur Radio Society.*

A very successful social and dance was held in the Hut, Church Hill, on March 10th, at which Mr. White, with four-valve set and loud speaker, demonstrated to a large audience.

On Thursday, March 15th, Mr. Vizard, of the Ilford Radio Society, illustrated an interesting lecture with his Transatlantic set.

Hon. Asst. Secretary, E. G. Whiter, Y.M.C.A., Church Hill, E.17.

Oldham Wireless Society.*

The above is the new name of the former Oldham Lyceum Wireless Society. Material alterations have been made in the constitution, and the Society has transferred its headquarters to St. Thomas's Schools, Coppice, Oldham. A feature of interest to all wireless enthusiasts in the district will be an Exhibition and Demonstration, which the Society is holding in St. Thomas's Schools on April 21st.

A hearty welcome to membership is extended to all radio enthusiasts, and those interested should communicate with the Hon. Secretary, Graham Halbert, 16, Southhill Street, Oldham.

The Trafalgar Wireless Society (Greenwich).*

On March 9th Mr. R. J. Stanley continued with his series of lectures on "The Production and Reception of Wireless Waves."

Steps are being taken to improve the Society's aerial.

Hon. Secretary, F. A. L. Roberts, 43, Adelaide Road, Brockley, S.E.14.

The Finchley and District Wireless Society.*

On Thursday, March 8th, at St. Mary's Schools, Finchley, Mr. Brown kindly lent a Siemens valve crystal set, which was interestingly demonstrated by Mr. Wilke, who also gave a short talk on the theory of grid leaks and their correct values.

Hon. Secretary, A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

The Ilford and District Radio Society.*

On March 8th Mr. C. H. Andrews gave a "Demonstration of Reception," in which he tackled the difficult problem of dual amplification and showed how to make one valve do the work of two.

Hon. Secretary, A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

Leeds and District Amateur Wireless Society.*

An instructional meeting was held on March 9th, when the Hon. Secretary lectured on "How to Receive **WQK, MSK, SUE** and **2 LO**, on a Single-Valve Indoor Aerial Set." A very keen discussion followed. A visit to the Telegraph Department, G.P.O., Leeds, took place on Saturday, March 10th, when, through the kindness of the postmaster, 40 members were enabled to examine the intricate mechanism employed.

Hon. Secretary, D. E. Pettigrew, 37, Mexborough Avenue, Chapeltown, Leeds.

Borough of Tynemouth Y.M.C.A. Radio and Scientific Society.*

On Monday, March 12th, Mr. W. G. Dixon, of the Newcastle Amateur Wireless Association, lectured on "Short Wave Receivers."

A number of members and friends on Thursday, March 15th visited the Daimler Motors Depot at Wallsend, when they had the unique experience of hearing **5 NO** while travelling at speed in a 30 h.p. Daimler limousine. Mr. Dent, the manager, kindly conducted the party over the works.

Broadcast licence holders will be welcomed as prospective members of the Society, and are invited to communicate with the Hon. Sec., Geo. J. S. Littlefield, 37, Borough Road, North Shields.

The Swansea and District Radio Experimental Society.*

The Society's Exhibition on March 1st was a great success, the attendance amounting to nearly 2,000. Stands were occupied by many prominent firms, including The Telephone Manufacturing Co., Fuller's, Siemens, and the General Electric Co. A novel feature was the Society's recruiting stand, at which many new members, including one lady, were enrolled.

On March 7th Col. Sinclair, A.M.I.C.E., delivered an interesting address on "The Effect of Moon Phases on Wireless Reception." After the discussion Col. Sinclair distributed prizes won in connection with a competition held at the Exhibition. It is proposed to hold another Exhibition next October.

All radio enthusiasts in the district are invited to join the Society.

Hon. Sec., Herbert Morgan, 218, Oxford Street, Swansea.

Hackney and District Radio Society.*

"The Care of Accumulators" was the title of an interesting lecture by Mr. Wall, given at the Y.M.C.A., Mare Street, Hackney, on Thursday, March 8th.

Hon. Sec., C. Phillips, 247, Evering Road, Clapton, E.5. (Letters only.)

The North London Wireless Association.*

An informal meeting was held on March 12th, when much interest was displayed in the tuning in of distant stations. The Morse class recently formed makes excellent progress, many new students being enrolled.

Applications for particulars of membership should be addressed to the Hon. Sec. of the Society, Northern Polytechnic Institute, Holloway Road, N.7.

Guildford and District Wireless Society.*

On Monday, March 12th, Mr. P. K. Turner delivered the third of his series of lectures, the subject on this occasion being "Single Valve Circuits." He expressed the opinion that a valve, when adjusted to rectify, never gave its best efficiency, and claimed that the most economical method of using a valve was to make it an amplifier pure and simple, and use a crystal as rectifier.

Hon. Sec., 148, High Street, Guildford.

Wolverhampton and District Wireless Society.*

A lecture was given by Mr. Geo. W. Jones, on March 14th, entitled "Building a Set from Scrap."

The lecturer could not have chosen a more appropriate title for his discourse, inasmuch as the cost of the entire apparatus (excluding headphones) only amounted to 10d. Hearty appreciation was accorded Mr. Jones on his successful experiment.

Hon. Sec., J. A. H. Devey, 232, Great Brickkiln Street, Wolverhampton.

The Belvedere and District Radio and Scientific Society.*

On Friday, March 9th, an instructive lecture was given by Mr. E. Metcalfe on the subject of "Rectifiers." Numerous additional points of interest were raised in the discussion which ensued.

Hon. Sec., S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

Scarborough Radio Society.*

An instructional meeting was held on March 9th, when Mr. Geo. R. Fawcett, one of the members, exhibited and described a five-valve set of his own construction.

Hon. Sec., F. Bulmer, 4, Carlton Terrace, Scarborough.

Liverpool Wireless Society.

Thursday, March 8th, was a special evening arranged for the broadcasters of the Society, and at the Royal Institution, Colquitt Street, Mr. Egerton Pulford gave demonstrations on various well known makes of broadcasting sets.

All users of wireless sets in the Liverpool district are cordially invited to become members.

Hon. Sec., G. H. Miller, 138, Belmont Road, Anfield, Liverpool.

The Bournemouth and District Radio Electrical Society.

A very interesting meeting was held on Friday, March 9th. An interesting discussion took place on the phenomenon of fading.

A very generous offer was made by Mr. P. G. G. Moon, in the form of a very substantial sum towards the initial outlay for the Society's receiving set. It was agreed that all members should bring along any spare parts that could be used in the building of the set. The aerial is now in course of erection.

Hon. Sec., L. O. Sparks, 3, Cotland's Road, Bournemouth.

The Beckenham and District Radio Society.

The meeting on March 8th was given over to the discussion of the Society's new set, it being decided to commence operations right away.

Hon. Sec., J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

Uxbridge and District Radio Society.

This Society, which was formed a few weeks ago, is making considerable headway. Meetings are held on alternate Tuesdays and Fridays in the club room, adjoining the "Swan and Bottle," High Street, Uxbridge. The Society's first lecture was given recently by the President, Dr. W. T. Dobson, M.R.C.S., L.R.C.P., who devoted his interesting remarks to the subject of accumulators.

Particulars of membership can be obtained from the Hon. Sec., J. R. M. Day, 10, Prospect Terrace, Cowley Road, Uxbridge.

The Magdalen College School (Brackley) Radio Society.

This Society was formed a short time ago when the following officers were elected:—President, Rev. R. F. Ashwin, M.A.; Hon. Treas., Mr. K. O. Ireland; Hon. Sec., Mr. J. E. Arnold. Meetings are held on Saturday evenings.

The Society has a three-valve set with 1 H.F. (with tuned anode), detector and L.F., used in conjunction with a home-made loud speaker.

Hon. Sec., J. E. Arnold, Magdalen College School, Brackley, Northants.

The Grays and District Radio Society.

At a meeting on March 8th, Mr. J. Bacon, addressed the Society on the construction of wireless sets.

Hon. Sec., J. H. Melville Richards, Surveyor's Office, 57, High Street, Grays, Essex.

Wimbledon Radio Society.

On Thursday, March 15th, at a meeting held at the Red Cross Hall, Church Road, Wimbledon, it was decided to form the Wimbledon Radio Society, to meet on every alternate Thursday for discussions on radio news, interchange of views, etc.

Mr. C. G. Stokes, Worple Avenue, Wimbledon, has kindly offered to act as Secretary, *pro tem*, and intending members should communicate with Mr. Stokes as soon as possible.

The Radio Society of Bradford-on-Avon.

The Society, the President of which is the Right Hon. Lord Fitzmaurice and the Vice-Presidents, Brig.-Gen. Palmer and Mr. C. W. Darbishire, M.P., was re-formed two years ago. During the last twelve months, the Society has built its own headquarters, equipping them with a crystal receiver, a three-valve receiver, with a full set of Burndept coils and other apparatus.

At a recent meeting the following programme was decided on:—Monday, Wednesday and Saturday evenings: Broadcast reception. Tuesday evening: Testing apparatus. Thursday and Friday evenings: Morse practice and constructional work. Lectures, both elementary and advanced, are to be given by Mr. A. H. Baker, B.Sc. (Vice-Chairman), and Mr. L. Boxwell.

Ladies and gentlemen are eligible for membership.

Hon. Sec., H. Helps, 4, Ivy Terrace, Bradford-on-Avon, Wilts.

Fundamental Principles of Radio Reception.*

By Maurice Child.

THIS lecture will be of a very elementary character at first, but I am not going to apologise for that, because I feel sure there must be many who are taking an interest in wireless now with very little, if any, knowledge at all of some of the very fundamental effects that are obtained with electricity.

I want in the first place to tell you something about such things as conductors, insulators, and what are very important in wireless work, dielectrics. Mr. Blake in his lecture last month showed a great number of experiments, in which were used copper conductors. I also am going to make use of some experiments in which I shall use copper conductors. The reason that copper conductors or copper wires are used is because silver, which is preferable electrically, is too expensive. Fortunately, however, the difference between silver and copper as electrical conductors is very small. The best electrical conductor is silver, and very, very close to it on the list of conductors we get copper. As copper is very much cheaper than silver it is consequently utilised. In the apparatus which I take it all of you have, or are going to have, there will be copper wires, and the object of these copper wires is to make what we call an electrical circuit, in which a current, or a number of varying currents, can flow. Now, in addition to copper conductors, we have other metals which may be considered as resistances; that is to say, they offer much more resistance to the flow of an electric current than copper. There is no such thing as a perfect electrical conductor. All electrical conductors, even silver, have a certain resistance; that is to say, they tend to absorb electrical energy from the circuit which they form. In addition to the copper and other metals which are used as electrical conductors, we have certain liquids which conduct fairly well, although nothing like so well as copper. The best liquids as conductors are those which have considerable proportions of salt in them—not necessarily what we know as common salt, but various chemical salts—and if we want to improve what we call the conductivity of water, we can add various acids; but pure water, that is distilled water, is a very poor electrical conductor.

It is interesting at this moment to tell you something about the importance of the conductivity of the earth as regards radiotelegraphy and telephony. It has been found by experience that electric waves travel very much greater distances —or I can put it in another way, they travel with less energy absorption—when they are passing over a good conducting surface. Now, the ordinary surface of the earth varies in its electrical conductivity. In some places we have a very much better conducting earth crust than in other places, and that very often accounts for a great deal of difference in the strength with which you may receive signals. If you are fortunate in having your house situated on a particularly good conducting earth, you are likely to get better signals than if your house happens to be situated on, say, a rock in which there may be quantities of iron. I have mentioned iron because in a few moments I am going to show you some of the properties of iron in connection with electrical practice.

Now we come to another very important piece of equipment called in electrical work an insulator. Various materials are found to possess the property of having such a very high electrical resistance that no current can pass through them. These insulators are of a very large variety. They consist of a large number of materials, all having different characteristics. I do not propose to go into those characteristics very much, but the common materials which are usually supplied by dealers for insulating the aerial wire for your wireless station may be porcelain, which is probably the most widely known, and ebonite, which is not a very good material for outdoor work, because it deteriorates when sunlight falls upon it; otherwise it is a very good insulating material. There is also glass which is a very good insulating material, and I shall demonstrate later on a new type of glass insulator for aerial insulation. The object of these insulators, whether glass, porcelain, ebonite or mica, which are employed, is to prevent the escape of electricity from one particular point or part to another. Wood, which may be considered as a partial insulator and a partial conductor, has to be dealt with very carefully in electrical apparatus; that is to say, we may use wood under certain circumstances with quite good effects, since it may be a sufficiently good insulator for certain purposes; on the other hand, for other purposes it may be a very bad insulator. From the point of view of a wireless receiving station, it is always safe to assume that wood is not a good insulator. It is better to be on the safe side, although the experienced radio man knows when and where he can use wood quite well without any serious loss of energy.

Another point that I want to deal with is what is called the dielectrics. Practically all insulators such as I have mentioned—glass, ebonite, mica, porcelain—are dielectrics; that is, if used, for example, between two metallic surfaces, the combined apparatus constitutes what is called an electrical condenser, and all those materials which are not good conductors may be considered as dielectrics. Some of them possess certain good properties as dielectrics, others possess properties which are purely good for insulators, but not for dielectric purposes. In all cases there is no such thing as a perfect insulator. It is only a relative term, in the same way that a condenser is only a relative term; therefore, whenever we use electrical energy in a circuit, there is a certain loss in the conductors, and in the insulators, and we have to use apparatus to make good that loss of energy. There is one further little point which I would like to impress upon you. In electrical practice, as well as in our daily lives, we never get

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* A paper read before the Radio Society of Great Britain on Feb. 16th, 1923.

something for nothing. In electrical practice our energy has to come from somewhere, and although it is being lost in the ways which I have already indicated—very often large losses occur—it has to be made up by the consumption of some existing form of energy. It would take too long to go right back through the various stages, but if one takes the trouble it is always possible to trace scientifically all expenditure of energy back to the sun.

We have many ways in which we can make electrical measurements, but there are two especially important units which we have to consider in dealing with electrical energy. We have what is called in everyday language a current of electricity, and we have that current at a certain pressure. You cannot have a current of electricity without a certain pressure, but you can have a pressure acting without necessarily any current flowing, in just the same way that you can always have a pressure of water on your water tap, trying to send water through the tap, but you need not necessarily have any water flowing. In the same way, with apparatus which comprises wireless circuits there is a pressure acting all the time from different batteries. These pressures are trying to cause a current to flow, but no current is actually flowing, unless we have a complete electrical circuit.

When we talk of a current of electricity it is natural that we should think of the ordinary dry cell or battery, and it is interesting to see what happens to it as a result of its giving out electrical energy. A battery or cell, of which thousands are sold every day all over the country, consists in the first instance of a zinc container lined inside with a sort of paste made up of flour and plaster of Paris, with a little gum mixed with it to make a paste, but the main thing is that it contains a solution of sal-ammoniac. Then inside that again we have a mixture of what is called chemically manganese dioxide, and that surrounds a carbon rod. It is commonly called a dry cell, I think, simply because there is no liquid in it to upset, but I can assure you that the moment the paste does get absolutely dry, you get no electrical energy from it.

(The internal parts of a worn-out dry cell were shown).

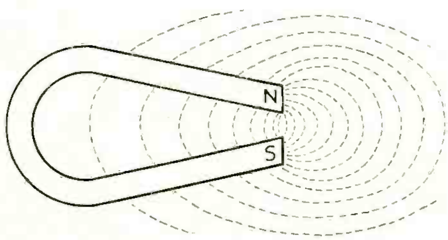


Fig. 1. The distribution of the magnetic lines of force around a horseshoe magnet.

When a cell is worn out it will be found that we have got our electrical energy at the expense of the zinc. Whenever we use any battery of any sort, there is always an expenditure of material somewhere.

The next point I have to deal with has nothing to do for the moment with electricity. I want to explain to you something about magnetism, because you will never understand how a wireless receiver works properly until you know a little bit about the properties of the magnet. In Fig. 1 is an illustration of what is called a horseshoe magnet. It is so called because it is something like a horseshoe

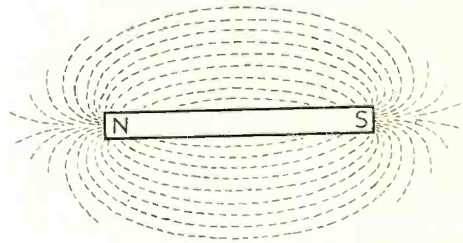


Fig. 2. The magnetic field located around a bar of magnetised steel.

in shape, though a horse would have to have a very funny foot for it to fit. It consists of a piece of hard steel which possesses the property of attracting iron towards itself, though it does not attract any other metal. There is no pull at all for instance on a sheet of aluminium, neither will it attract wood or brass. If, however, a steel knitting needle is brought near it, it likes the steel knitting needle, and holds it very tightly to itself. (*Demonstration.*) A little piece of soft iron is usually kept on the pole pieces at the extremity of the magnet in order that it shall retain its magnetism. Round the end of the magnet there is what is called a magnetic field. That magnetic field

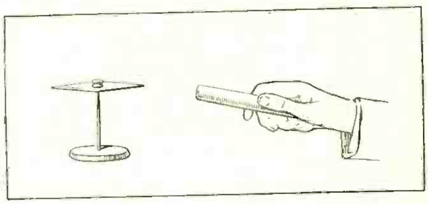


Fig. 3. A bar magnet causing a magnetic needle to move.

is spread out over a wide area and passes through you, if you are in the neighbourhood, though you are none the worse for it. You have many magnetic fields passing through you every day of your life. If you get into a tram-car, there are magnetic fields whirling round you all the time.

To illustrate that this magnetic field does exist you can put the magnet under a card, or say a sheet of aluminium. Using a simple bar magnet, in this way, by sifting some iron filings or dust all over the card or aluminium and then giving the card a little tap, there will be a slight movement amongst the dust, which will arrange itself around the poles of the magnet in the form shown in Fig. 2. If you do this experiment for yourself you will notice that just near the poles of the magnet the little iron particles stick up on end.

If you put a little magnetic needle consisting of an ordinary piece of steel which has been magnetised on a pivot, the needle will tend to point towards the north and south poles of the earth. A piece of soft iron, such for instance as is kept across the poles of the magnet, will cause the needle to move, because the needle is attracting the iron as in Fig. 3. It is not necessary for the needle and iron to touch, therefore we can have magnetic pressure just as we can have electrical pressure.

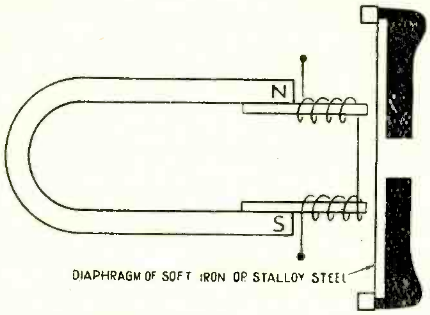


Fig. 4. A diagram showing the components and action of the telephone receiver.

Fig. 4 shows a diagram of an old pattern of telephone receiver, and inasmuch as the telephone receiver is used for the reception of wireless signals, and also for wireless telephony, it is perhaps interesting to consider how a telephone actually works. It is not a difficult thing to understand. It consists of a little permanent magnet, similar to the horseshoe magnet, but very much smaller, and with the two ends of the magnet parallel to each other. At the pole ends are two iron extensions on which are bobbins of wire. If the receiver is of what we call the watch pattern the construction is essentially the same, but with a difference in the shape of the magnet. Over the two poles is placed a thin disc of tin or iron and fixed by means of a screw cover which can be placed against the ear. Now we come to a very important experiment, which shows us that there is a definite relationship between an electric current in circuit and a magnetic field. If we place a card on a coil of insulated copper wire, and pass an electric current through the coil from the battery, whilst at the same time we sift some iron dust on to the card we will be able to see that the iron dust will arrange itself in a similar way to that which has already been shown in the case of iron magnets.

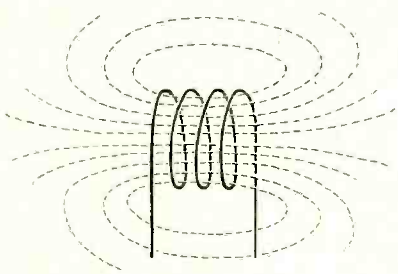


Fig. 5. Lines of force distributed around a coil wire through which a current is passing.

When the current is put through the coil, the dust begins to arrange itself until eventually it takes the form shown in Fig. 5.

This experiment indicates that whenever we pass a current through a copper wire, or through any wire for that matter, there is associated with that electric current a magnetic field similar to the field we get from a steel magnet. To illustrate this fact a little more definitely, if you take a larger coil of wire on a wooden bobbin, with a hole through the centre, and pass a current through it, there will be a magnetic field produced and from a previous experiment it was shown that the needle tends to move towards a piece of soft iron, or is repelled from one pole of another magnet. If you get the wrong pole near it, it goes away. Now if we place a piece of iron in the coil of wire, the iron becomes a magnet—a very strong one so long as a current is passing through the coil. The effect is indicated by the way the needle behaves. The iron is being pulled into the coil of wire through the current in the coil—the magnetic field is trying to pull the iron in all the time—and this can be illustrated by the fact that you can lift the whole coil up by the iron and the coil only falls off when the current is switched off. *(Demonstration.)*

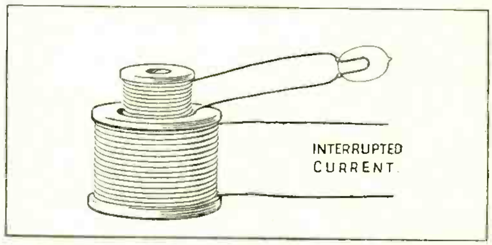


Fig. 6. An interrupted current passing in the outer coil is setting up a current in the inner coil and causing the lamp to glow.

That same principle is adopted for pulling up a tram-car on the track. When the driver wishes to stop his tram very suddenly, or when it is travelling at a moderate speed, he has only got to make a powerful electro-magnet come down on the rails, and it drags the whole tram on the rails and prevents it from moving. If these magnets are strong enough, a tram travelling at thirty miles an hour could be pulled up in two car lengths, but with, perhaps, disastrous results to the passengers inside.

Returning to the telephone receiver, we can now understand its action easily.

Under the normal conditions the permanent magnet exerts a strong pull on the soft iron diaphragm (which must not quite touch the pole pieces). If now a current is passed through the little coils on the pole pieces, they will be either strengthened or weakened according to the direction of the current. In either case the normal "pull" on the diaphragm is changed, and a very minute movement takes place, which results in a "click" being heard.

The telephone operates, therefore, only when an intermittent or varying current flows, but it is an extraordinarily sensitive device, and one of the most perfect electrical devices we have.

Now we can come to another little experiment, which is very important from the point of view of radio reception. If we take two coils of wire and place one coil inside another coil with a little lamp connected to its ends, that little lamp will light up if we keep on switching on and off the current in the first coil, though there is no actual connection between the two. The lamp flashes every time the circuit is broken. If iron is placed within the coils, we increase the effect very considerably. (See Fig. 6).

To get electrical energy transferred from one circuit to another, one must always see that the current in the first circuit is started and stopped, and that circuit is generally called the primary circuit.

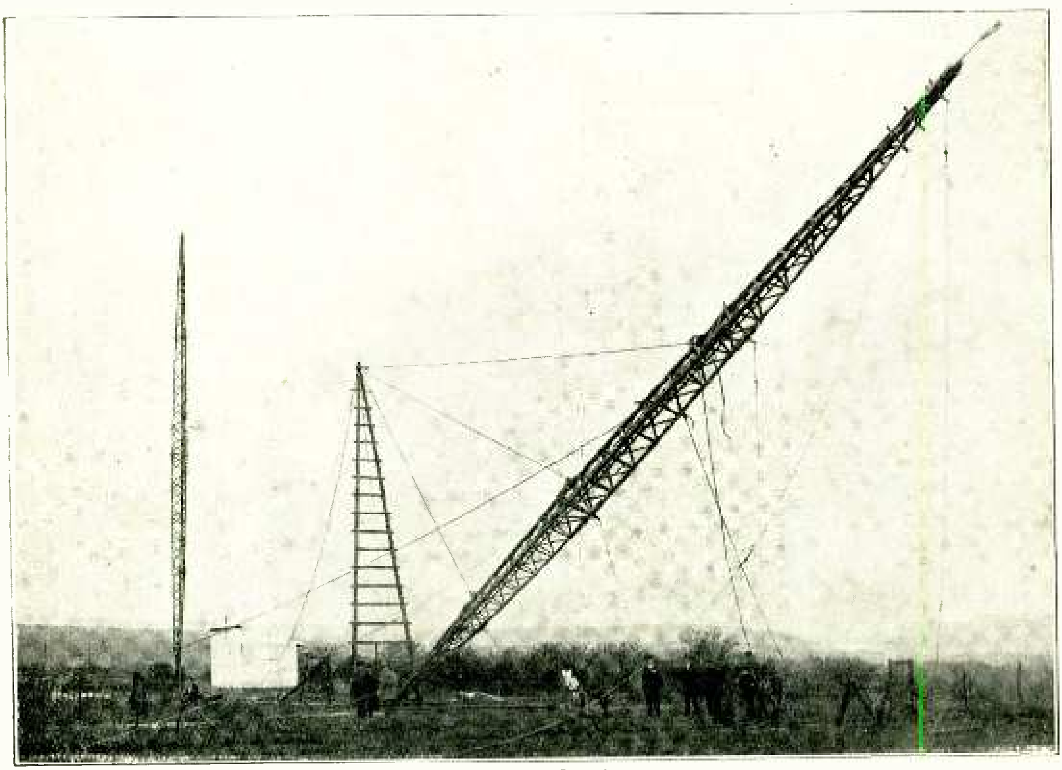
To light the little lamp steadily, we put what is called an alternating current into the primary coil. Nearly all electric lighting work is done by means of an alternating current—a current which is being made to flow and then stopped, and then started in the reverse direction and then stopped again—not flowing steadily like water through a pipe, but surging backwards and forwards.

If iron is present, forming as it were a core to the coil of wire, the magnetic field is stronger than without the iron. All these experiments indicate very well that effects produced in the second coil are due simply to the close proximity of the two coils of wire. If we use an instrument which we call a galvanometer, for detecting the presence of a current in a circuit and place the galvanometer in series with the second coil of wire, and drop say a steel magnet through the first coil, that little needle will deflect, the direction of deflection depending upon which way round the galvanometer is connected, and the particular pole of the magnet which is inserted.

(To be concluded.)

8 AE at Reuil.

La T.S.F. Moderne, our French contemporary, has erected a transmitting station at Reuil (Seine-et-Oise), which is some 10 kilometres south-west of Paris. The station is situated on an elevated plateau commanding the valley of the Siene midway between Mont Valéron and the village of Reuil. Each mast is 35 metres high and 50 metres apart. The masts are constructed entirely of wood, and are stayed and insulated, as can be seen in the illustration.



8 AE *at Reuil.*

At present this station has two sets of apparatus installed, one of 100 watts and the other of 1,000 watts, both operating on 200 metres. Numerous tests are being made on each of these powers, and the experience thus gained will be at the disposal of the French amateurs. Broadcasting from this station is under consideration, but has not yet reached the stage where it can be undertaken.

E. A. G.

Notes

Irish Import Duties on Valves.

Wireless valves are included among the articles on which the Irish Free State has just decided to impose an *ad valorem* duty of $33\frac{1}{3}$ per cent. if imported into Southern Ireland. The regulation comes into effect as from April 1st.

Wireless in India.

Wireless schemes for India were recently the subject of questions in the Legislative Assembly at Delhi. Sir Sydney Crookshank, Public Works Member, stated that the main wireless station of India, for which Agra appeared to be the most convenient centre, would probably be handed over for construction and working by private enterprise, the Government retaining a certain amount of control through the possible possession of shares or by reversion.

Proposals for a broadcasting scheme were also reviewed. Sir Sydney Crookshank assured the Assembly that all possible publicity would be given to broadcasting schemes before the Government entered into any agreement or contract. The Government was anxious for the setting up of a Rupee Company with Indian directors.

Change of Address.

We are informed by Messrs. R. M. Radio, Ltd., that their offices have been moved temporarily to 21, Garrick Street, W.C.2.

Marconi-Mullard Judgment in the Lords.

On March 23rd, the Court of Appeal, consisting of the Master of the Rolls and Lords Justices Warrington and Younger, affirmed the judgment of Mr. Justice Lawrence, that the Mullard Radio Valve Co., Ltd. (defendants), had not infringed certain patents of Marconi's Wireless Telegraph Co., Ltd. (plaintiffs). A cross appeal on the part of the defendants, attacking the validity of the plaintiffs' patents, failed. A further report of the proceedings will appear in our next issue.

Broadcast Reception in Aberdeen.

We have received some interesting details from Mr. James S. Duthie, 148, Forest Avenue, Aberdeen, Hon. Sec. of the Aberdeen Wireless Society, concerning the strength of the various broadcasting transmissions as heard in Aberdeen. "Using three valves (one H.F.), just on the point of oscillation, it is possible at times," he says, "to hear in Aberdeen all the broadcasting stations now in operation. Of these London is the best, the others in order of merit being Newcastle, Manchester, Birmingham, Cardiff and Glasgow."

An Acknowledgment.

We regret that we omitted to state that in our issue of January 13th, certain of the matter included in the article "How to make use of the Scientific Time Signals," by Mr. W. G. W. Mitchell, B.Sc., was taken from the article "Wireless Time Signals" in "The Admiralty List of Wireless Signals." The covering permission of the Controller of H.M. Stationery Office has been obtained.

Wireless Control in U.S. Navy.

The value of electrical transmission in naval operations was well demonstrated at U.S. Navy manœuvres recently carried out at the Pacific entrance to the Panama Canal. The fire of the battleship *Mississippi* was turned on the battleship *Iowa*, which, steaming at full speed without a crew, simulated an enemy vessel attempting to escape. The *Iowa* was steered by wireless from Shawmut, several thousand yards away, and was in perfect control throughout the practice.

Radio Research in Russia.

In radio research, as in other respects, Russia was almost completely cut off from the outside world from 1918 to 1921. Unusual interest, therefore, attaches to a report we have received dealing with the researches of the Russian radio engineers during this period, when they had to rely exclusively on their own creative genius.

Wireless engineers in Russia are linked together in a private society known as the Institute of Russian Radio Engineers, founded in 1918. This Society then possessed 34 members, and this number has now increased to 200. The headquarters are in Moscow, and there are branches in Petrograd, Nijni-Novgorod, Kieff and Odessa.

One of the objects of research has been the three-electrode valve. Numerous constructive improvements are claimed to have been evolved and subsequent knowledge has shown that these improvements have followed very closely the principles of English and German developments.

Wireless telephonic transmission has been improved, and speech has been very clearly heard in Christiania and Berlin. Several improvements have been introduced in modulators and microphones.

An interesting musical instrument producing varying oscillations by means of cathode tubes has been invented by Engineer L. S. Terman, and concerts have been given with this device in Moscow and Petrograd. Progress has been made in the domain of high frequency machines. The Poulsen ray generator has been widely used for wireless telegraphy in Russia during the last four years, and a station of 100 kw., embodying the principle, was erected at Moscow (Shabolovka) in 1919, communication being effected with England, Italy and elsewhere.

Attention has been given to receiving antennæ, particularly the frame variety, which has been employed extensively for direction finding. In regard to transmission antennæ, a theoretical improvement is claimed in the Alexanderson s stem. The principle embodies the use of only one mast and it is hoped that practical tests will soon be possible.

Improvements are also recorded in amplifiers, wavemeters and other measuring instruments, resistances, cathode tubes for wire transmission and wireless transmission of photographs.

It is significant that, in spite of difficulties encountered during the last four years, popular interest in R ssia has permitted the continuous publication of two periodicals specialising in radio.

The Radio Society of Great Britain.

At the Ordinary General Meeting of the Society held on Wednesday, March 28th, the following candidates were elected :—

Members.

William Henry Glazer, Guy C. Beddington, Christopher Childs, Rev. Philip Sidney Sidney, Dr. William Mailer, Capt. Maurice A. Ainslie, Edward Carlyle Allen, Arthur Fielder, Ernest Herbert Robinson, Thomas Henry Dyke, Cecil Alfred Roper, William A. Anderson, John Edward Llewellyn, Stanley Wm. Barter, George Fred Robinson, Arthur Ewart Stephens, Henry Claude Carter, Capt. Wm. Robert Hargroves, M.B.E., Brian Leonard Armstrong, C. H. P. Hutter, L. B. Bignamy, Alfred Denys Cowper.

Associate Members.

George Taverner Heyes, J. E. Greville Parritt, A. Desmond Fitz-Gibbon.

The following Societies were also accepted for affiliation :—Whitley and Monkseaton Y.M.C.A. Wireless Society, The Dewsbury and District Wireless Society, Reading Radio Research Society, Heckmondwike and District Wireless Society, South Shields and District Radio Club, The Radio Society of Birkenhead, Chesterfield and District Radio Society, The Hornsey and District Wireless Society, The Stratford-on-Avon and District Radio Society, Windlesham and District Radio Society, Harpenden Radio Society, The Hinckley and District Radio Society, The St. Bride Radio and Experimental Society.

Wireless Operators' Hours.

The Admiralty, says *The Times*, have directed Commanders-in-Chief in certain areas to report whether they consider that the hours of naval watch-keeping laid down in the Allied Wireless Telegraphy Instructions, 1919, should be altered in conformity with the change recently made in the Merchant Shipping (Wireless Telegraphy) Statutory Rules, 1920. In order to give an unbroken period of rest to wireless operators the hours of watch-keeping by merchant ships carrying less than three operators have been altered in Zones " B " and " C " and are now as follows :—

Zone.	Times of Watch. (One operator.)	Times of Watch. (Two operators.)
	H. H.	H. H.
" B " ..	From 4 to 6	From 0 to 2
	" 8 to 10	" 4 to 10
	" 12 to 14	" 12 to 14
	" 16 to 18	" 16 to 18
	—	" 20 to 24
" C " ..	From 0 to 2	From 0 to 6
	" 4 to 6	" 8 to 10
	" 8 to 10	" 12 to 14
	" 12 to 14	" 16 to 22

The above periods refer to Greenwich mean time. It will be seen that with only one operator no watch is kept in " B " zone from 18 hrs. (6 p.m.) to 4 next morning, and in " C " zone from 14 hrs. (2 p.m.) to zero (midnight), giving in each case ten hours off duty.

Forthcoming Events

SATURDAY, APRIL 7th.

Finchley and District Wireless Society. At Arcadia, Church End, Finchley. Grand Dance.

MONDAY, APRIL 9th.

Cambridge and District Radio Society. Lecture: " Recent Experiments on the Elimination of Atmospherics." By Mr. E. V. Appleton, M.A.

Wireless Society of Hull and District. At 7.30 p.m. At Signal Corps Headquarters, Park Street. Lecture : " The Various Forms of Inter-Valve Coupling H.F." By Mr. A. W. Spreckley.

Newcastle and District Amateur Radio Association. Lecture : " The Possibilities of Inter-Planetary Communication." By Mr. Sargent. (Members only).

WEDNESDAY, APRIL 11th.

The Institution of Electrical Engineers (Wireless Section). At 6 p.m. At Savoy Place, Victoria Embankment, W.C.2. Experimental Demonstration : " Magnetic Drum High Speed Recorder and Key Transmitter." By Dr. N. W. McLachlan.

Manchester Wireless Society. At 7.30 p.m. In the Council Chamber, Houldsworth Hall. Lecture : " Accumulators, their Construction and Management." By Mr. W. R. Anderson, A.M.I.E.E.

THURSDAY, APRIL 12th.

Kensington Radio Society. At 8.30 p.m. At 2, Penywern Road, Earl's Court. Lecture by Mr. Blake, A.M.I.E.E.

BROADCASTING.

Regular evening programmes, details of which appear in the daily press, are now conducted from the following stations of the British Broadcasting Company :—

London	2LO	369 metres.
Birmingham	5IT	420 "
Manchester	2ZY	385 "
Newcastle	5NO	400 "
Cardiff	5WA	353 "
Glasgow	5SC	415 "

DUTCH BROADCASTING.

PCGG. The Hague, 1,050 metres, Sunday : 3 to 5.40 pm., Concert. Monday and Thursday : 8.40 to 9.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

FRENCH BROADCASTING TIMES.

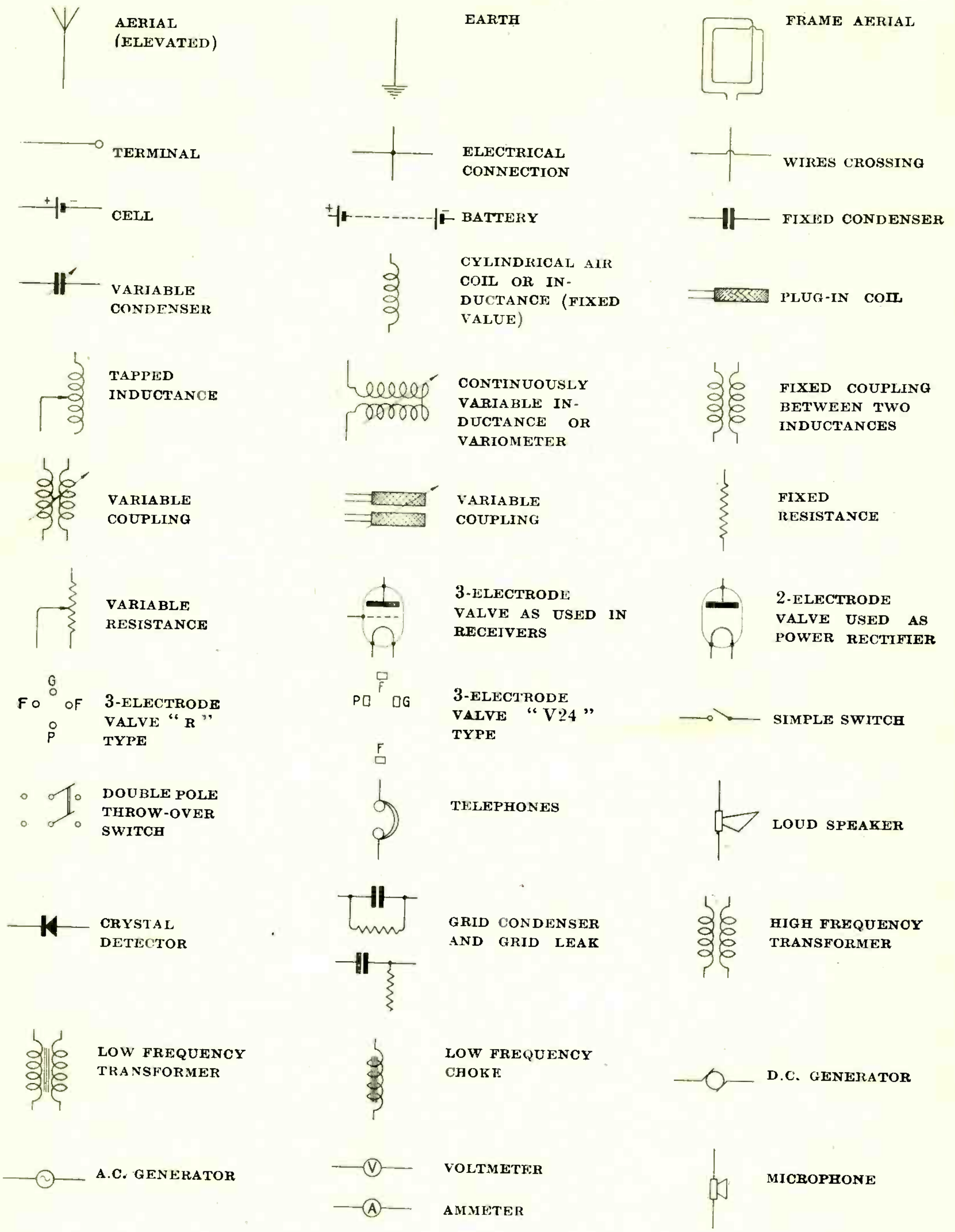
Eiffel Tower. 2,600 metres. 11.15 a.m. weather reports (duration 10 mins.) 6.20 p.m., weather reports and concert (duration about 30 mins.) 10.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,565 metres., 5.5 p.m. news ; 5.15 p.m. concert till 6 p.m. ; 8.45 p.m. news ; 9 p.m., concert till 10 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 7.45 p.m. to 10 p.m. Saturdays, 4.30 p.m. to 7.30 p.m.

SYMBOLS

It is thought a number of new readers may find it difficult to appreciate the meaning of the various symbols which collectively form a diagram. Below are given the symbols ordinarily used, together with sufficient explanatory text that the reader should in future be in a position to properly interpret diagrams with which the symbols are associated. The symbols and the text are extracted from the 1921 and following editions of *The Year-Book of Wireless Telegraphy and Telephony*, published by The Wireless Press, Ltd.



Questions and Answers

"J.R.E." (Ely) *asks* (1) *Whether accumulators may be charged from "Daniel" cells.*

(1) It is not economical to charge accumulators from "Daniel" type primary batteries. A very large primary battery would be required, which would be expensive, and would require a great deal of attention. In addition, no advantage would be gained by the use of an accumulator. We suggest you abandon the idea.

"H.W." (Harrogate) *asks why signals fade away after the receiver has been working a short while.*

The reason why the signals fade after the receiver has been working for a short time is very probably due to the high tension or low tension battery. The voltage of the batteries should always be measured while connected with the receiver. The reading given by the cells when no load is being taken from them is no guide whatever. If the batteries are old or run down, the internal resistance is high, and the internal resistance does not affect the voltage until current is being taken from the cells. The variable condenser should be taken down and cleaned and the plates smoothed, and, when re-assembled, a megger should be applied to test the insulation. A condenser which is leaking has a very serious damping effect upon the signals, and every care should be taken to ensure that the condensers connected in a wireless receiver have perfect insulation. It would be as well, if possible, to connect the megger with the grid leak, and take its resistance. Care should, however, be taken that the grid leak is not burnt out through turning the handle of the megger too quickly. When purchasing components for a wireless receiver it is as well to deal with those firms who have an established reputation, because, as you remark in your letter, there is a large amount of useless wireless apparatus being sold.

"W.H." (Manchester) *submits a diagram of his receiver and asks for advice with regard to the prevention of the generation of oscillations.*

With a receiver wired according to the diagram submitted, unless care is taken, it will be found that oscillations will be generated when the anode circuit is tuned to the wavelength of the closed circuit. To prevent the oscillations being generated the secondary circuit should be connected to +L.T. instead of −L.T. The grid leak connection also should be made between the grid and +LT. As suggested in your letter, with this arrangement signals are slightly reduced in strength, but one has the advantage that the operation of the receiver is steadier and altogether more satisfactory. The ideal arrangement is to provide a potentiometer, the potentiometer being connected across the filament battery. The sliding contact has connected with it the closed circuit and the grid leads. In this way the potential of the grids is easily varied for best results, and we think it would be worth your while to make this addition to your receiver. It is sometimes very satisfactory to couple the reaction coil with the tuned anode winding, and we suggest you try this arrangement.

"K.F." (Norway) *asks the inductance value of coils he has constructed.*

The inductance values of the coils constructed are as follows :—

1,500 turn coil	..	130,000 microhenries.
1,250 ,, ,,	..	90,000 ,,
200 ,, ,,	..	2,000 ,,

The distributed capacity of the coils constructed is probably sufficiently low for them to operate satisfactorily. Winding the coils with double cotton covered wire only slightly reduces the capacity, and it would be necessary to impregnate the coil with an insulating material to prevent moisture being absorbed by the cotton covering of the wire. The coils are suitable for use in the Armstrong super-regenerative receiver. We do not recommend "Q" type valves for use in the super-regenerative receiver. We suggest the use of "R" type valves throughout.

"R.R." (Carnforth) *submits a diagram of his receiver and asks for advice.*

We have examined the diagram submitted and the wiring is correct. To receive the broadcast transmissions we suggest you keep the aerial tuning condenser is series with the A.T.I., and use a much smaller secondary circuit tuning condenser. A suitable condenser would have a maximum value of about 0·0004 mfds. Small coils should, of course, be employed. We think the whole trouble is that you are unable to reduce the wavelength to that of the broadcasting stations. If you do not care to change the variable condenser in the secondary circuit we suggest you connect a small fixed condenser having a value of 0·0005 mfds. in series with the tuning condenser, as shown in the diagram.

"A.E.W." (Liverpool) *refers to the three-valve receiver described in the article "Experimental Station Design." in the issue of October 28th, and asks the reason for the* 0·0003 *mfd. fixed condenser and switch which is provided in the aerial circuit.*

When receiving signals which have a wavelength such that the aerial tuning condenser is working near its maximum value, this condenser should be short-circuited. When receiving shorter wavelength signals it is found that the adjustment of the aerial tuning condenser is very critical. If the switch connected across the 0·0003 mfd. fixed condenser is open so that the condenser is in circuit the effect is to reduce the total capacity of the circuit so that the maximum value of the fixed and variable condensers in series is a little less than 0·0003 mfd. Changing the setting of the variable condenser from zero to its maximum value will therefore change the capacity of the circuit from a small value up to a little less than 0·0003 mfd. The result is that the condenser setting does not need such delicate adjustment.

"D.J.W." (Huddersfield) *asks* (1) *What kind of wire to use for the winding of a* 2,000 *ohm telephone earpiece.* (2) *What distance should separate the diaphragm and the pole pieces.*

(1) We suggest you fill the magnet bobbins with No. 47 D.S.C. wire. We cannot say the number of

turns which will be required to fill the bobbin, because you have not given us its dimensions. (2) It is not possible to say the precise distance between the diaphragm and the pole pieces. The space should be as small as possible consistent with the distance being so great that when the receiver is operating the diaphragm will not strike the pole pieces.

"L.S." (Derby) *asks for a diagram of a three-valve receiver which would enable him to hear the transmissions of distant broadcasting stations.*

We would refer you to Fig. 2, page 677, of February 17th issue. Suitable values for the components used in a receiver of this description are given in most of the issues of this journal, in the "Questions and Answers" section.

"A.D.S." (N.19) *submits a sketch of his aerial, and asks* (1) *Is the usefulness of his aerial reduced owing to the bend.* (2) *Would any advantage be obtained through raising the lower end of the aerial an extra 4′.*

(1) Serious losses will occur at the point of the bend in the aerial, because of the proximity of the aerial at this point with the building. We suggest you try results without the 28′ of wire which is connected above the roof. (2) The lower end of the aerial should be raised as high as possible. If it could be raised to a height of 30′ it would be better.

"D.F.T." (Cambridge) *submits a diagram of his receiver, and asks* (1) *For criticism of the circuit.* (2) *Is it advisable to earth the cores of low frequency transformers.* (3) *Which is the correct way to connect up a low frequency transformer.* (4) *What capacity condenser should be connected across the high frequency intervalve transformers.*

(1) and (4) The proposed arrangement is suitable, although you may find it better to connect the aerial tuning condenser in series with the A.T.I. The values of the condensers are as follows :—

Aerial tuning condenser, maximum of 0·001 mfd.
Closed circuit condenser, maximum of 0·0005 „
Reaction condenser, maximum of 0·0002 „

High frequency intervalve transformers of the type described probably work best without the addition of tuning condensers. If tuning condensers are used, they should have a maximum value of 0·0002 mfds. The grid condenser has a value of 0·0003 mfds., and the grid leak 2 megohms. A 0·001 mfd. fixed condenser should be connected across the telephone transformer, and the primary winding of the transformer connected in the anode circuit of the detector valve. The condenser connected across the high tension battery should have as large a value as possible—2 mfds. would be suitable. You would probably find it of great value to connect a potentiometer across the L.T. battery and connect the end of the high frequency transformer secondary windings with the sliding contact. (2) It is not always necessary to earth the cores of intervalve transformers. The cores may, however, be connected with earth if desired, as it may help to prevent the generation of audible frequency in the low frequency portion of the circuit. (3) The method of connecting up intervalve transformers varies according to the manufacture. If the primary and secondary windings are wound in the same direction and the primary is wound on first, O.P. should go to plate and I.S. to grid.

"J.R.H." (Durham) *asks* (1) *Why his variable high frequency transformer will not function when the switch is connected to stud* 1. (2) *Which is the best type of radio-frequency amplification.*

(1) We suggest you test out the transformer. The winding may be disconnected, or the first portion of the winding may have short circuits. It may be the capacity of the wiring of your receiver is such that the lowest wavelength to which the transformer tunes is higher than the wavelength signals which you want to receive. (2) We consider the best method of high frequency amplification is that known as the reactance capacity method. In this method, tuned anode coils with grid condensers and leaks are used.

"C.Y.B." (Croydon) *asks* (1) *Whether the proposed method of generating high tension current for a transmitter is useful.* (2) *What would be suitable dimensions.* (3) *For a diagram of a single valve telephony transmitting circuit.*

(1) and (2) We do not think the proposed method of obtaining a high tension supply will be suitable. It would be very difficult to smooth out the pulsating direct current produced after rectification, and the note produced would be of audible frequency, and telephony would not be possible. We suggest you use an interrupter drum driven by a small motor for providing the pulsating primary current of the transformer. The secondary circuit of the transformer would be completed as shown in the diagram submitted. Suitable interrupters may be purchased from firms who deal in Government Disposal Board apparatus. (3) A diagram of a telephony transmitter is given in Fig. 3, p. 815, March 17th issue. The grid control method of modulation is employed. We do not think you will be successful in conducting transmissions with a wavelength so low as 30 metres unless you have access to very special apparatus, including special valves.

"F.H.F." (N.2) *asks* (1) *For particulars of a tuner to enable him to tune in* 180 *metre wavelength signals.* (2) *How may an extra negative potential be given to the grid of valves connected in the L.F. portion of the receiver.*

(1) The primary winding of the tuner may be 3″ in diameter and 3″ long, wound with No. 18 D.C.C. wire. Six tappings should be taken. The secondary may be 2″ in diameter and 3″ long, wound with No. 24 D.C.C., and three tappings should be taken. The aerial tuning condenser should be connected in series with the aerial winding. (2) To provide a negative potential for the grid of valves connected in the L.F. portion of a receiver, one or two cells should be connected as shown in a number of diagrams which have appeared recently.

"T.A.T." (Acton, W.) *asks* (1) *For criticism of the diagram submitted.* (2) *Whether switches could be arranged so that a crystal could be connected in place of the rectifying valve.*

(1) The diagram submitted is not quite correct. A suitable diagram is given in Fig. 1. The lay-out of the receiver is quite suitable. It is well to provide Vernier condensers to assist in making fine adjustments. The method of connecting switches so that a crystal detector may be used in place of the valve detector is given in Fig. 2, page 814, in the issue of March 17th. We do not think

the addition of a second wire to your aerial will be of much benefit.

"J.S." (Scotland) *asks what would be the dimensions of suitable coils for use in a three-coil tuner. It is desired to receive broadcast transmissions.*

For the aerial circuit we suggest you use 50 turns wound upon the former 2″ in diameter. The closed circuit coil could have 30 turns wound upon the same diameter former, and the reaction coil 25 turns. If a coil is required for use in the anode circuit of the high frequency valve, one having 70 turns would be suitable.

"G.O.P." (Bristol) *asks why he cannot receive short wavelength signals. A diagram of his receiver is submitted.*

The reason why you cannot receive short wave signals is because the aerial tuning condenser is in parallel with the A.T.I., and the A.T.I. has too many turns of wire. We suggest you join the aerial tuning condenser in series, and construct a coil 3″ in diameter and 3″ long, wound full of No. 20 D.C.C. with six tappings, for the A.T.I.

"D.T.W." (W.7) *refers to Fig. 5, page 645, February 10th issue, and asks what would be suitable dimensions for the aerial and closed circuit coils.*

For the aerial coil we suggest you use a winding 3″ in diameter and 3″ long, wound with No. 20 D.C.C. with six tappings. The secondary circuit should be 2″ in diameter and 3″ long, wound with No. 26 D.C.C. Three tappings should be taken.

"CONCERT" (N.T.) *asks whether we have any particulars of the station which he heard transmitting during an evening recently. The transmissions were in French.*

These concerts are transmitted by the Radiola Company of Paris, we believe.

"A.J.T." (Formby) *asks (1) With reference to the reply given to* **"E.J.P." (Kent)** *in the issue of February 10th, the second high frequency valve is given a 2 megohm grid leak. Why is a crystal detector necessary for rectification. (2) If a crystal detector is a real advantage, could the connections of a two-valve receiver—one H.F. crystal detector and one L.F. valve—be given. (3) What would be suitable values for the condensers. (4) What is the correct H.T. voltage to employ.*

(1) With reference to the diagram referred to, the purpose of the 2 megohm grid leak is to give the grid of the second valve a suitable potential. The combination of grid condenser and leak shown is not for the purpose of rectification, although there is no doubt that slight rectification does take place. (2) A suitable diagram is given in Fig. 2, page 614, February 3rd issue. (3) The aerial tuning condenser should have a maximum value of 0·001 mfds., and the anode tuning condenser, 0·0002 mfds. It is generally necessary to connect a by-pass condenser of 0·001 mfds. across the L.F. transformer, and another across the telephone transformer. The anode coil should have 150 turns wound upon a former having the dimensions of the closed circuit coil. A number of diagrams have been given recently in which a crystal detector is used for rectification. (4) We suggest you use a tapped anode battery variable up to 90 volts.

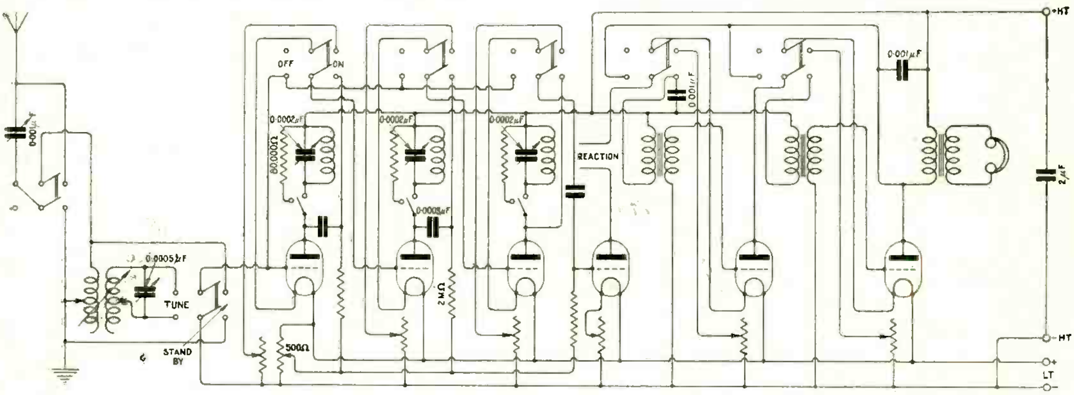


Fig. 1. **"T.A.T." (Acton, W.)** *The diagram gives the connections of a 6-valve receiver—3 H.F., detector and 2 L.F. The high-frequency amplification may be obtained with either the tuned-anode or resistance methods. Reaction may be obtained by coupling a reaction coil with one of the anode coils, or with the closed circuit coil of the tuner. A receiver built according to this diagram will give satisfactory reception of all wavelengths.*

"T.G.N." (Kent) *submits particulars of his primary coil and (1) Asks for the dimensions of a suitable secondary coil. (2) How should a condenser be connected across the high tension battery when a number of tappings are taken. (3) Is the suggested method of connecting a grid condenser and leak when a high frequency transformer is used satisfactory. (4) What is the wavelength range of the coils referred to in (1).*

(1) We suggest you wind a coil 4½″ in diameter and 8″ long full of No. 30 D.C.C. wire. Eight tappings should be taken, and the winding should be tuned with a 0·0005 variable condenser. (2) The condenser which shunts the high tension battery should be as large as possible (2 mfds. would be a suitable value), and it should be connected between the plus and minus terminals irrespective of the position of the plugs. (3) The method of connecting the grid condenser and leak is quite a common one, and is quite satisfactory. (4) The approximate wavelength range of the coils mentioned in (1) is 300 to 8,000 metres.

"A.J.E." (S.W.1) *submits a diagram of his receiver, and asks* (1) *Whether the connections are correct.* (2) *Whether the interference which he experiences is because he is living so close to the broadcasting station.*

(1) The diagram submitted is quite correct, and good results should be obtained. (2) As you live so close to the London broadcasting station, we suggest you use a frame aerial, and add another high frequency connected valve. This will enable you to hear with success the broadcast transmissions of other broadcasting stations. It is a very difficult matter to tune out the local broadcast transmissions when an ordinary outdoor aerial and earth system are employed.

"D.O.E." (Glam.) *asks* (1) *Whether the circuit Fig. 7, page 464, February 10th issue, is permitted by the Post Office. If not, what alteration would have to be made.* (2) *How are different negative potentials applied to the grid circuits of high frequency, rectifier, and low frequency connected valves.* (3) *How is the value of a variable condenser which is set at its minimum value obtained.*

(1) In the diagram referred to the reaction coil is shown coupled with the closed circuit coil. If you wish to receive the broadcast transmissions, we suggest you couple the reaction coil with the first tuned anode coil. The Post Office would then approve of this circuit. (2) A number of circuits have been given recently in which separate anode voltages may be applied to valves which are functioning in different portions of the receiver, and in which the grid potentials are adjustable for best operation. In particular we would refer you to the article entitled "Refinements in a Four-Valve Receiver," which appeared in the issue of February 4th. It will be seen here that potentiometers are used to control the grid potential of the high frequency and detector valves, and cells are connected in the grid circuits of the low frequency valves. The anode circuits have individual taps to the H.T. battery. (3) It is not possible to calculate the value of the variable condenser when set at its minimum value. The value is measured either with the aid of a capacity bridge or with the aid of a wavemeter and standard coil.

"J.J.R." (Gibraltar) *asks* (1) *For the connections of a three-valve receiver suitable for the reception of telephony.* (2) *Which coils would be most suitable for use with the receiver.* (3) *How many amplifying valves would it be necessary to use to successfully receive the London transmissions from Newcastle.* (4) *Are "R" type valves suitable for use in a circuit of this description.*

(1) We would refer you to Fig. 4, page 678, February 17th issue. It will be noticed a three-coil holder is used, and the high frequency valve has in its anode circuit the primary winding of a high frequency transformer. Suitable values are given. The heterodyne wavemeter cannot very well be used with the receiver for the reception of telephony. (2) The type of coil referred to is quite suitable for use in the three-coil holder. (3) The diagram referred to in (1) shows the connections of a receiver which should enable you to hear the London broadcast transmissions when installed in Newcastle. (4) "R" type valves are quite suitable for use in a receiver of this description.

"J.A.S." (Stonehaven) *asks* (1) *Could we give the dimensions of four coils which would be useful for the reception of transmissions, using a wavelength between* 200 *and* 900 *metres.* (2) *With reference to the diagram submitted, is it possible to receive C.W. and spark signals.*

(1) We suggest you make one coil with 35 turns of No. 20 D.C.C., the second with 50 turns, the third with 75, and the largest coil with 100 turns. (2) The diagram submitted is quite suitable for your purpose, and with a receiver wired up according to it, C.W. and spark signals should be received.

"J.H.G." (S.E.19) *submits a diagram of his receiver and asks* (1) *Whether we can offer any suggestions for improvements.* (2) *Is it an advantage to have a condenser connected across the high tension battery.*

(1) The diagram is correct. We would refer you to the article entitled "An Experimental Single Valve Receiver," page 856, February 17th issue. (2) A condenser should be connected across the high tension battery. One having a value of about 2 mfds. would be suitable.

"G.C." (Birmingham) *asks* (1) *Whether honeycomb type coils may be used as anode coils* (2) *What would be suitable number of turns which, in conjunction with a* 0·00025 *mfd. variable condenser, would tune from* 200 *to* 3,500 *metres.*

(1) Honeycomb type coils are very suitable for use as anode coils. If a two-coil holder is available the anode coil may be coupled with the reaction coil to obtain reaction effects, or two coils may be plugged into the coil holder to form the primary and secondary windings of a high frequency transformer. (2) We suggest you wind coils having the following numbers of turns: 50, 75, 100, 150, 200, 250, 300, 350, and 400.

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:— (1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review,** 12/13, *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE
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Developments in Commercial Radiotelephony.

The recently announced appointment by the Postmaster-General of a Special Committee to consider, in the light of recent progress, the possibility from a technical point of view, of the establishment of commercial service of transatlantic telephony marks a very great step forward in wireless development.

It is stated that this action has been taken as a direct result of the successful demonstration conducted by the Western Electric Company in conjunction with the American Telephone and Telegraph Company and the Radio Corporation of America some two months ago. Personally we feel that to some extent at any rate the great success of the Amateur Transatlantic Tests, both those held recently and the Tests of a year ago, has also contributed to focus public interest on this subject and has emphasised the possibilities that lie ahead.

The amateur would not, of course, suggest that the commercial engineer has much to learn from amateur experimental work, but at the same time the amateur is perhaps in that happy situation where, for the very reason that he is an amateur and not a professional, he can pursue his enterprises without requiring to take any precautions against the possibility of even temporary failure, whereas the professional, from motives of business policy, hesitates to undertake a public demonstration unless success is fairly well assured.

The Neon Tube.

In this issue we publish a further article on the subject of the Neon Tube and a description is given of its application to relays and recording. It is surprising that very little has hitherto been published in this country on the subject for it is one which is full of possibilities for the experimenter and has many novel applications to wireless circuits. The record of patents granted indicates, perhaps better than any other means, the importance attaching to this new field for investigation which promises to be almost as fruitful of new circuits as the valve itself.

It is hoped that the publication of these articles may encourage experimental work in this connection, and that the results may appear in the pages of this journal for the benefit of others.

The Neon Tube—II.

APPLICATION TO RELAYS AND RECORDERS.

By S. O. Pearson, B.Sc.

Concluded from page 5 of the previous issue.)

WE now come to consider the application of the neon lamp to the automatic recording of wireless signals, a subject which has always been particularly interesting to radio experimenters, and from time to time articles on this subject have been published in this Journal. Quite a number of circuits have been devised for recording, some of them complicated and others simple, and there is little doubt that the simpler arrangements have proved to be the most reliable in practice. In every instance thermionic valves are used, since weak signals must be amplified up before they can be made to operate relays, etc.

The principles involved in the most usual arrangements may be briefly stated as follows: The incoming signal received by the aerial is usually amplified at high frequency by one or more valves, then detected or rectified so as to give an audible note. If the signals are C.W., either a self or separate heterodyne is employed to produce a beat note. This audible note, which is divided up to represent the dots and dashes of the Morse code, is now amplified further by means of a note magnifier, and is then rectified a second time to produce unidirectional pulses of current corresponding to the dots and dashes of the Morse code. These current pulsations are made to operate the recording instrument through the medium of some sort of a relay, and it is the satisfactory operation of this primary relay that has been difficult to attain, especially for high speed work. It is in this connection that a neon lamp can be used to great advantage, making an exceptionally reliable and sensitive recorder.

Limitations of Old Type Recorders.

In order to see clearly why the neon lamp has these desirable qualities it will be necessary to consider briefly the limitations of the ordinary recording arrangement where the relay is connected in the plate circuit of the last valve, which acts as the second rectifier. As in the first or high frequency detector, this last valve may be made to rectify by either of the well-known methods, *viz.*, by operating at one of the bends in the characteristic curve or by the leaky grid-condenser method. The former has the advantage that, if operated at the lower bend, the normal value of the current through the relay is small and the percentage change of current for a given signal strength is comparatively large, but this necessitates the application of considerable negative potential to the grid and the adjustment is somewhat critical. When the grid condenser method is employed the system has the advantage that rectification takes place on the grid side of the valve which may be operated on the straight portion of its characteristic curve and hence critical adjustment of the grid voltage is not necessary. In this case, however, the normal value of the plate current is large and the relay must be carefully "biased" to compensate for it.

But no matter which of these two systems of rectification is employed, there is a serious difficulty which is encountered in practically all relay circuits, namely time-lag in the relay itself. A relay such as used for recording purposes is a current operated device, the varying current producing a varying magnetic field which acts on a movable iron armature, and is therefore highly inductive. Now it is well known that a current cannot be suddenly started or changed in an inductive circuit; if an E.M.F. is suddenly applied to the ends of an inductive coil the current builds up gradually, obeying the same law as indicated by the voltage curve of Fig. 3. The final value which is reached by the current is quite independent of the inductance, being given by V/R, where V is the applied voltage and R the total resistance of the circuit. However, an interval elapses before the final steady value is reached and the length of this interval is governed by the inductance L and the resistance R, being proportional to L and inversely proportional to R. The current reaches 0·632* of its final steady value in L/R seconds, and the same time lag occurs when stopping a current or when changing the value of a current in an inductive circuit. The quantity L/R is called the *time constant* of the circuit,

*0·632 = $(1 - 1/\epsilon)$, where ϵ = base of natural logarithms.

and it is this time constant which usually puts a limit to the speed at which a relay will work.

For high speed working then, the ratio L/R should be as small as possible, but unfortunately the inductance cannot be reduced in the winding of the relay coils without at the same time decreasing the sensitivity of the relay. But if a relay is found to have too large a time constant and is sluggish at a given speed of working, a fairly high resistance can be connected in series, and this is very often done in practice. In Fig. 6(*a*) and 6(*b*) are given the two most usual methods of connecting the relay, without and with extra series resistance respectively, the last valve only being shown.

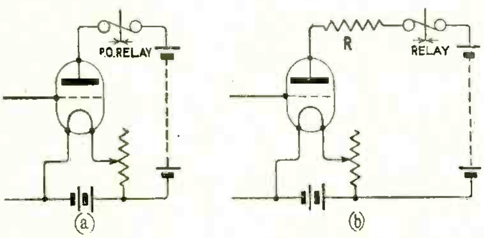


Fig. 6. Usual methods of connecting a Relay.

The addition of resistance in series, however, while reducing the time constant and stabilising the system, has a serious effect on the action of the valve, namely, there is a considerable voltage drop across the total resistance and as the anode current increases the voltage on the plate of the valve falls proportionately. The result is that the characteristic curve of the valve is greatly reduced in steepness and usually an extra stage of amplification

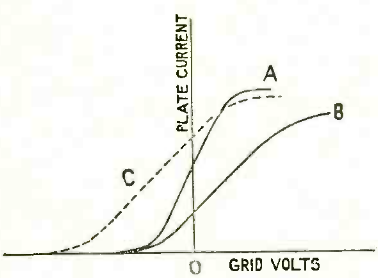


Fig. 7. The effect of series resistances on the characteristic curve.

is necessary. If the grid voltage-plate current curves were obtained for each of the arrangements of Fig. 6 they would be similar to those shown in Fig. 7. It is assumed that the resistance of the relay itself is small compared to the internal resistance of the valve. Curves A and B show the plate current for various grid voltages without and with added resistance respectively in the anode circuit, the H.T. supply voltage being the same in each case. The chief point to note is that the steepness of the curve is greatly diminished by the insertion of a resistance which is at all comparable with the internal resistance of the valve, and thus the rectifying properties are seriously reduced. The two curves meet at the lower bend, but the upper bend of curve B is moved to the right and is considerably rounded off or flattened out, this being due to the fact that the plate potential at these higher values of current is so low that the valve does not function properly. This is overcome by increasing the voltage of the H.T. supply, giving another curve such as C further to the left, but this also has a diminished slope as compared with A, resulting in a decreased percentage variation of current in the relay for a given signal strength. From the foregoing considerations it will be seen that although the addition of resistance in series reduces the time constant of the circuit, it at the same time reduces the sensitiveness of the valve.

The Anson Relay.

Suppose now we inserted in the anode circuit a resistance which varied with the plate current in such a manner that the potential difference across it was almost constant for all values of the plate current. The plate potential would then remain practically constant for all values of anode current and therefore the steepness of the characteristic curve would remain about the same as if no resistance were present. It will be shown that the neon lamp constitutes a resistance which possesses this desirable property, and in addition its average value over the working range is quite comparable with the internal impedance of the valve. Thus when a neon lamp is connected in the anode circuit in series with the relay, the time constant of the system is greatly reduced and the stability improved without in any way reducing the sensitivity of the valve; in fact the sensitivity is increased, for reasons given below. Such an arrangement is called "The Anson Relay," after the inventor, and an instrument embodying these principles is manufactured by Messrs. H. Tinsley & Co. The diagram of connections is given in Fig. 8. The best results are obtained by using the type of valve which normally operates with fairly low plate potentials, such as the Mullard "Ora" or Marconi V.24.

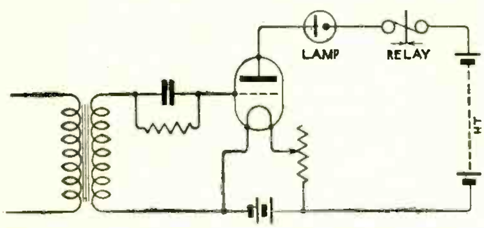


Fig. 8. Diagram of connections for the Anson Relay.

The characteristic curve of the neon lamp (Fig. 2) shows that the resistance varies very rapidly with change of current. The effective resistance for any given value of the current is equal to the ratio of volts to amps at that particular point on the characteristic curve, and the resistances have been worked for various currents through the same lamp considered previously and plotted as a curve in Fig. 9. It will be noted how rapidly the resistance falls with increase of current, especially for the lower values of the current. This resistance could be considered as a combination of two components, namely,

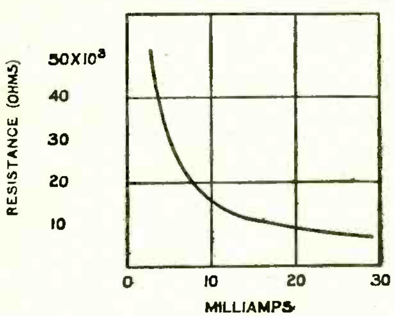


Fig. 9. Variation of resistance of Neon Lamps with current.

a constant positive resistance and a negative resistance which increases with the current. For high values of current the negative component becomes so large that the discharge through the lamp takes the form of an arc between the electrodes ; but, when in the valve circuit, the neon lamp operates on the lower portion of its characteristic curve, and the effective value of the resistance is very high, the average value over the working range being more than 30,000 ohms.

The grid voltage-plate current curve for a Mullard "Ora" valve was obtained with a neon lamp connected in the plate circuit (curve A, Fig. 10). Curve B is the characteristic of the valve alone without the lamp in circuit, but with the same H.T. and L.T. voltages. It will be seen that the slope of the two curves is practically the same, despite the fact that the lamp has a high resistance over the whole range of currents concerned, the reason being that the lamp resistance varies in such a manner that the potential difference across the electrodes varies by about

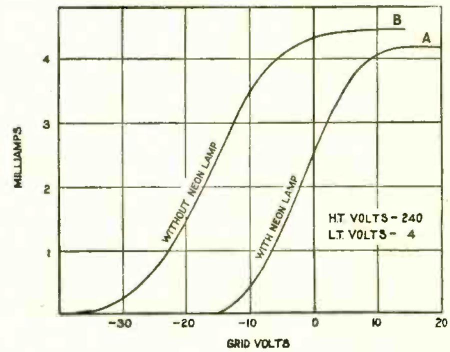
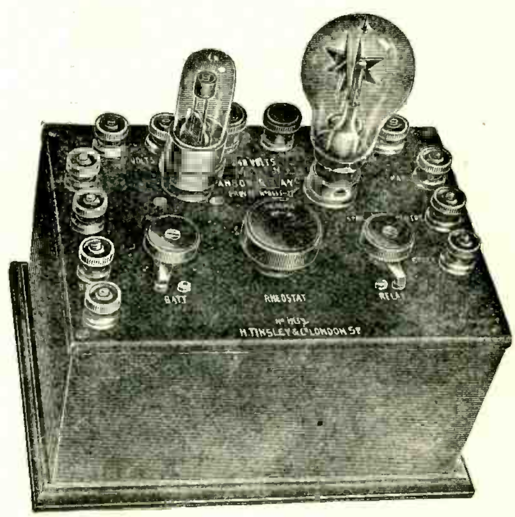


Fig. 10. Effect of Neon Lamps on characteristic curve.

10 volts only over this range of currents. With the neon lamp in circuit the curve is moved considerably to the right, this being a distinct advantage when fairly high voltages are



"The Anson Relay" as manufactured by Messrs. H. Tinsley & Co.

employed in the anode circuit, since a high negative potential need not be applied to the grid.

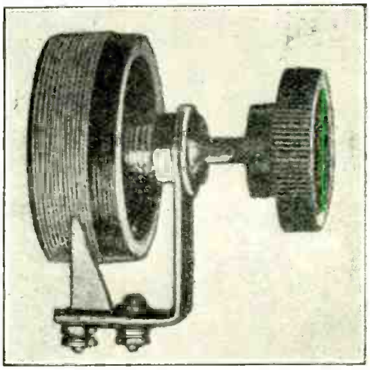
In order to pass sufficient current to make the lamp glow, the valve should be operated at or near the upper bend of its characteristic curve as found with the lamp in circuit. Efficient anode rectification could be effected by operating right on the upper bend of the curve without the use of a grid condenser, but this requires critical adjustment of the grid potential and filament current since the position of the upper bend varies with filament temperature, being the saturation point. By employing the leaky grid-condenser method of rectification the valve can be operated just below the upper bend in the characteristic curve, and when a suitable H.T. voltage is used the normal grid potential can be fixed at zero, and critical adjustment of the filament temperature is not necessary. However, it is advisable to work fairly near the upper bend, in which case we get both anode and grid rectification simultaneously. Grid rectification under the ordinary conditions has the disadvantage that the grid condenser does not acquire its full negative charge until several cycles of the oscillation have passed; in other words a time lag is introduced here.

It should be observed that, of the two curves shown in Fig. 10, the curve A has much sharper bends than B, and therefore by including a neon lamp in the circuit, the rectifying properties of the valve are improved. The valve could be made to rectify on the lower bend of the curve but in this case the system is not quite so stable and a grid battery and potentiometer are necessary. At these lower values of the current the effective plate-to-filament resistance of the valve is so high that in all probability the neon lamp operates under the intermittent conditions described in the first part of this article. The sensitivity is very great at this lower bend however, since the normal value of the plate current is extremely small and is particularly suitable for certain types of relays.

In the diagram of Fig. 8 the relay is an ordinary Post Office "B" type, wound to a moderately high resistance, and the transformer shown is the usual low frequency intervalve type with a step-up ratio of about 5 to 1. For satisfactory operation the H.T. supply should be at least 240 volts, the grid condenser should have a capacity of about 0.01 mfd., and the grid leak should be roughly 2 megohms. Using this arrangement signal speeds up to 200 words per minute have been successfully recorded.

The following method of removing the series resistance from the cap of the commercial type of neon lamp should be helpful to experimenters. By means of a small pair of pliers pull out one of the brass pins at the side of the cap; insert in the hole so formed a suitable spike and prise the metal of the cap outwards sufficiently to enable it to be gripped by the pliers. Now, by means of the pliers, tear away the brass part of the cap by rolling the pliers in much the same way as a tin is opened with a key. When all of the brass has been removed in this way, the base of the cap will remain suspended by the lead-in wires which should be nipped off quite close to the base. Do not remove the old cement from the glass. After pulling out the resistance bobbin detach it from the lead to which it is joined. Before fitting a new cap it is necessary to lengthen the lead-in wires by soldering to each a piece of 26 gauge copper wire about three inches long. The new cap may be taken from an old burnt-out Osram lamp. Clean out the old cement and unsolder the old wires, seeing that two clear holes are left through the solder so that the lead-in wires of the neon lamp can be threaded through. The cap will usually be found to fit tightly over the old cement on the neon lamp and when in place, bend over the wires projecting through the base and solder in. The lamp may now be used in an ordinary socket and the series resistance connected externally.

Novel Variable Resistance.



Fine control is arranged in this variable resistance by causing the drum on which the resistance wire is wound to ride forward on a thread as it is rotated.

Receiving Telephony without Reaction.

By P. G. A. H. Voigt, B.Sc.
Member of the Wireless and Experimental Association.

ALTHOUGH no reactionless circuit can have the range of a reactive circuit, the circuits here described will be found much better than the standard reactionless valve detector.

It is well known that the reactionless valve detector is very little better than the crystal detector except at short range. If it is desired to get the best results (without reaction) with only one valve, it is obvious that it will be necessary to use the valve as an amplifier and the crystal for detection.

Those amateurs who scrapped the crystal detector long ago owing to unreliability will no doubt still fight shy of crystal detectors, but I can assure them, that by the use of two crystal detectors, with a switch to change over from one to the other, half the unreliability disappears. The reason is simply that when the crystal is suspected of inefficiency it is compared with the other, and nine times out of ten will be found perfectly sensitive.

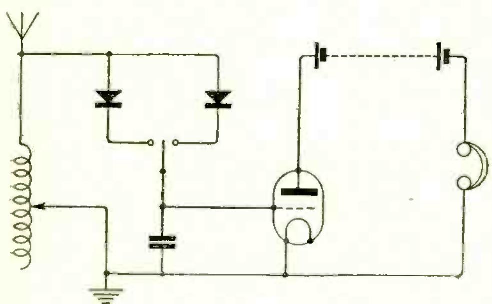


Fig. 1.

The other half of the unreliability disappears when a stable detector such as that illustrated on page 252 of *The Wireless World and Radio Review* of May 27th, 1922, is used. If the moving part is made very light and rigid, such a detector will keep its point for days even on a portable set which is carried from place to place.

When a valve is used as amplifier in conjunction with a crystal detector the usual question will be, "Shall I use the valve as H.F. or L.F. amplifier?" My answer is,

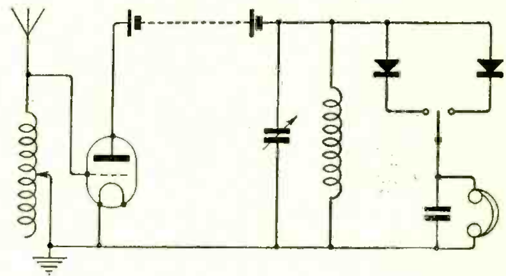


Fig. 2.

use the one valve simultaneously for both purposes, that is, use the valve as a dual amplifier.

Fig. 1 shows the simplest circuit in which the valve is used as a note magnifier. The value of the blocking condenser is not critical, and may be almost anything from 0·0001 to 0·005 μF. In Fig. 2 the valve acts as H.F. amplifier. This circuit will not have any tendency to oscillate below 500 metres, when used on a full size aerial without series condenser. Fig. 3 shows Figs. 1 and 2 combined, one valve acting as H.F. and one as L.F. amplifier.

It will now be shown how one valve can do both amplifications at the same time.

(1) If the loud speaker with a blocking condenser (about 0·002 μF) is inserted between the negative H.T. and the tuned anode circuit, the H.F. efficiency will not be altered.

(2) If the connection between negative filament and earth is broken at "X" and the dotted connection between earth and second valve grid is put in, the efficiency will still be unaltered if there is no grid current.

If the present circuit (Fig. 4) is now examined it will be seen that the L.F. voltage between second grid and filament is applied *via* the A.T.I. to the grid of the first valve. The

L.F. variation in the plate currents of both valves is therefore the same, and consequently the second valve shown dotted, with its current consumption, etc., can be dispensed with.

This circuit is one of the simplest dual amplification circuits it is possible to have, but like most simple circuits it has several disadvantages.

First the loud speaker is on the high potential end of the tuned plate circuit and may not be touched or replaced by headphones on the operator's head. To overcome this trouble, the loud speaker or phones may be inserted between the tuned circuit and earth, but to prevent the phone voltage being passed by the crystal back to the grid it is necessary to separate the crystal from the plate circuit, or to use a low frequency transformer.

The crystal can be separated from the plate circuit in several ways.

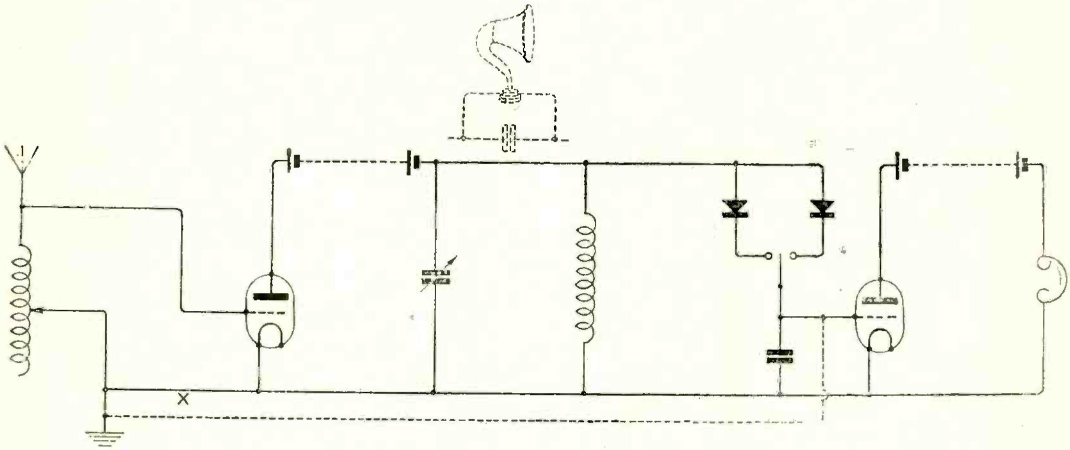


Fig. 3.

(1) *A secondary winding* connected to crystal and negative end of the filament may be wound over the tuned coil. The secondary winding should only have half to two-thirds the number of turns of the primary, as the crystal has a lower impedance than the valve and the best results are obtained by stepping down to it.

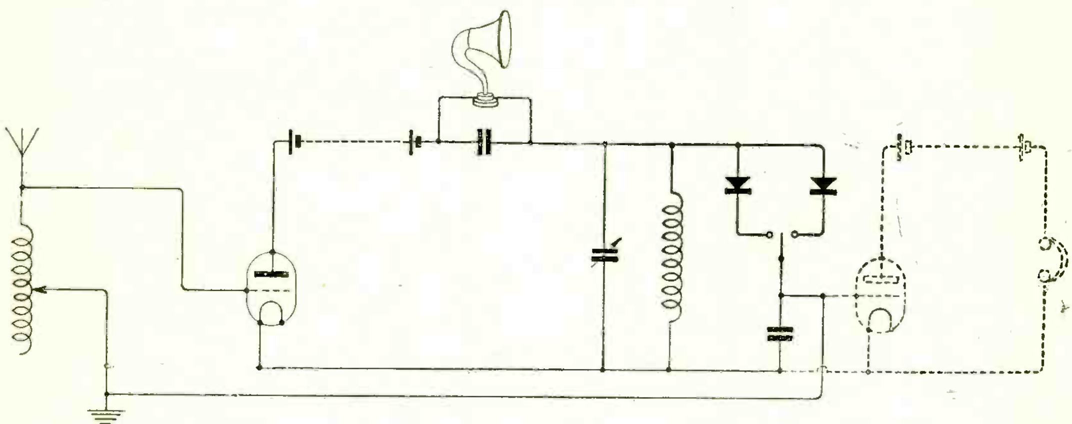


Fig. 4.

(2) *An aperiodic transformer* can be used. A transformer which works well from 300 to 500 ms. can be made as follows :—Three tiny

basket coils with an inside diameter of $\frac{3}{4}$ in. wound with 150 turns on seven spokes with fine copper wire such as 40 or 42 S.S.C are placed side by side with the directions of winding the same. The inner basket is the secondary between crystal and negative filament, the two outers are the primary in the plate circuit,

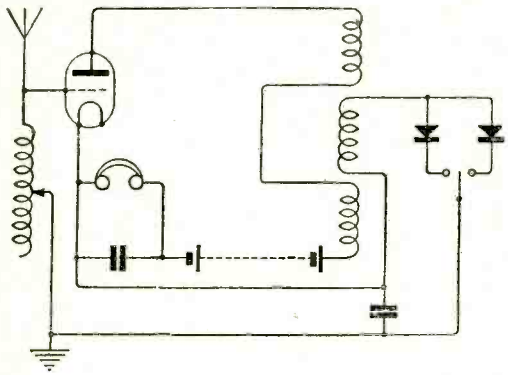


Fig. 5.

the inside of one being connected to the outside of the other. The H.T. should be on the earth side of the H.T. coupling. This circuit is shown in Fig. 5.

(3) *A choke coil* (*i.e.*, a coil of greater inductance than the tuned coil), for example a coil about 2 ins. diameter with 200 turns of fine wire is suitable below 600 ms., can be connected in place of the secondary, while a 0·002 μF condenser between crystal and top of tuned circuit passes the H.F. voltage to the crystal. There is generally a slight improvement if the coupling condenser is connected to a tapping half or two-thirds up the tuned coil instead of to the top of it.

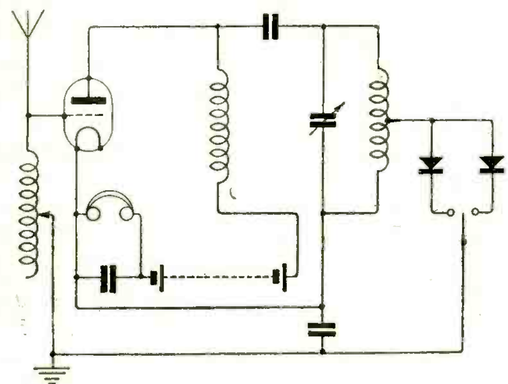


Fig. 6.

(4) *The choke and tuned circuit* in (3) may be interchanged, and the voltage can be stepped down by connecting the crystal to a tapping half way up the tuned circuit, as shown in Fig. 6.

In these circuits it will be noticed that the filament batteries are not earthed. This easily causes trouble from lighting mains, and also causes howls when note magnifiers are used.

The batteries can be earthed in several different ways.

(1) *Tight-coupled transformer.* Instead of connecting the grid to the aerial, and crystal output to earth, they can be connected to a coil which is closely coupled to the aerial, as in Fig. 7.

With pancake coils the secondary coil can be tied to the first, and with cylindrical coils, one winding can be wound over the other with a layer of wax paper between.

A step-up can be obtained by winding $1\frac{1}{2}$ to 2 times as many turns on the secondary as on the primary.

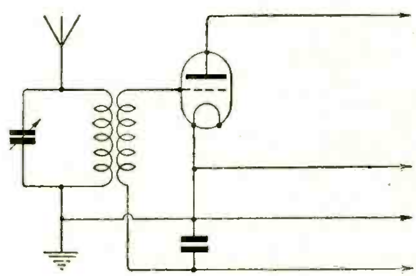


Fig. 7.

Too great a step up will cause oscillation. The secondary being tightly coupled, requires no tuning.

(2) *Loose-coupled transformer.* As oscillations are easily obtained if the coupling is loose, this should not be used.

(3) *Choke.* With tuners such as slider tuners and variometers, it is not possible to wind secondary oils over the winding, and then a choke must be used instead of the secondary, while a fixed condenser of say, 0·001μF passes the H.F. from the aerial to the grid, as shown in Fig. 8.

With the choke method the advantage of stepping up to first grid cannot be obtained.

The tight coupled transformer is therefore best between aerial and first grid, while the aperiodic transformer is the most convenient in the plate circuit.

We now come to those circuits in which a low frequency transformer is used between the crystal and the grid. There is a considerable voltage drop across the blocking condenser when a conducting path such as the primary of a transformer is connected to it, but this drop is rather more than made up for by the step up from primary to secondary.

But whether the increase in strength is worth the extra cost of a transformer depends on circumstances.

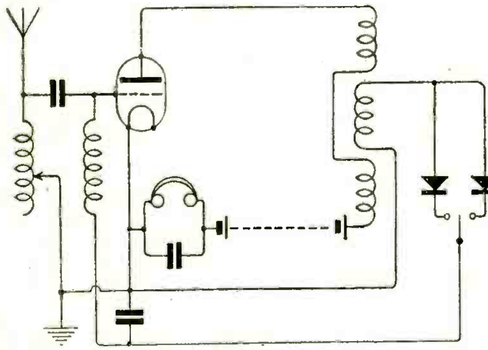


Fig. 8.

The use of a L.F. transformer, however, has the advantage that the crystal need not be separated from the plate circuit, but can be tapped direct on to the tuned circuit, so that the circuit in Fig. 9 can be used.

The additional blocking condenser on the transformer secondary should be kept small, say 0·0003 μF or less, and when the choke is used to separate grid from aerial the condenser between aerial and grid should be reduced to say 0·0003 μF.

This is undoubtedly the most efficient single-valve reactionless circuit known, having when properly adjusted at least the range and strength of an ordinary reactionless two-valve circuit. But once again, I doubt if the L.F. transformer is worth its cost. Filament batteries have been left out for clearness in the diagrams.

The writer always uses 4 volts without a resistance. There seems to be no improvement when dimming the filament below 4 volts, and the increase in the life of the valve is not noticeable.

For the L.F. transformer in Fig. 9 an ordinary intervalve transformer can be used.

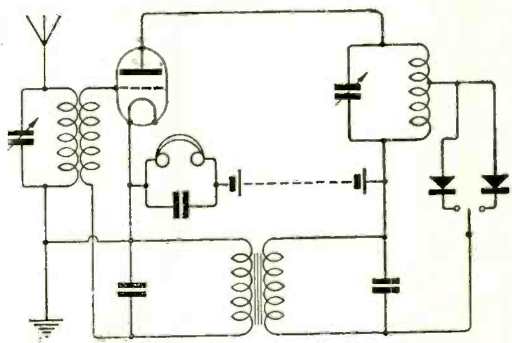


Fig. 9.

Fig. 5 is about the simplest of the good dual amplification circuits, while Fig. 8 is recommended if it is desired to add note magnifying valves. The step up between aerial and grid as in Fig. 7 gives still better results, but requires more expensive apparatus, and Fig. 9 is the best and most expensive circuit of the lot.

In Figs. 6 and 9 it will be noticed that if the crystal is connected to the top of the plate tuning coil, the tuning coil together with the crystal detector may be an ordinary crystal receiver. The remainder may then be a "dual amplifier" unit with four terminals for the addition of the ordinary crystal set. If the tuning coil on the crystal set is variable, the tuning condenser may be a small fixed one, or with a large coil be left out entirely.

When a note magnifier is added and it is desired to use a common high tension, the H.T. and telephones in the circuits given will have to be interchanged, and the primary of the low frequency transformer inserted in place of the telephones.

Used in London on a good aerial any of the circuits from Figs. 5 to 9 should receive **5 IT** during the rare pauses of **2 LO**.

If it is desired to compare this circuit with valve detection it is only necessary to lift the cat whisker off the crystal. The valve will then act as detector.

THE WIRELESS WORKSHOP

By F. H. HAYNES.

Articles under this heading will appear in alternate issues and give elementary practical advice on the working of materials employed in wireless constructional work as may be helpful to the amateur worker. The construction of the components of a complete our-valve receiver will be given to explain home workshop methods.

Working in Ebonite.

FORTUNATELY ebonite, which possesses such good insulating properties, rendering it so suitable for the mounting of the components of wireless apparatus, has a

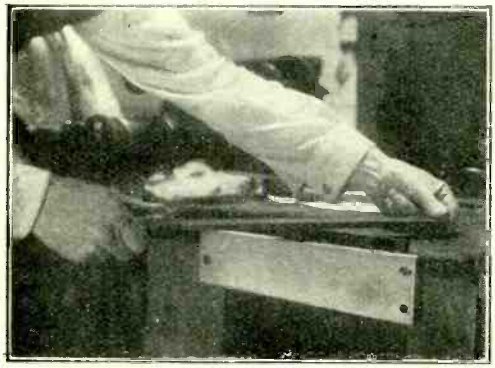


Fig. 1. Truing up an edge. The method of securing the panel is clearly indicated.

degree of hardness which permits of accurate working, whilst it is not so hard that considerable effort has to be expended to bring it to the required shape. Also it is grainless and perfectly homogeneous, both very desirable properties, though when cold and in certain grades is somewhat brittle.

The best grades of ebonite only should be procured for wireless instrument making. Poor qualities have been known to cause high resistance leakage, apart from the fact that they cannot be worked in such a satisfactory manner as better qualities, and do not lend themselves to such good finish. Sheet ebonite, when purchased, should have a high glassy polish on both sides, and must be examined to ensure that it is perfectly flat, which can easily be done by glancing along the edges providing they have been more or less squared up. If sheet ebonite is stored for any length of time it is necessary for it to lie in contact with a flat surface, or otherwise it is apt to acquire a bend.

It is intended that the instructions given in these articles shall be useful to all amateur instrument makers, yet there is the reader who is new to wireless as a hobby, and who is desirous that in the working out of these exercises a useful instrument will be evolved though he may not have in mind any particular design to follow. For this reason dimensions have been introduced which relate to the construction of a four-valve receiver for all wavelengths, comprising high and low frequency amplification with switches for cutting out amplifiers not required, and wired to a circuit which cannot produce serious interference effects by radiation.

A piece of polished sheet ebonite, 14 ins. by 12 ins. by ⅜ ins. will be needed. A word on the thickness of ebonite to be employed for various sized panels may be helpful here. If blind threaded holes of 6 BA. or smaller are to be made, the thickness should not be less than 5/16 ins., whilst for blind holes of 2, 3 or 4 BA., a thickness of ⅜ in. will be needed in order to get sufficient threads. For panels

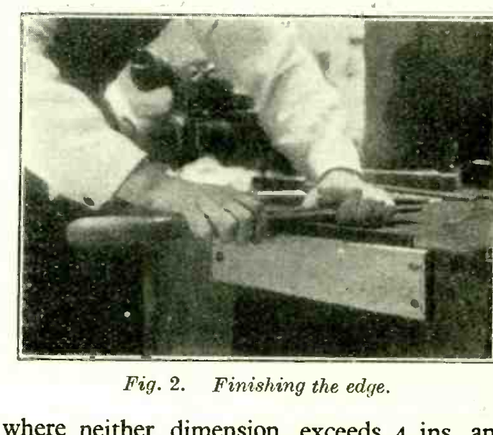


Fig. 2. Finishing the edge.

where neither dimension exceeds 4 ins. and the area is not more than 12 square ins., a thickness of 3/16 in. will suffice. Where neither dimension exceeds 6 ins. and the total area is not more than 30 square ins., a thickness of $\frac{1}{4}$ in. will be required. For larger areas up to 12 ins. by 12 ins., 5/16 in. thickness must be adopted, whilst for still larger areas a thickness of $\frac{3}{8}$ in. is needed. These thicknesses must be regarded as minimums for the sizes of work mentioned, and for experimental purposes the reader is advised to adopt 5/16 in. for even small panels, and $\frac{3}{8}$ in. for large panels such as may be required for elaborate receiving or transmitting gear.

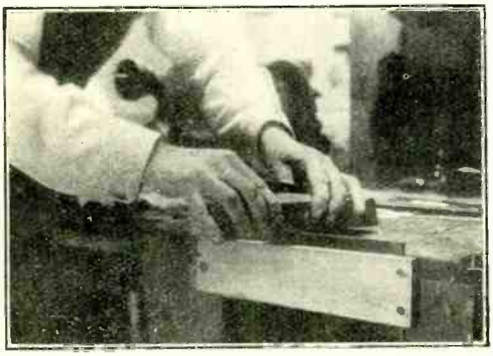


Fig. 3. Removing the scratches.

Close up to one of the longer edges a fine firm line should be drawn with a sharp pointed pencil. It is customary, when marking ebonite, to use a sharp steel point, or scriber, but on this edge, where the line will probably not be filed away, it is better to work to a pencil line so as not to disfigure the face of the panel. The large size of the panel prevents it being gripped conveniently in the vice for filing, and it should therefore be clamped to the side of the bench by means of a piece of hard wood, $\frac{1}{2}$ in. or more in thickness, and two or more stout screws as shown in Fig. 1. The top edge of the piece of wood should be level with the top of the bench and the line on the ebonite panel may be about $\frac{1}{2}$ in. above this. Always when gripping work in the vice or other improvised device for filing, sawing, drilling, etc., arrange for the work to project as little as possible, in order to prevent vibration. That objectionable screeching noise which is sometimes heard when filing or sawing can always be eliminated by putting the work further into the vice.

With a large medium-cut file, file the edge so that it is straight and equidistant from the pencil line. The file must pass across the work at right angles to its faces and must not be allowed to rock. It is a good plan not to drive the file straight forward, but to adopt a forward and sideways swing to avoid deep cuts being made at any one point. The aim must be, while filing, to produce an edge that is at exact right angles to the faces. This can be checked by means of the steel square, but with a little practice it will be found that the square need only be used when finishing, as the eye can detect minute discrepancies in matters of straightness and right angles. With the source of light behind the work and the steel rule stood along the edge it is possible to determine whether or not the edge is true. The light will shine through at the hollows, and the high places which are in contact with the rule should be marked with pencil by the beginner, and filed down. The edge may be finished with a fine file, not by sliding the file across the work, but by holding the two ends of the file in the two hands and rubbing it along the edge (Fig. 2). The removal of scratches is accomplished by rubbing with a piece of emery paper wrapped round a rectangular block of wood (Fig. 3).

Having trued up an edge the reader will next proceed to finish one of the ends which is at right angles to it and marked "2nd" in Fig. 4. A pencil line is drawn close up to the end with the aid of the steel square and the same procedure adopted as above, excepting that now, of course, there is the additional consideration that this end must be at right angles to the finished edge as well as to the faces, and to be perfectly straight.

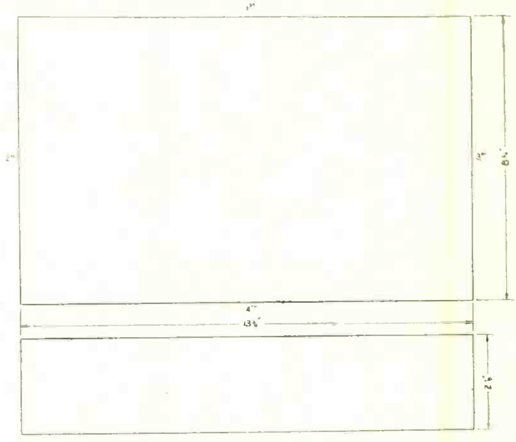


Fig. 4. Dimensions of the panels for a four-valve receiver.

It is next necessary to measure off the length of the panel along the finished edge which is, in this case, $13\frac{3}{4}$ ins. Using the steel square, and this time a sharp pointed scriber instead of the pencil, scratch a firm line across the work to denote the length.

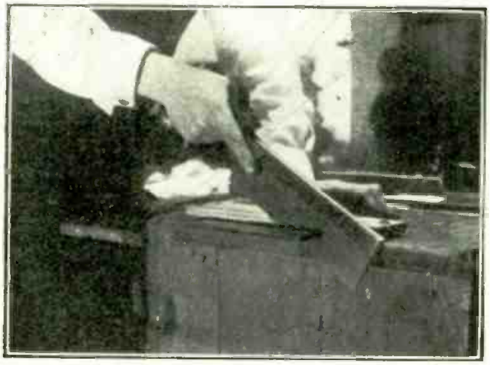


Fig. 5. The panel is secured to the bench for sawing off.

Mind that the square does not slip while doing this. Now file down to this scratch line, bearing in mind all of the points mentioned above.

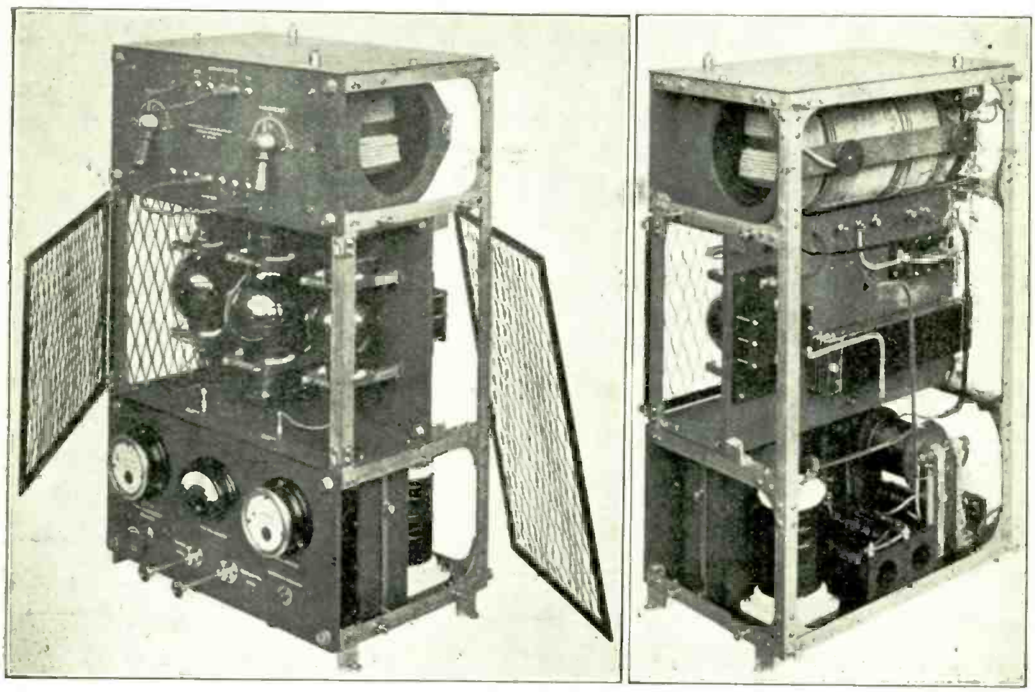
The width of the panel is to be 8¾ ins. Measure off this distance from the first finished edge along each end and join the two points with a scratch line. This line should prove to be at right angles to the ends if the ends themselves are at right angles to the first finished edge.

Now clamp the panel down to the face of the bench by means of the piece of wood which was used to secure it to the side of the bench and with the scratch line projecting about ¼ in. (Fig. 5). With the small tenon saw, saw away the spare portion at a distance of about 1/16 in. from the scratch line and finish as already described.

The strip that has been removed must now be brought down in depth to 2⅞ ins., the edges being made at right angles to the ends already finished.

Two panels have thus been prepared, exactly equal in width, viz., 13¾ ins. and of 8¾ ins., and 2⅞ ins. deep.

Continuous Wave Transmitter.



By Courtesy of Marconi's Wireless Telegraph Co., Ltd.

This C.W. transmitter is designed for a power consumption of 1·5 kW. at 500 cycles. The various components can easily be identified.

Wireless Theory for the Listener-in and Experimenter.

By W. James.

It is the purpose of the writer to deal with the principles underlying the action of receivers and transmitters. Those who know **why**, *obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.*

The earlier articles deal with electrical principles, as without this knowledge one cannot expect to obtain a correct understanding of wireless operation and design.

7. Resistance.

It will be noticed that the electrons flow from the negative pole to the positive pole—that is, opposite to the usually accepted direction. This is because the terms positive and negative were applied before scientists thought out the electron theory. No confusion should result, however, and it is proposed when dealing with circuits in these articles to consider the flow of electricity as taking place from the positive pole to the negative pole as is generally understood.

Now it is known that when a body is heated, the molecules forming the body are agitated. Similarly, when a current flow is established, heat is generated, due to the collisions caused by the movements of the electrons. The amount of heat generated depends upon the readiness with which the electrons are moved when stimulated (as, for example, with the application of a potential difference by connecting a dry cell), the number of electrons which move, and for a given conductor upon its length and area. Of course, the readiness with which the heat is conducted away is an important factor, but need not be considered here. It must be obvious the larger the conductor—that is, the greater its cross section—the easier it will be for the electrons which will flow when the potential difference is applied to move through the conductor. It should also be obvious, the greater the length of the conductor, the greater its resistance, or, in other words, its opposition to the flow of electrons. The resistance of a conductor is expressed in ohms, and using symbols, R for resistance, A for area, and L for length, R is equal to $\frac{L \times P}{A}$ ohms. Now the factor P is known as the specific resistance of the material, and varies with different conductors. Copper is a good conductor, and has a low value of specific resistance. German silver or Eureka, on the other hand, have high specific resistances. Copper wire is used when we desire a low resistance conductor, and it is obvious the lower we require this resistance to be, the larger should be the diameter of the wire chosen, and the shortest possible length should be used; thus, copper wire is used for wiring up the components of a wireless receiver. Generally No. 18 standard wire gauge (abbreviated, S.W.G.), is used. When it is required to make use of the property of resistance, as in the case of a filament resistance or potentiometer, German silver or Eureka wire is used, and the wire chosen should have no larger cross section than will enable it to carry the current without becoming unduly hot, and so springing, or scorching the panel in which it is connected. The value of the specific resistance P is obtained from tables, and the values given represents the resistance between the opposite faces of a cube of the material with cm. sides. The resistance of a piece of any conductor, such as a wire, may be found with the aid of the formula. It is only necessary to use the same units throughout. Thus, if the length and area are in inches and square inches, the value of P should be in ohms per one inch cube.

SPECIFIC RESISTANCE OF METALS.

(A microhm is one millionth part of an ohm.)

Metal.	*Resistance in microhm per centimetre cube.*
Aluminium	2·828
Brass	7·0
Constantan	49·0
Copper (annealed)	1·7241
Copper (hard-drawn)	1·771
German Silver	33·0
Manganin	44·0
Nickel	7·8
Phosphor Bronze	7·8
Platinum	10·0
Tin	11·5
Zinc	5·8

It is found a very simple relation exists between the voltage applied to the circuit and the resistance, and this is expressible as follows: The resistance R is equal to the potential difference E divided by the current I, or in the form of an equation $R = \frac{E}{I}$. The unit of pressure is the volt. An ordinary dry cell has a potential difference across its terminals of about 1·4 volts, while an accumulator has two volts across its terminals when charged. The unit of current I, is the ampere. From the equation it is seen that if the pressure is 1 volt and the resistance of the conductor is 1 ohm, the current which flows is 1 ampere. A more exact definition of an ampere is as follows. An ampere is that current which, when flowing between two platinum plates immersed in a neutral solution of silver nitrate, deposits silver at the rate of 0·001118 of a gram per second.

As an example of the above relationship, which is known as Ohm's Law, suppose we connect a resistance of 30 ohms across a battery which has a potential difference (or voltage difference) of 6 volts across its terminals, what current will flow in the circuit?

Now we know the resistance $R = \frac{voltage}{current}$, and therefore current $(I) = \frac{voltage\ (E)}{R}$.

Substituting the known values we have

$$I = \frac{6}{30} = 0{\cdot}2 \text{ amperes.}$$

The current which flows in the circuit is therefore 0·2 amperes. It is convenient often to use the term milliampere. One milliampere is equal to 0·001 ampere. We may say then, the current in the circuit is 200 milliamperes (mA).

The effect of increasing the voltage of the battery is to proportionately increase the current flowing so long as the temperature of the resistance does not greatly change. Thus, if the battery voltage is double, the current flowing will be doubled.

Ohm's Law is accurate when applied to a simple circuit such as the above, so long as the temperature of the resistance does not change. Most metals when heated by the passage of the current show an increase in resistance. For all ordinary changes in temperature the resistance increase is slight and negligible, but when the metal is heated to incandescence, as in the case of a valve filament, the resistance when hot is several times greater than the resistance when cold. This point will be dealt with later when dealing with the valve.

8. Series and Parallel Connections.

When apparatus is connected in series, the same current must flow in all portions of the circuit. Referring to Fig. 8, we have a circuit containing a resistance R, and a valve filament F, connected in series with a battery B.

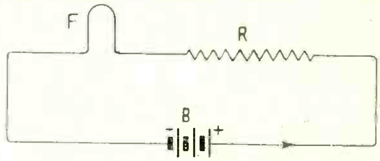


Fig. 8. Here we have a series circuit. The resistance R is joined in series with the valve filament F.

The circuit is similar in every respect to the circuit comprising the water pipes and pump shown in the lower figure. It is obvious the same quantity of water passing point A must pass point B. Another point to be noticed is the sum of the fall in voltage across each piece of apparatus must equal the difference in potential between the terminals of the battery B. From Ohm's Law we know $I = \frac{E}{R}$; therefore we may put $E = RI$.

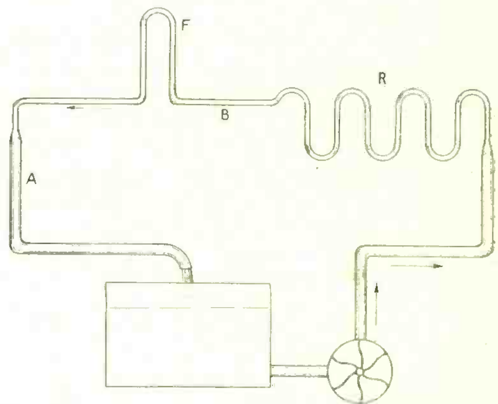


Fig. 8a. This circuit is similar to the electrical circuit of Fig. 8. The same quantity of water passes each point. In the electrical circuit the current is the same at each point in the circuit.

The voltage drop across the valve filament F is therefore given by the product of the current flowing in the circuit and the resistance in ohms of the filament. The voltage drop across the resistance R is also equal to the resistance times of the current. Calling the drop across the valve filament V_v, and that across the resistance V_r, we have $V_v + V_r = E$, the potential difference across the battery terminals. In the case of the valve filament $V_v = R_v \times I$ where R_v is the valve filament resistance; $V_r = R_r \times I$ where R_r is the resistance of the series resistance. From a little consideration of the two equations, since the current in each case is the same, the voltage drop is proportional only to the resistance. This is an important fact to remember. If the value of the resistance R is high compared with that of F, then the voltage drop across R is larger than that across F in the proportion of the resistance. Thus, if the resistance of R is 10 ohms and that of F 5 ohms, the voltage drop across R is twice that across F.

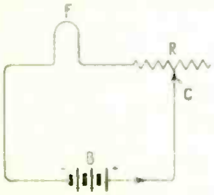


Fig. 9. This is a series circuit comprising a variable resistance R, a valve filament F, and a battery B. The current flowing in the circuit may be varied by shifting the contact C.

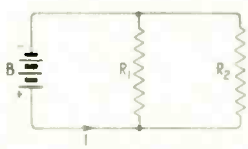


Fig. 10. This is a parallel circuit. The resistances R_1 and R_2 are connected in parallel. The effective resistance of R_1 and R_2 is less than either of them.

The relationship should be examined further. It will be noticed that if we have a circuit such as Fig. 9, where the battery B has a given voltage, F represents a valve filament and R a resistance which is variable; the more resistance included in the circuit by shifting the contact C to the right, the smaller is the current which flows.

As an illustration of the above principle, suppose a filament resistance is required to connect in series with the filament of a valve, and we are given the current in the circuit is 0·45 ampere when the voltage drop across the filament is 3·5 volts. If a six-volt battery is connected, the voltage drop across the resistance must be $(6 - 3{\cdot}5)$ or 2·5 volts, and the resistance $R = \frac{E}{I}$ is $\frac{2{\cdot}5}{0{\cdot}45}$, or 5·5 ohms. This is a usual resistance value for a filament resistance used in conjunction with a receiving valve.

9. PARALLEL CONNECTIONS.

When resistances are connected in parallel, as shown in Fig. 10, the voltage across each being equal, the current will divide according to the value of the resistances.

If the resistance R_2 is twice that of R_1, twice as much current will flow through R_1. If the total current is I amperes, the current will divide in the ratio of 1 to 2, two-thirds of the current flowing through R_1 and one-third through R_2. The resultant resistances R_1 and R_2, may be regarded as equal to a resultant resistance R so far as the total current I is concerned. The value of R is given by $\frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$ ohms. The resultant value of resistance may be found, whatever the number of resistances in circuit. If these are called

$$R_1, R_2 \text{ - - - - } R,$$

then R resultant $= \dfrac{1}{\frac{1}{R_1} + \frac{1}{R_2} \text{ - - - } + \frac{1}{R}}$ ohms.

If the resistances have the values given in Fig. 11, the resultant resistance is—

$$\frac{1}{\frac{1}{1} + \frac{1}{2} + \frac{1}{4}} = \frac{1}{\frac{14}{8}} \text{ or } \frac{4}{7} \text{ ohms.}$$

With a six-volt battery the current is given by $\frac{E}{R} = 6 \div \frac{4}{7}$, or 10·5 amperes. Of this total current, 6 amperes will flow through the

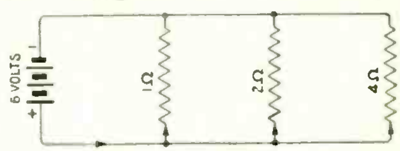


Fig. 11. The effective resistance of the three resistances connected in parallel is 4/7 ohms. The current divides according to the resistances.

1 ohm resistance, 3 amperes through the 2 ohms resistance, and $1\frac{1}{2}$ amperes through the 4 ohms resistance. Of course, in the above example, the currents could have been found directly by applying Ohm's Law to each resistance in turn; thus, the current in the 1 ohm resistance $= \frac{6}{1}$, or 6 amperes. The example shows that when circuits are joined in parallel, the total current from the battery is the sum of the currents in each branch. When valve filaments are connected in parallel, therefore, the total current from the battery is given by the current taken by one filament times the number of filaments in circuit, assuming, as is reasonable, each filament takes the same current. If the filaments take different currents, the total current is obtained by adding together each of the currents.

(*To be continued.*)

Accumulators and H.T. Batteries.*

1. An Explanation of the Action of the Accumulator.

By L. F. Fogarty, A.M.I.E.E.

THE title clearly shows that the advice to be offered is intended to cover only the nature and source of the currents used in wireless receivers. It is intended specially for those whose first acquaintance with electrical science has been brought about by a desire to investigate the possibilities of Radiotelephony as a means of intellectual recreation and amusement.

As an early member of the committee of the "Wireless Society of London" (now the Radio Society of Great Britain), I can say with full knowledge that its principal object has been to assist all investigators in radio science, and in particular the amateur experimenter, so that once embarked, he will never turn back for want of help.

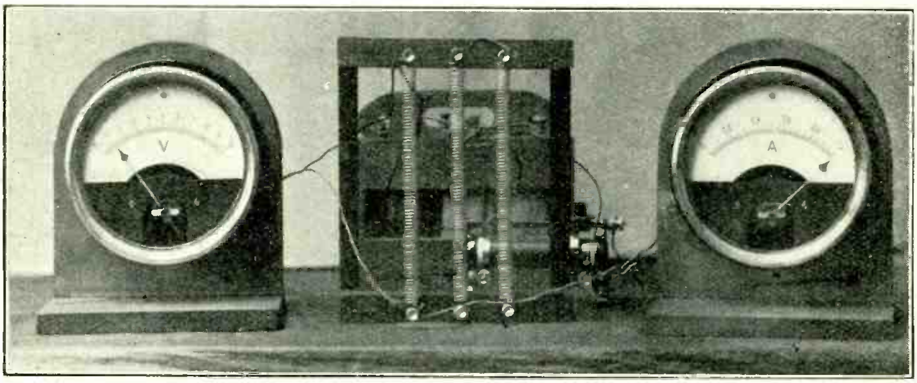


Fig. 1. An experiment illustrating Ohm's Law. The coils in the centre have a resistance of 1 ohm, the potential from the battery is regulated to 1 volt and the ammeter on the right indicates that a current of 1 ampere is flowing.

I propose to deal briefly with elementary matters, that are well-known to every electrician, and probably to the more advanced amateur experimenter.

I think I may safely say that the greater part of the receiving sets in use utilise either accumulators or dry cells, but only too often in the enthusiasm of listening-in to the excellent programmes now broadcast from London, Birmingham, Manchester, etc., we are perhaps very prone to forget that the filament accumulator and the anode battery need occasional attention of one kind or another.

The condition of these two components is vital to good reception in every valve-operated receiver, but it is possible under certain conditions to dispense with one or both, as I hope to describe later.

Although it may occupy some little space, it will probably be advisable at this point to revise our acquaintance with the meaning of one or two electrical terms in very common usage, and which we shall refer to frequently later on. The electrical units in common use are the ampere, the volt, and the ohm.

For the benefit of those who may be entirely without acquaintance with the subject, I would mention that the ampere is the international unit of electrical current, and represents the amount of current which will deposit a certain definite weight of silver per second. It is the current which flows in a circuit of 1 ohm resistance, under a pressure of 1 volt.

The volt is the universal unit of electrical pressure, and for elementary purposes can be defined as the pressure required to send a current of 1 ampere against the resistance of 1 ohm.

The ohm is the unit of resistance, and for scientific purposes is defined as the resistance offered to an electric current by a column of mercury 106·3 cms. long, having a uniform cross section and a weight of 14·4521 grammes at 0°C.

A spiral of wire is shown in Fig. 1 with a resistance of practically 1 ohm, with means of applying between the ends a pressure of 1 volt as indicated on the voltmeter (v) on the left, and when the circuit is closed, a current of 1 ampere

* A lecture for Associates arranged by the Radio Society of Great Britain on March 16th, 1923.

ensues, and is recorded by the ammeter (A) on the right.

The relationship between the current, the voltage, and the resistance, is defined as Ohm's Law, and is written $I = \frac{E}{R}$ so that if we know any two of the three factors, we can always determine the third.

A good voltmeter and ammeter are therefore tools of the utmost value to the electrician.

In addition to the fundamental units, the volt, ampere, and ohm, there are submultiples. The millivolt, which means the 1/1000 part of a volt, the milliampere, or 1/1000 part of an ampere, and the megohm which indicates 1,000,000 ohms. All these units and many others are regularly encountered in text books on radio work.

It is important to realise that neither volts, nor amperes, nor ohms by themselves represent electrical power, the unit of which is the watt and represents the power conveyed by a current of one ampere through a conductor whose ends have between them a pressure of one volt, or in other words a watt is the rate of work done when an ampere flows through one ohm. The watt is equal to the 0·746 of one horse power.

In any circuit carrying a steady unvarying current, resulting from a steady unvarying voltage, we can always ascertain the power expended, for if we measure both the volts and the amperes, and multiply these values together, the product will be the power expressed in watts. Likewise if we know the resistance of the circuit in ohms, and the current flow in amperes, we have but to multiply the resistance by the square of the current to find the power. Thirdly, if we square the value of the voltage, and divide by the ohmic resistance, the quotient again equals the power in watts expended.

For commercial purposes, power is reckoned in watt hours, and 1,000 watt hours is known as a Board of Trade unit, thus 10 amperes at 100 volts for one hour, or 5 amperes at 200 volts for the same period, would represent one Board of trade unit. Electric meters reading in these units are fitted in all premises using electricity for lighting, heating, or power.

The foregoing brief review will perhaps serve to make the way easier to a better understanding of those matters which have yet to follow.

In Fig. 2 is arranged a glass cell, containing two lead plates in a sulphuric acid solution, and if we pass a current from one lead plate to the other (the fact that the current is passing can be indicated by the amperemeter in circuit), it will be observed that the current is causing the production of bubbles of gas at the surface of the plates, and that at one plate the production of gas is much more rapid than at the other. These gases are oxygen and hydrogen, the former being liberated at the plate connected at the positive charging wire, and the hydrogen liberated at the negative. Both are produced by the dissociating action of the electric current on the water, which enters into the composition of the sulphuric acid solution.

The reader is aware that the chemical composition of water is written as H_2O, that is to say, that in every complete water unit, or molecule, there are two hydrogen atoms to one of oxygen, consequently when we split up a water unit, we should expect to get two volumes of hydrogen for every one of oxygen, and we should now readily understand why the gas is given off more freely at one lead plate than at the other.

The liberated oxygen attacks the lead plate with which it is in contact, forming lead oxide, as can be seen by the brown colouration, whereas the hydrogen is at first hardly absorbed at all.

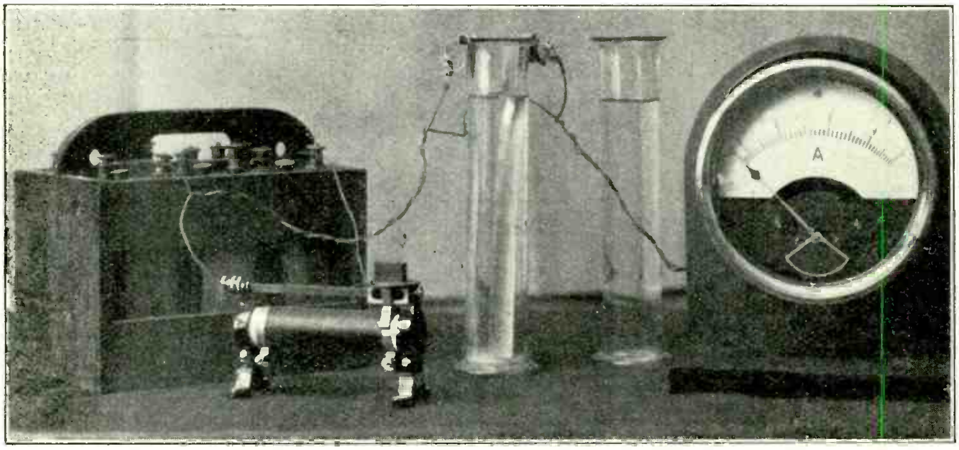


Fig. 2. The centre jar contains acidulated water in which two lead plates are immersed. A current is passed from the battery and through the regulating resistance on the left which is indicated by the ammeter on the right. Bubbles of gas are liberated from the plates due to the effect of the current in disassociating the hydrogen and oxygen from the water molecules.

After passing the current for some time in one direction, if we arrange to discharge the cell at a reasonable rate, and subsequently recharge the cell in the opposite direction, we should produce hydrogen in contact with the plate, previously

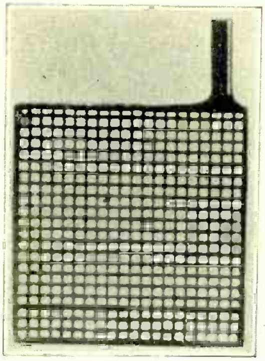


Fig. 3. Lead grid ready to receive paste.

coated with lead oxide, which later will combine with the hydrogen to form water, and a coating of lead in a spongy form will be left all over the surface of the lead plate, and the other plate will become oxidised in its turn.

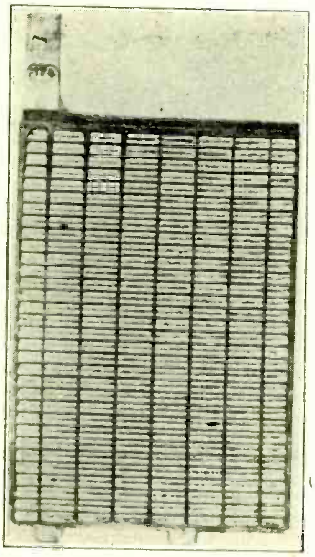


Fig. 4. A lead grid of special design to hold the paste securely.

By repeating this process for a very long time, we can build up a thick spongy coating on both plates and produce a practical accumulator, but it will obviously be a tedious process, now fortunately unnecessary, since Faure invented a process which greatly simplifies matters.

The improvement introduced by Faure consists in making the lead plates of an open-work, or lattice structure (Figs. 3 and 4), and of forcing a paste of lead and acid into the spaces thus provided (Fig. 5). Such plates when dried are obviously of an absorbent, spongy nature, offering a very large internal surface to the acid, and therefore when put on charge are able to use a large proportion of the gases liberated right from the first, and thus become charged, and in fit condition for use, much more quickly than was possible before this process was invented.

I think these remarks have explained that an accumulator of this kind does not accumulate electricity, but on the contrary stores energy in the form of chemical change in the cells' constituent parts, and that it is only when these chemical components are allowed to re-combine that a current of electricity becomes available.

Each individual cell when tested immediately after a complete charge should give a reading of nearly $2\frac{1}{2}$ volts, and in this connection it should be

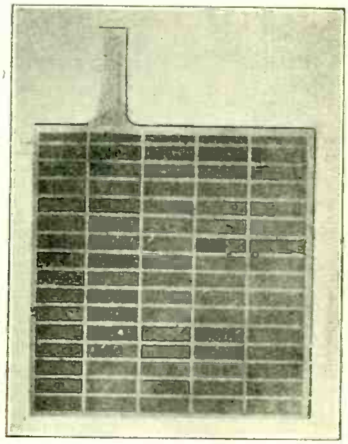


Fig. 5. A pasted plate.

remembered that the size of the cell has no influence whatsoever on the voltage which it is capable of giving. Increase in the size and the number of plates serves to increase the storage capacity, so as to enable it to be charged and discharged with a greater current rate, but size is without influence on the voltage which each cell provides. We must therefore take one cell for every two volts required, that is to say two cells for four volts, three cells for six volts, and so on.

Bearing in mind what has been said, a large accumulator cell therefore means that it will deliver larger currents for longer periods.

As soon as an accumulator cell or battery is put to work, the voltage will rapidly drop to approximately 2, and thereafter remain constant during nearly the whole period of the permissible discharge time, for when the cell has been discharged to a point where the voltage has fallen to not less than 1.8, it should be immediately disconnected, and recharged again.

(*To be continued.*)

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

The Trafalgar Wireless Society.*

At a meeting held on March 13th, Mr. R. J. Stanley lectured on various types of detectors.

The Secretary will be pleased to hear from any gentlemen wishing to become members, or to see them personally any Tuesday evening at The Trafalgar Hotel, Greenwich.

Hon. Sec., F. A. L. Roberts, 43, Adelaide Road, Brockley.

The City and Guilds Wireless Society.*

On March 8th, B. Hogue, Esq., D.Sc., gave a lecture on "Resonance." The lecturer explained this with reference to mechanical examples, and altogether gave a very comprehensive outlay of the subject.

On March 20th, a successful demonstration of broadcasting was carried out at the Imperial College Union, on the occasion of a dinner given to old R.C.S. students and staff.

The Hornsey and District Wireless Society.*

On March 12th a demonstration of home-made apparatus was given by various members. Each member was allotted 10 minutes to explain the method of constructing his apparatus.

On March 19th Mr. James F. Doyle, of the Radio Society of Great Britain, was elected to serve on the Committee. The evening was mainly devoted to questions. Many interesting subjects arising out of the questions were discussed.

Hon. Sec., H. Hyams, 188, Nelson Road, Hornsey, N.8.

Headquarters, Queen's Hotel, Broadway, Crouch End, N.8.

The Leicestershire Radio and Scientific Society.*

Mr. C. T. Atkinson opened a discussion on broadcast receivers at the meeting held on March 19th, and mentioned the abnormal amount of howling that prevailed in the district.

A very interesting discussion followed on the methods calculated to stop radiation.

All communications to be addressed to Hon. Sec., J. R. Crawley, 269, Mere Road, Leicester.

Wolverhampton and District Wireless Society.*

At the meeting held on March 28th Mr. E. Blakemore, A.M.I.E.E., gave a paper on "Ether Waves."

Mr. Blakemore was well applauded at the conclusion of his paper, and it is hoped to secure his services at a later date to complete his course of lectures.

Hon. Sec., J. A. H. Devey, 232, Great Brickkiln Street, Wolverhampton.

The Belvedere and District Radio and Scientific Society.*

On March 23rd a very instructive lecture was given, by Mr. H. H. Smith, on "Aerials and Earths."

Valuable hints were given by the lecturer on erecting masts and aerials, which were much appreciated.

The Secretary read out the particulars of the exhibition to be held at the Erith Technical Institute, April 19th, 20th and 21st.

Hon. Sec., S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

Sheffield and District Wireless Society.*

A most interesting and instructive lecture dealing with the design and construction of wireless receiving sets was given at the Department of Applied Science, on March 16th, by Mr. W. Burnet.

During the course of a very animated discussion which followed, the lecturer announced his intention of presenting the demonstration set to the Society, and the appreciation of the members was shown in a cordial vote of thanks.

A demonstration of the reception of broadcasting terminated a most enjoyable evening.

Hon. Sec., L. H. Crowther, A.M.I.E.E., 18, Linden Avenue, Woodseats, Sheffield.

The North London Wireless Association.*

The 122nd meeting of the above Association was held on Monday, March 19th.

The whole evening was given to the testing of members' newly constructed sets.

The chief comment throughout the evening was "The false economy of cheap transformers."

The 123rd meeting of the Association was held on Monday, March 26th, at which the functioning of the local oscillator was explained by Mr. Frank S. Angel.

The Secretary wishes to make known that reduced fees are in operation for youths desirous of becoming members, and full particulars can be obtained from J. C. Lane, Hon. Sec., c/o The Northern Polytechnic Institute, N.1.

The Finchley and District Wireless Society.*

On March 22nd, a number of short papers on aerials were handed in by the members for competition, and were read before the members.

On March 29th, after the junior morse class and other business, Mr. Wilke gave an interesting talk on "High Frequency Inter-Valve Transformers."

Hon. Sec., A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

Liverpool Wireless Society.*

A meeting of the above Society was held on March 22nd, at which the President, Professor E. W. Marchant, D.Sc., gave an exceedingly interesting lecture on "Methods of Reducing Interference in Wireless Receiving Sets." The lecturer explained diagrammatically several circuits designed specially for the elimination of atmospherics and interfering signals. A set made on the Hinton Circuit principle, admirably demonstrated to the meeting the selectivity of this circuit.

Hon. Sec., G. H. Miller, 138, Belmont Road, Anfield, Liverpool.

Streatham Radio Society.*

At the meeting held on March 15th, a lantern lecture was given by Mr. A. G. King. The slides, which were kindly lent for the occasion by Messrs. The Marconi Company, illustrated many of the applications of radio work. Ten new members were elected, including the first lady member.

Hon. Sec., S. C. Newton, A.M.I.E.E., "Compton," Pendennis Road, S.W.16.

North Middlesex Wireless Club.*

The annual general meeting of the above Club was held at Shaftesbury Hall, Bowes Park, N., on March 7th, Mr. A. G. Arthur being in the chair.

A résumé of the doings of the Club for the past year was given by the various officers, and the balance sheet was presented and adopted.

Mr. Savage expressed his regret that pressure of business prevented him from continuing to act as Secretary.

The election of officers and committee was then proceeded with, and resulted in the following gentlemen being declared elected :—

President, A. G. Arthur ; Vice-President, E. M. Savage ; Hon. Secretary, H. A. Green ; Installation Officer, M. Symons ; Treasurer, W. A. Saville ; Librarian, E. W. Cornford ; Chairman, A. J. Dixon ; Committee, Messrs. Chapple, Cartland, Holton, Weare, and Wordham.

On March 21st, Mr. C. W. Wordham gave a paper on "Simple Harmonic Motion and its Applications to Wireless." The lecturer made this somewhat technical subject very clear by means of diagrams and everyday illustrations.

The latter part of the evening was devoted to a demonstration of the Club's new valve panel, which was coupled up for the occasion to a tuning unit lent by one of the members.

All wireless enthusiasts are invited to write to the Hon. Sec. for particulars of membership.

Hon. Sec., H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

Birmingham Experimental Wireless Club.*

On Friday, March 23rd, Mr. Amies attended the regular meeting of the Club and delivered a lecture on the problems of transmission of telephony and gave much interesting statistical information regarding the Birmingham Broadcasting Station. A new type of microphone was specially referred to in the lecture and a sample of same was shown. Mr. Amies has kindly consented to give the Club a lecture at a later date on "Modulating Circuits for Speech Transmission."

At the same meeting Mr. Whitfield exhibited and explained a new and highly efficient three-valve circuit he has devised for working on the broadcasting band of wavelengths. This circuit has been very successful in cutting out a broadcasting station only one or two miles away and getting clear telephony from any other more distant broadcasting station at the will of the operator. Splendid results were obtained on the Club's aerial.

Hon. Sec., A. Leslie Lancaster, c/o Lancaster Bros. & Co., Shadwell Street, Birmingham.

Bath Radio Club.*

On March 23rd, Mr. Boxwell concluded his series of lectures with a talk about low frequency amplification with the valve, followed by a fully-explained diagram of an ideal three-valve set.

Hon. Sec., Geo. J. Barron Curtis, F.S.A.A., F.C.I.S., 6, Pierrepont Street, Bath.

Darwen Wireless Society.*

The first meeting in the Society's new rooms was held on March 22nd, when the members were invited to make suggestions regarding the future activities of the Society.

The Society's apparatus will be installed immediately, and the Hon. Sec. would be pleased to hear from any gentlemen who would be willing to give a lecture or demonstration.

New members will be welcomed at the new headquarters in Arch Street, any Thursday evening, or full particulars may be obtained from the Hon. Sec., T. H. Mather, 8, Hawkshaw Avenue, Darwen.

The Stoke-on-Trent Wireless and Experimental Society.*

The annual general meeting of the Stoke-on-Trent Wireless and Experimental Society was held at the Y.M.C.A., Hanley, on March 29th. The following officers were elected for the ensuing year.

President, F. E. Wenger ; Vice-Presidents, H. S. Pocock and L. F. Fogarty, A.M.I.E.E. (Treasurer Radio Society of Great Britain) ; Chairman, F. Jenkinson ; Vice-Chairman, T. R. Clark ; Treasurer, H. Marshall ; Secretary, F. J. Goodson, B.Sc. ; Asst. Secretary, R. W. Steel.

Messrs. F. T. Jones, F. Bew, A. Whalley, J. Warburton, F. W. Hopkinson, A. J. Goodwin, W. H. Reid and Student Brindley, were elected to the Committee.

A resolution was adopted reducing the subscriptions to 10s. 6d. per annum for ordinary members, and to 7s. 6d. per annum for student members. It was hoped thereby to greatly increase the scope of the Society.

The number of entries by students for the prize of 10s. 6d. offered for the best paper was very gratifying, and the standard of the papers submitted was very high. The prize was awarded to Mr. Brindley for an excellent paper on "Valve Amplification."

All communications and applications for membership should now be addressed to the Hon. Sec., at Tontine Square, Hanley.

Radio Society of Birkenhead.

Owing to the shortage of lecturers, March 15th was an experimental night. Mr. Watson brought his transmitter (5 HA) to show and demonstrate, and Mr. Hughes brought a seven-valve Radio Company's receiving set to demonstrate, and rendered 2 ZY audible to the meeting. Experiments were then tried with the transmitter, and after some trouble with the lighting mains, speech of rather an impure quality was produced owing to the hum of the mains.

It has been decided that all blind and deaf people shall be admitted to the Society as hon. members.

The Secretary wishes to bring to the notice of all members that the next meeting will be held on April 12th instead of the 1st, owing to the room being required by the rightful owners. The second meeting in next month will therefore take place on the 26th prox. This will be the last meeting of the winter season, and it is hoped that an open night and soirée will be held. A field day will be arranged this summer, and some very interesting experiments will be carried out.

Hon. Sec., R. Watson, 35, Fairview Road, Oxton, Birkenhead.

Middlesbrough and District Wireless Society.

A meeting was held on Monday, March 19th, when Mr. Chas. Thewliss read a paper on "The Aerial," which was most interesting and very acceptable to the recently enrolled members.

Hon. Sec., Frank King, 45, Queen's Road, Linthorpe.

Cambridge and District Radio Society.

On Monday, March 12th, an interesting lecture on "High Frequency Amplification" was given by Mr. Ellison, who is well known in the Yorkshire area as 2 JP—transmitter on the short wave.

Future meetings of the club will be held fortnightly on Mondays (7.30 p.m.) in the rooms of the Cambridge Liberal Club. In April a lecture will be given by Mr. Driver on the simple crystal circuit, the lecturer proposing to build up the set on the table as he proceeds. An attempt will be made to listen in to 2 LO when the set is complete.

Subscriptions for the year 1923 have been reduced to 5s., and those interested will be welcomed by Mr. Butterfield, King Street, Cambridge.

Watford and District Radio Society.

On March 16th Mr. Christie gave an interesting lecture on "Ohm's Law."

On March 23rd Mr. A. Houlton gave an interesting account of his experiences as a wireless operator in the Mercantile Marine, showing both the humorous and the serious side of a wireless operator's life afloat.

Local amateurs should communicate with the Hon. Sec., F. A. Moore, 175, Leavesden Road, Watford.

Beckenham and District Radio Society.

On Thursday, March 22nd, the Chairman apologised for the non-appearance of Lt. Walker, who had promised to give a lecture on that date. It was decided to carry on with the proposed diagram of the Society's set. A proposed diagram was then put on the blackboard for general criticism. After a most interesting discussion this set was agreed to after making certain modifications, and the meeting then closed.

Hon. Sec., J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

The Peckham Wireless and Experimental Association.

The Association hope to give a public demonstration at the Central Hall, Peckham, on April 26th next.

At the ordinary meeting on March 21st, the Jumble Sale of members' surplus apparatus was a great success, nearly all lots put up were disposed of, and both purchasers and sellers were convinced that they had secured genuine bargains.

Mr. Voigt, member, was very interesting on the subject of "High Frequency Circuits," going minutely into the details of transformers and their connections.

The Eccles and District Radio Society.

A meeting was held at the temporary club rooms on March 22nd, 1923, when a good number of new members were enrolled. An interesting discussion arose on the value of a frame aerial for eliminating foreign noises.

New members are invited to attend at the next meeting.

Hon. Sec., A. Norris, Laburnum Cottage, Green Lane, Patricroft, Lancashire.

Warrington Radio Association.

A meeting was held in the Y.M.C.A., Market Gate, Warrington, on Thursday, March 22nd, when Mr. R. W. Taylor, M.P.S., gave a very interesting address on "Crystals and Crystal Detectors, with Suggestions as to Why They Act." Apparatus was displayed which helped to make the lecture all the more interesting. A very interesting discussion then followed, the lecturer replying to points which were raised.

Hon. Sec., W. Whittaker, Brickmakers Arms, School Brow, Warrington.

A New Spanish Wireless Club.

At Barcelona, Spain, a new club has been formed under the title of "The Radio Club Cataluna," with headquarters at Plaza Santa Ana 4. The objects of the Society are to further radio research in Spain, and to secure co-operation between amateurs and professionals, guarding their mutual interests. The membership of the club already exceeds 150.

Dr. J. Balta Elias, Professor in the University, has been elected President, and Dr. J. Febrer Carbo, Vice-President. The Treasurer is Dr. A. Bartrina, and Dr. A. Estublier holds the position of Secretary. The Technical Committee is composed of the following members:—Dr. E. Calvet (of the Industrial School of Villanueva y Geltru), Mr. E. Laurent, telephone engineer, Professor F. Espinosa and Dr. F. Lopez Pando.

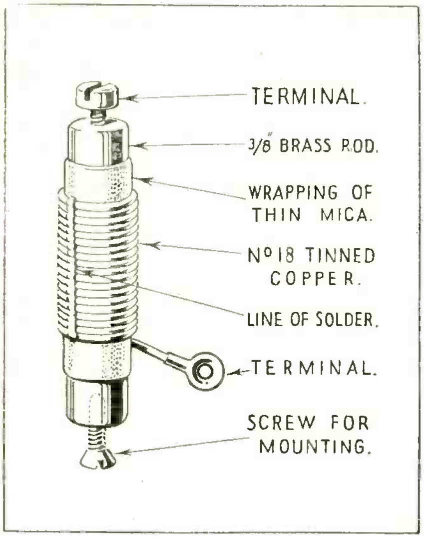
The first official meeting of the club was held at the University, on March 26th, when the President, Dr. Balta, gave experimental demonstrations on "The Electronic Emission as Employed in Radiotelegraphy."

The Society sends cordial greetings to all English amateurs, with whom it will be pleased to conduct correspondence.

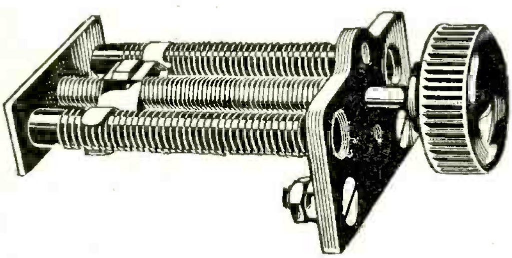
Useful Devices

SOME PRACTICAL IDEAS FOR THE EXPERIMENTER.

A reliable grid condenser can be easily built up by wrapping a short piece of brass rod with mica and winding on a layer of bare copper wire. The rod may be tapped at

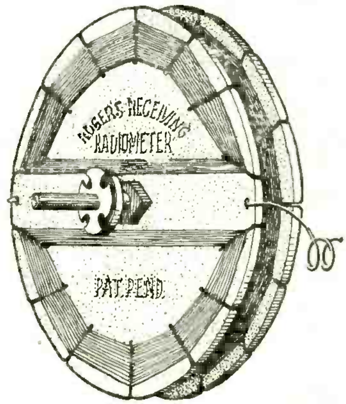


the ends to provide for fixing to the panel and arranging terminal connection. A little solder run along the turns of wire will hold the winding securely in position.

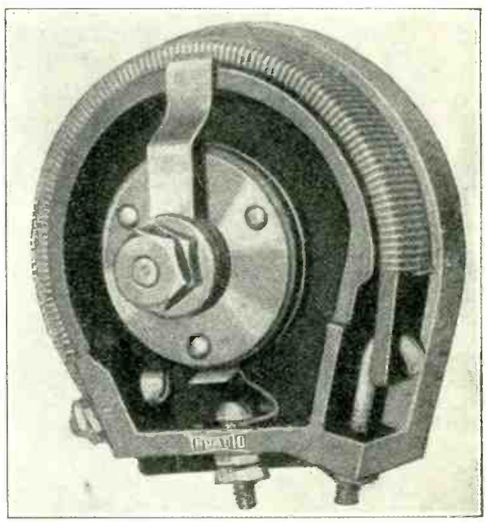


An adjustable resistance providing critical adjustment. Two resistance coils are bridged by a clip which is slowly moved by means of a threaded spindle. Such a device is useful for adjusting the filament current of two valves, one of which may be switched in or out of circuit without altering the other.

This variometer is of very simple construction and occupies very little space. It gives a large variation of inductance value, or, if



the two coils form the inductances of separate circuits, the coupling provided is critical and reversible.



In this filament resistance the wire is wound upon a former which is bent round the face of the moulded material and pulled tight by means of an adjusting screw.

Fundamental Principles of Radio Reception.

By MAURICE CHILD.

(Concluded from page 25 of previous issue.)

Fi . 7 shows in diagram form the arrangement whereby a lamp can be made to glow by means of induction. This figure is the same arrangement as that which was shown in Fig. 6.

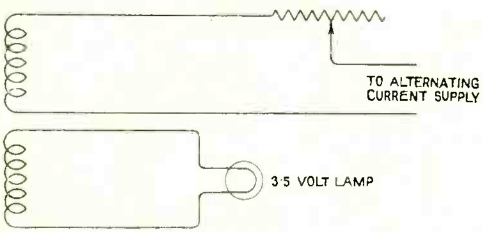


Fig. 7. Circuit to demonstrate transformer action.

Fig. 8 shows the method of demonstrating the deflection of the galvanometer needle when a steel magnet is passed in and out of the coil of wire. Fig. 9 shows the same arrangement in diagrammatic form.

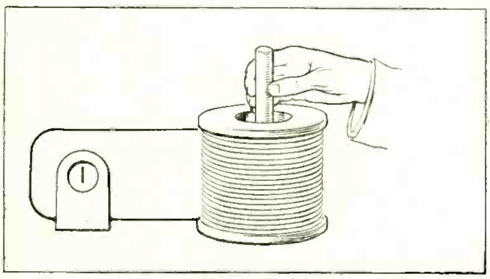


Fig. 8. Circuit for indicating galvanometer deflection.

So far we have ascertained that when we have a current which is altering in direction, then that current will set up in the coil or circuit associated with it another alternating current.

We will now pass on to another part of our subject altogether, and refer to Fig. 10.

This may appear a rather complicated sort of diagram. I must first of all describe some of the things on the diagram. We have two wires on the left which we will assume are copper conductors carrying a supply of current of an alternating character indicated by the symbol ~. These wires are connected to the primary winding of a transformer. Now this transformer (there is nothing mysterious about the device) consists of two coils with an iron core in the middle. This is an ordinary electrical transformer, but the primary winding on the left consists of relatively few turns of copper wire wound round an iron core, and the secondary consists of many thousands of turns of fine wire wound on top of the primary with insulating

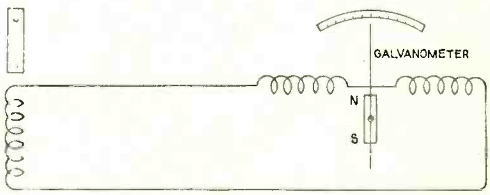


Fig. 9. Diagram of the arrangement in Fig. 8.

material between them. If we pass an alternating current through the primary coil we shall get magnetic fields in the iron core, which will set up electrical pressures across the ends of the secondary coil, which will be of a very high value. We can make these pressures so high that when we bring the two knobs represented in the figure within an inch or two of each other, an electric spark will jump across the air space. What happens is that the air becomes a conductor when that pressure acts upon the small air space, and we get what is called an oscillatory spark. In practice the apparatus in this circuit includes an electrical condenser which consists of metal plates close to each other (with some dielectric between), indicated in the diagram as two thick black lines. The condenser has one end joined to the transformer and the other to a coil of wire as shown in the figure

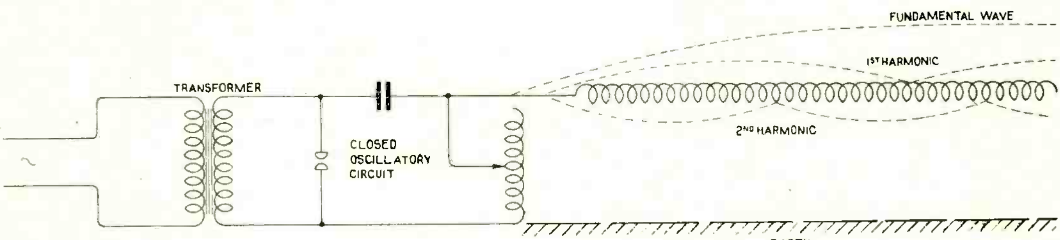


Fig. 10. Diagram of apparatus for demonstrating harmonics.

This circuit makes what is called, in radio work, a closed oscillatory circuit.

By means of the high pressure across the transformer we charge the condenser, and a spark takes place between the knobs. The condenser discharges itself round the circuit, and it does so in an alternating manner; that is, we get a flowing of currents backwards and forwards, the changes following on each other with enormous rapidity. We may get current surges in that circuit to the order of a million in a second of time, or even more. Now these oscillations will produce varying magnetic fields round the long coil shown on the right, and we shall get oscillating pressures between the earth and the end of this long coil. Now, with this arrangement, an interesting experiment can be shown. It is a very old experiment, first made something like fifteen years ago by Professor Fleming, but he did it for a different purpose from that for which I want to do it to-day. I shall show you what actually happens in your aerial wire when you fix it up and it is receiving signals. By the means already described we set up in this coil a series of alternating currents, and these alternating currents are going to surge up and down, producing pressures at the far end. We can only get pressures there because the end of the coil is insulated and there is nowhere for the current to flow. As the air is a good insulator, and providing the pressure is not too high, then we shall get practically no current flowing from that end of the coil at all. We get pressures all along the coil, but increasing up to the end, and the full length of the coil gives what is called the fundamental wavelength of the helix, or coil itself.

The long coil shown in the diagram consists, for the purpose of this experiment, of a tube wound with some two or three thousand turns of a very fine silk-covered copper wire. Now, in order to show whereabouts the pressures are greatest on this spiral, we can use a little tube which has had the air exhausted from it, with a very small trace of the gas called "neon" left, and this tube, if brought near a circuit which is oscillating rapidly, glows with an orange light. If we put this remote from the free end of the coil there is not very much light in the tube, but if we move towards the free end of the coil, at the free end we should find that the tube glows with much greater intensity. Now if you think of this coil here as being your elevated aerial wire, when you are getting radio signals or music from any transmitting station, then you are getting similar oscillating potentials set up, only much weaker, of course, and at the far end of the aerial there will be relatively considerable pressure; at any rate it will be considerable compared with that at the instrument end which is in your room.

When you make certain adjustments with your apparatus it may happen that you can receive what we call a harmonic, that is, you can receive a wave considerably shorter than the wave which your aerial is adjusted to receive with maximum strength. If we cut out most of the small coil shown in the centre of the diagram the current will oscillate very much faster, and a rather interesting effect can be observed. Taking the little tube containing neon gas and moving it along the coil it will be seen to glow brightly at certain definite places, which are those where there is considerable pressure, and it goes out at others. We are therefore setting up on that aerial wire what is called the first harmonic. This is very frequently done with receiving apparatus when near-by transmitting stations are working. Many of us are very much troubled by receiving harmonics when we don't want them, but I do not think we are so much troubled as the people who own the stations which produce them. There are certain stations which set up very powerful harmonics of various frequencies, that is, the strong waves which they radiate are of certain length, but there are other wavelengths radiated which are short and which you have already seen can be set up even by the circuit we have been dealing with. We can also receive these short wavelengths on the very same apparatus with the same adjustment of our aerial system to the fundamental wave, but the fundamental wave is, of course, very much stronger, and it is even possible for this apparatus to show a complete wave form comprising the second harmonic. (*Third and fourth harmonics were shown also*).

I now propose to refer to one or two things with regard to insulators, because it is rather a happy opportunity to do so.

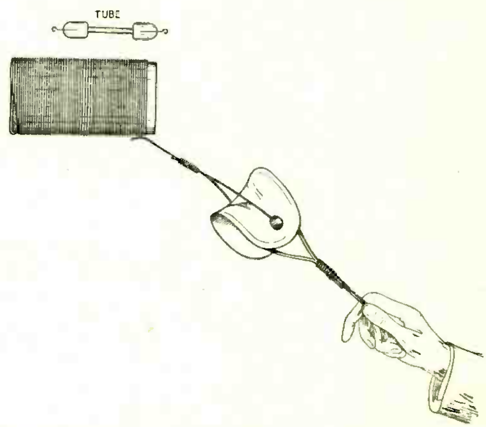


Fig. 11. *Demonstration to show absorption by an insulator.*

Those of you who have set up aerials have probably purchased insulators of different kinds. One or two properties of insulators are of special interest. You get very considerable losses of energy by the use of unsuitable insulators. These losses are not directly due to the fact that the insulators do not insulate; they are due to condenser action. In Fig. 11 is shown a type of insulator with which most of you, I suppose, are familiar. It is a little porcelain insulator with two holes at right angles. Now with this insulator, and the apparatus of Fig. 10, I want to show you how losses can occur. I am afraid I am going to exaggerate a little—making things much worse than in actual practice. First of all we will fix the Neon tube near the end of the long coil so that it maintains a bright glow. Then, if we bring up the insulator as in Fig. 11, you will see that the lamp goes dim or goes out, entirely due to the energy pouring into the insulators. If you use these insulators, try two or three of them in series, that is, have a number of them in line, when you will be less likely to get any loss. That loss is not due to actual leakage from the material. It is due to the fact that these two connections to

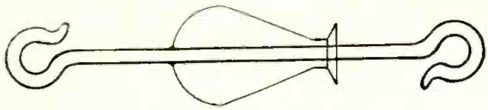


Fig. 12. A new type of insulator.

the insulator (one would be a wire and the other would be a rope) constitute a condenser, and the material between is a dielectric, and when you have very high frequency currents or voltages applied to that dielectric, you get, theoretically, a heating up of the material and what are called "dielectric currents."

Fig. 12 shows a new glass insulator which has recently been brought out, and if we try the same experiment with this it will be noticed that very little absorption takes place. Glass does not appeal to many people because it is liable to break, but, as a matter of fact, I have put a weight up to 70 lbs. on this and it holds perfectly well. There is no reason why glass should not be used. You have to be careful while you are fixing it, but, once up, glass should do as well as any other material.

It is best to always employ an insulator of considerable length, as thereby the loss is reduced.

Notes

Change of Wavelength of the Radiola Concerts.

The Radiola Concerts have changed their wavelength from to 1,565 metres to 1,780 metres as from March 19th.

The French Government uses an Amateur Station.

Mr. Thuillier, at Algiers, whose call sign is 8 AY, has been authorised by the Government to transmit daily meteorological forecasts on 200 metres. *The Wireless World and Radio Review* would be glad to receive reports of reception of this station in England.

Telephone Transmissions from Lyons.

With the exception of Sundays, Lyons **(Y N)** now transmits gramophone concerts daily from 10.45 to 11.15 a.m. on 3,100 metres. Six 250 watt valves are used, and reception is reported at Ajaccio (Corsica) with crystal followed by L.F. amplification.

Transatlantic Telephony ?

It is reported by Mr. R. W. Galpin **(5 NF)**, of Herne Bay, that a transmission of great clearness and of rather a frivolous nature was intercepted by him on 380 metres during the early morning of the 25th March. The accent suggested that the speech was of American origin, which is rather surprising in view of the signal strength. Did any other listeners intercept this transmission ?

250 Miles on 1 Watt.

Mr. C. E. Morriss **(5 WR)**, of Belvedere, Kent, reports that he called **OMX** (Amsterdam) using a power which he estimates at only one watt. An immediate reply from Amsterdam, which is nearly 250 miles away, indicated that his signals had been heard.

Brussels Concerts.

Concerts are now transmitted on Sunday, Tuesday and Thursday, at 6 p.m., on 1,300 metres, about 1 kW. At 4.50, after the usual meteorological report, the programme of the evening's concert is announced. Call sign, if used, BAV.

The Removal of Sulphate in Accumulators.

A very useful preparation is now available which is claimed to have the property of removing sulphate from accumulator plates. It is in liquid form and is simple to use. If there is sediment, a little of the liquid poured into the cell after the acid has been removed will soften it, so that it can be flushed out as a fine sludge. For sulphated plates the acid is removed and replaced by the liquid, with the result that the sulphate is cleared in about 24 to 48 hours and no dismantling required, whilst the active material of the plates is in no way affected. The manufacturers are Morgan's Works Supply, of 50, Stradey Road, Llanelly, Carm.

Wireless Talks on Music.

The British Broadcasting Company has just completed arrangements with the Federation of British Music Industries which will add to the wireless concert programme a new and an attractive feature. Once a week, in the course of the concert, a five minutes' chat on music will be given by the Federation Director of Education, Major J. T. Bavin. He will deal with the subject in the simplest possible manner. His talks will consist of an exposition of the construction of music in all its forms, and hints for listeners to music, which gradually will develop into a complete course of lessons in musical appreciation.

The London talks will be duplicated from other stations. A great public will thus be assured to them, and they will carry out one of the primary intentions of the Federation of British Music Industries, that of assisting the development in this country of musical knowledge. The scheme was inaugurated on Tuesday, March 27th, at 8 p.m., and will be continued on successive Tuesdays.

Removal of Receiving Apparatus.

The following letter has been addressed to the Hon. Secretary of the Hackney and District Radio Society in reply to a letter enquiring as to whether users of licensed receiving apparatus may transfer their equipment to other premises than those stated on the licence :—

General Post Office,
February 28th, 1923.

SIR,—With reference to your letter of February 16th, I am directed by the Postmaster-General to say that he sees no objection to members of the Society taking their wireless receiving apparatus occasionally to other private houses for the purposes of comparison or demonstration.—I am, etc.,

(Sgd.) T. W. WISSENDEN,
For the Secretary.

Forthcoming Public Wireless Demonstration.

The Wireless and Experimental Association have acquired the Central Hall, Peckham Road, S.E., for a public demonstration on April 26th next, on wireless in general and the reception of broadcasting, one of the main efforts being to bring to the notice of the public in general the advantage of wireless in the home, and also the misuse of reaction. The demonstration will be from 7.30 p.m. to 10.30 p.m.

Radio Society for Barnet and District.

A number of wireless enthusiasts in the Barnet district met at the Barnet P.S.A. Hall, on Thursday evening, March 22nd, to discuss the possibility of forming a local radio society. Mr. C. Randall, the Barnet postmaster, and a keen wireless experimenter, was voted to the chair, and an enthusiastic meeting resulted. It was unanimously decided that a society should be started, and that it should be named the Radio Society of Barnet and District. Mr. J. Nokes, assistant postmaster of Barnet, was appointed Hon. Secretary, and a small committee was formed.

Those desirous of becoming members should communicate at once with Mr. J. Nokes, whose address is "Sunnyside," Stapylton Road, Barnet, Herts.

A New Invention.

An instrument known as the Cathode Oscillograph has been made by M. Dufour, a professor of physics at the Faculty of Sciences, Paris, which is capable of recording the millionth part of a second. It is possible, with this wonderful appliance, to register minute currents of high frequency electricity, and it is proposed to apply the invention to the reception of high-speed wireless messages.

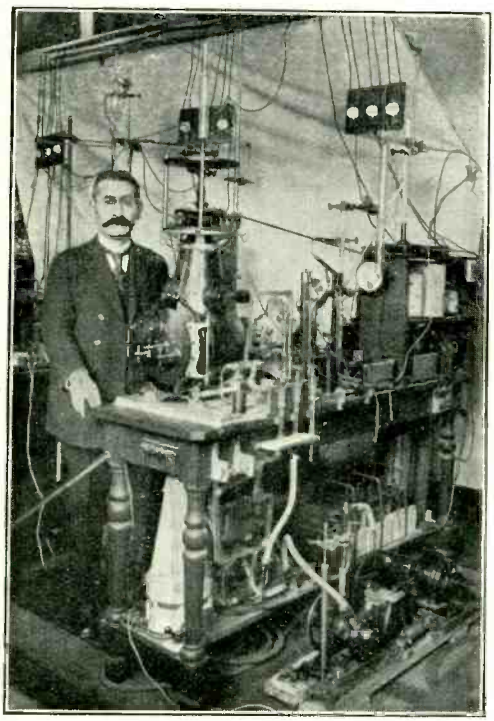


Photo: Dorien Leigh, Ltd.

Correspondence.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

CHARGING BY A.C., D.C. RECTIFIER.

SIR,—As one who has considerable experience of A.C. rectifiers of all types, including Noden valves and its several modifications, mercury arcs, vibrating reeds, Tungars and motor-generators, I should like to obviate any misapprehension that might conceivably arise after reading Mr. Mortimer A. Codd's remarks in his letter referring to the efficiency and running costs of the Tungar rectifier.

I hold no brief for the vendors of the Tungar or any other type of rectifier, but I would venture to advise all wireless amateurs who desire to charge batteries from A.C. mains with safety, efficiency and a minimum of trouble, to avoid chemical rectifiers in their present stage of development. They are messy. The elements are subject to corrosion. They are liable to fail to function unless they are maintained with the greatest skill and care.

Vibrating reed rectifiers give rise to trouble due to sparking and arcing at the contacts unless maintained by an expert.

Motor generators are satisfactory, but involve running machinery and safety devices.

The Tungar rectifier compares favourably as regards first costs. Practically the whole of the running costs are in bulb replacements. The bulb is more robust than an ordinary thermionic receiving valve, and its average life is greater. The Tungar operates noiselessly and may be left, charging batteries, entirely unattended for long periods.

I do not agree with Mr. Codd's statements that the cost of replacements amounts to 1s. 6d. per recharge, nor that the efficiency is 29 per cent.

Mr. Codd states that the makers of the Tungar bulb guarantee a 600 hours life. That is good news. If any type of electric incandescent lamp burns for 600 hours, its life is likely to be much longer. It is as unreasonable to assess the cost of replacements of Tungar bulbs on the guaranteed life as it is to assess the cost of replacing a motor-car on a maker's twelve months' guarantee. Cases are known of a Tungar bulb being in operation for 3,000 hours. The fact is that under normal conditions of use, the average life of a Tungar bulb is equal to that of the average metal filament lamp, viz., 1,000 hours. The chances are that it will be greater seeing that the lighting lamp makers do not guarantee any length of life for their products.

As to Mr. Codd's statement that only one wave is rectified (I take it Mr. Codd means that only one half wave is rectified), and the implication that therefore the Tungar is inefficient; is Mr. Codd not aware that the suppressed half-wave is wattless and is therefore only a small and almost negligible factor in the summation of losses? I have no difficulty in recharging my own batteries at an efficiency of 40 per cent.

Mr. Codd's figure should be corrected to 9d. per recharge, including the proportionate cost of bulb replacements and power—an expense which no reasonable person can object to in view of the great convenience of the system.

E.-in-C.'s Office,
G.P.O. J. G. Lucas.

The following is a translation of a letter received from Dr. Corret, President of the Comité Français des Essais Transatlantiques:—

To the Editor of The Wireless World and Radio Review.

Sir,—We have read with great interest, in Nos. 184 and 185 of *The Wireless World and Radio Review*, the information given on the subject of the British Radio Relay League, and the discussion which took place on the subject at the meeting of the Radio Society of the Great Britain.

The views expressed by Mr. Coursey and Mr. Child in this discussion are in exact agreement with those of the majority of our committee.

Although not able to give you details at present, I am pleased to inform you that in France an organisation of amateurs is being formed, which will be very happy to work with amateurs of other countries, particularly those of Great Britain.

With all wishes for useful and fruitful co-operation between amateurs of our two countries,

(Sgd.) Dr. Pierre Corret.

Radio Society of Great Britain.

The next elementary lecture arranged by the Society for Associates will be held at 6.30 p.m. on April 18th at the Institution of Electrical Engineers. Mr. E. Redpath will describe "The Elementary Principles of the Valve." Non-members of the Society may obtain tickets on application to the Hon. Sec., 32, Quex Rd., N.W.6.

Forthcoming Events

THURSDAY, APRIL 12th.

Kensington Radio Society. At 8.30 p.m. At 2, Penywern Road, Earl's Court. Lecture by Mr. Blake, A.M.I.E.E.

FRIDAY, APRIL 13th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Practical Demonstration.

Leeds and District Amateur Wireless Society. Lecture: "The Construction of a Relay." By Mr. R. E. Timms (Hon. Treas.).

Belvedere and District Radio and Scientific Society. Lecture: "Theory and Construction of a Wavemeter." By Mr. S. Burman.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove, N.6. Lecture: "Construction of a Crystal Set." By Mr. F. L. Hogg.

MONDAY, APRIL 16th.

Ipswich and District Wireless Society. At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. S. Dawson.

TUESDAY, APRIL 17th.

Fulham and Chelsea Amateur Radio and Social Society. At Chelsea Polytechnic, Manresa Road, Chelsea, S.W.1. Ladies' night. Topical Readings and Demonstration.

WEDNESDAY, APRIL 18th.

Manchester Wireless Society. At 7.30 p.m. At Houldsworth Hall. Elementary Lecture No. 4 by Mr. G. W. P. Evans.

THURSDAY, APRIL 19th.

Ilford and District Radio Society. Lecture on "Short Wave Reception," by Mr. A. G. S. Gwinn.

Derby Wireless Club. At 7.30 p.m. At the Shaftesbury Restaurant. Lecture: "Radio Gadgets," by Mr. F. J. Cowlishaw.

Belvedere and District Radio and Scientific Society. Radio Exhibition at the Erith Technical Institute. (3 days. April 19th, 20th and 21st.)

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily press, are now conducted from the following stations of the British Broadcasting Company:—

London	**2 LO**	369	metres.
Birmingham	**5 IT**	420	,,
Manchester	**2 ZY**	385	,,
Newcastle	**5 NO**	400	,,
Cardiff	**5 WA**	353	,,
Glasgow	**5 SC**	415	,,

FRANCE.

Eiffel Tower. 2,600 metres. 11.15 a.m. weather reports (duration 10 mins.) 6.20 p.m., weather reports and concert (duration about 30 mins.) 10.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 5.5. p.m. news; 5.15 p.m. concert till 6 p.m.; 8.45 p.m. news; 9 p.m., concert till 10 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 7.45 p.m. to 10 p.m. Saturdays, 4.30 p.m. to 7.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 10.45 a.m. to 11.15 a.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 6 p.m.

HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday: 3 to 5.40 p.m., Concert. Monday and Thursday: 8.40 to 9.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

Questions and Answers

"C.B.W.B." (Coventry) *submits a diagram of his receiver, and asks why no signals are received.*

The diagram of connections is correct, although it would be better to connect a fixed condenser having a capacity of 2 mfds. across the H.T. battery. The reason why no signals are heard is probably due to bad crystals. We suggest you couple a buzzer near the receiver, and notice whether the buzzer note is heard in the receivers. A crystal receiver is not satisfactory for the reception of broadcast transmissions unless you are situated within about 20 miles of the broadcasting station.

"A.T." (Ashton-on-Mersey) *submits a diagram of his three-valve receiver, and asks* (1) *Are the connections correct.* (2) *Whether the condensers are properly connected.* (3) *Why is it no signals are received unless reaction is used.*

(1) The diagram submitted is correct, except that the aerial tuning condenser should be connected in series with the A.T.I. when it is desired to receive the broadcast transmissions. A large value condenser should be connected across the H.T. battery; 2 mfds. would be suitable. It is not necessary to use the 0·0005 mfd. condenser in conjunction with the tuning arrangements already provided. (3) A condenser should be connected across the primary winding of the low frequency transformer connected in the anode circuit of the detector valve. Reaction, of course, is very helpful in increasing the strength of signals, but you should overhaul the aerial and earth, and make sure that they are as effective as possible under the circumstances. The earth connection should be short and should run direct to the earth. Proper aerial insulators should be used, and the aerial wire held away from the sides of the house.

"C.J.V.S." (Oxford) *asks* (1) *Whether the proposed arrangement for switching on the high tension battery is suitable.* (2) *What is the advantage of having the aerial tuning condenser in the earth lead of the receiver.* (3) *Could a diagram showing how the syphon recorder, described in the December 2nd issue, is connected be given.*

(1) We do not care for the method of switching suggested. We would refer you to the article entitled "Some Methods of Controlling L.F. Valves," on page 624, of February 10th issue. (2) We suggest the aerial tuning condenser be connected in the aerial side of the receiver. In this way the apparatus below the tuning condenser is at earth potential. (3) No special connections are required. The output from the last valve of the receiver is connected to the winding of the recorder. If a low resistance earpiece has been used in the construction of the recorder, a telephone transformer should, of course, be used in the anode circuit of the last valve. (4) The method illustrated in your sketch "A" appears to be the best arrangement.

"W.A.McK." (S.E.24) *submits a diagram of his receiver, and asks* (1) *For criticism.* (2) *What type of valve is recommended.*

(1) The arrangement shows one high frequency and one detector valve, to which are added five stages of low frequency amplification. This is a very poor arrangment, and we suggest you abandon it. As you wish to use a frame aerial, we suggest, you use a combination of three H.F., one detector, and three L.F. valves. Signals could not be received with a frame aerial without the addition of H.F. connected valves. A number of diagrams have been given recently, and if you are not familiar with the operation of high frequency valves, we suggest you commence by using one high frequency, adding additional valves as you become more experienced. We suggest you use "R" type valves throughout the receiver, and we would refer you to the diagram given on page 702 in the issue of February 24th.

"S.B." (Midhurst) *has a pair of* 4,000 *ohm receivers which are defective, and wishes to rewind them to a low resistance, and asks* (1) *What wire should be used.* (2) *What wire should be used to wind a potentiometer.*

(1) We suggest you wind the earpieces with No. 34 S.S.C. wire. (2) The potentiometer should be wound with No. 36 Eureka wire, which has a resistance of 15 ohms per yard. The potentiometer should be wound so that it has a resistance of the order of 400 ohms.

"T.C." (E.12) *submits a diagram of his aerial circuit, and asks* (1) *Which of the proposed arrangements is best.* (2) *Is the proposed method of leading in the aerial wire suitable.* (3) *Should the aerial wire be bare or enamelled copper wire.*

(1) We suggest you use scheme A. The aerial would then be 30′ high, and the length of the upper portion would be 58′. (2) The lead-in wire may be connected in the manner suggested, provided the terminals are very carefully insulated, and are mounted away from the walls. (3) We suggest you use enamelled stranded copper wire. Enamelled 7/22 would be quite suitable.

"PLATTING" (Manchester) *submits a sketch of his frame aerial and asks why signals are not received.*

The frame aerial should be wound with eight turns of the No. 20 gauge wire in your possession, the wires being spaced ¼″ apart. You cannot expect to get good results unless high frequency amplification is used, and we therefore suggest you use two stages of high frequency amplification before the detector valve. The method of connecting high frequency valves is given in an issue of this journal.

"WINDINGS" (N.) *asks* (1) *Whether there is any formula by which he may find the wavelength to which coils will tune.* (2) *With reference to the sketch of the aerial submitted, should it be expected that interference will be experienced.*

(1) There is certainly a formula which will enable you to calculate the required number of turns in a coil. If you have a tuning condenser with a given maximum and minimum value, the condenser values may be inserted in the wavelength formula Wavelength $= 1{,}885\ \sqrt{LC}$. This will give you the value of L. The values of C and L in the formula are in microfarads and microhenries respectively. The value of L thus obtained may be used in conjunction with an inductance formula. In the case of cylindrical coils, the formula for inductance is $L_{cms} = \pi^2 d^2 N^2 L K$. Where $\pi = 3{\cdot}14$, d = the mean

diameter of the winding in centimetres. N=the number of turns in the winding per centimetre of length. L=the length of the coil. K is the factor which depends upon the ratio of D to L, and may be obtained from a book of tables. We would refer you to the book entitled "Measurements of Capacity and Inductance," by Nottage, which may be obtained from the publishers of this journal at 12, Henrietta Street, W.C. (2) We do not think you will experience interference through the telephone wires running somewhat closely with aerial wires, neither will the portion of lead roof shown in the diagram harmfully affect reception.

"A.T.M." (S.E.6) *asks for a diagram of a three-valve receiver comprising one H.F., one detector, and one L.F. valve. The voltage applied to the anode circuits of the valves should be independently variable. It is desired to use the tuned anode method of high frequency amplification.*

The diagram is given in Fig. 1, and suitable values are indicated in the diagram.

"AJAX" (Surrey) *asks* (1) *Whether a hot water radiator which is close to his receiver may be used as an earth. Would it be safe to connect the aerial earth switch so that when the aerial is connected with earth any lightning discharges would pass through the aerial to earth via the radiator.* (2) *Particulars of the tuning arrangement are submitted, and it is asked how the correct settings for the wavelengths of distant broadcast stations may be obtained.*

(1) We do not advise the use of the aerial earth switch connected as suggested. In the event of the aerial being struck by lightning, the lightning would have to enter the house through the aerial wire before it passed to earth. We suggest the use of a small earth plate connected outside the building. The radiator, may, of course, be used as an earth when receiving if it is found that good strong signals are received. (2) We are afraid we cannot indicate the settings of the variable condenser which, together with the tuning coils, will enable you to hear certain broadcast stations. When listening-in for the distant broadcast stations in which difficulty is experienced, we suggest you use very loose coupling between the aerial and closed circuits. The result will be that tuning will be much finer, and, provided the receiver is sufficiently sensitive, the stations should be picked up. The diagram of connections submitted is, of course, correct, although we think you would probably obtain an increase in signal strength if you used a higher voltage H.T. battery. We suggest 60 to 90 volts.

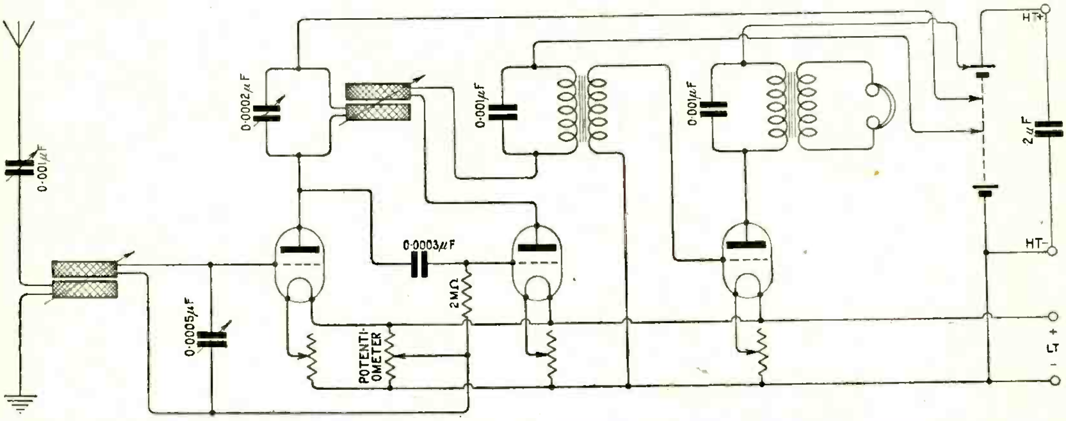


Fig. 1. **"A.T.M." (S.E.6.)** *The diagram gives the connections of a three-valve receiver, one H.F., detector and one L.F. connected valves. It will be noticed the tuned anode method of high frequency amplification is employed, and the reaction coil is coupled with the anode coil. The circuit is a non-radiating one. The potentiometer is connected so that the normal potential of the grids of the first and second valves may be varied. When the grids are given a slightly positive potential with reference to the negative end of the filament by moving the potentiometer slider nearer the positive L.T., a small grid current flows, which is sufficient to prevent the generation of oscillations.*

"H.L." (N.16) *asks what length of wire should be used when constructing an indoor type aerial.*

As you propose to use a crystal receiver, we do not think you should use an indoor type of aerial. If, however, you are so situated that an outdoor aerial cannot be used, we suggest you try using a total length of 80′ of wire supported upon the arrangement referred to in your letter. You will probably find, with a little experimental work, that there is a best length of wire to use, and you should experiment in order to determine this length for yourself.

"GRACE" (Derbyshire) *submits a diagram of a receiver and aerial, and asks whether he should expect to receive the Birmingham broadcast transmissions.*

The aerial arrangement is quite satisfactory. The receiver is wired correctly, and we think you should certainly hear broadcast transmissions. A small condenser should be connected across the telephones and the H.T. battery.

"IMPROVEMENTS" (Skipton) *submits a diagram of connections of his receiver and asks* (1) *With reference to the values indicated in the diagram, are these correct.* (2) *What is the cause of the fading away at times of the transmissions from* **2 LO.** *This effect is noticed by all listeners-in in the neighbourhood.*

(1) The anode tuning condenser should have a maximum value of 0·0002. If better results are obtained when 0·0005 mfds. are used, it is because

the anode tuning coil has not sufficient inductance, and therefore a larger coil should be used. The L.F. transformer, which is connected in series with the reaction coil, should have its primary winding shunted with a 0·001 mfd. variable condenser. The telephones should have a 0·001 mfd. condenser connected across them. It would be well to connect a 2 mfds. condenser across the H.T. battery. (2) We are unable to give any exact explanation as to the cause of fading. A number of theories have been put forward, and it is very noticeable that in some districts fading is prevalent, so that it would appear that the nature of the surrounding country has a good deal to do with the strength of the signal waves which one receives upon the aerial.

"A.C.J." (Burton-on-Trent) *asks* (1) *Whether a third wire can be suspended between two wires of his two-wire aerial, the third wire being connected with a separate receiver.* (2) *Is it necessary to have a knowledge of the Morse code before one is able to obtain a transmitting licence.* (3) *How may a frame aerial be constructed which would have a natural wavelength equivalent to that of a standard P.O. aerial.* (4) *Would placing the grid leak to the negative of the filament of a single-valve receiver alter the signal strength.*

(1) We do not think the arrangement will prove satisfactory. If the tuner attached to the third wire is tuned to a certain wavelength and valve receivers are used, the tendency will be for the energy flowing in the twin aerial to have the same wavelength as that in the third wire. Mutual interference would result. (2) It is essential that one should know the Morse code, and indeed should be a proficient operator before a transmitting licence is obtained. (3) We suggest you use a frame aerial having 4′ sides wound with eight turns of No. 18 wire, the turns being spaced ½″ apart. (4) It is always advisable to try the grid leak connected between the grid and minus L.T. and between the grid and plus L.T. in order to ensure that the best position of the two is used. There is often a slight difference in the signal strength. Very often the signal strength will be greater when the grid leak is connected between the grid and positive L.T.

"W.G." (Dulwich) *asks whether, if his aerial were taken down and the insulated copper wire (which is used at present) is removed, and bare copper wire used in its place, will the results be appreciably better.*

We do not think results will be very greatly improved on this account.

"SALOPIAN" (Salop) *submits a diagram of his receiver and asks* (1) *For criticism.* (2) *Would results be better if a variometer were used in the second anode circuit.* (3) *May a voltmeter and an ammeter be connected in the receiver.* (4) *Is it possible to connect a crystal detector with a switch so that the crystal may be used in place of the valve detector when required.*

(1) and (2) The diagram of connections submitted is correct, and is quite a standard circuit. If desired, a variometer or vario-coupler may have one of its windings connected in the anode circuit of the high frequency valve, and the other winding in the anode circuit of the detector valve. The extent of coupling between the reaction coil and the anode coil is then variable by changing the coupling between the two coils. (3) A voltmeter and an ammeter may easily be connected if desired. The ammeter may be connected in series with the low tension battery, and the voltmeter may be connected across the H.T. battery or the filament batteries as required. If it is desired, jacks may be fitted and connected across the filaments of the valves, and the voltmeter connected with the plug so that the potential across any of the valves may be measured. The method of connecting a crystal detector so that it may be used in place of a valve detector has been given in recent issues. We would refer you to the diagram on page 814, Fig. 2, in the issue of March 17th.

"PRIMARY" (Manchester) *asks* (1) *How many small Leclanche cells should be connected in parallel to satisfactorily deliver current to the filaments of valves.*

(1) We do not think you will obtain satisfactory operation by connecting a number of primary cells in parallel. You could, of course, try using four or five cells connected in parallel. Four sets of these cells should be connected in series, and the filament current regulated with a resistance.

"L.E.S." (S.W.14) *asks* (1) *For criticism of the diagram submitted.* (2) *What is the correct potential to apply to the anode circuit when Mullard "Ora" type valves are used, and when "R" type valves are used.*

(1) The diagram submitted is correct, and is indeed an ordinary standard circuit. (2) We suggest you use an anode potential of 45 volts when "Ora" type valves are used, and between 60 and 80 volts when "R" type valves are used. We have no knowledge of the other type of valve referred to.

"B.T.G." (Surrey) *submits a diagram of his receiver and asks whether the circuit is suitable, and whether it would be passed by the Post Office.*

The diagram of connections is correct. The aerial tuning condenser should preferably be connected in series with the aerial tuning inductance when receiving short wavelength transmissions. The anode tuning condenser should have a maximum value of 0·0002 mfds. The by-pass condensers should be fixed condensers, with a capacity of 0·001 mfds. A 2 mfd. condenser should be connected across the H.T. battery. The aerial circuit and the reaction coil may be coupled as suggested to form a variometer, but this would hardly be approved by the Post Office. We suggest you couple the reaction coil with the secondary winding of the high frequency transformer.

"S.W.T." (Torquay) *asks* (1) *Is the diagram submitted correct.* (2) *What are suitable values for the condensers.* (3) *Could a variable condenser be usefully employed at X in the diagram.*

(1) and (3) The circuit is quite suitable, provided the tuning condenser is inserted at X in the diagram. The condenser is an ordinary aerial tuning condenser, and should have a maximum value of 0·001 mfds. The high frequency transformers may give better results if their windings are tuned with variable condensers having a maximum value of 0·0002 mfds The small bridging condensers may have a value of 0·0005 mfds, although the best values should be determined by experiment, as the construction of the transformer will decide the best value to be used. The grid condenser should be 0·0003 mfds., and the grid leak 2 megohms.

The potentiometer could have a resistance of the order of 350 ohms.

"E.L.H." (Portsmouth) *asks for a diagram of a three-valve receiver employing two intervalve transformers, one variometer, two variable condensers, and a series parallel switch. It is desired to use reaction.*

The connections are given in Fig. 2. The variometer windings should be divided, the stator being joined in the aerial circuit and the rotor in the anode circuit. Only one variable condenser is required.

"P.H." (Surrey) *asks* (1) *Why his set is not working properly.* (2) *Whether the receiver may be tested.*

(1) If the set is constructed according to the articles the results should be very good indeed. Quite a number of our readers have constructed the receiver, and have reported very good results. We suggest you go through the wiring of the receiver and make sure nothing has been omitted. (2) We are afraid we cannot suggest anyone who will test and put the receiver in order for you.

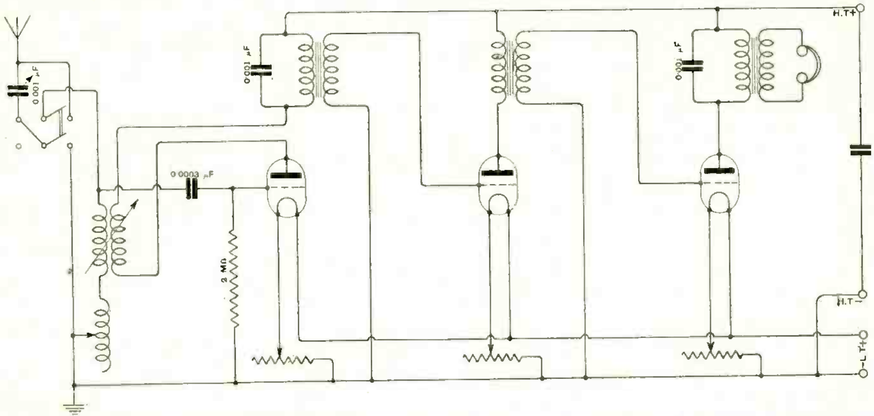


Fig. 2. **"E.L.H." (Portsmouth).** *The diagram gives the connections of a valve receiver with a detector and two note magnifiers. The reaction coil is coupled to a portion of the aerial coil. This arrangement is not recommended for the reception of broadcast transmissions because it is so easy to cause oscillating energy to flow in the aerial circuit.*

"C.B." (S.W.12) *asks for particulars of basket coils which will tune from* 300 *to* 3,000 *metres.*

We suggest you use a number of coils having the following values:—Diameter of former 1½", 15 spokes, 3/16" thick. For the shorter wavelengths, coils having 25, 40 and 60 turns of No. 24 D.C.C. may be used. For the higher wavelengths the coils may be wound with No. 28 D.C.C., and have up to 120 turns. The best values are found by experiment, as it is not possible to accurately calculate the inductance of coils wound in this manner.

"G.S.E." (Stretford) asks (1) *For a diagram of connections, with suitable values of the components, of a five valve receiver, the first two valves being high frequency connected.* (2) *Will the low frequency transformers, particulars of which are submitted, be suitable for use with this receiver.* (3) *What are suitable connections for tapped high frequency transformers.* (4) *How many pairs of* 120 *ohm telephones may be connected with the secondary winding of one telephone transformer.*

(1) The diagram of connections is given in Fig. 3. (2) The transformers have too few primary turns.

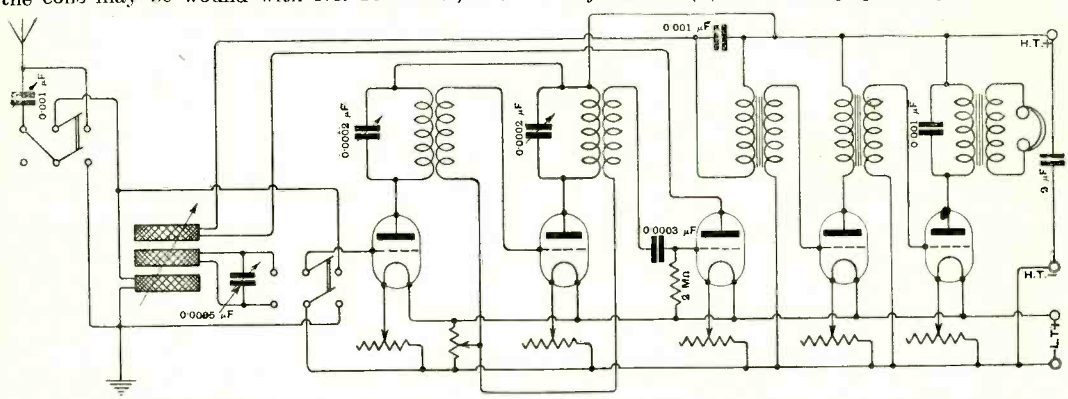


Fig. 3. **"G.S.E." (Stretford).** *Here we have a diagram of a five-valve receiver. In the aerial circuit is a series-parallel switch, and a tune-stand-by switch is connected so that either the aerial or closed circuits may be joined with the first valve. The first and second valves operate as high frequency amplifiers using the transformer method. The third valve is the rectifier, while the fourth and fifth are note magnifiers.*

We suggest 6,000 turns for the primary and 18,000 turns for the secondary. The stalloy stampings should be quite suitable, provided care is taken to make the butt joints good. (3) The transformers are connected in the ordinary manner, but if you have purchased the tapped high frequency transformers, we suggest you communicate with the manufacturers and ask them for the connections. (4) We think you will be able to connect the four pairs of low resistance telephones across the telephone transformer without any bad results. We gested will give any great increase in signal strength. (4) For the aerial wire we suggest you use a No. 50 coil, and for the closed circuit a No. 35. Perhaps better results would be obtained if the aerial coil were a No. 75, and the closed circuit a No. 50. It is assumed the aerial tuning condenser is connected in series. The reaction coil could be 100 turns of No. 36 S.S.C. wire, wound in a former 2″ in diameter, with a slot ½″ deep and $\frac{1}{10}$″ wide. The reaction coil would be suitable for the wavelengths desired.

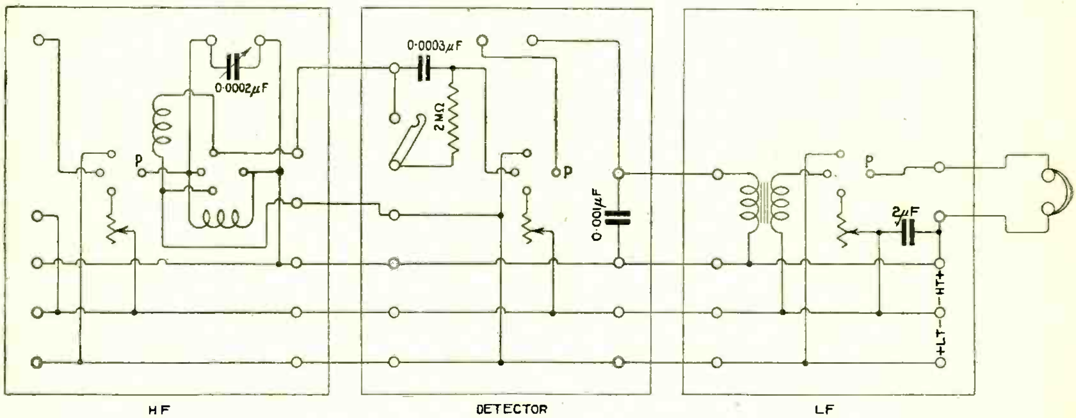


Fig. 4. **" E.R.S." (Hammersmith).** *We regret the diagram given in reply to* **" E.R.S." (Hammersmith)** *on page* 845 *of March 24th issue was not correct. The connection between the negative L.T. and the secondary of the H.F. transformer should be removed. The correct diagram is given above.*

suggest you connect them in series and parallel—two in series and two in parallel.

" QUERIST " (Kent) *submits a diagram of his receiver and asks* (1) *What are the capabilities of the receiver.* (2) *Should it be expected that a receiver of this type will operate a loud-speaker without further amplification.* (3) *Would the substitution of* 7/19 *silicon bronze for the existing* 7/22 *copper wire in the aerial give better results.* (4) *What particular coils should be used for the primary and secondary windings of the tuner, and how many turns should be used in the reaction coil.*

(1) The diagram of connections is quite correct, and very good results should be possible with a receiver wired according to the diagram. The aerial is rather low at the far end, and we suggest you raise it to 35 feet. A good scaffold pole would make an excellent mast. The lead-in wire in the diagram is shown 20 ft. long. This would probably cause a great reduction in the signal strength, especially if the wire is run round the sides of the room close to the walls. We suggest you connect a 0·001 mfd. condenser across the telephones. (2) We do not think you can expect this receiver to operate a loud speaker, because the first two valves are high frequency connected, and the third is a detector valve. Two low frequency connected valves should be added if it is desired to operate a loud speaker. With proper tuning you should then be able to receive any of the broadcasting stations, and also other long distance transmissions. (3) We do not think the change in the aerial wire sug-

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :— (1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed " Questions and Answers," Editor,* **The Wireless World and Radio Review,** 12/13, *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the " Questions and Answers " coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a " nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE
WIRELESS WORLD
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The New Type of Licence.

In our issue of April 7th reference was made to the pending reorganisation of Wireless Licences, and since that date a good deal has been published in the daily press on the subject.

It is promised that an announcement will be made by the Post Office at a very early date as to the action which will be taken to make the way clear for those who desire to construct their own apparatus, so that they may do so legally under the provisions of a new licence.

In the present issue we are authorised, as the official organ of The Radio Society of Great Britain, to publish the text of a Memorandum which has been forwarded to the Postmaster-General by the Society, supported by endorsement from the affiliated societies throughout the Kingdom.

The view which is most forcibly presented in the memorandum just forwarded to the Postmaster-General, is that under no circumstances should those who desire to experiment with wireless telegraphy and telephony be hampered. It should make no difference, as far as this freedom is concerned, whether the experimenter is one who has had a long acquaintance with wireless, or whether he has been more recently attracted to the subject through the publicity given as a result of broadcasting, and the attention devoted to the subject generally during recent months.

Positively there *must* be no restrictions imposed which will prevent experimental investigation of scientific matters. In no other branch of science has such restriction ever been imposed.

The Wireless World and Radio Review has long foreseen the difficulty which would arise under the existing regulations, and as long ago as December 23rd, 1922, there was published in this journal an article dealing with the problems of the experimental licence, and pointing out the necessity for the introduction of a third type of licence which would entitle anyone to make up his own apparatus, who desired to do so. In that issue a detailed scheme was given providing for freedom for the experimenter. This was the first occasion on which any constructive scheme had been proposed to cope with the difficulty, and indeed before those chiefly concerned had realised the necessity which existed for a revision of the present regulations.

It is a matter of considerable satisfaction to this journal to know that this proposal received strong support at the time and has since been advocated by contemporary journals and the daily press, and we see, further, that it is exactly along these lines that the new regulations about to be introduced are based.

It must be apparent to all parties concerned that the most effective solution is likely to be found in one which will not seriously disorganise the work which has hitherto been done in the development of broadcasting, and therefore the proposals which are now being framed will, we believe, be designed to give freedom to those who desire to experiment and to make up their own apparatus without unduly disturbing the existing regulations.

It is evident that still further changes are likely to be found necessary as time goes on, but these can be effected gradually without disorganising an industry and public service which it is the desire of all of us should flourish.

The "Neutrodyne" Circuit.

Details are now available of a new type of receiver built according to the design of Professor L. A. Hazeltine. In the receiver is included a means for neutralising the valve capacity, and the apparatus is called the Neutrodyne Receiver. The evil effects of valve capacity are well-known. The valve capacity acts as a coupling between the anode and grid circuits, and when each circuit is tuned to the same wavelength, the amplitude of the signal builds up and oscillations are generated. To prevent the generation of oscillations, it is usual to employ damping devices such as potentiometers. The signals suffer distortion because the amount of regeneration is variable, noises are generated, and grid current is encouraged to provide damping. In addition, the full amplification of the valve and associated circuits cannot be utilised.

The Neutrodyne Receiver is designed so that valve capacity is neutralised by the addition of small condensers suitably connected. The advantages obtained are very substantial ones. The need for stabilising devices and its attendant evils has gone. The receiver is under much better control and much greater amplification per stage is obtainable. Signals do not suffer distortion, because now the circuits are designed from the point of view of amplification and quality. Perhaps the greatest advantage of all is that the receiver will not generate oscillations, unless of course a reaction coil coupled with the aerial circuit is employed.

For the reception of C.W. signals, a variometer may be joined in the anode circuit of the detector valve when oscillations can be generated in the detector valve circuits. The oscillations will not be transferred back to the aerial circuit.

The disadvantages of reaction coupled with the aerial or closed circuit tuning circuits are well-known. Unless very skilfully used, signals are distorted, noises are amplified, and the amount of amplification is variable. It is better then to cut out the reaction coil and to design the receiver so that the desired degree of amplification is obtained.

Experimenters will find the particulars of the Neutrodyne Receiver given elsewhere in this issue of great interest and, it is hoped, profit.

The Application of a Revolving Magnetic Drum to Electric Relays.

At the Institution of Electrical Engineers before a meeting of the Wireless Section, on April 11th, Dr. N. W. McLachlan, M.I.E.E., read his paper bearing the above title, and gave a demonstration of the apparatus.

The instrument consists of a revolving drum of iron, which carries a winding. Riding on the drum is an iron shoe, which is coupled with a lever. The lever may carry contacts, or may be connected with the mouth of a siphon. When signals are passed through the winding, the shoe is dragged in the direction of rotation of the drum. The pull between the shoe and drum is very much greater than one would expect from the laws of electro-magnets. The magnitude of the force is such that heavy contacts may be moved at high speed with ease.

The instruments used as recorders and transmitting keys only differ in size.

The recording apparatus was connected with a wireless receiver tuned to Paris, and signals were recorded. The instrument gives satisfactory operation at 350 words per minute, and the tape record is remarkably legible.

When punched tape is fed through a Wheatstone transmitter which controls the current through the coils of the instrument arranged as a transmitting key, the transmitter signalling circuit is made and broken through heavy contacts. The contacts provided to the instrument exhibited were three-eighths of an inch in diameter. A pull of the order of 30 or 40 pounds was required to separate the contacts when current passed through the drum winding.

A description of the instruments, together with the circuits used when recording or transmitting, will be given in next week's issue of this journal.

A NEW TYPE OF NON-OSCILLATING RADIO-FREQUENCY AMPLIFIER

THE NEUTRODYNE

A HIGH FREQUENCY AMPLIFIER OF FIRST IMPORTANCE.

It is worth the while of every experimenter to build a receiver according to the data given and to make experiments along the lines suggested. In the event of difficulty, reference can be made to the Questions and Answers Department.

By W. JAMES.

1.—VALVE INTER-ELECTRODE CAPACITY.

CAPACITY is present between the filament and grid, filament and anode, and grid and anode. These inter-electrode capacities are not negligible at radio-frequencies, in fact they modify considerably the operation of the valve as compared with low frequency amplification. The capacities are due to the geometry of the valve—the relative position of the electrodes, the connecting wires which are sealed in the glass, and the base which holds the valve legs which are joined to the wires leaving the seal. Considering Fig. 1, it is evident that across the tuned circuit A B we have a capacity which

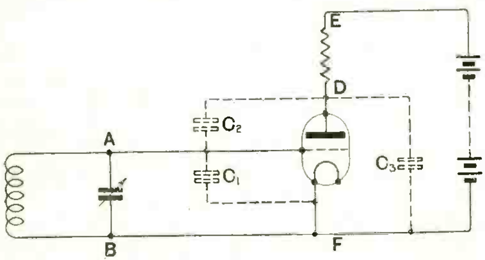


Fig. 1. The circuit shows a valve coupled with a tuned circuit, and with a resistance in the anode circuit. The valve capacities are represented by C_1, C_2 and C_3.

is the resultant of C_1 C_2 and C_3. Similarly across the output circuit D E we have shunted the capacity C_3 together with C_2 and C_1. This is so because E is connected with the filament at F through the high tension battery.

2.—THE EFFECTS OF VALVE CAPACITY.

The effective capacity across the input circuit varies according to the nature of the output circuit, and is generally many times greater than the input capacity, measured when the valve is not joined in a circuit.

The capacity C_2 between the grid and anode and that between the grid and filament C_1 may interact, so that potential fluctuations across C_2 cause potential fluctuations across C_1, with the result that the input circuit is given negative conductance. This is equivalent to saying power is transferred from the output to the input circuit. The power fed back being in phase with that in the input circuit, augments the input power which is amplified again. The coupling is sufficient to transfer enough power to cause the generation of continuous oscillations when both the input and output circuits are tuned to the same frequency. Thus with the arrangement shown in Fig. 2, when the circuit L C is tuned to the same frequency as the circuit L_1 C_1 continuous oscillations may be generated although there is no magnetic coupling between coils L and L_1. The circuits shown may form part of a high frequency amplifier. Thus in Fig. 3 we have the circuits L C and L_1 C_1 connected to give high frequency amplification.

It is the usual practice to provide damping to prevent self oscillation. A potentiometer may be used when the value of the grid current may be regulated by making the grids more or less positive with respect to the filament. The objection to this method lies

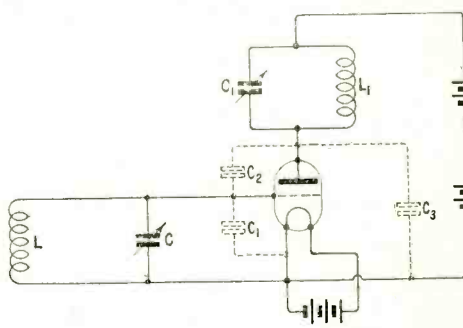


Fig. 2. Here the tuned anode method of amplification is used. The valve capacities are shown at C_1, C_2 and C_3.

in the distortion of the signal produced as well as the broadening of the tuning. Furthermore, the efficiency of the high frequency amplifier is reduced.

Another method consists in including a resistance in the circuit $L_1 C_1$, or building coil L_1 with metal rings secured so that they are in the field of the coil. These devices are termed stabilisers. They have been called (and rightly so) "lossers." All these methods broaden the tuning of circuit $L_1 C_1$ and seriously reduce the amplification. A method sometimes employed is to couple the reaction

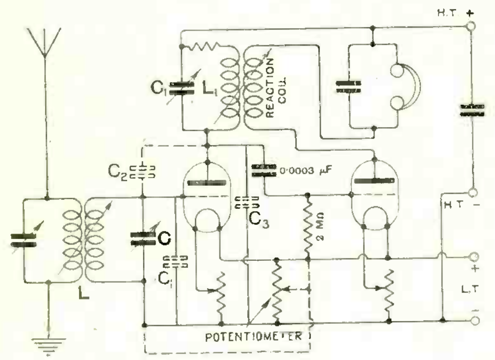


Fig. 3. Here we have a two-valve receiver with one high frequency and a detector valve. The various stabilising devices commonly used are indicated. Thus a resistance may be included in series with the anode coil, or a potentiometer may be connected.

coil with either of coils L or L_1 so that the energy fed back is out of phase with the energy in the coils which results in damping and a reduction in amplification. Whichever method is employed to prevent the valve generating oscillations in its associated circuits through the valve capacity it will be noticed three ill effects occur: (1) tuning is broadened, which is a disadvantage since one is then not able to tune out signals with frequencies a little different from that of the signal desired; (2) amplification is reduced, involving more valves; (3) the signal suffers distortion. It is necessary to provide means of preventing regeneration, even though oscillations are not generated, because with the valve bordering on generating oscillations, working is unstable, due to variations in the degree of regeneration. Distortion and noises result.

In the above discussion the effect of the wiring providing coupling has been neglected. One should always wire the receiver to provide minimum coupling between circuits due to capacity between wires.

3.—The Advantages of a Receiver in which the Capacity Coupling is Neutralised.

It is evident an arrangement which will operate to neutralise the capacity coupling will bring with it most important advantages. Unless a means for obtaining reaction is deliberately employed it will not be possible for the receiver to generate oscillating energy. This will at once render the use of the damping devices mentioned above unnecessary, with the result that tuning will be sharper and higher amplification per stage obtained. The windings employed in the high frequency circuits may be designed to have the lowest possible losses. Thus instead of fine wire coils, coils wound with No. 24 D.C.C. are used. In addition signal distortion through the effects of grid currents and regeneration will not occur, unless of course, as explained above, reaction effects are obtained in the usual manner with the aid of a coil connected in the detector valve circuit coupled with either coils L or L_1 (Fig. 3).

Professor L. A. Hazeltine has designed receivers in which the valve capacity coupling is neutralised.

The capacity coupling is neutralised with the aid of fixed condensers, and the receivers are called by him "Neutrodyne" receivers.

4.—The Theory of Capacity Neutralisation

Suppose we have the arrangement given in Fig. 4. Here A and B represent circuits which are coupled by a stray capacity C which may be considered as the resultant

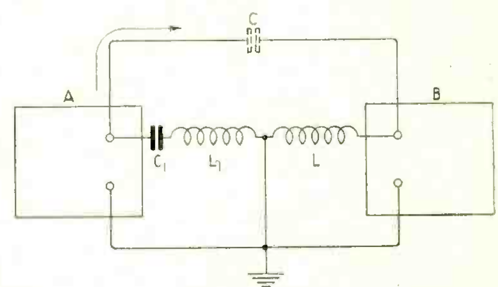


Fig. 4. This circuit illustrates how, with the aid of coils L and L_1 and condenser C_1, the effect of the stray coupling capacity which is coupling circuits A and B may be neutralised. The current which tends to flow through the stray capacity is represented by the arrow.

of the valve inter-electrode capacities, on one side, and the other sides are connected together as shown. If circuit A contains radio frequency energy some will pass through the capacity C to circuit B. Now suppose the condenser C_1 and coils L and L_1 are connected. If the values of C_1, L and L_1 are suitably chosen, some current will pass through C_1, L_1 to earth. L_1 and L are tightly coupled.

Therefore a pressure will be induced in coil L. This pressure will neutralise that across the condenser C and no current will flow through the condenser from circuit A to circuit B. To obtain complete neutralisation the following relation holds.

$$L_1 C_1 = C L.$$

Thus if the capacity of C_1 is made equal to that of C, the coils L_1 and L have the same number of turns.

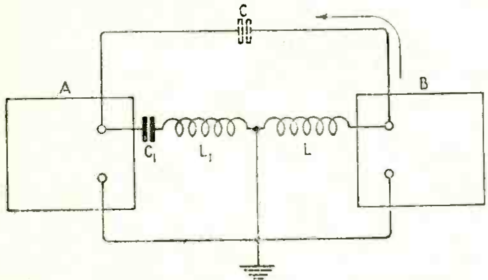


Fig. 5. This circuit is similar is principle to that of Fig. 4, but here the current tends to flow through the stray coupling capacity from circuit B to circuit A.

In Fig. 5 the neutralising arrangement is the same, although the stray current is now considered to pass from circuit B. With proper values the current is neutralised, and the whole circuit behaves as though no capacity coupling is present.

5.—Principles of Application to High Frequency Amplifier.

In Figs. 6 and 7 are given the connections of a valve amplifier with neutralising arrangements. by A. The neutralising winding is coil L_1 and the neutralising condenser C_1. The disturbing current is supposed to originate at B and the tendency is for a current to flow

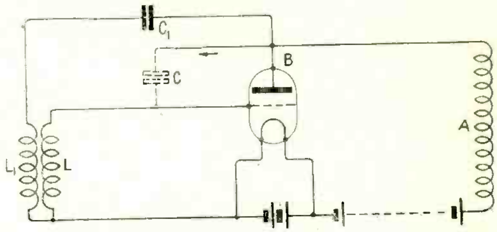


Fig. 6. Here the circuit is arranged so that the capacity of the valve is neutralised. The neutralising condenser is represented by C_1. The principle of this circuit is identical with that of Fig. 4.

through C. Since the arrangement is identical with that of Fig. 4, neutralisation is secured provided coils L and L_1 are correctly coupled. The upper ends of the coils L and L_1 should be of opposite polarity. The neutralising winding is coupled to the grid coil.

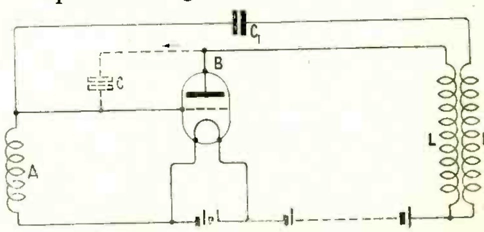


Fig. 7. This circuit is similar in principle to Fig. 5. The neutralising condenser is C_1.

In Fig. 7, the disturbance originates at B,

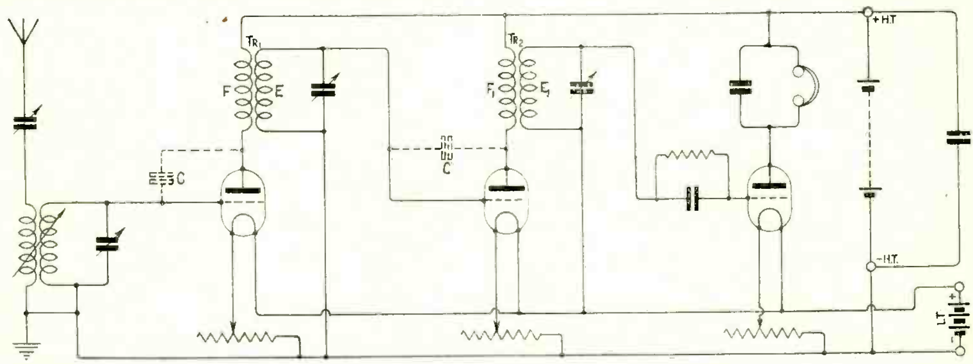


Fig. 8. This circuit gives the connections of a radio frequency amplifier, using high frequency transformers. The last valve is the detector valve. The valve capacities are represented by condenser C.

It will be noticed the arrangement of Figs. 4 and 6 are identical, and so are Figs. 5 and 7. In Fig. 6 the valve capacity is represented by C, the grid coil by L, and the anode coil the neutralising coil is coupled with the anode coil, and the neutralising condenser with the grid. This arrangement is identical in principle to that of Fig. 5.

6.—Practical Application to High Frequency Transformer Coupled Amplifier.

The high frequency portion of a radio frequency tuned transformer amplifier is given in Fig. 8. It will be noticed the primary windings of the transformers F and F_1 are connected together and with the filament through the H.T. battery. The grid circuit windings E and E_1 are each joined to the filament battery. The stray coupling capacity is indicated by the dotted condensers C.

The resemblance between Fig. 8 and Figs. 6 and 7 are easily seen, and one should expect that the two windings of the radio frequency transformer will take the place of the coils L and L_1. In the receivers designed by Professor Hazeltine the two windings of the transformer are utilised in the same way that coils L and L_1 were utilised in the previous figures, and it is only necessary to provide fixed condensers to make all of the circuits similar. Referring to Fig. 9, if we suppose the disturbance is at B, the neutralising condenser C_1 is connected between the anodes. This circuit is then electrically the same as that given in Fig. 6. In Fig. 10 the disturbance is supposed to operate from point B, and the neutralising condenser C_1 is joined between the grids. This arrangement is similar to Fig. 7. The correct value of the neutralising condenser C_1 is given by the equation $C_1L_1 = CL$ or $C_1 = \frac{L}{L_1} \times C$. With L and L_1 similar, C_1 and C are equal. When a step-up ratio of turns is employed between primary and secondary the capacity C_1 is larger than C. Thus if the ratio CP to S is ½, where P and S represents the primary and secondary turns of the transformer T_R, C_1 is four times as large as C, the stray capacity in the case of Fig. 9, because coil P is equivalent to coil L_1 and S to L.

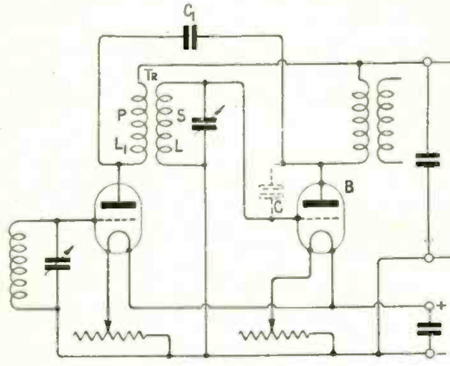


Fig. 9. Method of connecting a neutralising condenser when radio frequency transformers are used.

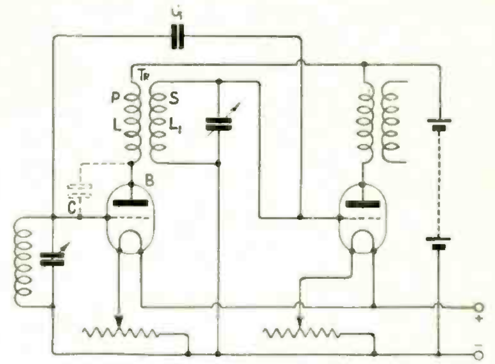


Fig. 10. Another method of neutralising valve capacity with a neutralising condenser C_1.

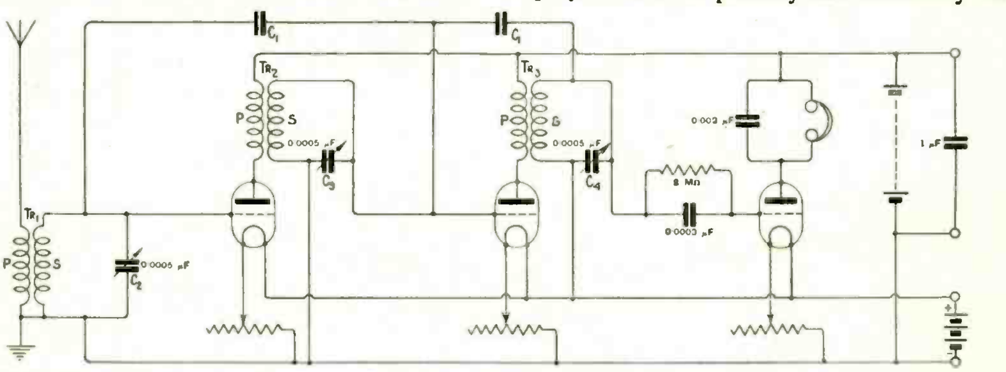


Fig. 11. Practical diagram of a three-valve receiver with two high frequency transformer coupled valves and a detector valve. The neutralising condensers are shown at C_1. If reaction is required, a reaction coil or variometer may be connected between the telephones and the anode of the detector valve. The wavelength range is 180 to 500 metres with the values given.

In Fig. 10, where the neutralising condenser is joined between the grids, with the same ratio between the primary and secondary windings, the neutralising condenser C_1 will have $\frac{1}{4}$ the capacity of C.

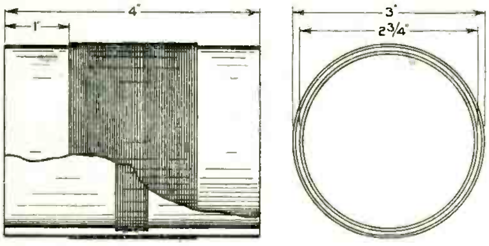


Fig. 12. Details of the high frequency transformers for a range of 180 to 500 metres.

7.—PRACTICAL DATA FOR RECEIVER.

Referring to the diagram given in Fig. 11 we have two high frequency connected valves with a detector. The three transformers, T_{R1}, T_{R2} and T_{R3}, are built the same. Each secondary winding is tuned with a 0·0005 mfd. tuning condenser. The primary windings each consist of 13 turns of No. 22 D.S.C. wire wound upon a former $2\frac{3}{4}$ ins. in diameter and 4 ins. long. The secondary windings each consist of 55 turns of No. 22 D.S.C. wound upon a former 3 ins. in diameter and 4 ins. long (see Fig. 12). The remainder of the circuit is straightforward. It will be noticed the aerial circuit is not tuned.

The neutralising coupling condensers C_1 are best made by experiment. Their correct value is of the order of 4 micro-microfarads. These cannot be built according to formula. Several methods are possible. Thus the wires from the grids may be run so that they practically butt together. A brass tube may be slipped over their ends, and its position varied until best results are obtained. Then the tube should be fastened. Once the correct value has been obtained it will not need to be changed unless valves with different characteristics are used (see Fig. 13). To obtain the correct value a strong signal is tuned in and then the first valve filament is switched off. The condenser is then varied until no signal is heard.

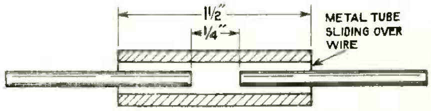


Fig. 13. A suitable method of providing the small neutralising capacity. The two wires are of No. 16 D.C.C., and the tube is slipped over them and varied until correct. The ends of the wires may be about ¼ in. apart.

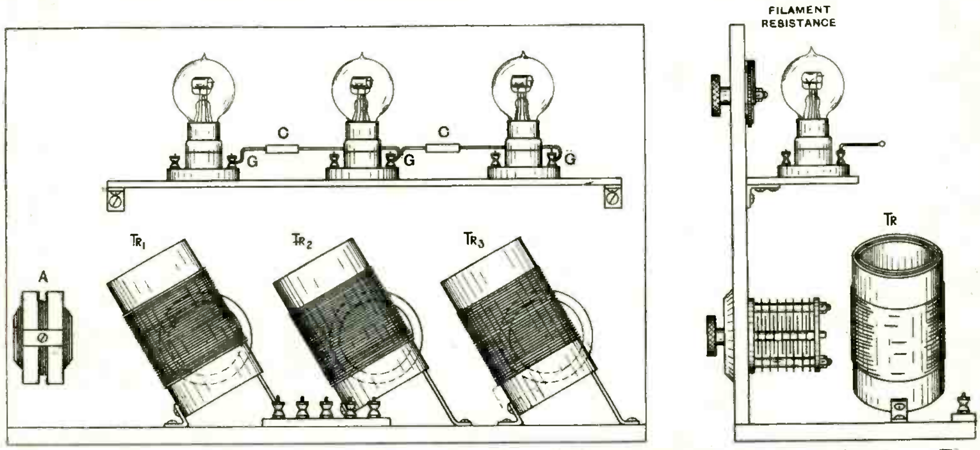


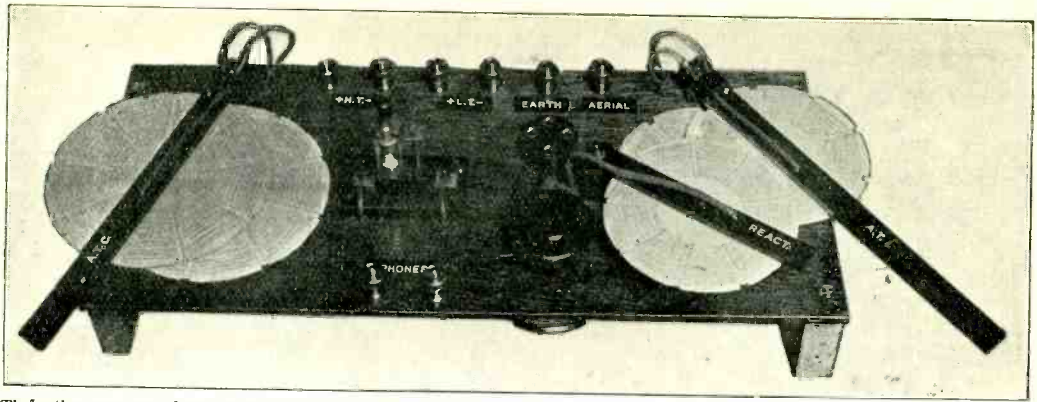
Fig. 14. Suggested layout for experimental work. A is the reaction coil or variometer. The neutralising condensers are marked C.

8.—SUGGESTED LAYOUT.

A suggested layout is given in Fig. 14. It will be noticed the coils are mounted to prevent interaction between their magnetic fields.

9.—TUNING.

When tuning in stations, since each transformer is alike and the tuning condensers are also alike, it follows that their settings should also be practically alike. Tuning is carried out in the following manner. The condenser settings are all set to the same value, and each of the settings are changed until a signal is received. Then fine tuning is carried out with C_4 first, then C_3, and then C_2. Tuning is carried out backwards, as it were.



The author constructed this receiving set from a description given in this Journal. Among modifications introduced, he has provided for reaction coupling to the tuned anode variometer. This receiver is useful for long-range reception on short wavelengths and is inexpensive to construct.

Making a VALVE and CRYSTAL RECEIVER

HINTS FROM A PRACTICAL EXPERIMENTER.

By H. E. Adshead, B.A.

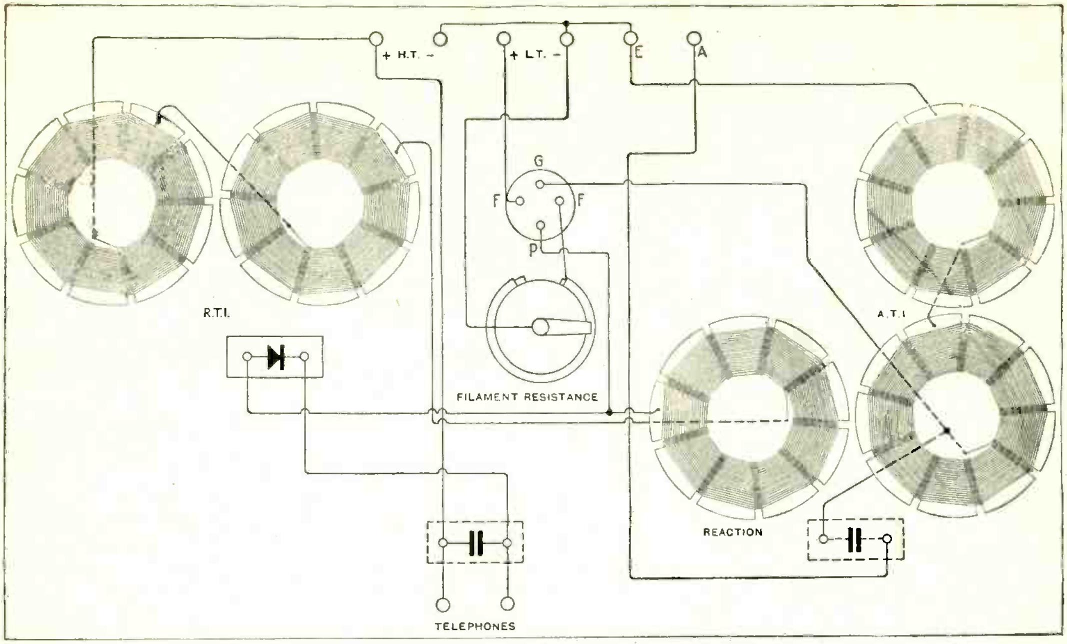
THE construction of this receiver is based on the article published in *The Wireless World and Radio Review* of March 3rd, 1923.

Several changes have been introduced, notably the centre panel of ebonite with its cramped arrangement of the terminals. At present these are put direct through the wood, but ebonite bushes will be added if I can discover anybody who sells them. I have added a reaction coil which is in series with the reaction tuning inductances. The detector is a rather neat pattern which plugs into sockets in an ebonite base-plate. I am rather afraid it is a foreigner, however, as it fails to pass my original Sherlock Holmes test for imported goods! I will reveal it for the benefit of *W.W.* readers. Measure up the chief dimensions of the suspected article and see if they come out in centimetres or inches. As few of our manufacturers use the metric system the test is fairly reliable. Try it, for instance, on the diameter of your watch glass.

I did not find the diameter of the cards in the article, which held 17 turns counting one side, big enough for the A.T.C., so another pair was made 4 in. diameter, holding about 25 turns, and are more effective. One of the small cards was used for a reaction coil and is mounted to swing on a block of wood $\frac{3}{4}$ in. high. In the maximum position the valve emits a low growl.

The cards may be about the thickness of a stout postcard, and the large coils take about 20 minutes each to wind. I soon found there were awkward and easy ways of doing this. The first thing to do is to wash one's experimental hands. The reel of wire is mounted in the vice on a piece of screwed rod, and held down by a spring washer and lock nuts to a nice tension. This is on one's left front. With the card in front, the tab, which is in the "three o'clock position," is nipped between thumb and finger of right hand and the wire steered through the slot immediately in front and pulled taut and downwards so as to keep the turns close. Before passing the wire through the next slot the fingers take hold of the next tab. In this way the card remains flat, the winding even, and the fewest useless movements. The winding goes round counter-clockwise, but either face can be used on top afterwards.

The panel measures 12 in. by $5\frac{1}{2}$ in., but it could with advantage be an inch or two longer. The long arms are inclined to catch on things,



The practical wiring as viewed from the top. The two inductances marked " R.T.I." (reaction tuning inductance) are labelled " A.T.I." (anode tuning inductance) in the photograph, in order to make use of engraved labels on the market.

and it might be advisable to saw off the piece that projects beyond the board and fix it on with a tape hinge so that it will fold back. That done and the detector removed enables the instrument to pack flat and small.

The size of the aerial series condenser is a matter of experiment. When tuned in on **2 LO** one requires a bit of inductance in hand, or it will not reach Birmingham. Using the common type of small ebonite condenser case, I have five foils with an overlap of $\frac{1}{2}$ in. by 1 in. each, and a capacity equivalent to about 30° of a 0·0015 condenser, *i.e.*, 0·00025 with mica dielectric 2/1000″ in thickness. A slight adjustment of the crystal may be necessary in order to get the valve to react properly. **2 LO** comes in with the coils spaced a little wider than in the photograph, but the setting of the R.T.I. did not appear to me to be critical. The cards were secured by nothing more complicated than a bootmaker's brass brad through the centre and clinched over.

A Wireless Slide Rule.

IN *The Wireless World and Radio Review* of February 4th, 1922, page 704, appeared a review of a slide rule by Brydon and Hodgson for solving equations of the $\lambda = K\sqrt{LC}$ type. I don't know if any readers thought of cutting out the illustration and mounting it up. I give a very belated photograph of how I did it. On November 21st, 1921 (review February 4th, 1922), there was an advertisement of another rule for solving Nagaoka's formula—this could be treated in the same way.

The whole diagram is pasted down first on a piece of photographic mounting card, and when dry is cut very carefully along the lines with an old razor blade and steel rule. A slightly wider piece is pasted on the back of the slide to form a rebate, and the whole built up on similar lines to the " Imperial " exposure calculator and others.

The slide should be left a very easy fit or it will bind and double up. The chief instructions for its use can be snipped out of the article and pasted on the back. H. E. A.

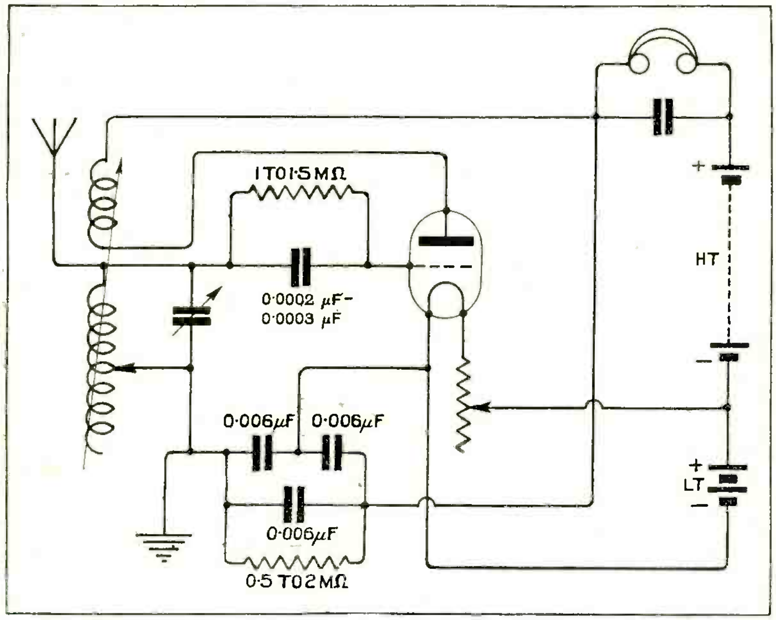
A NEW CIRCUIT.

BRIEF PRACTICAL DETAILS FOR APPLYING THE PRINCIPLE.

THE circuit given in the accompanying diagram is one which is receiving considerable attention from American amateurs at the present time. The arrangement is attributed to Mr. E. T. Flewelling.

It is stated that, as a single valve circuit, it is highly efficient, and compares favourably with the Armstrong super-regenerative arrangement, having some advantages in that it is simpler to operate and the circuit itself is less elaborate to arrange.

As in the case of the Armstrong circuit, it is claimed that a considerable increase in signal strength can be obtained from the employment of a power valve, although good results can be obtained with an ordinary receiving valve. Mr. Flewelling himself recommends that the leak across the bank of condensers should at first be set to a value of half a megohm, and all other adjustments be made with the variable grid leak, though it is explained that these values differ with different types of valves.



The circuit makes use of the drop of potential across condensers to stimulate self oscillation, whilst damping is effected by a leak resistance.

The circuit is published in order that readers may have an early opportunity of trying it out, and *The Wireless World and Radio Review* would appreciate reports on results with a view to publication.

The controlling factor in the operation of the circuit is the value of the grid leak, which should be critically variable. The resistance shown as 0·5 to 2 megohms, should also be variable, and on the adjustment of these two values depends the operation of the receiver.

The circuit is very noisy until the station is correctly tuned, after which all foreign noises except a whistle are eliminated, and by careful setting of the value of the grid leak the whistle also can be reduced to such a minimum that it ceases to be troublesome.

Low frequency amplification can be added, which of course increases the strength of signals considerably.

It is stated that the circuit can be used either with an outside aerial or a frame.

THE AMATEUR'S EXPERIMENTAL LABORATORY

II.—A Simple Valve Oscillator and Resonance Indications

BY

PHILIP R. COURSEY, B.Sc., F.INST.P., A.M.I.E.E.

THE production of oscillations by means of a three-electrode valve with feed-back from the plate to the grid circuit may be accomplished with several arrangements of circuits, but not all of them are equally suitable when it is desired to use the oscillator for the purposes of carrying out high frequency measurements. Undoubtedly the most satisfactory procedure is to employ on all occasions a heterodyne wavemeter in which all the components are rigidly mounted in one instrument. Constructional details of an instrument of this type have been published by the writer elsewhere,* and those interested are referred to that description.

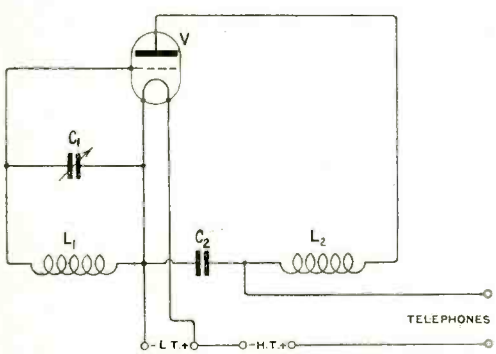


Fig. 1. Circuit diagram of a valve oscillator.

For the present, however, to meet the needs of those who do not possess such a wavemeter, or do not wish to build one at this juncture, it will suffice to mount the necessary components upon a simple baseboard, and to wire them up in the manner drawn out in Fig. 1, or even simply to set them out upon a table, so that when used they can be dismantled and employed for other purposes. When setting the parts out on a baseboard they may conveniently be arranged somewhat in the manner sketched in Fig. 2. It will be noted that on the left-hand side a coil-holder to take two coils is shown. While for the purposes of this use only two coils are required, a coil-holder for three coils can of course be used if one is available, using two of the sockets only, so as to avoid purchasing another coil-holder if one for two coils is not available. It can conveniently be mounted on a small bracket so that the coils hang in vertical planes over the baseboard, as indicated.

For the fixed condenser C_2 a convenient value is about 0·01 microfarad. Any good fixed condenser can be employed here, a Dubilier type 577 condenser of this value being convenient for mounting in the position shown. In the centre of the board is the valve holder, of the ordinary "R" type, preferably of a pattern designed for mounting flat upon the baseboard with terminals at the front. At the right the variable condenser can conveniently be mounted, and connected up to the coil as shown.

With regard to the wiring up of the coil-holder, the set will not function properly if the reaction, or feed-back coil L_2 is not connected in the correct direction. If the four small circles in Fig. 3 represent the sockets of the coil-holder the correct arrangement of the wiring will be as marked. This arrangement will ensure that the reaction coil is in the correct direction for the production of oscillations by the valve.

Any standard pattern of plug-in coils can be used in the coil-holder of this oscillator, the size of coil to be used depending upon the wavelength that it is desired to set up. The reaction coil should, in general, be of much the same size as the coil used in the grid

* "The Radio Experimenter's Handbook" (Second Edition), Part II. By Philip R. Coursey. Published by *The Wireless Press, Limited.*

circuit. For the shorter wavelengths, the next size larger coil in the series of plug-in coils should be employed, while for the longer wavelengths, the reaction coil may be one or two sizes smaller than the coil used in the oscillation circuit.

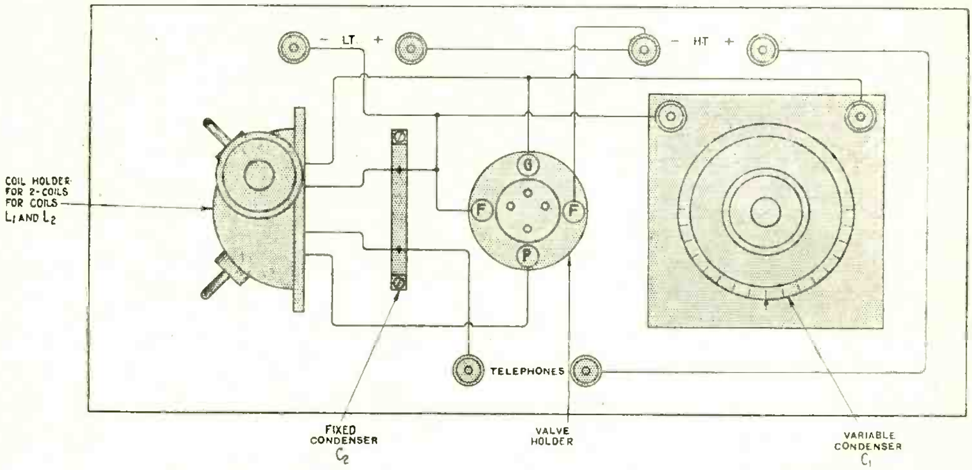


Fig. 2. Practical layout and wiring of a valve oscillator to the circuit shown in Fig. 1.

The variable air condenser used for tuning the oscillation circuit may conveniently have a maximum capacity of about 0·001 microfarad.

Any available type of ordinary receiving

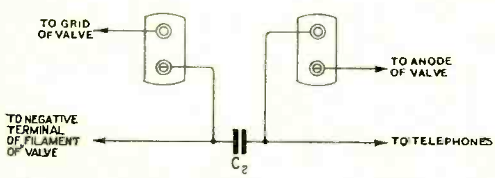


Fig. 3. Method of connecting leads to the coil holder circuits.

valve may be used with this oscillator—such as an "R," "AR," "Ora," "Cossor," or if a suitable adaptor is used, a "V24" valve. As a general rule an H.T. voltage of about 30 volts will prove sufficient, with a 4-volt accumulator for the L.T. supply.

This oscillator may be most simply used with the double-click method for indicating resonance, to which reference has already been made in the first article in this series. Those experimenters who already possess an ordinary buzzer wavemeter, such as the Townsend, may, if they wish, determine an approximate calibration for the oscillator by setting the buzzer wavemeter into operation at various settings, and adjusting the oscillator condenser until the loudest sounds are heard in the telephones.

Suppose now we set up another oscillation circuit closely adjacent to this valve oscillator, this second circuit consisting solely of a coil and a condenser, we can easily determine when the two circuits are in resonance without connecting any additional apparatus to the second circuit. This arrangement is indicated in Fig. 4. In this diagram a portion only of the circuits of the valve oscillator are drawn in, the essential parts being the coil L_1 and condenser C_1 as these determine the frequency of the oscillations. The second oscillation circuit consists of the coil L_3 with the variable condenser C_3 connected across its ends.

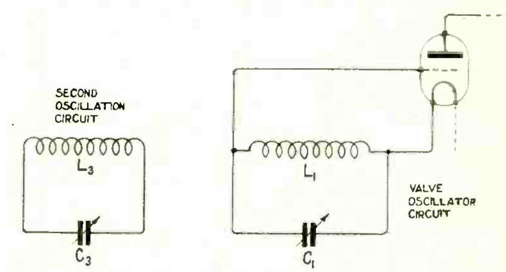


Fig. 4. Arrangement for calibrating a tuned circuit.

If the sizes of the coil L_3 and of the condenser C_3 are such that the natural frequency of the circuit so formed is the same as that generated by the valve oscillator, the second oscillation circuit will absorb energy from the valve, and, if the coupling between the two circuits is sufficient, the oscillations will almost if not quite cease. This causes a click in the telephones connected to the valve oscillator, and this click can be used as an approximate indication of resonance.

What actually happens is that as the second circuit passes through resonance, as its tuning condenser is varied, oscillations are induced in it, the strength of these oscillatory circuits increasing as resonance is approached. If the condenser C_3 is turned further, beyond the resonance value, forced oscillations persist in the circuit, the near-by oscillator forcing the current in L_3 C_3 to oscillate at its own frequency. A point is eventually reached, however, when the valve oscillator can no longer maintain the forced oscillations in the second circuit, so that a sudden jump of frequency occurs, and the frequency of the oscillator which had been changed slightly by the effect of the near-by second circuit suddenly reverts to its proper value, this change accompanying the click in the telephones.

Thus it will be seen that the click in the 'phones occurs not exactly at the true resonance point, but when the second circuit is slightly detuned from the oscillator. Similarly, if the tuning condenser C_3 is turned in the opposite direction a click will again be heard in the telephones just after the resonance point has been passed, but in this case the click will occur on the opposite side of the resonance point to the first click, that is to say, one click will occur just above the resonance point and one click just below. The amount by which these clicks are separated depends upon the coupling between the two oscillation circuits—*i.e.*, upon their nearness together—the closer the coupling the more widely they are separated.

For all ordinary purposes it suffices to note the readings of the condenser scale of C_3 at which the two clicks occur, and to take the mean position as the true setting for resonance. By loosening the coupling between the two circuits, *i.e.*, by moving them further apart, the clicks become closer together, almost merging into one, so that by adjusting the relative position of the two circuits quite an accurate setting for the resonance point can very easily be obtained.

The reality of the existence of oscillations induced in the second circuit L_3 C_3 at the resonance point can be shown by tapping one terminal of the condenser C_3 with a moistened finger as the setting of this condenser is moved through the resonance value, while listening in the telephones attached to the valve oscillator. At the resonance setting a click will be heard in the telephones each time the condenser terminal is touched, since touching the terminal in this way throws the circuits into and out of resonance.

Likewise the fact that the second circuit draws energy away from the valve oscillator can be shown in a similar manner. If the terminal of the condenser C_1 of the valve oscillator, that is connected to the grid of the valve, is tapped with a moistened finger while listening in the telephones a loud click will be heard each time the terminal is touched, thus forming an ordinary indication of the presence of oscillations in that circuit. When the second circuit is brought into tune with the oscillator the strength of these clicks will be much reduced, while they may even cease entirely if the coupling is close enough, thus showing that the second circuit is drawing away most of the oscillatory energy from the first. Either of these two "tapping" methods forms a good alternative to listening for the double click for indicating resonance, and under certain conditions of coupling, etc., these methods enable a more accurate indication of resonance to be obtained than is given by the double clicks.

These indications of resonance can very readily be applied to the comparison of capacities and to the calibration of variable condensers in a manner that will be dealt with in detail in the next article.

PROGRESS IN BROADCASTING.

It is stated that 260 Wireless Manufacturing firms have become members of the British Broadcasting Co. The number of types of Broadcast Receiving apparatus approved by the P.O. is 1,450. Wireless Receiving Licences at present issued total approximately 115,000, of which about 80,000 are in respect of receiving sets bearing the trade mark of the British Broadcasting Co.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—III.

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why*, obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

The series has been specially designed so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

By reason of his work in supervising the replies to the queries and difficulties of readers, the writer has an experience which is not possessed by other engineers. Readers will appreciate that this experience will be reflected in both the selection and the method of presenting the subject.

By W. JAMES.

(*Continued from page 47 of the previous issue.*)

10.—Electrical Power.

Electrical power is expressed in watts, and is the product of volts and amperes in a circuit; thus, watts (W) = VI. As an illustration, the power lost in the 1ω resistance in the last example is the product of 6 amperes and 6 volts, which gives 36 watts. The power may be expressed in another form. As volts=IR, instead of writing the equation $W = VI$, we may write $W = I^2R$ watts.

11.—Cells in Series and Parallel.

The reader is probably familiar with the construction of the ordinary type of dry cell. A section of a dry cell is given in Fig. 12.

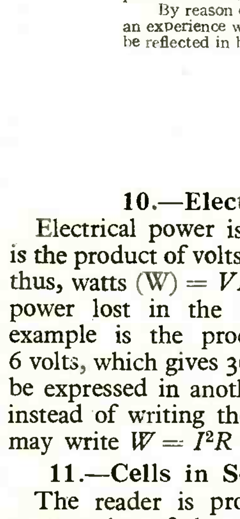
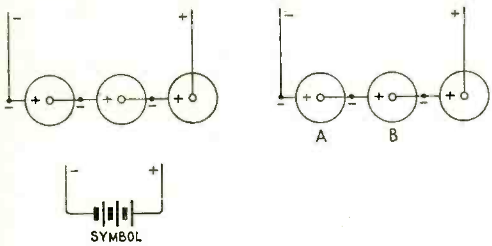


Fig. 12. *Section of dry cell.*

It consists of a zinc cylinder A, which forms the containing vessel. The base I is fitted to the cylinder, and consists of 75 per cent. asphalt, 12½ per cent. paper pulp, 12½ per cent. resin. The carbon rod D is surrounded with a depolarizer C of manganese dioxide and plumbago, wrapped round with porous paper. The excitant, B, consists of sal-ammoniac, which is mixed with other salts and forms a paste, and it is poured between the zinc case A and the depolarizer C. The top of the cell consists of a layer of cork, E, and is sealed with a layer of pitch, F. The tube G is to provide an escape for any gases which may be produced by the chemical action of the cell. A terminal H is fitted with the carbon rod, and a wire J with the zinc container. The cell has an electromotive force (or generates a potential difference across its terminals) of 1.55 volts. The carbon rod is the positive terminal. The chemical reaction which takes place when the cell is connected with a circuit is such that zinc chloride and hydrogen are formed. The hydrogen travels in the direction of the current and tends to collect around the carbon. In the cell, however, the carbon rod is surrounded with the depolarizer, which is rich in oxygen. The hydrogen unites with the oxygen, forming water. When a large current is taken from the cell, the hydrogen collects faster than it can be absorbed by the depolarizer, with the result that as hydrogen gas has a very high electrical resistance, the current in the circuit falls off. Dry cells are therefore only suitable for supplying small currents. During the life of the cell the zinc is slowly consumed. The cell, of course, offers resistance to the passage of current. The resistance will be smaller the larger the cell. During the life of the cell, its resistance increases as the constituents are gradually consumed. The larger the cell, the longer will be its life, and the greater the current which may be taken from it without its voltage falling off.

CELLS IN SERIES.

To connect cells in series, the zinc of one cell is connected with the carbon of the next, or generalising, the positive of one cell is joined with the negative of the next, as shown in Fig. 13. The rule applies, of course, whether the term cell is used to indicate dry cells or accumulators. The positive terminals



Figs. 13 and 14. The diagram shows cells joined in series. The positive terminal (+) of one cell is connected with the negative terminal (−) of the next, and so on. The total voltage is then that of one cell multiplied by the number of cells in series.

are usually coloured red, and the negative black. The effect of connecting cells in series is to increase the total voltage. Thus, if each cell has a potential difference of 1.5 volts, and forty are connected in series the total voltage available is 40×1.5 or 60 volts. That the voltages of cells in series must add together is obvious when we consider that the negative terminal of cell B, Fig. 14, is at the same potential as that of the positive terminal of cell A, since they are connected with a wire. The positive terminal of cell B is 1.55 volts above that of its negative terminal, therefore the voltage difference between the negative of A and the positive of B is $2 \times 1{\cdot}55$ volts. If the internal resistance of a single cell is r ohms, and there are N cells connected in series,

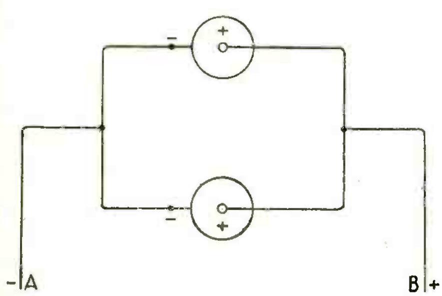


Fig. 15. Here we have two cells joined in parallel. The two negative terminals (−) are connected and form one pole, while the two positive terminals are connected together and form the positive pole. The pressure available is equal to that of one cell. The current which may be taken, however, is twice that which may be taken from one cell.

from what has been explained before, the total resistance of the cells will now be $N \times r$ ohms.

The current available is that which may be taken from a single cell. When we wish to obtain voltages greater than that of one cell we join them in series. The current available is that which may be taken from a single cell.

CELLS IN PARALLEL.

With cells in parallel, the positive terminals are all joined together, and the negative terminals are all joined, as shown in Fig. 15. The voltage between AB is that of a single cell, but the current which may be safely taken from the combination is doubled. If there are N cells connected in parallel, and it is permissible to take a current of i milliamperes from one cell, with the cells connected in parallel, Ni milliamperes may be taken.

The total internal resistance of the cells is now $r \div N$ ohms, where r ohms is the internal resistance of one cell.

12.—The Condenser.

It has been stated previously that if we have two bodies which are insulated from each other, that is, they are held so that they are separated with a non-conductor of electricity, and one body is given an excess of electrons or is charged negatively, while the other is robbed of electrons or is positively charged, an electric strain is set up between the two bodies. The distribution of electrons will be something similar to the distribution illustrated in Fig. 16.

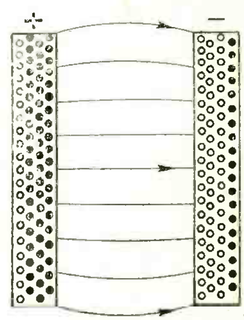


Fig. 16. This figure gives an idea of the electrical state of affairs when two bodies held close together are charged. Here the left hand conductor is charged positively, that is, it has less than the normal number of electrons. The right hand conductor is negatively charged, and consequently has an excess of electrons. An electric strain is set up between the conductors.

There is a tendency for the electrons accumulated on the negative plate of the condenser to be drawn over to the positive plate. Consider now the arrangement shown in Fig. 17. Here we have a switch S with which we are able to connect a battery B with the plates, or, with the switch in position 2, the connecting wires are connected across the plates. When the switch circuit is closed at the contact 1, a current will flow, rapidly at first, and then more slowly until it ceases altogether. The action is this. When the battery

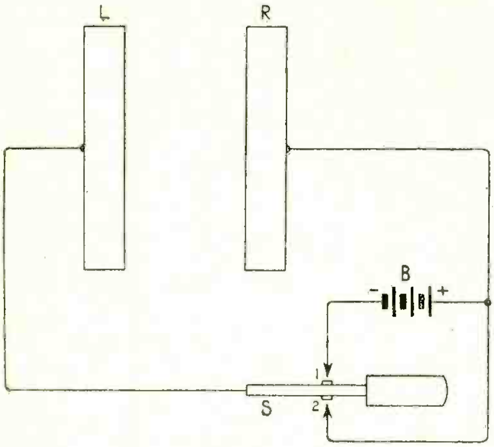


Fig. 17. With the switch S in position 1, the battery is connected, and there is an electron flow until the plates are charged. Plate L will receive an excess of electrons, while plate R is robbed of electrons. The electron flow is shown in Fig. 10a, curve A. When the electron flow ceases, it is plain the back pressure set up due to the lines of force is equal to the pressure of the battery. The variation in pressure across the condenser terminals is shown by curve B, Fig. 10a.

is connected, an electron current begins to flow due to the potential difference of the battery, the plate R parting with electrons which accumulate on plate L. At the moment of switching the battery into circuit there is no electric strain between L and R, and consequently a large flow results, but as electrons begin to collect on plate L, an electric strain

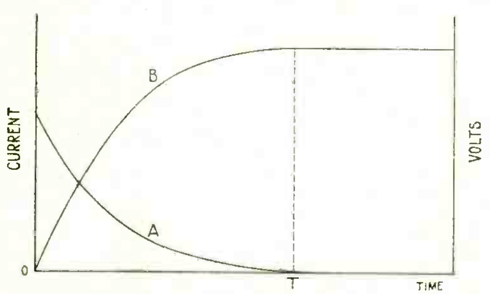


Fig. 17a. These curves show the rise of the back pressure across the condenser and the fall of the charging current as explained in connection with Fig. 10.

is set up, and consequently the rapidity of the electron flow is reduced until the magnitude of the strain is such that no more electrons will pass to L (see Fig. 17a). The plates are now fully charged, and if we wish to give them a larger charge the number of cells in the battery must be increased, or, what is the same thing, a battery with a higher potential difference must be connected. It is apparent then that a larger number of electrons will accumulate on plate L, because electrons will continue to flow until the electric strain produced has the same magnitude as the difference in pressure of the battery. The charge may be increased in other ways. Thus, if the area of the plates is increased, more electrons will flow, or the increase may be brought about by bringing the plates closer together.

Suppose now the switch is moved to position 2. The electrons accumulated on plate L will rush to plate R, which is deficient in electrons, through the connecting wires, until each plate has again its normal distribution of electrons. At the same time the electric strain disappears, and there is therefore no difference of potential between the plates.

The current which flowed into the condenser is called the charging current, while, due to the electric field, a small displacement has occurred in the dielectric, as the material which separates the plates (in the case considered, air) is termed. The displacement in the dielectric is called a *displacement current*.

The arrangement is termed a condenser. Suppose now the condenser is charged again, and then the switch left in its neutral position. If a dielectric such as a sheet of mica is now placed between the charged plates, the potential difference across the plates falls immediately to a lower value, because the mica is a better conductor of electric strain lines than air. If the switch is again closed so that the condenser may again be fully charged, the final charge will be several times greater than when only air separated the plates. The *capacity* of the condenser has been increased. The ratio of the capacity of the condenser when the dielectric is mica to that when the dielectric is air is called the dielectric constant of mica, or its specific inductive capacity. It is found different substances affect the capacity in various degrees. Below is given the dielectric constants of various substances.

Substance.	Dielectric constant or specific inductance capacity.
Air	1·0
Glass	4·0 to 10·0 (depending on the grade of glass)

Mica	4·0 to 8·0 (an average value is 5)
Paraffin ..	2·0 to 3.0
Shellac	3·0 to 3·7
Wood	3·0 to 6·0
Castor oil ..	4·7
Transformer oil	2·5
Water	81·0

The capacity of a condenser is measured in *farads*, and a condenser has a capacity of one farad when it receives a charge of one *cou'omb*, when a potential difference of one volt is connected to it. The coulomb is the unit of electrical *quantity*, and is the quantity of electricity transferred by a current of one ampere in one second. The coulomb may be looked upon as similar to the gallon. If water is flowing in a pipe we may say so many gallons have passed a certain point in the pipe. We could also say water is flowing through the pipe at the rate of so many gallons per second, which corresponds with the ampere. A condenser possessing a capacity of one farad is never used, and in wireless work we use capacities of the order or microfarads (one millionth part of a farad), abbreviated mfd. or μfd. Sometimes the micro-microfarad (mmfd. or $\mu\mu$fd.) is used. Condensers ordinarily used have capacities ranging from 2 mfds, or 2,000,000 mmfds., down to 0·00005 mfds. or 50 mmfds.

When a condenser is charged it should hold the charge for a considerable time without diminution. If the dielectric is not a perfect insulator the charge will slowly leak away. With some condensers, the condenser may be fully charged, and then, after a moment or two, if the charging battery is again connected, another small charge will be taken. This is due to dielectric absorption, and is due to the time which the electric strain in the dielectric takes to penetrate the dielectric. In a similar manner the dielectric takes time to recover from the strain. If the condenser is discharged by connecting a wire across its terminals, and the wire is then removed, it will be found that a second and even smaller discharge may be taken.

Dielectrics may be the seat of losses in a condenser. The charging and discharging, with its corresponding setting up and collapsing of the strains in the dielectric heats the dielectric, and so power is lost. This is liable to cause further trouble, as the insulating properties of the materials used as the dielectric is often seriously reduced when heated. Condensers which are used in high potential circuits, such as wireless transmitters, where they are subjected to strains which may vary many thousands of times per second, should therefore be built with a dielectric which has a small power loss, otherwise it should be expected the condenser discharge will sooner or later take place through the dielectric.

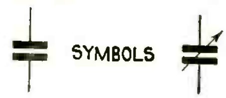


Fig. 18.

Condensers are represented by the symbols given in Fig. 18. The symbol to the left represents a fixed condenser, while that to the right represents a variable condenser, that is, one in which the capacity may be varied by altering the distance between the plates.

(*To be continued.*)

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily press, are now conducted from the following stations of the British Broadcasting Company :—

London	**2 LO**	369 metres.
Birmingham	**5 IT**	420 „
Manchester	**2 ZY**	385 „
Newcastle	**5 NO**	400 „
Cardiff	**5 WA**	353 „
Glasgow	**5 SC**	415 „

FRANCE.

Eiffel Tower. 2,600 metres. 11.15 a.m. weather reports (duration 10 mins.) 6.20 p.m., weather reports and concert (duration about 30 mins.) 10.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 5.5. p.m. news ; 5.15 p.m. concert till 6 p.m. ; 8.45 p.m. news ; 9 p.m., concert till 10 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 7.45 p.m. to 10 p.m. Saturdays, 4.30 p.m. to 7.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 10.45 a.m. to 11.15 a.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 6 p.m.

HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday : 3 to 5.40 p.m., Concert. Monday and Thursday : 8.40 to 9.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

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RADIO BROADCASTING*

By Dr. N. W. McLachlan, M.I.E.E.

After a discussion of the general principles which apply to the transmission of speech and music in radiotelephony the all-important question of musical quality is treated in detail.

Probably the most difficult instrument to reproduce is the piano. The reason for this is the percussive or impulsive action of a piano which causes the microphone system to vibrate in two ways instead of only one. The fundamental frequencies or vibrations per second on a piano vary from about 20 to 3,500, but the overtones extend much beyond the latter figure. Speech vibrations or frequencies vary from 100 to 5,000 per second. Most of the energy is carried by the frequencies below 1,000 periods per second, but the essential characteristics determining interpretation are carried by frequencies greater than 1,000.

Telephonic systems can be severely tested when reproducing the high audio-frequency hiss in the sibilants, the jingling of coins, the high notes on a violin or piano, drums and clapping of hands. Good test words begin or end with "s," "f," "th," "nd," "v," "e," for example, "sink," "five," "thrive," "invaluable."

It is a difficult matter to find a single microphone which will reproduce all types of musical instruments and different voices, and in order to secure good reproduction from solo instruments, and proper blending in orchestras, it is advisable to use a number of microphones of different characteristics.

A certain amount of distortion in a radio broadcasting system is due to the microphone. An unpleasnt effect is obtained if a horn is used in conjunction with the microphone to increase the strength of the speech or music.

Distortion is introduced in a degree by iron-cored transformers. To obviate this as much as possible, special amplifiers in which the valves are coupled by resistances and condensers are used.

By pushing reaction too far it is possible to spoil a transmission which is otherwise good. This is due to the selectivity of the circuit being too high, and at the same time variable. Thus to get the best from broadcasting there should not be a paucity of valves.

A source of distortion which becomes readily evident is over-control of the transmitter.

Since a rectifying valve is employed in the receiver, it creates, in virtue of the curvature of its characteristic curve, two frequencies from an out-going single frequency from the transmitter. In a complex musical sound there are many different frequencies, and when these are all doubled and the combination ones resulting from the interaction of the different vibrations are added, the result is aurally offensive. When the modulation of the transmitter is not too deep the alien frequencies are of minor importance.

Distortion due to improper adjustment of the valves at the receiver, and the use of unsuitable valves is a common occurrence. An amplifying valve should not approach its rectification or saturation points. Thus for loud signals it is necessary to use large valves at the output to the loud speaker. Grid currents should be avoided.

With almost all varieties of loud speaker the best quality is obtained when the intensity is moderate. When the sounds are very loud the effect is to introduce in the loud speaker tones which are not present in the incoming waves, as in the case of over-control there are produced rather distressing combination tones.

Furthermore, owing to the use of vibratory mechanism in all forms of loud speaker or telephone headgear hitherto manufactured, there is a variation in the intensity of sound when the pitch is altered. At the beginning and the end of a musical sound, especially from percussive instruments, the natural frequency of the loud speaker and its family of overtones are superposed in varying degrees upon the main vibration. Thus, owing to the variable action of the mechanism on the incoming acoustic vibration, the output is distorted.

Finally, to make allowances for the distorting influences in the transmitter and the receiver, it is necessary to distort the input from the microphone to give pleasing quality in the telephones or loud speaker.

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* *Abstract of Lecture to Institution of Electrical Engineers at Birmingham.*

Accumulators and H.T. Batteries.

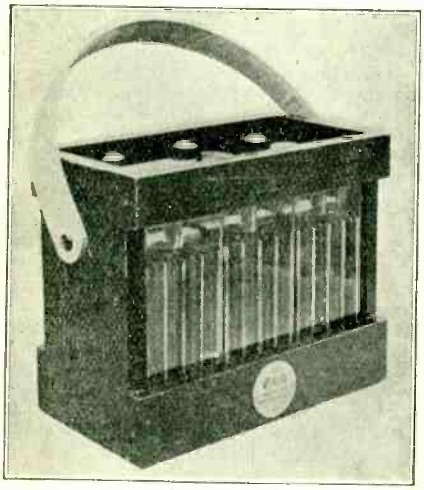
2. MAINTAINING ACCUMULATOR BATTERIES IN GOOD CONDITION.

By L. F. FOGARTY, A.M.I.E.E.

(*Continued from page 50 of previous issue.*)

Through the kindness of many well-known accumulator manufacturers, I am able to show you several modern forms of accumulators (Figs. 6 to 12). All these types are suitable for radio work.

When a new accumulator is purchased in a dry, uncharged condition, the first charge will require to be continued for a period of 30 to 50 hours, n order to bring it into proper condition for long service.

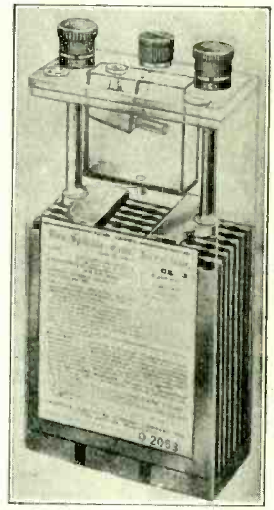


By courtesy of the Chloride Elect. Storage Co., Ltd.
Fig. 6. Portable accumulator for filament heating.

Certain manufacturers have produced types which permit of very rapid charging, and in which it is not necessary to give an uninterrupted first charge of 30 to 50 hours, but apart from these details and other variations, such as the type of container and separator, all lead accumulators operate on the same principle, and all require practically the same treatment and care.

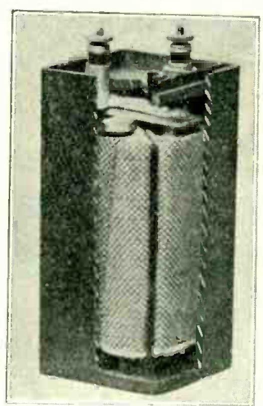
For instance, it is very important in the first place to fill the accumulators with acid of the right kind and of the right specific gravity in accordance with the maker's instructions. To ascertain this we make use of an instrument called a hydrometer, which enables one to measure the gravity at all times, for this latter changes in accordance with the charge in the cell.

When we speak of a specific gravity of 1·200, we mean that the acid solution is 1·2 times heavier, bulk for bulk, as compared with an equal volume of pure distilled water, so that if a cubic centimetre of pure water weighs 1 gramme we would know that a cubic centimetre of the acid solution woul weigh 1·2 grammes.

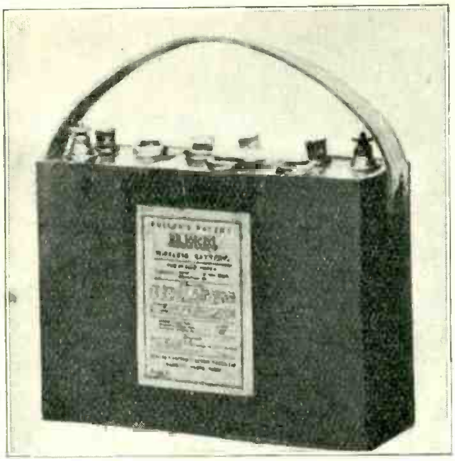


By courtesy of the Chloride Elect. Storage Co., Ltd.
Fig. 7. Unspillable type for filament heating accumulator.

A certain type of hydrometer, shown in Fig. 13, is very suitable for use with small accumulators of the portable kind, where the opening in the container and the space between the plates would not permit of introducing the hydrometer directly into the solution. The type shown consists of a glass tube drawn out at one end, and fitted with a rubber bulb at the other, similar to a fountain pen filler but of much greater size. Within this outer tube there is placed an ordinary hydrometer consisting of a glass tube, the small end of which carries a graduated scale and the large end contains a number of lead weights secured in position by cement. The scale is calibrated by placing the tube in acid solutions of known definite strength and noting the depth to which the tube sinks. Naturally the tube will sink deeper into a light liquid and less into a dense liquid. By means of the rubber bulb it is possible to suck up acid out of the accumulator in sufficient quantity to float the hydrometer proper, when a reading can be taken and the acid returned to the cell from which it was originally taken. Fig. 14 shows an enlarged view of the hydro-



By courtesy of Fuller's United Electric Works, Ltd.
Fig. 8. The special Fuller Block Accumulator. A unique construction possessing several advantages.

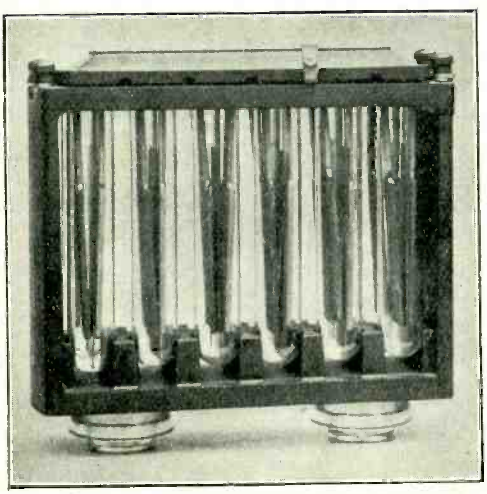


By courtesy of Fuller's United Electric Works, Ltd.

Fig. 9. Portable Fuller Block Battery for filament heating.

meter floating in the acid and indicating a reading of 1·280.

The hydrometer readings serve to indicate the amount of charge in the battery, and it is advisable to take readings of each cell from time to time, which should be done immediately after a charge, as at that time the density or gravity of the acid will be uniform in each cell.

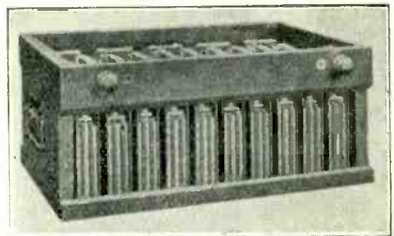


By courtesy of the Chloride Elect. Storage Co., Ltd.

Fig. 10. A new type of accumulator, designed to replace the dry cell high tension battery.

The specific gravity of the electrolyte falls during discharge in proportion to the ampere hours taken out of the battery. For instance, if the specific gravity of a fully charged cell equals 1·250, a reading of 1·200 will mean that the cell is slightly more than half charged, whilst a reading below 1·200 and above 1·15 indicates that the battery is less than half charged.

A specific gravity of 1·150 or below indicates that the battery is completely discharged, and should be given a full charge forthwith. Similarly, if the gravity of the acid in a fully charged cell falls to 1·18 after a short time, and without having been discharged, it will indicate some trouble, which must be located and rectified.



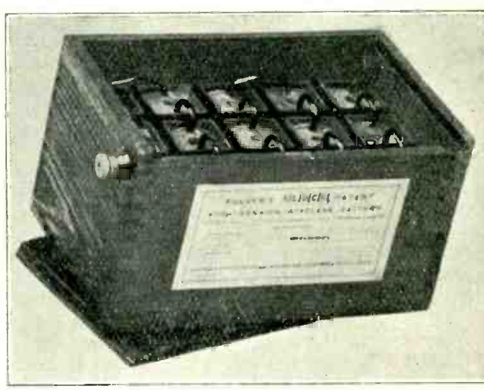
By courtesy of the Hart Accumulator Co., Ltd.

Fig. 11. A portable accumulator for supplying valve plate currents.

Hydrometer readings should never be taken after water has been added to bring up the level of the acid, as in such cases the water would rest on the top of the denser acid solution, and the hydrometer readings would be misleading. The cells should therefore be filled so as to well cover the active parts and fully charged. The specific gravity readings may be taken after the cells have freely gassed.

It should be noted that in normal operation an accumulator does not lose acid, but that the lowering of the level of the solution is due to evaporation of the water constituent only, and for this reason acid should not be added to an accumulator, but only pure water, preferably distilled; but rainwater may be used.

When a battery is insufficiently or irregularly charged it cannot be expected to work properly, for the normal sulphate hardens and increases in bulk, thereby filling the spongy pores in the plates and impeding the free circulation of the acid. Unless the battery receives proper and immediate attention it will be entirely ruined. On the other hand, constant overcharging tends to detach the



By courtesy of Fuller's United Electric Works, Ltd.

Fig. 12. The Fuller Block High Tension Battery.

active material from the positive plates, and ultimately produces a state of affairs equally as bad as sulphation.

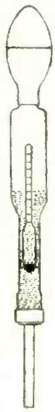


Fig. 13. *The hydrometer.*

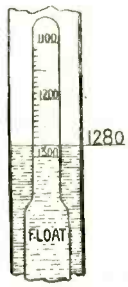


Fig. 14. *An enlarged view of the floating hydrometer.*

Both the density of the acid and the charging rate indicated by the makers should be rigidly adhered to, as each maker knows the values most suitable to his product.

Incidentally the battery should be kept clean and dry and all connections securely tightened down. Any corrosion of the copper or brass terminals should be well cleaned with a weak solution of soda or ammonia, and vaseline applied to protect them from further destruction.

A fully charged battery should not be allowed to stand idle for many months at a time, but be given a charge every two months or so, and water added to keep the plates well covered. The charge to be given should be sufficient to make all the cells gas freely.

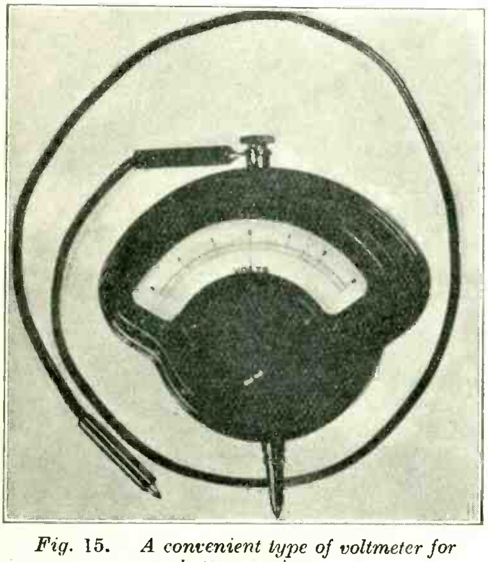


Fig. 15. *A convenient type of voltmeter for battery testing.*

A good accumulator, if fully charged, may be put on one side for a period of six months without serious harm, but it will be better if it can be given a charge more frequently as before mentioned.

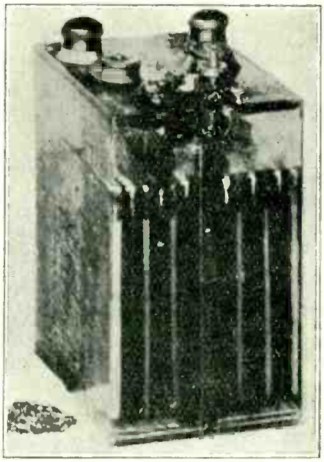


Fig. 16. *A burnt celluloid container caused by fusing of the connector and current leakage along the path of the acid.*

On the other hand, if it has stood for the full period, it should be given a long charge of at least 30 to 50 hours at half normal rate before being put into regular use.

As most of the batteries used for wireless reception are of the portable pattern, fitted in transparent cases, it is easy to ascertain their condition by observing that there is no protrusion of active material or deposit in the bottom of the container.

It should also be ascertained that the plates are not broken or distorted, and that crystal deposits are absent on the positive plates, which should be of a dark brown colour in comparison to the light grey negatives. One can also verify the specific gravity and the voltage of the cell under normal discharge. A very convenient voltmeter for this purpose is shown in Fig. 15.

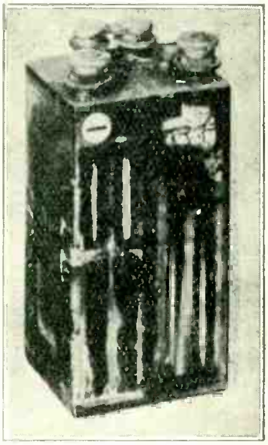


Fig. 17. *Effect of neglect. The acid has not been kept up to the required level and dirt has entered through the missing vent plug.*

Wherever a portable battery of the kind described requires cleaning out it should first be fully charged, and then, replacing the vent plug, be well shaken up, turned over, and as much of the acid and sediment as possible poured out. By repeated filling with clean water and shaking, all the sediment may be washed away. The cell may then be filled with fresh acid of the correct specific gravity, and given a prolonged charge at the rate shown on the instruction label.

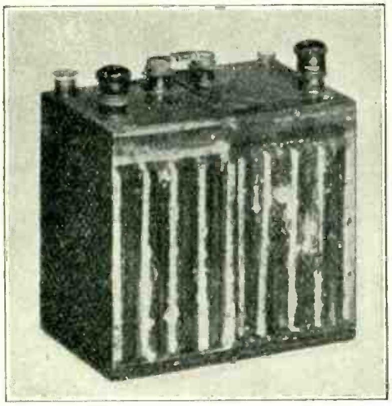


Fig. 18. A sulphated battery due to running it too low on discharge.

Where a number of cells of different capacity are charged in series, the battery having the lowest charging rate will determine the current to be used.

An accumulator cannot be considered as fully charged until all the cells are gassing or bubbling freely, and the specific gravity of the acid has risen to a maximum stationary value maintained for several hours.

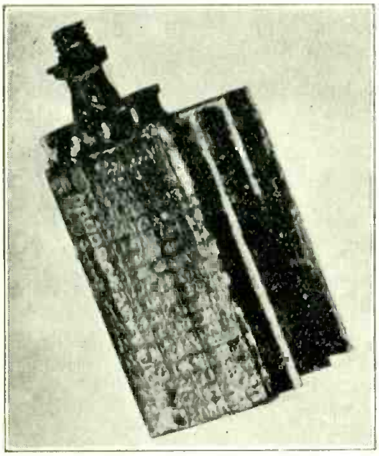


Fig. 19. The use of impure acid and water has caused bad sulphating and pitting of the connecting bars.

If the battery becomes warm during charging it is advisable to stop, or reduce the rate, as the temperature must not be allowed to exceed 100° F. In every case free ventilation must be provided and the vent plugs removed, otherwise the explosive gases will be unable to escape and may be detonated through a spark at any time. Similarly, whenever charging is being done from a supply exceeding 50 volts, care must be taken to insulate the battery from earth, and to see that there is not a film of acid on the surface which may act as a short circuit. The evil effect of carelessness in this direction is shown in Figs. 16 to 20.

The first example shows a fused celluloid container caused by heating of the terminals and leakage of current along the path of acid. Fig. 17 shows the effects of ill-treatment through failure to keep the plates covered with acid and the entrance of dirt through a missing vent plug.

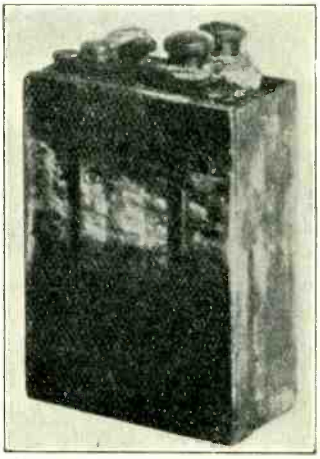


Fig. 20. The insulation to earth has been destroyed by the supply current during charging.

The next example (Fig. 18), is of a hydrated cell and shows the effect of running a cell too low on discharge.

The fourth example (Fig. 19) shows the damage caused through the use of impure acid and water, the plates being badly sulphated and the bars pitted and corroded. (Fig. 19.)

The fifth example (Fig. 20), shows a cell in which insulation to earth has been destroyed by the voltage of the supply current used for charging. It is most important that proper precautions be taken when accumulators are charged direct from the mains in order to avoid such breakdown or shock to the operator.

(To be concluded).

Radio Society of Great Britain.

The next meeting of the Society will take place on Wednesday, April 25th, at 6 p.m. (tea 5.30) at the Institute of Electrical Engineers, Savoy Street, Thames Embankment, London, W.C., when Mr. G. G. Blake, M.I.E.E., will deliver a lecture entitled "Historical Notes on Wireless Telegraphy and Telephony".

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Hackney and District Radio Society.*

On March 22nd, at the Y.M.C.A., Mare Street, Hackney, Mr. Ince brought along his two-valve set for exhibition and criticism. Mr. E. F. Walker also exhibited a five-valve set of good appearance and finish. To it was connected an Amplion loud speaker, and for test purposes the window was thrown open and the loud speaker turned facing the street. The reception of 2 LO was apparently of sufficient interest to the passers-by to keep them waiting for some six minutes during one interval. Towards the end of the evening the crowd became so great that the test was closed at the request of the police. It was decided during the evening to communicate with local hospitals offering to provide the inmates with radio concerts.

At the meeting held on Thursday, April 5th, it was announced that in connection with a lecture to be given on May 10th by Mr. L. L. Robinson, Borough Electrical Engineer for the Borough of Hackney, the Mayor of Hackney had kindly consented to preside.

After the usual formal business, Mr. Bell demonstrated the wiring of the frame aerial he had presented to the Society, and some excellent signals were received on the Society's set by means of the frame aerial.

Non-members of the Society are heartily welcomed to all meetings of the Society, and especially to a lecture to be given by Mr. O. S. Puckle, on "Telephone Receivers," on Thursday, April 19th, 1923, and to the above-mentioned lecture by Mr. L. L. Robinson.

Hon. Sec., C. C. Phillips, 247, Evering Road, E.5. (Letters only.)

The Ilford and District Radio Society.*

On March 22nd Mr. J. F. Payne lectured on "Short Wave Reception, with Special Reference to the Armstrong Regenerative Circuit."

March 29th was an informal evening. Mr. L. L. Vizard spoke on the various ways of applying the "tuned anode" method of H.F. amplification, demonstrating the circuits by means of his receiver.

On April 5th Mr. A. S. Laudsler, L.D.S., R.C.S. (Eng.), lectured on "H.F. Currents," and gave a very impressive demonstration by means of a spark coil and a Tesla coil. He showed how H.F. currents of fairly high amperage could be passed through the human body without any ill effects or unpleasant sensations.

Hon. Sec., 77, Khedive Road, Forest Gate, E.7.

Sunderland Wireless and Scientific Association.*

At a meeting held on Saturday, March 24th, at Westfield House, Mr. W. T. Maccall, M.Sc., M.I.E.E. presiding, Mr. M. G. Scroggie, B.Sc., of the University of Edinburgh, lectured upon "Some Experiments on Wireless Reception, with Special Reference to Valve Amplification." The lecturer described in a clear and simple manner original work that he had performed in the subject of resistance retro-action.

Hon. Sec., A. Richardson, Westfield House, Sunderland.

Ipswich and District Radio Society.*

At a meeting held at 55, Fonnereau Road, on Monday, March 26th, the competition was decided for the best home-made wireless receiving set, for junior members only, the judging being carried out by Messrs. Walsh, Akester and Bird. Masters J. Mayhew and Douglas Barbrook each entered a single valve panel and two-valve set, entirely made by themselves at home, and submitted written papers showing such a grasp of the subject and lucid exposition of the means whereby the results were obtained that it was almost impossible to prefer one to the other, but, on points of originality, the first prize was awarded to Master Mayhew, and the second to Master Barbrook, the third being given to Master A. Tonkins for a two-valve cabinet.

After a few remarks by the Chairman, Mr. Page proposed a hearty vote of thanks to the judges, and also to the Secretary, for instituting so interesting a competition.,

Hon. Sec., H. E. Barbrook, 46, Foundation Street, Ipswich.

Portsmouth and District Wireless Association.*

There was a welcome increase in attendance at the weekly meeting held at the John Pile Memorial Rooms, Fratton Road, on March 28th, when Mr. G. J. Claret gave an address on "A $1\frac{1}{2}$ kW. Marconi Spark Transmitter."

Amongst the Club's recent activities was a demonstration of wireless telephony given at the Institute for the Blind, North End. Music and speech were received through a seven-valve set which operated two loud speakers, entirely filling the large and packed hall with sound.

On Wednesday, April 4th, for the benefit of beginners, a special lecture was given by Mr. A. G. Priest, on some simple receiving sets. He first described a crystal receiver and finally dealt with a two-valve tuned anode set with crystal rectification.

The first number of the Club's magazine, "The Portsmouth Aether," will be ready on or about the 1st of May.

Enquiries regarding the Club's activities will be welcomed by the Hon. Sec., Stanley G. Hogg, 9, Pelham Road, Southsea.

The Woolwich Radio Society.*

On March 28th, at the Y.M.C.A., Mr. A. G. Beeson gave a lecture on "X-Rays," which he had been specially asked to repeat in view of its immense popularity last year.

Hon. Sec., H. J. South, 42, Greenvale Road, Eltham, S.E.

The Clapham Park Wireless Society.*

A general meeting was held on March 28th. Following the business of the evening, Mr. C. D. Richardson gave some instructive remarks on the elementary principles of electricity in so far as they concern wireless, dealing with potentiometers, galvanometers, and the Daniel standard cell.

On April 24th Mr. A. L. Beedle explained the workings of the G.P.O. telegraphs to an interested audience.

The Society is a very active one, devoted solely to scientific matters, and the Hon. Sec. states that social pursuits such as dancing are eschewed, the members evidently being of sterner stuff. All *bona fide* amateur experimenters, whether novices or otherwise, are welcomed. Meetings are held every Wednesday at 67, High Road, Balham, at 7.30 p.m.

Hon. Secretary, J. C. Elvy, A.M.I.E.E., 12, Tavistock Street, Strand, W.C.2.

Swansea and District Radio Experimental Society.*

On Wednesday, April 4th, the Society listened to a very interesting lecture given by Mr. D. W. Walters, of Gowerton, on "Transatlantic Tests." The lecturer was congratulated on being fifth in order of merit during the recent Transatlantic Tests, and the Society feel honoured at having such a distinguished amateur. Mr. Walters gave a description of the circuit used in these tests.

At an interesting Discussion Meeting of the Society, held on April 4th, the log extract of one of the members, Mr. A. T. Cole, showed that he was successful in hearing five of the British Broadcasting Stations on a crystal set, viz., Glasgow, London, Manchester, Newcastle and Cardiff.

All those in the district interested in Wireless are invited to join the Society.

Hon. Sec., H. Morgan, 218, Oxford Street, Swansea.

The Wireless and Experimental Association.*

At the meeting of the Association at the Camberwell Library on April 4th, the Secretary was welcomed back after his long absence on business in the North of England, where he had profitably occupied his time in starting a new Wireless Association. The Secretary then gave a talk on variometer construction with examples. Mr. Herbert, member, read a short and very amusing paper on "How I became a Wireless Enthusiast."

Hon. Sec., Geo. Sutton, 1, Melford Road, S.E.22.

The Finchley and District Wireless Society.*

On Thursday, April 5th, at St. Mary's Schools, Church End Finchley, Mr. Howard gave an interesting talk on the charging of accumulators at home.

The Hon. Secretary wishes to draw attention to the slackness of a large number of the members.

Hon. Sec., A. E. Field, 28, Holmwood Gardens, Finchley, N.3.

Dewsbury and District Wireless Society.*

The Hon. Secretary issues a strong appeal to members to be more regular in attendance.

It has been suggested that a "Difficulties" night be held in the near future, at which members may discuss their radio troubles. It is also hoped that a number of Field Days can be organised for the summer months.

Hon. Sec., Fred Gomershall, A.S.A.A., 1, Ashworth Terrace, Dewsbury.

North Middlesex Wireless Club.*

On April 4th, at Shaftesbury Hall, Bowes Park, the members enjoyed a very instructive and interesting account of Mr. Garland's experiments with High Frequency Amplification. The most effective way of increasing the selectivity of receiving apparatus is undoubtedly, in Mr. Garland's opinion, the use of High Frequency Amplification.

Following the lecture, Mr. L. C. Holton answered various questions which had been placed in the Club question-box at the last meeting. This question-box promises to be a very popular institution among the members.

Hon. Sec., H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

The Hall Green Radio Society.

The above is the title of a new Wireless Society which has been formed at Hall Green, Birmingham. Application for membership should be made to the Hon. Sec., F. C. Rushton, 193, Robin Hood Lane, Hall Green, Birmingham.

Nottingham and District Radio Experimental Association.

Attention is drawn to the change of Hon. Secretary and the gentleman who now holds this position is Mr. H. B. Old, 10, St. Jude's Avenue, Mapperley, Nottingham.

Eastern Enfield Wireless and Experimental Society.

A successful wireless exhibition, organised by the Society, was held in St. James's Hall, Durants Road, on March 16th and 17th, the surplus proceeds being given to the Ponders End, Enfield Highway and District Nurse Fund. The Hon. Sec. of the Exhibition was Mr. W. F. Ling.

The Exhibition was opened on the 16th by Dr. C. E. Hiatt, of the Edison and Swan Electric Co., Ltd., and on the 17th by Mr. Councillor F. J. Spackman. A comprehensive range of apparatus was on view, and the exhibitors included Messrs. Rich and Bundy, Edison and Swan, Falcon Garage and Hawker and Wildman. Four aerials, erected in the Hall, were used for demonstrations which excited considerable interest.

Asst. Hon. Sec., W. F. Ling, 234, Durants Road, Ponders End.

The Uxbridge and District Radio and Experimental Society.

A very successful meeting was held on March 27th, when an able discourse on "Wave Motion" was given by Mr. H. E. Wild, followed by Mr. G. G. Bailey, who lectured comprehensively on "The Crystal Set and its Functional Powers," demonstrating his remarks with apparatus. Mr. S. E. Newton also gave the members some very interesting information on Headphones.

Hon. Sec., J. R. M. Day, 10, Cowley Road, Uxbridge.

Rawtenstall and District Radio Society.

On Wednesday, April 4th, Mr. Deavin, of the Dartford Radio Society, gave an interesting lecture on "The Earlier Methods Used in Wireless," and a lively discussion ensued. The speaker had on view three radio sets, including a crystal set on which he receives **2 LO** at a distance of 30 miles. The whole set only measured 3 ins. square by 3 ins. deep.

A hearty welcome is given to all radio enthusiasts in the district to become members and those interested should communicate with the Hon. Sec., J. W. Butterworth, 11, Bank Street, Rawtenstall, Lancs.

Bournemouth and District Radio and Electrical Society.

Capt. Hobbs, M.C., of the 4th Tank Battery, lectured to the Society on Friday, April 6th, on "Amplification and Switching Arrangements."

There was a splendid attendance, and everything points to the Club becoming a power in the radio world.

Hon. Sec., A. Reynolds, Town Hall, Bournemouth.

Rye and District Radio Society

On Friday evening, April 6th, a demonstration of radiotelephony was given at the Baptist Schoolroom, Rye, to about 200 people. A four-valve set was used (1 H.F., 1 R., 2 L.F.), reactance capacity coupled, built by two of the members, which, with the assistance of a Brown relay and two Amplion loud speakers, made the concert from **2 LO** audible throughout the hall.

It has been decided to restrict the meetings to once a month during the summer and to endeavour to arrange some outdoor work during the fine weather.

Hon. Sec., W. E. Philpott, 18, Eagle Road, Rye, Sussex.

The Sydenham and Forest Hill Radio Society.

The Society, which has been in existence for some time, caters for both advanced and elementary students of wireless, and all interested are cordially invited to come to the meetings, which are held every Monday between 7 and 10 p.m. at the Greyhound Hotel, Sydenham (in the chess room).

Hon. Sec., M. E. Hampshire, 139, Sydenham Road, S.E.26.

The Redhill and Reigate Radio Society

The first general meeting since the Society's reorganisation was held on Thursday, April 5th, when the Secretary reported a very satisfactory financial position. Members were very gratified to hear that a number of influential local gentlemen, including Brigadier-General Cockerill, and Mr. Charles Wordingham, the well-known consulting engineer, had honoured the Society by becoming Vice-Presidents. It was decided to hold informal meetings on the first Thursday in each month at 8 p.m., and formal meetings with lectures on the third Thursday at the same hour.,

New members will be welcomed at any of these meetings, or should apply direct to the Hon. Sec., C. W. Johnson, 111, Station Road, Redhill.

TEXT OF THE MEMORANDUM ON

Broadcasting and the Licence Problem

Addressed to the Postmaster-General by the Radio Society of Great Britain.

A MEMORANDUM upon Broadcasting has been forwarded to the Postmaster - General by the Radio Society of Great Britain. *The Wireless World and Radio Review*, as the official organ of the Society, is authorised to publish this memorandum in order to bring it prominently to the notice of all readers. This memorandum has previously been sent all over the country to the Societies affiliated with the Radio Society of Great Britain, and has been discussed at their various meetings. All the main points are strongly supported by the Societies which have reported to date, and the large majority have accepted in full the detailed suggestions also.

The following is the text of the Memorandum:

The Radio Society of Great Britain is an organisation representing about 160 of the wireless societies scattered throughout the British Isles and about 30,000 persons. The Society includes men of science who have worked upon the fundamentals of wireless, engineers and designers, artisans and operators, and an even larger number of non-professional students of the subject. All these meet with the common ideal of spreading the study of electricity in one of its most fascinating phases among all classes of the community and join hands in the public-spirited endeavour to foster wireless science in the national interest.

The study of wireless is one of the best gateways to all electrical knowledge. The design and construction of wireless apparatus is a valuable part of electrical education. The practice obtained by actual use of the apparatus is an excellent way of acquiring skill in manipulation, and makes the amateur a participator in the regulation of the world's wireless traffic. All this is immensely to the public advantage, for, in the first place, in our modern electrical civilisation our commercial survival depends upon the attention given to electrical subjects. In the second place, the existence of a nucleus of persons trained in wireless is an important contribution to the national security. In the third place, the wide dissemination of electrical thought produces an atmosphere that fosters electrical ability and facilitates the emergence of electrical genius. Unless this encouragement exists we shall become even more indebted than we are at present to foreign discovery and invention, and we shall have to pay an even larger tribute as royalties on foreign patents than we do to-day.

The Radio Society of Great Britain can therefore claim that its activities are in the highest degree of national importance, and it need hardly be said that in spreading a love of the study and practice of wireless the Society is absolutely disinterested. In this spirit the Socety has welcomed the advent of broadcasting for at least two reasons. It appears probable that all those who listen-in frequently will gain information of the possibilities and of the limitations of wireless intercommunication, and it is probable that some of those who begin by listening-in for amusement may be led on to take a thoughtful interest in this branch of science. The Society therefore looked forward hopefully to the rapid multiplication of students, constructors and operators of wireless apparatus.

Three or four months' experience of broadcasting have brought unexpected consequences. For instance, practice in the art of receiving signals with modern apparatus has been made difficult or physically impossible in certain areas at certain times. Again, many new restrictions have been imposed on old licence-holders, and the obtaining of new licences has been made less easy. All this is so clearly against the public interest, and affects so many members of the Radio Society, that the matter has been forced to the urgent attention of the Committee.

The principal ways in which members of the Society and others are affected adversely may be summarised as follows :—

(*a*) Experimental receiving stations within a few miles of a broadcasting station are jammed so badly that practice in picking up other stations, in learning the Morse code and in testing apparatus, are impossible during the hours usually available to the experimenter. It is even impossible to calibrate a wavemeter for strictly scientific purposes.

(*b*) Experimental transmitting stations are greatly hampered because the co-operating station is jammed, and because it is impossible to intercept before transmission on the licensed wavelength in the manner required by the permit. A branch of science with high potentialities is thus destroyed during a large portion of each day.

(*c*) The existing broadcasting regulations prohibit an owner from studying or improving his own apparatus. This prohibition, if it could be enforced, would be an edict compelling ignorance, and would destroy the only chance that broadcasting had of being of national educational value as well as an entertainment.

(*d*) The granting of experimental licences has been made more difficult rather than more easy, and serious would-be learners of wireless science are hindered in beginning their studies. This is quite contrary to the public interest, and appears besides to be contrary to the intention of the Act of Parliament. It is said to have led to much evasion of the regulations, and possibly to infraction of the law.

(*e*) The selling of apparatus in sealed cases is tending to lower the standard of manufacture, and the limiting of designs to certain standard types usable only in this country cannot but react most injuriously upon all attempts to build up an export trade in wireless apparatus.

The Committee collected a number of suggestions for the amelioration of the disadvantages enumerated above. The technical suggestions included the following :—

1. The broadcasting stations should be prohibited from emitting high frequency harmonics or overtones, and should be restricted absolutely to their proper wavelengths.

2. The power to be employed should not be allowed to exceed an allotted figure.

3. Modern methods of modulation should be made compulsory.

4. More blank hours should be arranged for the use of students of wireless, especially on Sundays, and the hours fixed should be adhered to. It is stated that at present the blank hour is frequently filled illegitimately, and the broadcasting station thereby becomes a permanent obstacle to the worker. For the benefit of the listener-in the blank hours might be taken in rotation by the various broadcasting stations.

The Committee also discussed a number of suggestions for the improvement of the present system of licences. As desirable guiding principles, it was agreed that every competent British subject must retain his right to possess a licence for experimental work, must remain entitled to construct and to use his own apparatus under the licence, and must not be coerced into paying any sum or sums towards the Broadcasting Company if he does not use the entertainment they provide, always excepting any proportion of the usual licence fee which the Postmaster-General may allocate to the company.

The following scheme of licensing was agreed upon as likely to be satisfactory to all parties concerned. Three kinds of licence might be issued :—

(1) The broadcasting licence for use with apparatus marked B.B.C., fee 10s.

(2) The experimental licence at a low fee for qualified persons not listening-in to the broadcasting transmissions, say 10s.

(3) The listening-in licence allowing the use of any apparatus, bought or home-made, for the purpose of listening-in, fee 20s. The Broadcasting Company might supply holders of this licence with a neat badge, changed annually, as acknowledgment of payment of the fee. Such a badge suspended near the apparatus would serve as a guarantee of payment for the entertainment.

The Committee suggested that a fourth kind of licence might be issued to hotels, restaurants, cinemas, etc., costing £5 or £10.

It was agreed that the Society could not accept the suggestion that any form of licence should be endorsed with a requirement that any component parts purchased under the licence must be marked B.B.C. The Society would offer no objection to an endorsement limiting purchasers to components marked of British manufacture.

The Committee decided to put on record their demand that action taken on the above suggestions should not affect the enjoyment or issue of transmitting licences for experimental purposes.

Notes

Reception of 2 LO in Italy.

A reader in Venice points out that he is able to receive regularly transmissions from the London Broadcasting Station, and, in fact, with his apparatus he finds that the signals are stronger than those transmitted in Paris by the Eiffel Tower and the Radiola Concerts. His aerial is a double wire about 65 ft. long, and the equipment a Marconi 16 type crystal tuner with a French three-valve magnifier.

Broadcasting in India.

A meeting has been held at Delhi to discuss the formation of a broadcasting company for India. The Government proposal to limit the licence of one company was opposed on commercial and geographical grounds, and nothing definite is likely to be settled for some months until the various interests have been called together for the purpose of expressing their opinions.

Wireless in New Zealand.

Radio telegraphic regulations for amateur, experimental and broadcasting stations, has been officially approved by the New Zealand Cabinet. The dominion is divided into four radio districts —Auckland, Wellington, Canterbury and Otago, each with inspectors. Evidence of British nationality must be furnished by applicants for licences, and a declaration of secrecy regarding public correspondence is required. The broadcasting of any information which might be regarded in the light of propaganda is forbidden.

Australian Broadcasting.

An Executive Committee will shortly be appointed in Sydney to consider the best means of eliminating any monopoly of wireless broadcasting in Australia, and recommendations are being prepared for presentation to the Wireless Board and the Federal Government.

The World Wireless Chain.

Apropos of our recent note on the Marconi Company's scheme for the erection of high power stations in this country for communication with European capitals, it is reported that a provisional site has been chosen for the first station on the Marlborough Downs, Wiltshire. An alternative site in the Midlands has also been under consideration. Mr. Godfrey Isaacs, managing director of the Marconi Company, states that they are only awaiting the issue of the necessary licence by the Government to begin with the erection of the station, which will really be a group of six stations. The English station will ultimately be linked up with ten other stations, to be situated in South Africa, Australia, Montreal, Vancouver, India, Buenos Aires, Rio, Pernambuco, Peking, and Tokyo. Each of these stations will include one transmitting section and three or four receiving sections.

[*Photopress.*

The Children's Hour at 2LO.

Miss Cecil Dixon (Aunt Sophie), Mr. Stanton Jefferies (Uncle Jeff), Mr. Rex Palmer (Uncle Rex), Mr. Arthur Burrows (Uncle Arthur), and Capt. Lewis (Uncle Caractacus), who are responsible for the Children's Entertainment at the London Broadcasting Station.

Ship Wireless in Ports.

A decision of importance to ship-owners has been made by the General Post Office in concurrence with the Government Departments concerned. In future, no objection will be raised to the use of licensed apparatus on a ship in all harbours and estuaries, with certain exceptions, in the United Kingdom. The exceptions are the naval harbours of Portsmouth, Plymouth, Chatham, Sheerness and Rosyth and also the Port of London above Cross Ness, *i.e.*, the lower extremity of Barking Reach.

The use of wireless on ships while in harbour has long been sought after, the objection to the practice being of course the possibility of interference with Government and commercial land stations. In the new arrangement, precautions are taken to prevent this and the concession may be withdrawn at any time at the discretion of the Postmaster-General.

Loss on State Wireless Stations.

The loss on the working of Leafield and Cairo P.O. stations was on April 5th, the subject of comment by Sir Burton Chadwick, M.P. for Wallasey. In discussing a statement from the Postmaster-General regarding the income and expenditure of these stations he said that a very disquieting state of things was revealed.

It appeared from this statement that the Leafield station was costing £36,000 a year, and that the revenue for the nine months ending January was only £24,200. The figures for the Cairo station were even more extraordinary. The expenses were estimated by the Post Office at about £49,000 a year, whilst the revenue for the nine months ending January amounted to only £4,700.

Low Power Amateur Telephony to Amsterdam.

We have received some interesting details of low power telephony from Mr. Hugh N. Ryan **(5 BV)**, of Wimbledon Park, S.W.19. His remarks are prompted by the letter from **2 SH**, published in our issue of March 24th, reporting transmission to Amsterdam with only 0.195 amperes radiation.

Mr. Ryan's claim is as follows. A few nights ago, at 2350 he received a call from **OYS**, Amsterdam. On his replying with 0.4 amperes radiation, **OYS** reported very strong signals. After reducing power step by step, he states that good reception was still reported with only 0.01 amperes radiation. The receiver was a single-valve set.

Broadcast Talk on Howling.

An instructive address to the listener-in was given from the Birmingham Broadcasting station recently by Dr. Ratcliffe, President of the Birmingham Experimental Wireless Club, who spoke on the use of valve sets and the avoidance of oscillation. It is stated that since the address the "canaries" have been less busy.

Wireless Advertising.

What is probably the first printed brochure devoted exclusively to Wireless Advertising has been issued under the title of "Progress," by the well-known wireless publicity specialists, Messrs. Bertram Day & Co., Ltd., of 9 and 10, Charing Cross, London, S.W.1. The special advertisement treatment required by the new industry is clearly dealt with and many interesting facts regarding illustration and display receive attention.

Birmingham Wireless Competition for Juniors.

The fascination exerted by wireless on the youthful mind was well demonstrated at a unique radio exhibition held at Cotteridge, Birmingham, on Thursday, March 15th, and opened from **5 IT** by Mr. Percy Edgar, the station director. The occasion was the exhibition of the wireless work of the students of the Cotteridge Day Continuation School. About 100 receiving sets, crystal and valve, and some 200 component parts were shown, almost all representing original ideas. The exhibitors were pupils in the wireless class of Mr. A. E. Vick, an assistant master and well-known in Birmingham wireless circles. Dr. Ratcliffe, President of the Birmingham Experimental Wireless Club, acted as judge and prizes were awarded as follows:—

Scamell and Abbott prize for best workmanship, general design and efficiency: S. Ackrill.

Scamell and Abbott prize for original ideas: 1. A. Harvey. 2. G. Curtis.

Dr. Ratcliffe's prize for best crystal set: B. G. Hewitt.

Mr. C. V. Bew's (Headmaster) prize for best class and school work: F. Sheldon.

Book Received

The "S & T" Wireless Log Book. (Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 1s. net).

Forthcoming Events

FRIDAY, APRIL 20th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture: "Sound Reproduction by Wireless," by Mr. H. Lloyd, B.Eng.

Leeds and District Amateur Wireless Society. Lecture by Mr. T. Brown Thomson.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove, N.6. Lecture: "Elementary Theory, Part III," by Mr. H. Andrewes.

SATURDAY, APRIL 21st.

Oldham Wireless Society. At St. Thomas's Schools, Coppice, Oldham. Exhibition and Demonstration.

The Fulham and Chelsea Radio and Social Society. At 7 p.m. Dance and Soirée.

TUESDAY, APRIL 24th.

The Fulham and Chelsea Amateur Radio and Social Society. At 8 p.m. Experimental Lecture on Radiotelephony, by Mr. G. G. Blake, M.I.E.E., A.Inst.P.

Dewsbury and District Wireless Society. At South Street, off Church Street. Lecture by Messrs. Burndept, Ltd. (Leeds).

WEDNESDAY, APRIL 25th.

Manchester Wireless Society. At 7.30 p.m. At Houldsworth Hall. Discussion.

THURSDAY, APRIL 26th.

Thames Valley Radio and Physical Association. At 8 p.m. Lecture: "The History of Radio," by Mr. G. G. Blake, M.I.E.E., A.Inst.P.

Radio Society of Birkenhead. Open Meeting and Soirée.

Hackney and District Radio Society. Informal Meeting.

Questions and Answers

"C.J.P." (W.C.1.) *submits a tracing, giving details of various stampings, and asks (1) Which size of stamping is recommended. (2) What gauge and quantity of wire should be used for an intervalve transformer and a crystal to valve transformer. (3) What would be suitable dimensions for a telephone transformer. (4) Is the proposed arrangement for coupling the telephone transformer suitable.*

(1) We suggest you use the stampings sketched in your Fig. 4. The primary winding should be wound with No. 42 S.S.C. wire, and should fill one-third of the bobbin. It is wound on first. The secondary winding should fill up the bobbin and should consist of No. 44 S.S.C. wire. The core should be built up to a thickness of ½″. (2) The crystal to valve transformer may be built up of the same size to the same thickness, but the primary winding should take up three-eighths of the winding space and the secondary the remaining five-eighths. Each winding may be of No. 42 S.S.C. wire. You would probably find it convenient to take one or two tappings from the primary winding which is connected with the crystal, and we suggest one at one-eighth and the other at a quarter of the winding depth. (3) The telephone transformer may consist of a core built up to the same dimensions as the previous transformers. The primary winding in this case should consist of 8,000 turns of No. 40 S.S.C. wire, and the secondary 1,200 turns of No. 32 S.S.C. wire. (4) The proposed coupling between the anode of the last valve and the telephones is quite suitable. The efficiency, as you say, will be high. The arrangement is very good, because no current flows through the telephones. You may find it an advantage to use a variable 0·002 mfd. condenser. The condenser could be roughly variable in steps until you have found which combination gives you the best value.

"TUNED ANODE" (N.3) *asks (1) For particulars of various condensers. (2) Should the tuned anode coil, when using the tuned anode method of high frequency amplification, have the same size as the aerial and closed circuit coils. (3) Can we, from the details submitted, say why one earpiece gives louder signals than the other.*

(1) We would refer you to the table given on page 479, January 6th issue. The mica submitted has a thickness of 2 mils, and is quite suitable for making up fixed condensers. In the table which gives the number of plates to produce condensers of various capacities, it will be noticed that the thickness of the copper foil does not enter into the calculation. If waxed paper is used instead of mica, the areas of the copper foil should be reduced by about 10 per cent. (2) If the aerial tuning condenser is in series with the aerial tuning inductance, and if the aerial tuning inductance is a No. 75 coil of the honeycomb type, the closed circuit coil will be a No. 50 coil, and the anode coil a No. 75 coil. These approximate ratios will hold throughout the receiver. (3) The winding of one of your earpieces has probably become disconnected, or perhaps the insulation has broken down, and the winding is in contact with the frame. We suggest you test the earpiece for continuity and for contact. As the earpiece has a low resistance, we think you will be able to rewind it yourself, if it is found faulty.

"HUNG UP" (Brighton) *asks (1) Whether the diagram submitted is correct. (2) Could the proposed connections be improved in any way. (3) Is it possible to include switches so that the various numbers of valves may be used in the receiver.*

(1) and (2) The diagram of connections is correct, and is, indeed, quite a standard circuit. You may find it advisable, however, to use a closed circuit winding coupled with the aerial tuning inductance. The values of the various condensers shown in the diagram are correct. (3) The method of switching valves is given in most of the issues of this journal and if you examine some of the diagrams, you will have no difficulty in choosing a diagram which is fitted with switching arrangements, and which is otherwise the same as the one which you have submitted.

"ELECTRODE" (Herts) *submits particulars of a crystal, and asks (1) What is the name of the crystal. (2) What would be suitable basket coils for use as the A.T.I., anode coil and reaction coil.*

(1) The crystal submitted is known as Hertzite. (2) The aerial coil may have a total of 60 turns of No. 26 double silk-covered wire. You could take three tappings from the coil. The closed circuit coil may be two basket coils connected in series, each coil having 45 turns. The coils could each have one tapping. The anode coil may consist of four basket coils, each with 40 turns of No. 30 S.S.C. wire. The coils should be connected in series, and tappings taken from the connections between the coils. The coils should be spaced about ⅛″ apart, so that the self capacity of the coils is not unduly increased.

"E.T.P." (Middlesex) *asks for criticism of the diagram submitted.*

The diagram of connections submitted is not quite correct. The aerial tuning condenser should be connected in series with the aerial tuning inductance. The closed circuit condenser should have a maximum value of 0·0004 or 0·0005 mfds. The condenser connected across the H.T. battery and primary of the telephone transformer need not be variable, but should be fixed at 0·001 mfd. With this arrangement it is quite possible for oscillating energy to be set up in the aerial circuit, and care should therefore be taken when making adjustments.

"H.A." (Manchester) *is having trouble with his tuning and asks for advice.*

We suggest you use an aerial and a closed tuning circuit in addition. For fine tuning care should be taken to reduce the resistance of the aerial circuit to as low a value as possible. If high frequency connected valves are used, you may find it an advantage to screen the coils. Thus, in the case of the tuned anode method of high frequency amplification, where the anode coil has rather a large area, we think the coil could be screened by being placed in a box containing a layer of metal foil. Alternatively you could use a frame aerial in place of the outdoor aerial, and take advantage of the directional properties of the frame.

"WILDOR" (S.E.12) *asks* (1) *How is it that he hears* **GFA** *with a crystal receiver.* (2) *With reference to the diagram of the T type aerial submitted, is one half of the top portion of the T of no value.* (3) *When listening in on his crystal receiver he hears noises. To what could the noises be attributed.*

(1) We think it is quite normal for you to hear the signals from **GFA** with your crystal receiver, although you will not hear a C.W. note. If other experimenters in your neighbourhood are using the beat method of reception and oscillating energy is being transferred to the aerial circuit, it is quite likely that the combination of the signal from **GFA** and the signal with the slightly different wavelength from your neighbours may act as a heterodyne to produce an audible frequency in your receiver. (2) Each of the top portions of the T-type aerial is of use. A T-type aerial will in general receive energy from two directions with equal strength, while an L-type aerial will receive signals with the greatest strength which come in a direction pointing along the aerial towards its free end. In addition, although the natural wavelength of the T-type aerial will not be very greatly in excess of the **L**-type aerial, its capacity will be greater, with the result that a slightly different value of the tuning coil will be required. (3) The noise which is heard in your receiver is probably due to induction from near-by telegraph or power wires.

"H.W.C." (Bedford) *asks* (1) *For a circuit showing how to connect one high frequency, one detector and one L.F. valves, with a switch for cutting in or out the H.F. valve and using a H.F. transformer.* (2) *Is a high frequency valve, crystal detector and L.F. amplifier combination a suitable circuit to conform to the Post Office requirements.* (3) *How many note magnifiers is recommended to be added to a crystal detector.* (4) *Is music or telephony received any clearer when a crystal detector is used in place of a valve.*

(1) and (2) See Fig. 1. It will be noticed the reaction coil may be coupled with the H.F. intervalve transformer. It will then conform with the Post Office regulations. (3) You may add as many note magnifiers as you please, although it should be remembered distortion of the signal generally results when L.F. amplifiers are used; usually two are quite sufficient to operate a loud speaker. (4) Very often the signals received, using a crystal detector in place of a valve detector, are clearer, particularly when the valve is badly adjusted.

"L.P." (Ealing) *submits particulars of his receiver and asks for a diagram of a low frequency amplifier.*

We suggest you use a two-valve note magnifier, particulars of which are given in Fig. 2.

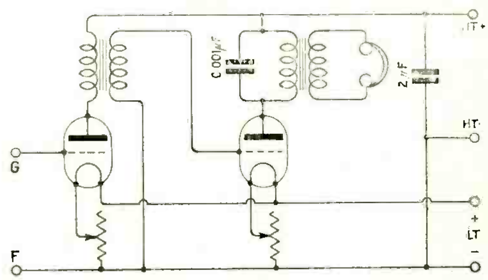


Fig. 2. **"L.P." (Ealing).**

"RIO VERDE" (Sussex) *asks* (1) *Why is it that in a wireless receiver the resistance of the secondary of a telephone transformer must equal the resistance of the telephones, or the resistance of the primary of the telephone transformer must equal the resistance of the anode filament circuit of the valve, when in ordinary wire telephony the microphone, which has a resistance of 30 ohms, works into a coil with a*

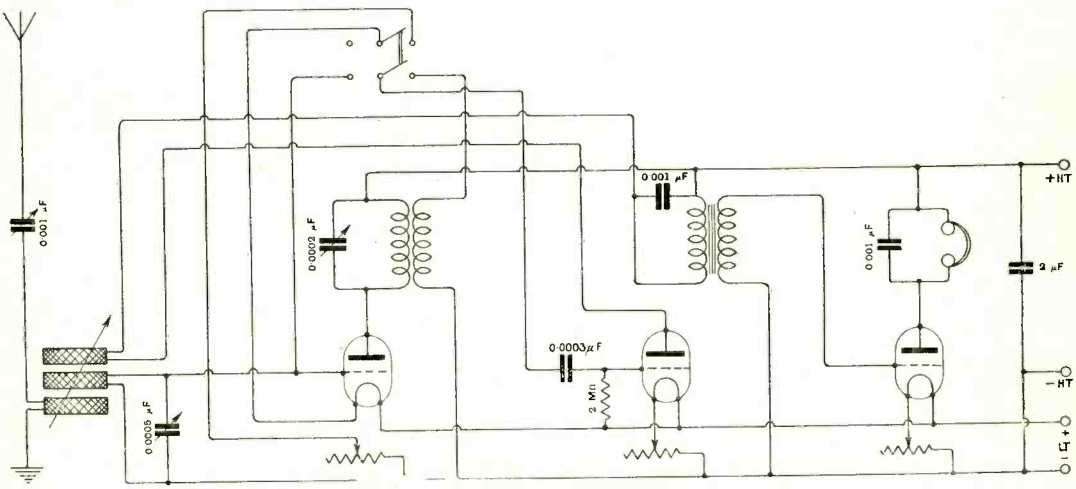


Fig. 1. **"H.W.C." (Bedford).**

resistance of 1 *ohm.* (2) *Would an attachment for plugging in to the electric light be as suitable as an outdoor aerial.* (3) *For a circuit of a current operated detector, such as the Marconi Magnetic Detector.*

(1) We are afraid you have confused impedance with resistance. The output impedance of a transformer should match as near as possible the input impedance of the apparatus to which it is connected. Although the microphone may have a resistance

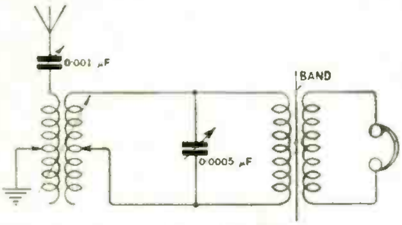


Fig. 3. **"RIO VERDE" (Sussex).**

of 30 ohms, the impedance of the primary winding of the transformer to which it works is probably very much higher than 1 ohm, which is simply its ohmic resistance. (2) We think good results will be obtained from the use of the attachment which is plugged into the electric light. (3) See Fig. 3.

"A.B." (Plymouth) *submits a diagram of his receiver and asks for criticism.*

The diagram sent you is very suitable for general receiving purposes, and when you wish to receive broadcast transmissions, we suggest you short-circuit the reaction coil, as generally reaction is not required. If you prefer, however, the reaction coil may be coupled with the tuned anode winding, as indicated in the sketch. The anode coils may conveniently be plug-in coils, if you wish to use this method of reaction. A two-coil holder would then be very useful for containing the first tuned anode winding and the reaction coil.

"F.W.S." (Redditch) *asks for diagram of a three-valve receiver comprising one H.F., amplifier, one detector, and one L.F., it being desired to use a crystal in place of the valve detector when required.*

The diagram is given in Fig. 4.

"R.C." (Surbiton) *asks* (1) *For a diagram of a crystal and single valve combination suitable for the reception of broadcast transmissions.* (2) *Would the arrangement asked for in question* (1) *provide sufficient power for the operation of two pairs of telephones.* (3) *What is the cause of a very persistent noise heard in the telephones when listening in with a crystal receiver.*

(1) The diagram is given in Fig. 5. Here the crystal is used as a rectifier, and the valve as a low frequency magnifier. The slider is quite suitable, and the 1 mfd. condenser may be connected across the H.T. battery, provided the insulation is good. The H.T. battery should be variable up to 60 volts, and the L.T. should preferably be 6 volts instead of 4. Other suitable values are given in the diagram. (2) Sufficient power should be obtainable to give good signals when two pairs of telephones are connected in series with the secondary winding of the telephone transformer. (3) It is a difficult

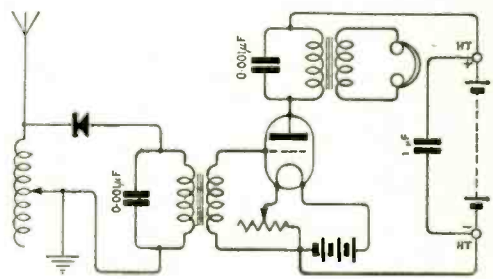


Fig. 5. **"R.C." (Surbiton).**

matter from the information submitted to definitely say what is causing the noise. Noises similar to that to which you refer are generally caused by induction from neighbouring power mains—perhaps the telegraph wires. If you are situated near tram or telegraph wires, the aerial should be run at right angles to them as far as possible. We think you will obtain better results if the aerial is raised to a height of 30 or 40 ft.

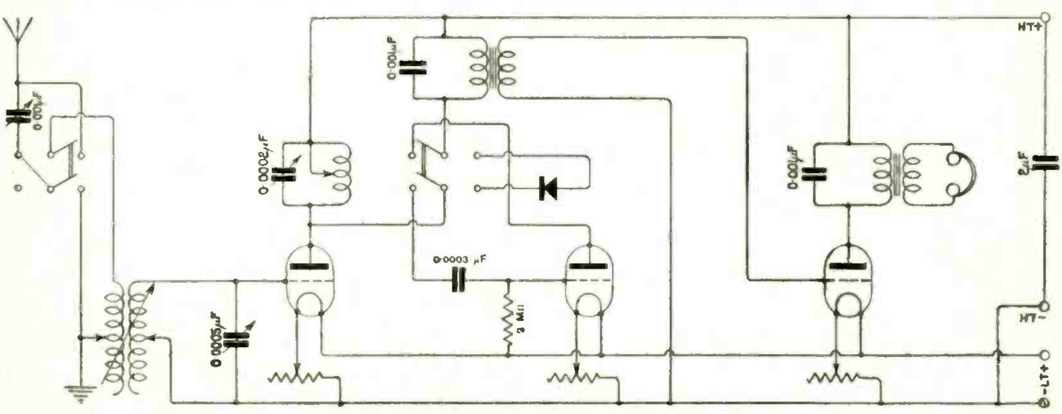


Fig. 4. **"F.W.S." (Redditch).**

"SWINGEY" (Thames Haven) *asks* (1) *For a diagram showing the connections of his receiver with the addition of a high frequency valve.* (2) *Will the addition of the H.F. connected valve enable him to successfully receive broadcast transmissions from other broadcast stations than London.*

(1) A diagram of connections is given in Fig. 6. The tuned anode method of H.F. amplification is used, and a switch is connected so that this valve may be cut out when not required. (2) With the addition of the H.F. connected valve we consider, with careful tuning, you should receive the broadcast transmissions referred to.

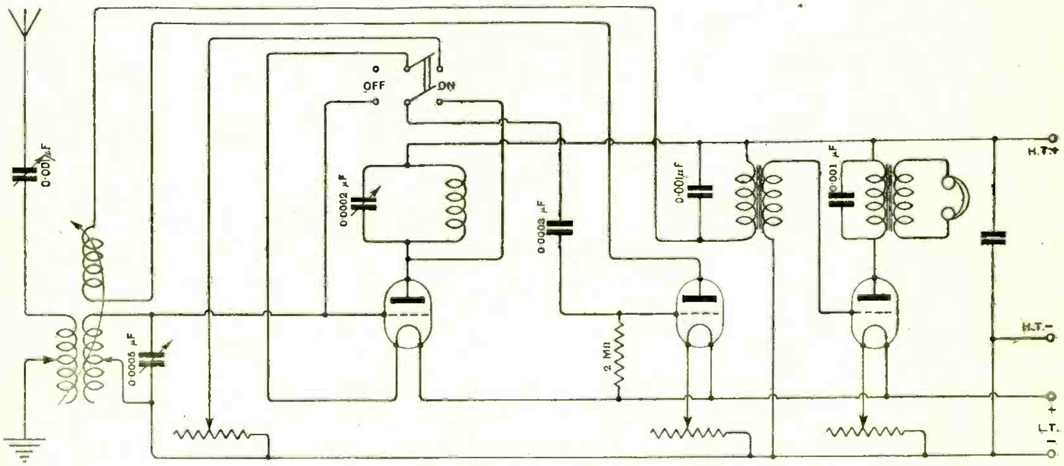


Fig. 6. **"SWINGEY" (Thames Haven).**

"PUZZLED" (Liverpool) *asks* (1) *What precautions should be taken for protection against lightning in the case of an indoor aerial consisting of four parallel wires immediately below the roof.* (2) *With reference to the diagram submitted, is it likely that oscillating energy would be generated in the aerial circuit.*

(1) We suggest you install a lightning protector, which could be in the form of two carbon discs separated a small distance apart, one carbon disc being connected with the aerial and the other being connected with earth. When the receiver is not in use a switch should connect the aerial directly with the earth. We do not think you need fear that any trouble will be caused through lightning, but the above precautions will prevent damage through lightning should it happen that lightning does strike the aerial. (2) The diagram submitted is quite correct and is a standard circuit. We think you need not fear that the receiver is oscillating. If the receiver is oscillating and you are attempting to receive speech the speech will be very much distorted and almost unrecognisable. In addition you would no doubt hear the whistling noises due to heterodyning the carrier wave of the transmitting station. When the receiver is oscillating there is a peculiar rustling noise, and in addition, when you touch the aerial and grid terminals there is a peculiar plucking sound in the receivers. Of course, if one ordinarily touches the aerial circuit pops will be heard in the receiver, but you will soon notice that there is a great difference between the sound caused due to touching the terminals when the receiver is oscillating and when it is not generating oscillations.

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following.* (1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review, 12/13,** *Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*

THE
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The Development in the Licence Question.

The Postmaster-General has declared his attitude towards the licence problem, but still nothing very definite in the way of policy has been decided.

Two points, however, which are of special significance, have been disclosed as a result of the Postmaster-General having taken the opinion of the Law Officers of the Crown. These are :—

(*a*) That, under the existing agreement between the Postmaster-General and the British Broadcasting Company, the issue of an additional type of licence is not admissible.

(*b*) That the Postmaster-General cannot legally withhold an Experimental Licence from any applicant who genuinely desires to conduct experiments.

This second point brings us once more up against the definition of an "experimenter," and the Postmaster-General has decided to leave this matter to certain expert members of his staff. There are, we are told, 33,000 applications for experimental licences at present being held up, and the case of each of these applicants is to be investigated individually to ascertain whether or not they come under the definition of experimenters.

The Postmaster-General appreciates the fact that this procedure with regard to applications made to date is only a temporary measure to meet the urgent need which has arisen for immediate action. The next step in the endeavour to solve the tangled problem definitely is the appointment of a strong Committee to investigate the whole position of broadcasting, and not to be confined only to the question of licences. This Committee is to be composed as follows :—

(*a*) Three or four members of the House of Commons.

(*b*) Two or three expert members of the Post Office staff.

(*c*) A representative of the Radio Society of Great Britain.

(*d*) A representative of the British Broadcasting Company.

We feel sure that readers will strongly endorse the action of the Postmaster-General in inviting a representative of the Radio Society of Great Britain to serve on this Committee. By such means the Wireless Societies throughout the Kingdom will have a voice in the proceedings which it is to be hoped will result in the formation of a definite and satisfactory organisation which will be in the interests of all concerned. Nothing could be more disastrous to the development of the science, of a valuable public service and a most promising industry, than the unsettled state of affairs which has prevailed during recent months.

EXPERIMENTAL FOUR-VALVE RECEIVER.

TUNING and DETECTOR VALVE UNIT.

This unit is designed so that it can be put into action as soon as it is completed, whilst the H.F. and L.F. amplifying units, to be described later, can be added without disturbing existing wiring. The complete outfit will comply with the requirements of the Postmaster-General for reception on broadcasting wavelengths.

By F. H. Haynes.

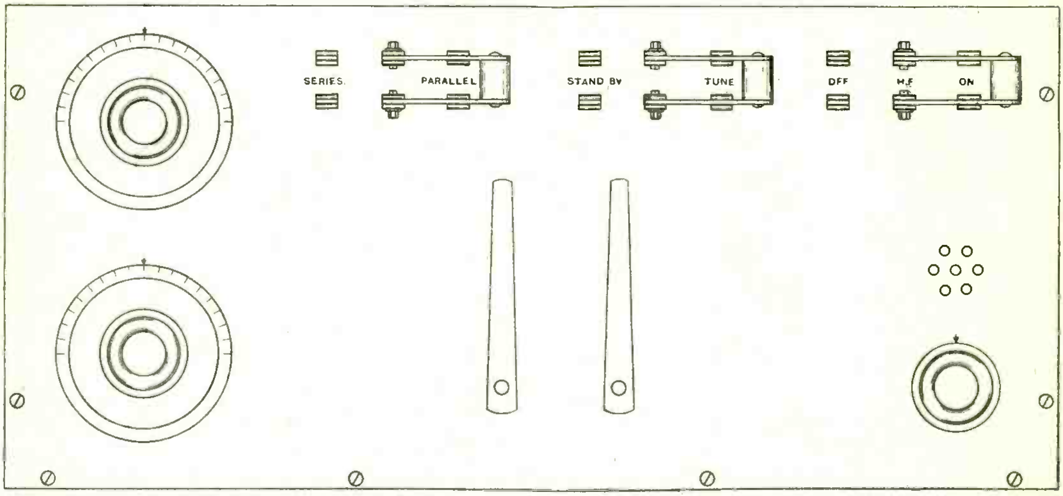
In describing the construction of receiving apparatus it seems hardly necessary to deal exhaustively with the making up of such parts as variable and fixed condensers, switches, coil and valve holders. These parts require elaborate workshop equipment for their construction, and the experimenter fortunately possessing such facilities usually has the necessary mechanical ability to make them without being furnished with detailed particulars. The majority, however, will find it more convenient to purchase the components and rapidly assemble them on the ebonite panel and its wooden base.

The design adopted is one which entails a minimum of labour, making use of components which have become more or less standardised.

For this unit, which comprises a loose coupled receiver with tune and stand-by, and series parallel switches, tuning coils, and the detector valve and H.F. amplifier switch, the following parts will be required :—

Aerial tuning condenser, 0.0003 mfds., with air dielectric. This value is lower than is perhaps usual, but it permits of fine tuning, particularly on short wavelengths.

Closed circuit tuning condenser, similar to that in the aerial circuit. Both of these condensers can be built up, if desired, from the stamped plates and turned spacing washers and spindles procurable from most wireless dealers. Eleven movable and twelve fixed plates is the usual number for the stated value, though, of course, this varies according to the dimensions of the plates and washers.



Front view of tuner and detector valve panel showing lay-out of components.

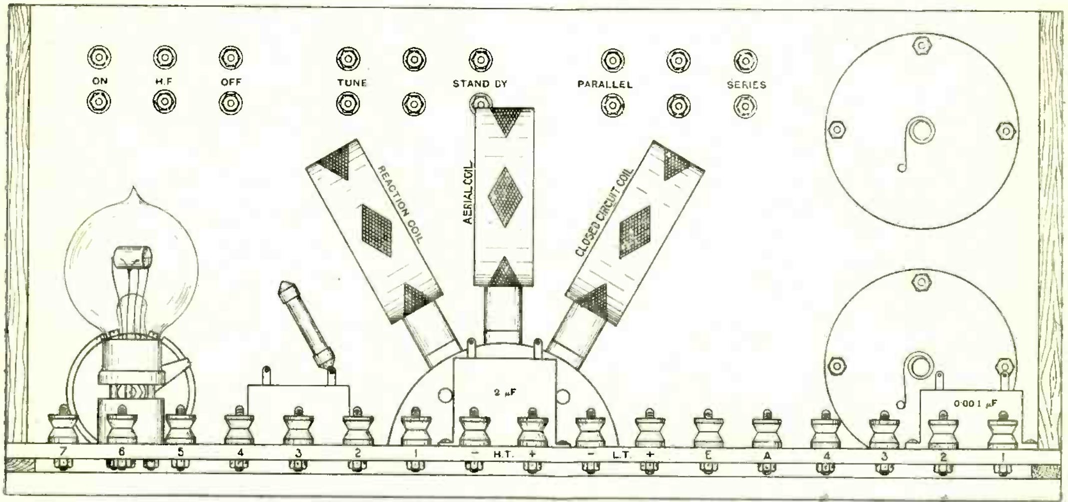
Grid condenser, 0.0003 mfds., of reliable make, or this can be built up from three strips of metal foil ⅜ in. wide, two forming one plate and the other placed between them for another, and separated with good quality mica, 0.002 in. in thickness, and having an overlap of 1 in.

Telephone condenser, 0.001 mfds., similar in type to the grid condenser described. This can be made up as mentioned above, except that nine strips will be required, four forming one plate, and five the other. The value of the condenser is not as critical as that required for the grid condenser.

High tension battery bridging condenser, 0.5 to 2 mfds. This type of condenser is easily procurable, particularly from dealers in ex-Government material, and can be identified by being enclosed in a small black or green japanned tin case.

Grid leak, 2 megohms.

Valve holder.

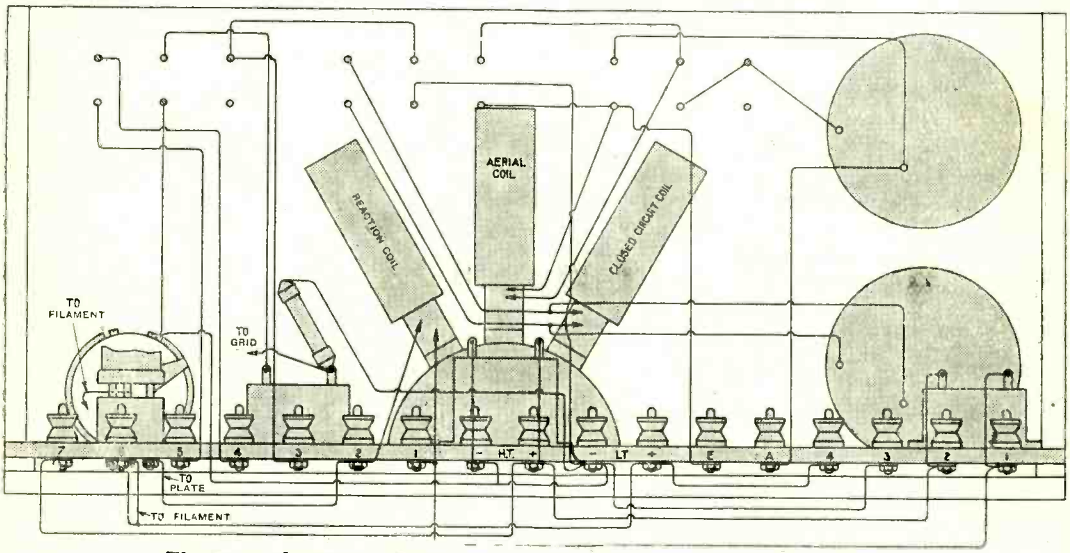


Back view of panel. The wiring is omitted so as not to obscure the components.

Circular pattern filament resistance.

Three-coil holder of the type shown in the back view of the panel.

A set of tuning coils for the wavelengths on which it is desired to receive.



The practical wiring. Rigid leads join the points shown connected by lines.

The movements of three double pole two-position switches. These can be obtained from many dealers, whilst in some cases it may be necessary to dismantle switches which are already assembled on base-pieces.

A piece of best quality polished ebonite, $\frac{5}{16}$ in. in thickness, from which can be cut a panel 18 in. by 8 in., and a strip 18 in. by 1 in. Another piece will be required 4 in. by 2 in. for the purpose of making the two levers which are attached to the spindles of the moving inductances.

A base-board of hard wood, 18 in. by 6 in. by $\frac{5}{8}$ in.

Another piece of hard wood, 7½ in. by 6 in. by ½ in., which, when sawn across diagonally, will form end supports for the vertical panel.

17 terminals.

8 brass wood screws, 1 in., No. 6.

½ lb. No. 20 tinned copper wire, and a quantity of insulating sleeving of various colours which will just slide over the tinned copper.

The first step is, of course, the squaring up of the ebonite panel and terminal strip, followed by a brief consideration of the exact location of the components on the panel, which will naturally depend upon the types adopted. The spindle centres of many patterns of variable condensers permit of them being located 2½ in. from the end of the panel, and 2⅛ in. from the top and bottom edges. The centres for the spindles of the coil holders will be about 8¼ in. and 10¼ in. from the condenser end of the panel, and of such distance up from the base as will allow of the holder being screwed to the wood. The filament resistance centre may be 1¾ in. from the end, and of the same height as the coil holder spindles. The centre hole of the grating in front of the valve will probably be 2 in. above the spindle of the resistance, but this must be verified by an examination of the height of the valve holder. The other six holes in the grating may be on a ½ in. radius circle. The middle contacts of the centre switch will probably be located 11 in. from the condenser end of the panel, whilst the middle contacts of the right-hand switch will be half-way between the right-hand position of the middle switch and the end of the panel. The left-hand switch will balance the right. One must see that the switch levers do not foul each other by virtue of their length, and should this happen it may be overcome in rather a unique manner by skewing the switches round to 45° from vertical. The levers for operating the coils are secured to the spindles by threading 0 BA. and using lock nuts.

To facilitate wiring up, a diagram is given showing the points between which leads are to be run. Do not bunch the leads together more than can be helped, and in particular keep those that are in the grid switching circuit away from the battery and plate circuit leads. When the leads are soldered use as little flux as possible, and resin is the safest material to use for the purpose.

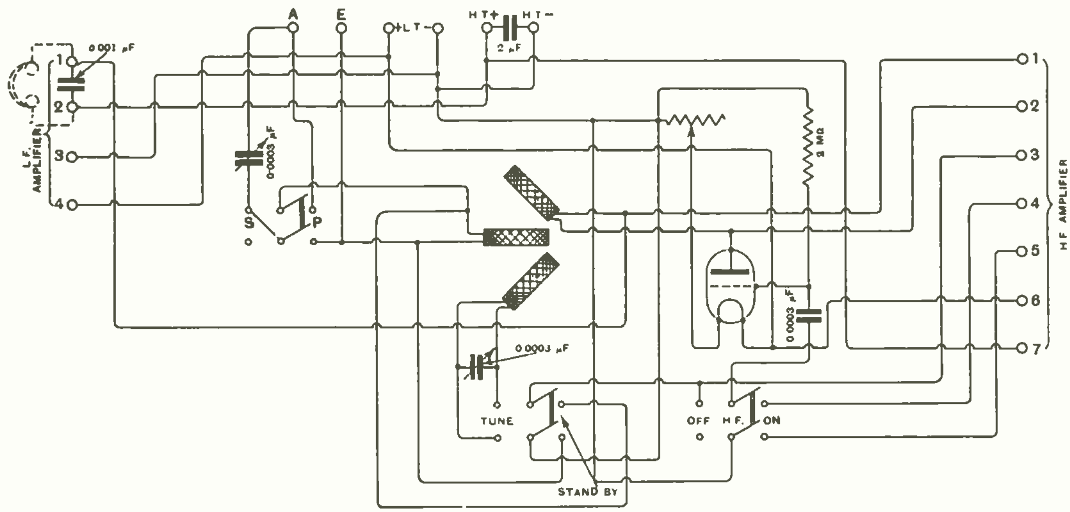


Diagram from which the action of the circuit can be traced out.

The unit, when complete, can be put into operation as a single-valve receiver, with reaction coupled to the aerial circuit, an arrangement which is permitted on wave-lengths other than those used for broadcasting. For short wave reception the aerial tuning condenser switch will be in series position. Tuning in is accomplished with the middle switch in the stand-by position and the signal adjusted to a maximum. The switch is then changed over to "tune," and the closed circuit condenser adjusted.

As a single-valve receiver the H.F. terminals 1 to 7 are left disconnected, the H.F. switch is in the "off" position, while telephones are connected to the L.F. terminals 1 and 2, and no connection is made to 3 and 4.

INSTRUCTIONAL ARTICLE FOR THE LISTENER-IN AND EXPERIMENTER.

WIRELESS THEORY—IV.

(Continued from page 81 of the previous issue.)

It is the purpose of the writer to deal with the principles underlying the action of wireless receivers and transmitters. Those who know *why*, obtain much pleasure which is not experienced by those who have no idea of the action of their wireless set.

The series has been specially designed so that the reader who follows each section as it appears will have obtained a complete wireless education with a minimum of time and trouble, and he will be in a position to successfully design his own wireless equipment.

By reason of his work in supervising the replies to the queries and difficulties of readers, the writer has an experience which is not possessed by other engineers. Readers will appreciate that this experience will be reflected in both the selection and the method of presenting the subject.

By W. JAMES.

13.—Condensers in Series.

The resultant capacity of condensers in series, shown in Fig. 19, is less than that of the smallest. If C represents the resultant capacity, we may write

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}, \text{ etc.}} \text{ mfds.}$$

In the case where there are only two condensers in series the equation may be simplified, and we have—

$$C = \frac{C_1 \times C_2}{C_1 + C_2} \text{ mfds.}$$

Thus, if C_1 and C_2 are each two microfarads,

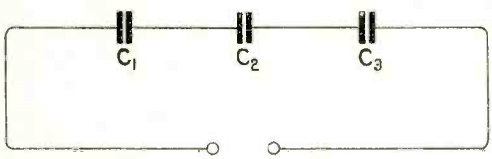


Fig. 19. Condensers connected in series. The resultant capacity is less than that of any individual condenser.

the resultant capacity when they are in series is

$$\frac{2 \times 2}{2 + 2} = 1 \text{ mfd.}$$

If each condenser has the same capacity, the resultant capacity is equal to the capacity of one condenser divided by the number connected in series.

Condensers may therefore be connected in series when we desire a total capacity which is smaller than that of any of the condensers at our disposal. Another advantage is obtained when condensers are connected in this way. If the condensers are built to safely withstand, say, 50 volts each, and we wish to connect some capacity across a circuit of 100 volts,

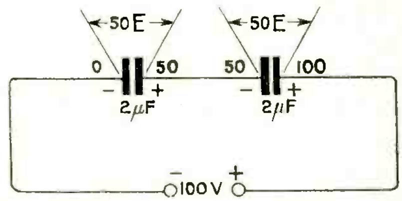
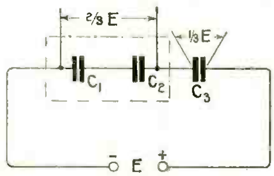


Fig. 20. Condensers in series showing the voltage drop across the condensers when each have the same capacity.

two condensers in series may be used, and their outer ends joined with the 100 volt circuit. When the capacity of each condenser is the same, the voltage is equally divided. In the case represented in Fig. 20 it is obvious the



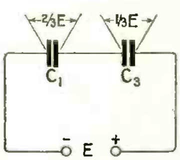


Fig. 21. The voltage drop across a condenser connected in series with others depends upon its capacity compared with that of the remainder. Thus when the capacity of C_3 is twice that of C_1 the voltage drop across C_3 is half that across C_1.

potential difference across each condenser is 50 volts. Should, however, one condenser have a smaller capacity than the other, the smaller one will take a much larger share of the pressure drop across it. Thus in Fig. 21, suppose the condensers C_1 and C_2 are equal in value, and are really made up in the form of one condenser, the fall of potential across this condenser will be twice that across C_3.

The condensers C_1 and C_2 could be replaced with one smaller condenser having half the area of plates and therefore half the capacity. Its insulation would therefore be subjected to a much greater strain than that of C_3. This should be guarded against.

The energy which may be stored in a condenser in the form of an electric strain in the dielectric is proportional to the charge of electricity held, and the potential difference between the plates, or in symbols $W=\frac{1}{2}QE$, where W is the energy stored in joules, Q is the quantity of electricity in coulombs, and E is the potential difference in volts. This may be expressed in another form—$W=\frac{1}{2}CE^2$—where C is the capacity in farads. The reason why the product CE^2 or QE is divided

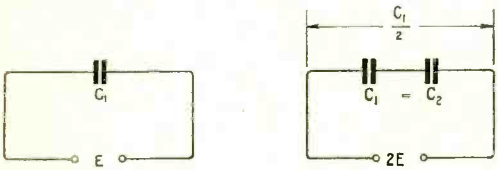


Fig. 22. If the power supplied to the condenser C_1 is P, the power applied to the two similar condensers C_1 and C_2 connected in series may be 2 P.

by 2 is this: a moment before the voltage is applied, the potential difference across the condenser plates is, of course, zero. When the voltage is applied the force due to the electric strain in the dielectric increases gradually until the condenser is fully charged. The average potential difference of the condenser during charging is therefore $\frac{1}{2}E$. The electric strain lines may be looked upon as producing a voltage which acts in opposition to the applied voltage. When the condenser is fully charged the back voltage and the applied voltage are equal. It is therefore quite permissible to speak of the average potential difference across the condenser being $\frac{1}{2}E$, although, of course, the full voltage of the battery is maintained the whole time.

The power supplied to the condenser is $P=\frac{1}{2}\frac{CE^2}{t}$ where t is the time in seconds.

With condensers connected in series, the power applied may be several times that which may be safely applied to a single condenser. Thus, if two similar condensers are connected in series the resultant capacity is halved, but the permissible voltage is doubled. Therefore the quantity $C\times E^2$ is twice the value for one condenser. See Fig. 22.

14.—Condensers in Parallel.

Condensers are shown joined in parallel in Fig. 23.

The resultant capacity is obtained by adding

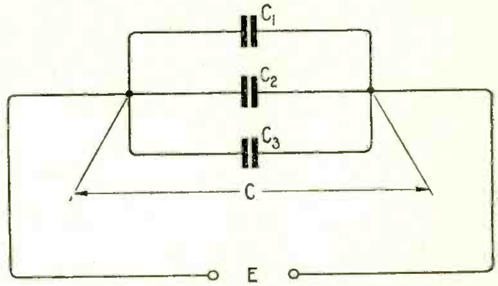


Fig. 23. Condensers connected in parallel. The resultant capacity is the sum of the individual capacities. Thus $C = C_1 \times C_2 \times C_3$.

together the individual capacities, thus:—

$$C = C_1 + C_2 + C_3$$

The voltage across each condenser is, of course, the same, but when the voltage is varying, so that the current in the circuit is continually varying, the currents which will flow into the different condensers will depend on their capacities. The condenser with the largest capacity will naturally take a larger charging current.

Condensers may therefore be connected in parallel in this manner when we have several small capacity condensers, and we wish to have the equivalent of a larger one.

15.—Inductance.

When a current of electricity flows through a wire a magnetic field is set up around the wire. The magnetic field is in the form of

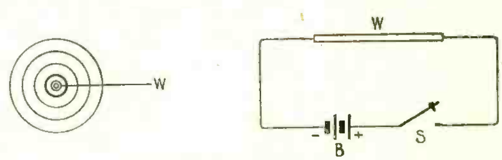


Fig. 24. If we have a wire W, which is joined to a battery B, magnetic lines of force are set up around the wire as shown by the circles.

circular lines of force with the wire as centre as shown in Fig. 24. Here W is the wire, and the lines of force are shown around it.

Suppose we have a wire W, Fig. 24, together with a switch S and battery B. Before the switch is closed there are no magnetic lines of force around the wire. If, now, the switch is closed, current flows, and magnetic lines of force are built up. They start from the centre of the wire and build up in larger and larger circles around the wire. In so doing

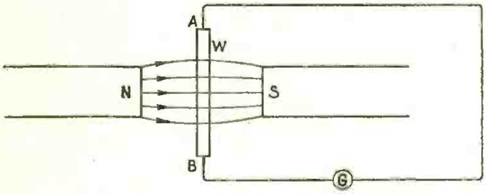


Fig. 25. If a conductor W, is moved across a magnetic field set up in this case by the magnets N and S, a pressure is produced in the wire, and when the ends A B are connected with an instrument G, the presence of the current is manifest through the movement of the pointer of G.

they "cut" the wire. Now, when magnetic lines of force cut a conductor of electricity a voltage is produced in the wire.

To take what may be perhaps a simpler case, suppose we have two magnets arranged as shown in Fig. 25. The magnetic lines of force will pass from the N to the S poles. If the conductor W is moved across the lines of force so that they are cut, an electromotive force, or what is the same thing, a voltage difference will be produced between the ends A and B of the wire. If the wire is joined to a galvanometer, which is simply an instrument which is used to indicate the presence of current, the needle will be deflected, because we know that when a potential difference is connected to a circuit a current will flow. The magnitude of the potential difference depends entirely upon the number of lines of force cut by the wire per second; for example, we can increase the voltage produced by making the field more dense by moving the magnets closer together; or we can increase the speed at which we move the wire so that more lines are cut per second. This is, simply, the principle underlying the action of electric generators.

Returning now to the wire which is connected with a battery, it is obvious that as the wire is cut by the lines of force which spring out from its centre when the current flows, a voltage is produced in the wire. This voltage acts in opposition to that of the battery which is trying to drive the current through the wire. This is a very important fact, and was stated by a scientist named Lenz. The facts are included in Lenz's law, which says the direction of the voltage generated is always such that it tends to oppose the pressure which is producing it. In the above illustration the voltage induced acts in direct opposition to that of the battery voltage which produced the current and magnetic lines of force. As in the case of the wire cutting the lines of force from the magnets, the magnitude of the counter, or back pressure, depends upon the *number* of lines which cut the conductor and the *speed* at which they cut the conductor.

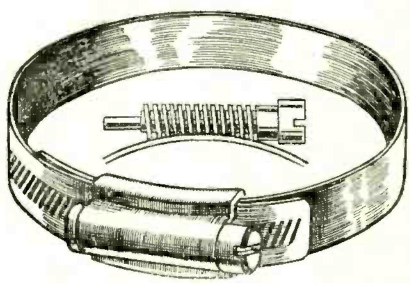
The back pressure is only produced while the current is *growing* from zero to its maximum value. When the steady state has been reached no lines of force are cutting the conductor. The lines of force are stationary around it, and no back pressure is being produced. It is easily seen the production of a back pressure must delay the rise of current. When the circuit is broken, that is the switch S opened, the current due to the pressure of the battery ceases, but the magnetic lines of force around the wire collapse, and in so doing cut the wire again. This time the wire is cut by the lines of force *collapsing*, whereas before the lines of force were growing. The back voltage produced now is evidently in the opposite direction to that when the lines of force were growing, and in fact now tends to prolong the current flow.

The property of a circuit tending to store electro-magnetic energy is called inductance. The effects described above are the effects of a circuit possessing inductance.

(To be continued.)

A NEW CLIP FOR EARTH CONNECTIONS.

On this page we illustrate a new device which should prove of great value in securing good earth



connections to water pipes, etc. The device, which, it is claimed, can be used for many purposes, employs a worm with heavy square-cut threads. It cannot strip, gives an even pressure, is easily fitted and is highly adjustable. Four sizes only are required and the sole concessionaires are Messrs. L. Robinson & Co., London Chambers, Gillingham, Kent.

A DEVELOPMENT IN RECORDING AND TRANSMITTING EQUIPMENT.

THE MAGNETIC DRUM RELAY

applied to

*WIRELESS RELAYS, SIPHON RECORDERS AND TRANSMITTING KEYS.**

Described by N. W. McLachlan, D.Sc., M.I.E.E., before the Institute of Electrical Engineers.

THIS instrument consists essentially of an iron drum with an annular recess, in which is situated one or more coils of wire, the ends being connected to slip-rings. The drum is mounted on ball bearings and its periphery is machined to run true to 0.0001 inch. The drum is shod with cast-iron rings. A small iron or steel shoe fits accurately the curvature of the rings. When a current passes through the coil, the drum is magnetised and this causes the shoe to be pressed on the cast-iron rings with considerable force. Thus if the drum is revolved, a force is required to cause the shoe to slide relatively to the rings. The pull exerted by an electro-magnet, consisting of a suitably shaped iron core with its winding and its armature, is equal to $B^2A/8\pi$ where B is the flux density at the contact surface in lines per square cm., and A is the total area of polar contact in square cms. If the quantities are expressed in square inches, and instead of dividing by 8π we divide by 72,134,000, the pull is given in pounds. The magnitude of the tangential pull thus obtained in the above arrangement, is many times greater than that calculated from the product of pressure due to magnetic attraction using the formula $B^2A/8\pi$ and an assumed coefficient of friction $\mu = \frac{1}{3}$. Subsequent experiments show that μ is about 0·6.

The ratio of experimental pull to calculated pull depends upon the flux density at the shoe contact and may exceed 50. Thus the operation of the device appears to depend on some form of cohesive action incited by magnetism. Making use of this phenomenon it is possible to operate electric relays, siphon recorders for line and radiotelegraphy, and transmitting keys for radiotelegraphy.

1.—General Outline.

The working of the instrument will be readily understood on reference to Figs. 1, 2 and 3, and photographs Figs. 4 and 5, which shows in plan and elevation the general arrangements of a recorder. The revolving drum of well annealed Swedish iron is mounted complete with two coils and corresponding pairs of slip rings in ball bearings. One end of the shaft is connected to a variable speed, 1/10th H.P. 3,000 R.P.M. motor through

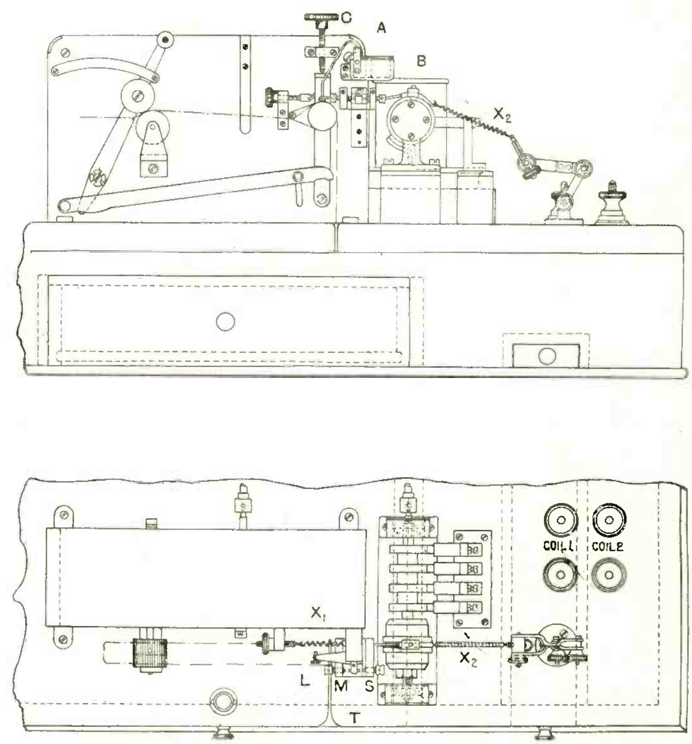


Fig. 1. The upper figure shows in elevation the general arrangement of a recorder. The lower figure is a plan. The driving motor and gearing is not shown.

* British Patent 176,932 of 1922.

reducing gear. To minimise wear, two cast-iron rings are forced over the drum. The shoe is made from a ring of Swedish iron and is fixed to a brass hook by means of a screw. The shoe rides on the revolving cast-

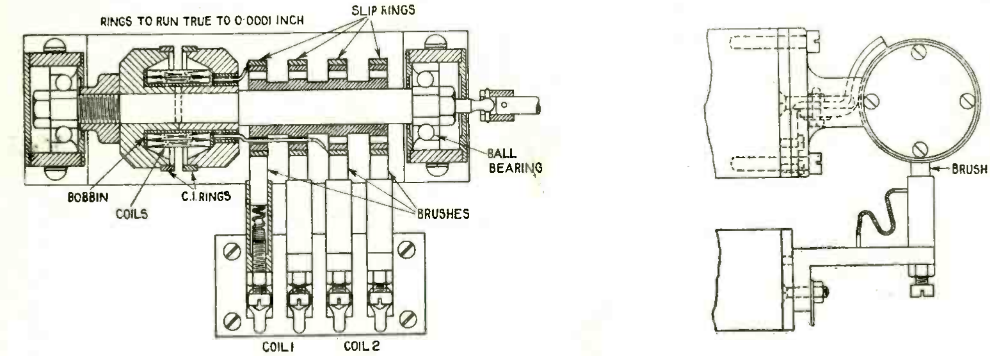


Fig. 2. Arrangement of drum and slip-rings of relay or recorder.

iron rings. Side play is prevented by a projection on the hook, which fits into a circular recess in the drum. One end of the hook is coupled to a weak spring X_2, which holds it in position. The other end goes to a rocking lever pivoted on the aluminium crank, L. On the other side of the rocking lever is a strong spring X_1, which in the absence of signals holds L against the stop S. The tension X_1 can be adjusted.

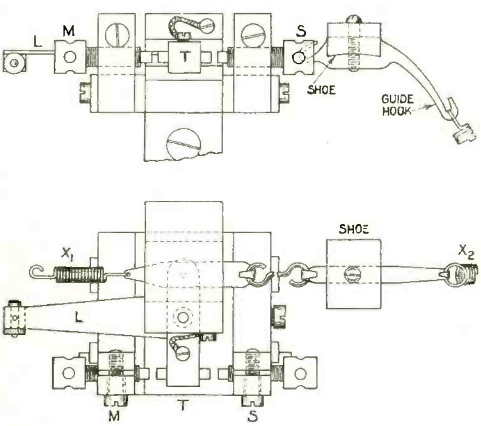


Fig. 3. Arrangement of recording mechanism.

The siphon A passes from the inkpot B, through lever L, where it is held by a locking device and projects about 3/16 inch beneath its lower face, resting on a paper strip which is pulled from the drawer in the base of the instrument by the paper drive. When the revolving drum is magnetised by the signal current passing through the coil, the shoe presses on the cast-iron rings and is carried round, thus pulling lever L on to stop M, where it is held until the current is interrupted. On cessation of the current, spring X_1 draws the lever back to the stop S. Thus the transverse motion of the siphon over the moving paper strip produces the record.

In its relay form the instrument is identical with the recorder, except that there is no paper drive, the motor is smaller and the contact arm is larger.

The drum is so designed that it may be removed and turned on its own centres in a lathe. The magnetic properties of the drum and spindle have to be such that the variation in reluctance of the path through the shoe is the least possible.

To assure that the shoe makes good contact with the rings over its whole area, the shoe is ground in with carborundum paste. The life of a shoe varies from 3,000 to 5,000 hours.

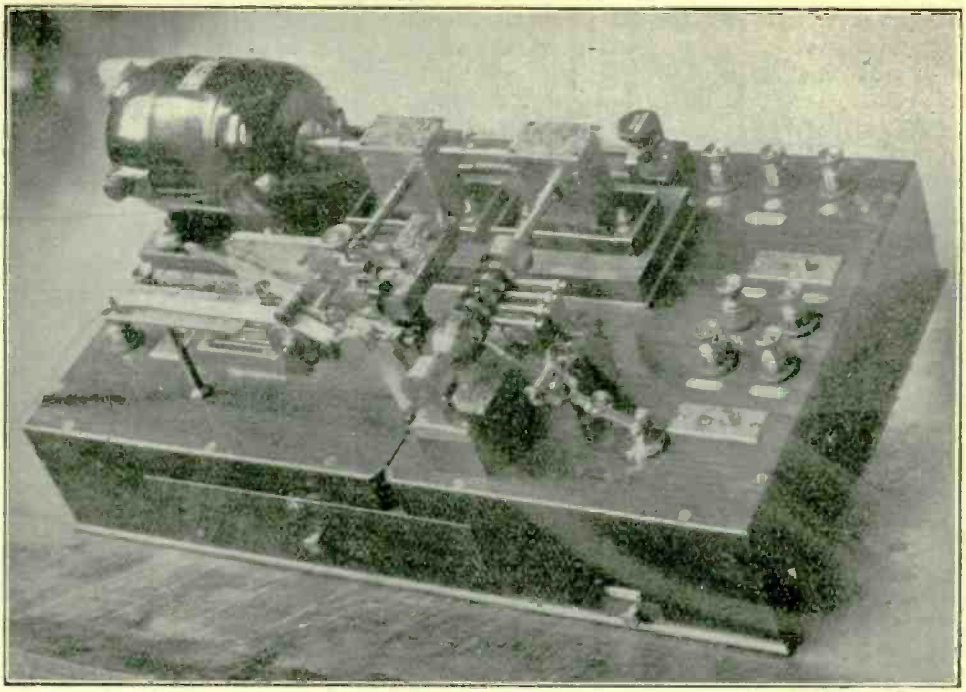
2.—Single-Current Working.

When the recorder is operated from a relay, and single-current working is used, the connections are as shown in Fig. 6.

The battery voltage B should lie between 70 and 100 volts. The shunted condenser combination $R_1 C$ ensure that the rate of current rise is rapid. With a battery of 100 volts, suitable values are $R_1 = 25{,}000$ ohms. $c = 0.5$ μF for a coil of 8,000 turns. The number of turns on the signal coil depends upon the speed of working, the current, and the voltage.

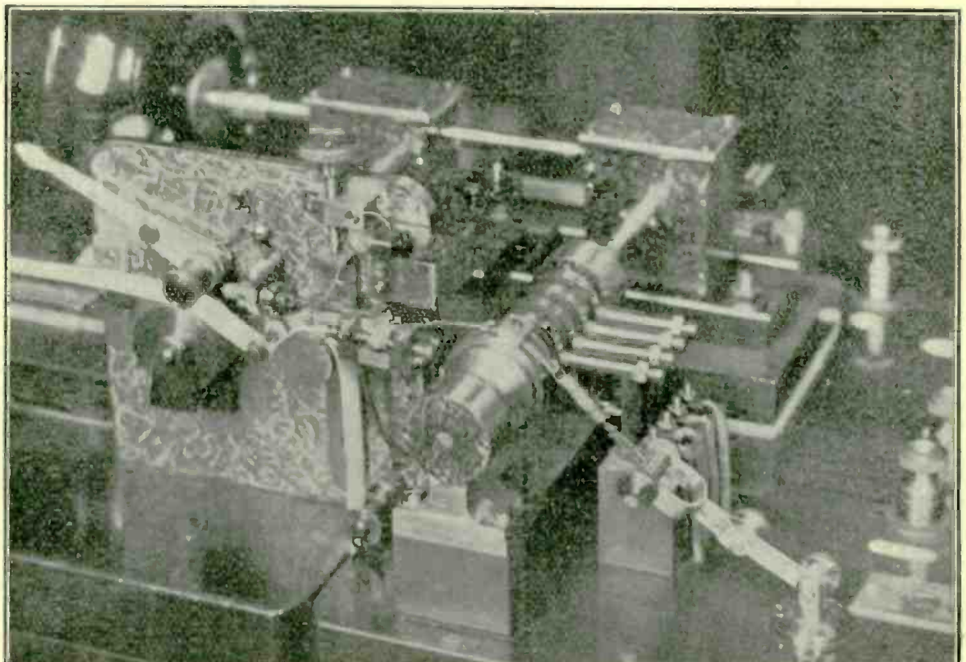
3.—Valve Circuit Working.

To secure an adequate voltage drop across the recorder when placed in a valve circuit, it is essential to increase the battery voltage, to connect several valves in parallel, or to use a single valve of low resistance. The usual recorder part of the valve circuit is shown in Fig. 7, where V_1 represents one or more recti-



"Wireless World" Photo.

Fig. 4. Photograph of complete recorder. The driving motor is coupled through gearing with the paper drive and the drum.



"Wireless World" Photo.

Fig. 5. A close-up view of the drum and recording mechanism. The slip rings, iron drum and shoe are clearly seen. The siphon may be seen passing from the ink-pot to the lever. The mouth of the siphon rests upon the paper.

fying valves in parallel such that the equivalent resistance is not greater than about 2,500 to 5,000 ohms. B is the anode battery of 150 to 200 volts. The condenser C shunts the recorder coil L_1 to smooth out the alternating portion of the anode current due to rectification. The arrangement is satisfactory up

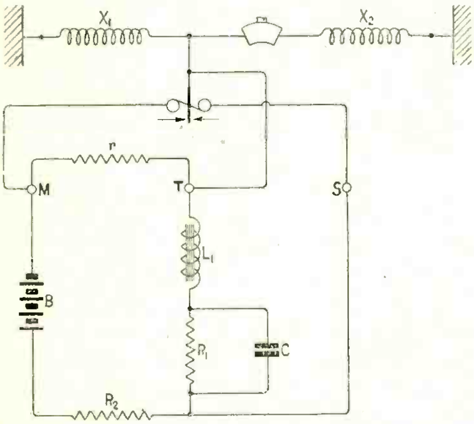


Fig. 6. Arrangement of recorder circuit for working single current. M = marking contact. L = left contact. S = spacing contact. CR_1 = shunted condenser combination. R_1 = 25,000 to 30,000 ohms. C = 0·5μF. B = 100 volts. r = resistance to prevent sparking at contacts 40,000 to 60,000 ohms. R_2 = safety resistance to prevent battery being shortcircuited through contacts. X_1 and X_2 are the springs shown in Figs. 3 and 5. L_1 = recorder coil.

to 50 words per minute. The currents passing through L_1 operates the recorder, which accordingly marks the paper slip.

To record signals at speeds exceeding 50 words per minute the valve circuit illustrated in Fig. 8 will be found satisfactory. Here the valve V_1 is the rectifying valve in whose anode circuit is a condenser resistance unit $C_2 R_2$. The ends of R_2 are taken to the

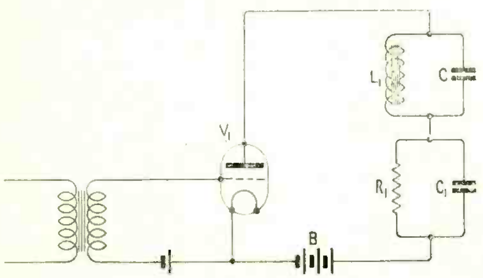


Fig. 7. Simple valve recording circuit. V_1 = rectifying valves in parallel. C = smoothing condenser (about 0·5 to 1 μF) found by trial according to frequency. R_1 = 10,000 to 20,000 ohms. C_1 = 3 to 1 μF. B_1 = 150 volts or more. L_1 = recorder coil.

grid and filament of the valve V_2. The recorder with shunted condenser $C_1 R_1$ is connected in the anode circuit of V_2. The condenser C_2 acts to smooth out the A.C. component of the anode current. Shunting the resistance R_2 with the condenser C_2 reduces the drop across R_2 at the beginning of a morse signal, therefore only part of the resistance is shunted.

The purpose of the resistance R_3 is to act as a discharge path for the condensers C_1 through the recorder coils. This hastens the demagnetisation of the iron circuit.

4.—TAPE RECORDS.

A sample of tape is shown in Fig. .

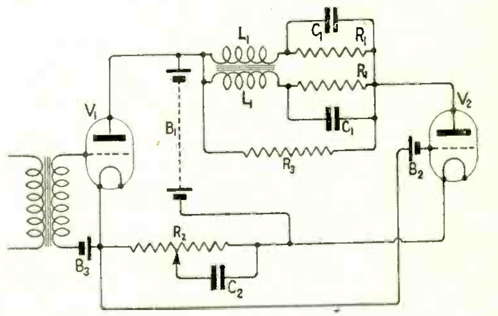


Fig. 8. Valve recording circuit in which two coils upon the drum are used. V_1 = V24 valve. V_2 = LS_4. R_1 = 30,000 ohms. C_1 = 1 μF. C_2 = 0·0μF R_2 = 50,000 + 50,000 ohms. R_3 = 4,000 ohms. B_1 = 150 to 200 volts. B- = − 40 to − 50 volts. B_3 = −20 to −30 volts. L_1 = 4,000 turns per coil. Using 300 volts, this circuit is highly satisfactory for all commercial speeds of working. About 2mA. in each coil gives good working.

5.—FEATURES OF THE APPARATUS.

These may be summarised thus :—

1. For a recorder, it is robust and compact.
2. The ratio, working torque to moment of inertia, is large for an electromagnetic recorder. The transit time for an amplitude of 0.05 inch, is about 1/700 second.
3. It is insensitive to change of speed.
4. The lengths of marking and spacing can be varied over a wide range.
5. The marking on the tape has a rectangular formation, and is very legible at all speeds.
6. The working current is small. Being fitted with relay contacts, the instrument can record signals and relay them simultaneously.
7. The marking end of the syphon is rigid.

Fig. 9. A sample of tape.

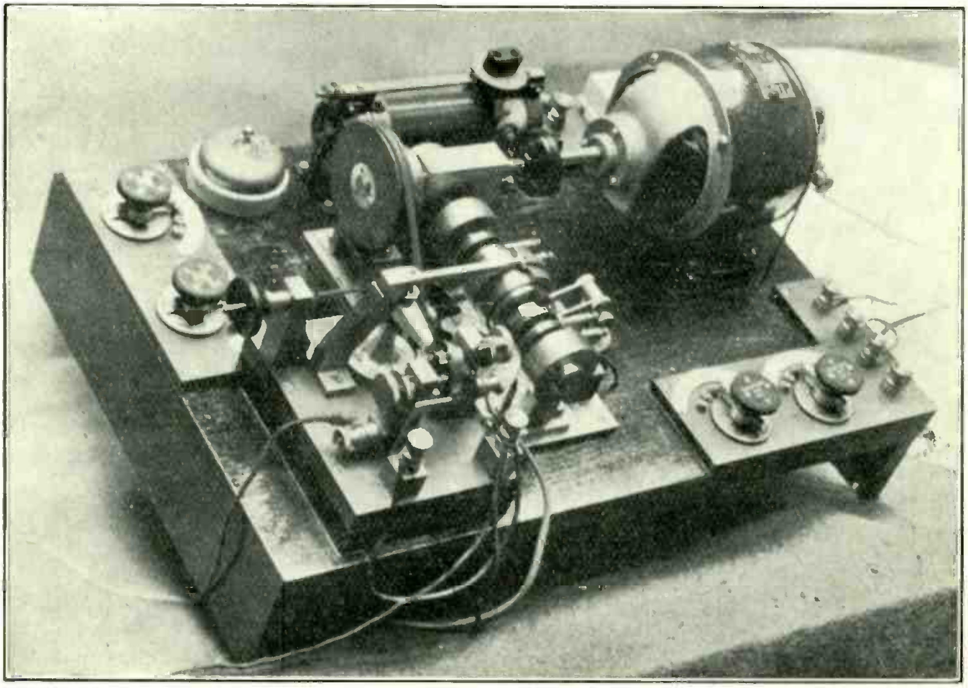
8. The highest speeds yet attained with a voltage of 100 is 300 words per minute and 360 with 200 volts.

6.—Transmitting Key.

The principles involved in the operation of transmitting keys are the same as those in relays and the recorders. The only essential difference is an increase in the size of the working parts to withstand the larger working forces.

In the early experimental work a double-drum model was made.

There are two methods of operating this form of instrument. (1) A polarising current is passed through one coil of each drum, usually from the same source. The operating current controlled by a Wheatstone transmitter is passed through the second coil of each drum so that in one drum the magnetising forces add, whereas in the other they annul each other. The lever therefore moves over from the spacing to the marking stop. If the current through the operating coils is now reversed, the lever moves over to the spacing stop, and so on. (2) Two separate electrical circuits are used, one for each drum. One drum operates for marking and the other for spacing. This necessitates the use of a Wheatstone transmitter with upper and lower contacts, and its adjustment is by no means easy. Apart from this there is the objection that, with the double-drum method for a key, one drum is always in operation, thus causing undue wear during idle traffic periods. A key of this nature with ¾ in. diameter contacts gave good results.



"Wireless World" Photo.

Fig. 10. Experimental transmitting key. The principle of the arrangement is the same as that of the recorder. The working parts are larger. With 90 mA. Flowing through the coil of the drum, a working pull up to 20 lbs. is obtained.

New Experimental Key.

This key is designed along the same lines as the recorder and is illustrated in Fig. 10. It will be noticed that the shoe is larger and is connected with a lever carrying large contacts. The current is carried from the contacts to the terminals through the flexible connections which are easily seen in the photograph

Wireless Club Reports.

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter and worded as concisely a possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Radio Society of Great Britain.**

Correspondence with Clubs should be addressed to the Secretaries direct in every case unless otherwise stated.

Southend and District Radio Society.*

On April 13th Mr. Plaistowe gave some interesting information regarding relays for high speed telegraphy, which was followed by a short talk by Mr. Mayer regarding the rectification of A.C. currents. The chairman, Mr. Percy Barnes, submitted a practical way of calibrating condensers for the benefit of those present. This was followed by a general discussion and questions and the programme also included the usual buzzer practice.

Hon. Sec., 4, Wimborne Road, Southend-on-Sea.

Wireless and Experimental Association.*

The meeting held on Wednesday, April 11th, was mainly devoted to preparations for the forthcoming public demonstration at the Central Hall, Peckham, on Thursday, April 26th. The Secretary, however, had time to describe the construction of several forms of variometers, and to discuss their operations as "ether jammers," and, as a result, several of the members became converts to radiometer tuning. Mr. Voigt, member, gave several lucid reasons for his preference for capacity reaction over magnetic reaction, and gave a helpful diagram on the blackboard. Mr. Kennedy, member, described a Reinartz tuner which he had constructed, and the work was in his usual careful style.

Hon. Sec., Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

The Radio Society of Highgate.*

The fourth of the special series of elementary lectures on "The Theory of Wireless Reception" was given on April 13th by Mr. H. Andrewes, B.Sc., his subject being "The Elementary Theory of the Valve." The lecturer gave a brief account of the modern theory of the constitution of matter, and a résumé of the historical development of the valve, the work of Edison, Fleming and De Forest.

Hon. Sec., J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

Tottenham Wireless Society.*

At an extraordinary general meeting held on Wednesday, April 11th, the following officers were duly elected: Chairman, J. Kaine-Fish; Hon. Secretary, S. J. Glyde; Hon. Treasurer, A. S. Haynes.

A hearty welcome to membership is extended to all interested in radio, and intending members should communicate with the Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Tottenham, N.17.

Newcastle and District Amateur Wireless Association.*

On Monday, April 9th, Mr. Sargent (of the Durham Wireless Society) lectured on the "Possibilities of Inter-planetary Communication" in an interesting and instructive manner. The relative positions of the planetary members of the solar system were dealt with, and problems of the power required and the probable action of the "Heavyside Layer" on attempts at long distance radio communication were all fully discussed.

Hon. Sec., Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

Radio Society of Birkenhead.*

The Secretary has much pleasure in announcing that the Society is now affiliated to the Radio Society of Great Britain.

A meeting was held at 36, Hamilton Square, Birkenhead, on the 12th inst. At 8 p.m. the Chairman, Mr. Hughes, gave out that the next meeting, which would be the last of this season, would be an open night and soirée, and asked all members to co-operate as much as possible.

On Thursday, April 12th, Mr. Heney gave an excellent lecture on various wireless subjects, including earths, the tuned anode system, and transformers.

After the lecture Mr. Mackenzie demonstrated the two-valve Gecophone receiver with power amplifier, and the Manchester Broadcasting Station was reproduced from the loud speaker with such volume as to make conversation difficult.

The Fulham and Putney Radio Society.*

Before a well-attended meeting held on Friday, April 13th, Mr. Winnett gave a very interesting lecture on the "Crystal Detector Set."

Later in the evening Messrs. Wooding and Gardiner, assisted by Mr. Finlay, demonstrated with the club set, which is designed on the unit system. It consists of several high and low frequency panels, with detector and condenser panels fitted into a special shaped stand, the whole being interchangeable so that various circuits can be arranged and tried. Great praise is due to the Technical Committee for the way in which they have designed the set, also for the excellent workmanship.

The meetings, under the chairmanship of Mr. Calver, are now a great success, and the membership is increasing.

Hon. Sec., J. W. Dewhurst, 52, North End Road, West Kensington, W.14.

The Wireless Society of Hull and District.*

Before a large attendance of members, Mr. A. W. Spreckley gave a very instructive lecture on April 9th, his subject being "The Various Forms of Inter-valve Coupling H.F."

All members who have any surplus pieces of apparatus are asked to note that a sale of such apparatus will be held in May.

The Hon. Secretary will at all times be pleased to hear from members who are willing to read papers or give lectures at the meetings of the Society.

Membership in the Society is open to all who are interested in any way in wireless telegraphy, telephony and allied subjects. Application should be made in the first place to the Hon. Sec. For the benefit of the youthful enthusiast there is a students' section for those between 12 and 18 years of age.

Hon. Sec., H. Nightscales, 47, Wenlock Street. Hull.

The Royal Small Arms Factory Radio Society.

At the first ordinary meeting, held on Thursday, April 5th, an instructive talk was given by the President, Mr. G. H. Roberts, C.B.E., M.I.C.E., M.I.M.E., on "Elementary Notions on Radio Transmission." The speaker divided his subject into three main divisions, viz., transmitting station, ether, and receiving station. Captain German, M.C., a Vice-President of the Society, occupied the chair. During the evening Mr. S. G. Williams, a member of the Society, gave a most interesting talk about his home-made three-valve set.

Meetings are held every Thursday evening in the R.S.A.F. Institute Library, Enfield Lock. New members will be welcomed, and should communicate with the Hon. Sec., A. P. Hitch, 151, Hertford Road, Waltham Cross.

The Beckenham and District Radio Society.

All interested in wireless matters in Beckenham or district are requested to get in touch immediately with this very active Society by communicating with the Hon. Sec., J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

Cambridge and District Radio Society.

On Monday, April 9th, Mr. Diver lectured on "The Simple Crystal Set," illustrating his remarks by blue print diagrams showing the most elementary single-slide tuner circuit, and gradually advancing to the double slider inductance with variometer or condenser for fine tuning. Various types of crystal detector were on show. Several home-made tuning inductances of the cylindrical pattern, tapped to studs at intervals, were exhibited, as well as ingenious sliding condensers, which cost only a few pence to make. A variable condenser, made from a shaving stick tin and a mica-covered tube of cardboard, was a shining example of the manner in which efficient wireless parts can be made inexpensively. As reception in the Chesterton area has been marred of late by persistent howling and re-radiation, a campaign to discover the guilty parties is being commenced. Perhaps owners of sets containing reaction will take the hint, and save unpleasantness by adopting a more sportsmanlike attitude.

The total membership of the club is now over 70, and others will be welcomed by the Secretary, J. Butterfield, 107, King Street, Cambridge.

Prestwich and District Radio Society.

A radio society has been formed at Prestwich, Lancs, for Prestwich and the neighbouring districts of Sedgley Park, Heaton Park and Whitefield, with temporary headquarters at the Parish Schools. Forty names for membership have already been handed in, and the Hon. Secretary will be very pleased to receive others or send particulars to anyone interested.

Hon. Sec., H. A. Wood, Spring Bank, Church Lane, Prestwich.

The Uxbridge and District Radio and Experimental Society.

On April 10th Mr. R. Piper lectured on "Wireless Transmission and Reception," demonstrating his remarks with apparatus.

Headquarters, Willow Bank Tea Rooms, Uxbridge High Street, Bucks End.

Hon Sec., J. R. M. Day, 10, Cowley Road, Uxbridge.

Bath Radio Club.

On April 11th the Chairman announced that a special radio auction night had been fixed for May 11th, when members would be able to dispose of all their surplus wireless and electrical gear. In connection with the same evening, a "Gadgets" competition would take place.

Following these announcements, after very little discussion, the Committee was authorised to take steps towards securing new and suitable premises.

The Chairman then introduced Mr. Leslie Bowen, who gave an admirable lecture on the principles of transmission.

Hon. Sec., Geo. J. Barron Curtis, 6, Pierrepont Street, Bath.

Sale and District Radio Society.

The official opening and exhibition of the new Society headquarters, at 37, School Road, Sale, Cheshire, took place on Saturday, April 7th. In the unavoidable absence of Councillor J. U. Thornton (President), Mr. B. Ingleby (Chairman) performed the opening ceremony, and appealed to all interested in wireless to join the Society. The exhibition was divided into two sections—one a show of apparatus entirely the work of amateurs, and the other of sets and parts by well-known local dealers, though a somewhat crowded attendance at night made the task of a general inspection rather difficult.

The section for amateurs was large and comprehensive, and included examples of work by Mr. J.R. Burne (winner of last year's Transatlantic Test), Mr. D. F. Owen, and Mr. G. R. Lewis. In addition to the finished work there were good examples of component parts by juvenile members of the Society.

The section devoted to dealers was contributed to by Messrs. A. G. Egginton & Son, Mr. H. Saville, Mr. F. W. White, and the Zeta Manufacturing Co., who all offered the latest in wireless sets and parts.

The headquarters are open each Monday and Thursday evening at 7.30, and a series of demonstrations is being given on workshop practice. The first one took place on Monday, April 16th, the subject being "French Polishing."

The Secretary will be pleased to welcome anyone wishing to join the Society in either the adult or juvenile sections.

Hon. Sec., H. Fowler, "Alston," Old Hall Road, Sale.

DESCRIPTION OF APPARATUS BEFORE THE RADIO SOCIETY OF GREAT BRITAIN.

THE ARMSTRONG SUPER-REGENERATIVE RECEIVER*

Prizes of £15 and £10 were offered by the Society for the most successful receiver embodying the super-regenerative principle. The competing sets were judged as to simplicity of design and control, portability, quality of results, the value of the high tension battery supply, and the number of tuning adjustments.

SINGLE-VALVE RECEIVER SUBMITTED BY A. D. COWPER, M.Sc., A.I.C.

(Awarded the Prize of £15)

IN the following description of a single valve Super-Regenerative Receiver, I think that some disappointment in two directions may be expected. Firstly as to the complexity of the circuit, and secondly as to the signal strength obtainable.

The complexity of the circuit is a minimum, and the signal strength falls somewhat short of the anticipations aroused by the sensational Press reports of Major E. H. Armstrong's historic demonstration before the Institute of Radio Engineers on June 7th, 1922.

It is also necessary, perhaps, to disperse certain delusions as to the alleged difficulty and general insensibility of the one-valve circuit in particular. By proper attention to certain general principles and by designing the receiver in accordance with these (in particular as to the Armstrong bridging condensers), the circuit becomes more stable by far than the ordinary single valve with critical reaction, and it is also exceedingly simple to tune and operate.

The principles to be borne in mind are :—

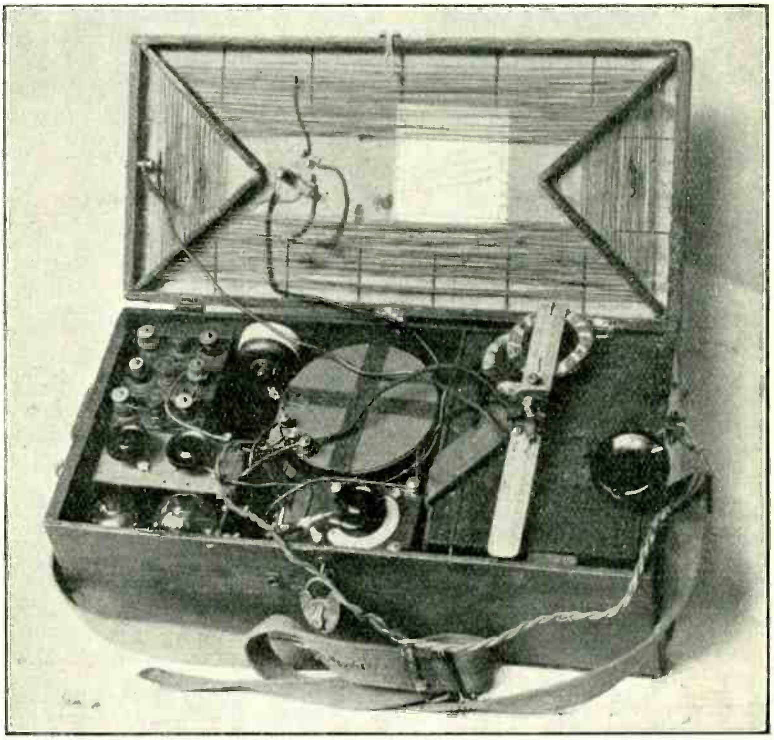
(1) That it is essential to have powerful quenching frequency oscillations, so that the Armstrong inductances must have fixed close coupling, and maximum high tension battery and filament temperature must be maintained. In addition, it was found preferable to employ a power valve.

(2) Exceedingly free and undamped high frequency oscillations must be built up in minimum time ; therefore large bridging condensers must be employed for the Armstrong inductances. The frame aerial must be small, and the grid circuit must have a minimum ohmic and radiation resistance combined with minimum H.F. reaction coupling.

(3) With the employment of English valves, rectification can be obtained with the conventional grid condenser and leak, the leak to be of a somewhat smaller value than usual.

In describing his set, Mr. G. P. Mair has ably explained the theory of the operation of the different circuits, and these remarks will therefore be confined to details of the portable receiver.

It may be well, however to point out here the analogy of the super-regenerative principle to the case of a nervous spirited horse which periodically



" Wireless World " photo.

The complete portable outfit, in case measuring about 21″ × 10″ × 7″, demonstrated by Mr. A. D. Cowper.

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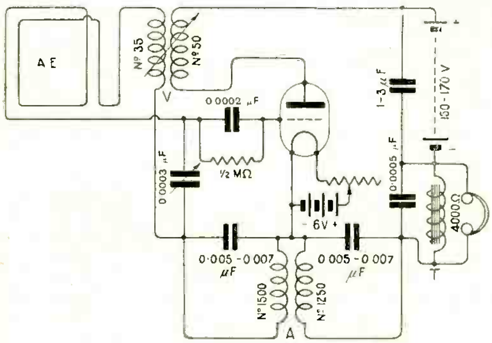
* Papers read before the Radio Society of Great Britain on March 28th, 1923.

bolts at a flick of the whip, and, as often, is pulled up short by a curb bit, the latter corresponding to the Armstrong quenching oscillation; as opposed to the steady plodding cart-horse mildly encouraged by the driver's voice, which may be considered as analogous to ordinary reaction. The accompanying diagram shows the circuit employed in the receiver, together with details of values of the components.



Circuit of single valve super-regenerative receiver, demonstrated by Mr. Cowper.

A.E. Frame Aerial: mean 6 *in. by* 18 *in., enclosed; four tappings,* 30 *turns No.* 22 *S.C.C. two-bank spacing of* ¼ *in.*

V. Vario-Coupler: low-capacity-wound, about 40 *turns each, No.* 22 *S.C.C., or coils Nos.* 35/50 *or* 50/75. *One tapping in aerial coil, for* 200-300 *metre range.*

A. Armstrong Inductances: in actual receiver, made up of 8 *five-inch-diameter cardboard spiders, full of No.* 32 *enamel, total about* 1,200 *turns, in series, piled in pie-form, as inductance;* 3 *of same size full of No.* 36 *enamel, total about* 1,000 *turns, as reactance; placed about* ¼ *in. above former, and taped in place. With bought coils, coupling at* 1¼ *in. centres, fixed, is best.*

T. Auto-transformer, in place of telephone tranformer; essential if H.R. phones are used; 2 *ozs. No.* 40 *enamel on* ⅜ *in. iron core, hedgehog pattern.*

The circuit was analysed on the blackboard, and an explanation given of the purpose of component parts indicating how the circuit was built up.

The cost of the actual receiver complete with batteries and valves was about £5. The tuning range is 180-700 metres with four tappings in the frame aerial. Considerable possibilities lie in the direction of the use of a crystal for rectification with a loose-coupled circuit, and it is suggested this may be found a means of eliminating a considerable amount of the "whistle" of the quenching frequency without the necessity of employing a filter. Simultaneous amplification may also be applicable.

The range of reception on the 6 in. × 18 in. frame shown in the photograph employing one "R" valve, is about 200-250 miles for powerful telephony. A pocket aerial consisting of a spider coil wound to dimensions of a 5 in. diameter has also been used as a "stunt" and readable telephony has been received with one valve at 250 miles with very careful tuning. There is an automatic limitation of signal strength when approaching within 40 miles or so of a powerful transmitting station, and this may be explained by the fact that the radio frequency component in building up the signals in the receiver is, at the best, only a fair-sized ripple on top of the Armstrong quenching oscillation and the latter consumes the best part of the power of the valve.

A matter which has been discussed and is of considerable interest, is the extent to which a circuit of this type may cause interference by radiation, but stringent tests indicate that with so small a frame, this danger is practically absent. It was found impossible to detect the presence of the receiver at a distance of a few yards under reasonable or likely circumstances.

No doubt there is a wide application for a portable compact receiver of this nature. It would be invaluable for flats for the reception of broadcasting, and as a portable receiver to take on holiday, also for police and military use it would be extremely convenient.

Some interesting tests have been made, such for instance as the reception of telephony quite clearly in a taxi-cab with one "R" valve whilst the taxi-cab was travelling at full speed over a rough road.

Since with this receiver the efficiency of the reception varies inversely as the square of the wavelength, it is particularly applicable for working on very short wavelengths and very great distances can be covered with the employment of C.W. morse transmission.

A good deal of controversy has already arisen on the question of priority of invention of this circuit, but, whatever view may be taken on this matter, it is to Major E. H. Armstrong that experimenters owe the fact of the circuit and its possibilities.

The Lecturer then gave a demonstration of the set in operation. Loud and clear telephony was received on one valve, the complete set being carried by a strap over the shoulder. The set was carried round amongst the audience, the telephones being handed to those who wished to listen.

Subsequently experiments were conducted showing the advantage of using a second valve as a note magnifier.

TWO-VALVE SUPER-REGENERATIVE RECEIVER SUBMITTED BY G. P. MAIR.

(*Awarded the Prize of £10*).

RECEIVING circuits up to a few months ago had reached a high state of perfection; but when taken in conjunction with the recent rapid advances of wireless telegraphy and telephony, they were at a standstill, and it remained for Professor Armstrong to introduce a great advancement. This new type of circuit is known as the Armstrong Super-Regenerative Circuit, and although it has in a number of hands given proof of its enormous amplification, it must not be taken as the final solution. This circuit opens up a new field of research and no doubt these present new circuits will be still further improved as time proceeds.

The general principle of the Armstrong Regenerative Circuit is doubtless well known. I do not propose to deal with the theoretical side, but with the practical working details of the circuit, as put roughly together in the instrument on the table. This instrument is not a pretty piece of workmanship, but it contains all the essential parts of a practical working receiver.

Before describing this circuit I will briefly set out the general theory. When using an ordinary receiving circuit and fitted with a feed-back circuit from the plate to the grid of the valve, or as it is generally termed "reactance," it is well-known that there is a limit to the amplification of speech and music by means of regeneration. If the coupling of the reactance is too close, the circuit generates continuous oscillations and the speech is indistinct. Besides this, the operator is a nuisance to his neighbours.

The maximum strength of distinct speech is received when the reactance coupling is in such a position that the receiving circuit is just on the point of oscillation, but is not actually oscillating. By opening the coupling the quantity of sound is reduced and so the reaction or feed-back circuit can be considered as introducing "negative resistance," and which partly eliminates the positive resistance of the valve and its circuits. When the two balance each other the valve produces continuous oscillations. Now if the negative resistance can be made to overrule the positive resistance without the valve oscillating, then the amplification can be still further increased. This is the problem which has been solved by Professor Armstrong. Let us take an ordinary receiving circuit fitted with reactance, and place the coupling in such a position that the circuit just oscillates, and the circuit has under these conditions negative resistance. Now let us apply rapidly varying resistance to this circuit and at a greater rate than the frequency of the incoming signals, then the oscillating circuit will be rapidly stopped at intervals. This action is not instantaneous, for the incoming signal takes time to build up. During the negative resistance period full use is made of the great amplification produced, but just before the circuit has built up sufficiently to reach oscillation, it is suddenly stopped by an external means. This switching out action may be made at any frequency desired, provided it is less than that of the incoming signals. There are several ways of carrying out this switching-out action.

(1) A H.F. current can be applied to the grid of the valve, and this in effect introduces a rapidly varying resistance.

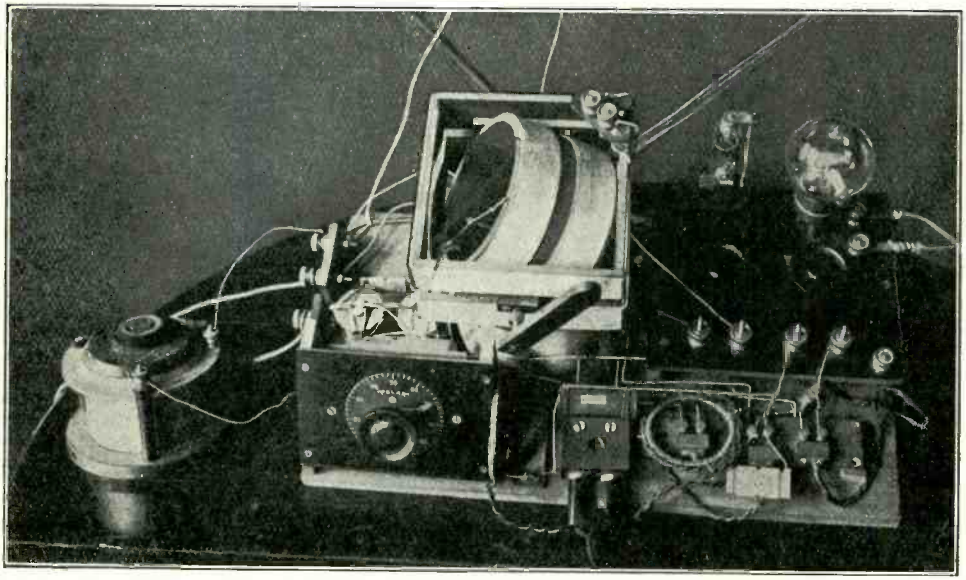
(2) The plate voltage can be rapidly varied.

(3) The two above arrangements can be combined.

The simplest way of applying the H.F. current is by an oscillating valve.

The apparatus is built up on this principle and is controlled by a rapidly varying positive resistance in the grid circuit. Two valves will be seen, that adjacent to the large coil is the detector and regenerator, and the second valve is the oscillator, or so to speak, the switching-off valve.

A number of articles have been written in the wireless Press on the Armstrong Super-Regenerative Circuits, dealing both with theoretical and

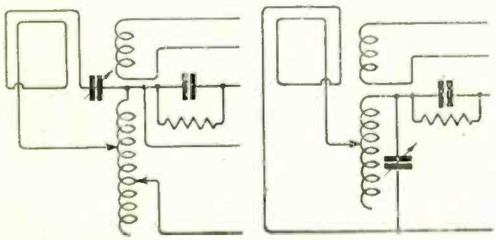


"Wireless World" photo.

The two-valve super-regenerative Receiver, demonstrated by Mr. G. P. Mair.

practical sides. All these articles state the simplicity of the arrangement, and ease of the operation, but like all new and varied wireless circuits, when once the circuit has been operated, one is apt to smile and laugh at all the initial difficulties. Like all experimenting, results cannot be arrived at in a hurry, and it is better to put a circuit together in a proper manner—and the author attributes his initial failures to a tangled mass of loose wires. After several unsuccessful attempts, it was decided to make the various components in an efficient manner. When these were ready they were spread out on a board, which was fitted with proper terminals so that connections could be easily changed.

Under these better conditions results were quickly obtained, but the tuning was so sharp that even with a ten-inch handle on the tuning condenser



Figs. 1a and 1b. Experimental methods of connecting the frame aerial to the tuning circuit.

a movement of one finger was sufficient to entirely lose signals, in fact the easiest way to tune was to rest one's body against the wall, and just move slightly. In addition to this trouble, one woke up in the morning with a headache owing to the shrill whistles experienced the previous evening. These experiences were sufficient to prove the circuit was too critical, and therefore useless, and the matter was dropped. Now nobody likes being beaten in an attempt, and further experiments were conducted and this led to a condensed form of the original apparatus, as now shown, and which is very staple and easy to operate, and further, gives extraordinary results.

The original trials were made with all the complications as suggested by Professor Armstrong, but these were mostly abandoned ; for instance a grid leak and condenser replaced the potentiometer for putting negative potential on the grid of the oscillator. The filter circuit was omitted but subsequently replaced.

This was the stage when the results were obtained but were too critical to be of any use. Being the possessor of an excellent outside aerial, and a relic of the pre-war crystal days and spark transmission, and believing in a good aerial and a minimum number of valves, I scorned frame aerials, in fact I had never tried one, so this led to checking the behaviour of a frame aerial on an ordinary receiving set, and using the arrangement as shown in Fig. 1 (*a*) I found the tuning with an ordinary receiving set fitted with reactance to be almost too sharp for comfort. Books were referred to for frame aerial circuits and finally the frame was put in series with the grid inductance, and a variable condenser in parallel with both. Fig. 1 (*b*).

This solved the mystery and the set became staple and quite easy to operate, and one can now move about and place one's hand near the coils without disastrous results. There then remained the high-pitched whistle from the oscillator valve and the only way to cure this was to fit a filter circuit, as can be seen in the circuit diagram (Fig. 2).

To turn to constructional details.

Coils : Main Inductance.

There is nothing special about this and it agrees with ordinary practice. In the actual set No. 22 double cotton-covered wire is wound on a cylinder. The diameter of the wire is sufficient to offer a low resistance to high frequency currents and the double cotton insulation spaces the turns and cuts down self capacity. This inductance consists of 60 turns with tappings taken off and without too much condenser across it tunes in up to 650 metres.

Reactance Coil.

This requires to be of larger dimensions than in the case of an ordinary receiving set. It actually consists of two parts ; a fixed coil coupled to the main inductance, and inside this fixed coil is a second coil which can be rotated, and the two together form a variometer enabling the coupling with the main inductance to be varied. The two coils forming the variometer are wound with the same wire as the main inductance, namely No. 22 double cotton covered.

Coils in the Oscillator Circuit.

The grid inductance and condenser should be chosen so as to give a wavelength of about 30,000 metres. Various coils have been tried but those on the instrument are the identical ones submitted to the judges. For the oscillator circuit some odd coils are used, which were wound up in the early days and long ago discarded as the self capacity was too high. Actually these coils are wound with No. 39 silk-covered wire and steeped in paraffin wax. The wire was rescued from a broken Ford car trembler coil. Modern coils

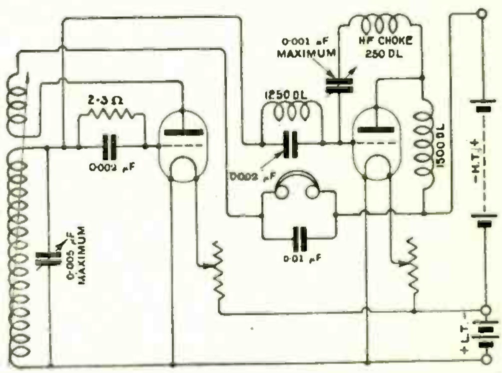


Fig. 2. The system of connections adopted, embodying a filter circuit.

wound with a minimum of self capacity have since been tried and do undoubtedly give much better results.

The remaining items such as condensers, filament resistances, etc., are the ordinary type and consist mostly of the various oddments to be found in the usual experimenter's store-box, and therefore do not call for any comment.

Valves.

Much has been said about suitable valves, and the first trials were made with a "V 24" as detector and regenerator, and the ordinary "R" valve as an oscillator. These valves were taken as they happened to be handy, and at the time not in use. Various valves of the receiving type have been tried, "QX," "V 24," Osram "R," "Ora" and some very pretty little valves made by the German firm of Lorenz. They all seem to work equally well, and the only valve in my possession which does not work at all, is a very early type and so soft that it gives a brilliant blue haze. Two valves in parallel give marked results as one would expect as the total plate current is increased.

Some small transmitting valves have been tested; signals are increased in strength considerably, but the great drawback is the large amount of current drawn from the high tension battery, and for the amateur this would be a serious expense, as the voltage required is high, and the life of the cells short. Perhaps the best method to work these valves would be to use high tension accumulators, but here again the initial outlay is considerable.

Plate Voltages.

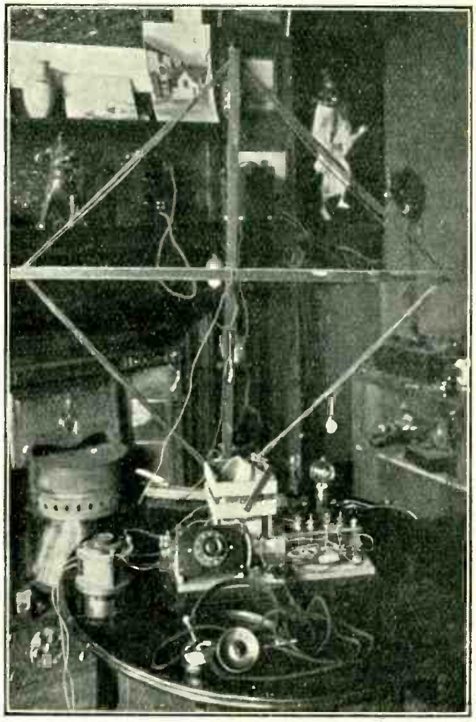
Voltages up to 120 have been tried and from 80 to 120 volts appears to be quite satisfactory; two "V 24" valves with a plate voltage of 30, however, work quite satisfactorily.

Radiation.

In view of the broadcasting restrictions I was naturally nervous about my neighbours and wished to ascertain what was happening outside my house, so tuned up the set to a known wavelength, making all adjustments by a wavemeter, and leaving the reactance closely coupled, but self oscillation was not taking place in the detector circuit. A friendly aerial lives across the road, and a careful search on this failed to disclose any free oscillations. Various tests were carried out, and it was found that when the set was properly understood and used, it can be placed within a few feet of an ordinary receiver fixed to an outside aerial, and both sets can receive the same signal without any interference. Tests were also made with the set oscillating and the radiation at 50 feet can only just be detected. What happens when the set is coupled to an aerial, it is difficult to say, as experience shows that no satisfactory receiving results are obtainable under this condition, at least by me.

I now turn to the practical results.

(1) When using two ordinary receiving valves with 80 to 100 volts on the plates, the average strength of signal is equal to that of a good P.O. aerial, and an ordinary receiving set with one detector and one low frequency amplifier valve and using full reactance. Or, in other words, the frame aerial of the size given, replaces a good outside aerial.



"Wireless World" photo.

The complete apparatus, showing the frame aerial.

(2) Weak signals are not amplified to the same extent as strong signals.

(3) The surroundings influence the strength of signals. In open ground signals are much stronger than when the frame is used in a room of a dwelling house. The frame has been tried in a garage with a galvanised iron roof, and signals under this condition are poor.

(4) Since for the same number of valves the frame replaces an outside aerial, it has the further advantage of being directional, and a badly interfering station can be cut out.

EXPERIMENTAL TRANSMITTING STATIONS

ALTERATIONS AND ADDITIONS.

The particulars given below include amendments and additions to the list of Experimental Transmitting Stations given in the "Year Book of Wireless Telegraphy and Telephony, 1923," published by THE WIRELESS PRESS, LTD., which comprises some 470 stations.

Readers are strongly recommended to extract details of the Experimental Stations given in the Year Book on to cards for the purpose of forming an index for ready reference. Such a card index facilitates rapid identification of stations heard, whilst cards containing new calls can be dropped in pending the publication of details of ownership and location.

Holders of Transmitting Licences are requested to keep this Journal advised as to particulars of their stations, while experimenters hearing calls not to be found in the "Wireless World" lists, should write to the Editor, giving details of the transmission intercepted, in the hope that some information concerning the transmitter may be available.

Reports of reception are usually welcomed by operators of Experimental Stations, and Listeners-in might do good service by passing reports of reception to the Transmitters concerned, pending the organisation of range tests by the British Wireless Relay League.

2 AG	10 watts, C.W. & T.	T. Moor, "Castlemaine," Lethbridge Road, Southport.
2 AJ	C.W., T. & Sp.	Radio Communication Co., Ltd., Barnes, S.W.13.
2 AZ	—	William Le Queux, St. Leonards-on-Sea.
2 BM	C.W. & T. ..	J. H. A. Whitehouse, Hampstead, N.W.3.
2 BO	—	Marconi's Wireless Telegraph Co., Ltd., Writtle.
2 CD	C.W. & T. ..	Burton-on-Trent Wireless Society, 66, Edward St., Burton-on-Trent.
2 CW	—	B. Hippisley, "Ston," Easton Park, Bath.
2 DG	10 watts, Sp., C.W. & T.	W. Burnet, 10, Coverdale Road, Sheffield.
2 DH	10 watts, Sp. & C.W. Portable	W. Burnet, 10, Coverdale Road, Sheffield.
2 DI	10 watts, Sp. & C.W.	W. Burnet, 10, Coverdale Road, Sheffield.
2 DT	—	Barrow & District Wireless Assn., Market Tower, Barrow-in-Furness.
2 DY	—	F. H. Haynes, 5, Regent Sq., W.C.
2 DZ	—	F. H. Haynes, 26, Avenue Road, South Tottenham, N.15
2 FC	25 watts, C.W.	W. Sinclair, 19a, Ladbroke Gardens, W.11.
2 FJ	10 watts, Power Buzzer, Telephone & C.W. Transmitter.	W. J. Fry, 22, Thirsk Road, Lavender Hill, S.W.11.
2 FK	Sp., T.T., C.W., & T.	F. C. Grover, 20, Rutland Road, Ilford.
2 FN	30 watts, T., C.W. & T.T.	L. M. Baker, Ruddington, Notts.
2 FT	C.W. & T. ..	Edinburgh & District Radio Society, 9, Ettrick Road, Edinburgh.
2 FX	Sp., C.W., T.T. & T.	H. C. Binden, 32, Oxford Road, Bournemouth.
2 FZ	10 watts & 1 kW. Sp., C.W. & T.	Manchester Wireless Scty., Houldsworth Hall, Deansgate, Manchester.
2 GG	—	R. H. Kidd, Marlborough House, Newbury.
2 GI	—	Lawrence Johnson, "Park View," Hinde House Lane, Pitsmoor, Sheffield.
2 GJ	—	Lawrence Johnson, "Park View," Hinde House Lane, Pitsmoor, Sheffield.
2 GK	—	Lawrence Johnson, "Park View," Hinde House Lane, Pitsmoor, Sheffield.
2 GL	10 watts, Sp., C.W. & T.	W. J. Henderson, 2, Hollywood Road, S.W.10.
2 GO	—	L. Bland Flag, 61, Burlington Road, Bayswater, W.2.
2 GP	10 watts, Sp., C.W. & T.	H. W. Nunn, 49, Leigh Road, Highbury Park, N.5.
2 GU	10 watts ..	The Halifax Wireless Club, Y.M.C.A., Clare Hall, Halifax.
2 HC	10 watts, C.W., Sp. & T.	F. M. J. White, Winchcombe Lodge, Bucklebury, near Reading.
2 HK	—	A. A. Campbell Swinton, F.R.S., 66, Victoria St., S.W.1.

2 HL	—	A. A. Campbell Swinton, F.R.S., 40, Chester Sq., S.W.1.
2 HQ	10 watts, C.W., T.T., T., & Sp.	A. W. Fawcett, 11, Leigh Road, Clifton, Bristol.
2 HW	10 watts, T.	H. Beresford, 213, Bull St., Birmingham.
2 IB	10 watts, C.W. & T.	W. Bemrose, "Four Winds," Littleover, Derby.
2 IH	—	C. G. Bevan, Technical College, Cathay Park, Cardiff.
2 II	10 watts, Sp., C.W. & T.	Southport Wireless Society, Queen's Hotel, Southport Sec., 26, Hartwood Road, Southport.
2 IJ	C.W. & T. ..	Southport Wireless Society, Queen's Hotel, Southport
2 IN	10 watts, C.W., Sp. & T.	J. E. Fish, "Thornley," Station Road, Thornton-le-Fylde, near Blackpool.
2 IV	10 watts, Sp., C.W., T. & T.T.	L. F. White, 10, Priory Road, Knowle, Bristol.
2 IW	10 watts, C.W., T. & Sp.	G. R. Marsh, Mallards Close, Twyford, Winchester.
2 JG	10 watts, C.W., Quenched Sp., T. Also Portable.	W. A. Seed, Crigglestone, near Wakefield.
2 JS	10 watts, C.W. & T.	Horace B. Dent, 25, Church St., Leatherhead, Surrey.
2 KH	C.W. & T. ..	Ashley Wireless Telephone Co., Ltd., Renshaw Rd., Liverpool.
2 KQ	10 watts, T.T., C.W. & T.	Harold Taylor, The Lodge, Tottenhall Wood, near Wolverhampton. Station installed at W'hampton.
2 LD	—	R. J. Cottis, 4, Crondace Road, Fulham, S.W.6.
2 LI	Sp., C.W. & T.	C. H. Wilkinson, 14, Kingswood Avenue, Brondesbury, N.W.6.
2 LT	10 watts, Sp., C.W. & T.	A. F. Bartle, "St. Cyres," 5, Coleraine Road, Blackheath, S.E.3.
2 LW	Sp., C.W. & T.	Tingey Wireless, Ltd., 92, Queen Street, Hammersmith, W.6.
2 MK	10 watts, C.W. & T.	A. W. Hambling, 80, Brondesbury Road, Brondesbury, N.W.6.
2 NB	10 watts, T. ..	J. W. Barnaby, Sylvan House, Broad Road, Sale, Cheshire.
2 NI	10 watts, Artificial Aerial.	Dartford & District Wireless Society, 84, Hawley Road, Wilmington, Dartford.
2 NL	10 watts, Sp., C.W. & T.	F. J. Hughes, 129, Wells Road, Bath, Somerset.
2 NN	10 watts ..	Brig.-Gen. Palmer, "Hill Crest," Epping, Essex.
2 NO	10 watts, C.W., T. & T.T.	H. R. Adams, Crescent Cabinet Works, Sutton Road, Walsall.

(A further list will appear in the next issue.)

5ZZ
CALL SIGN

NAME J. G. Smith
ADDRESS 31, London Road
S.E. 23.

NATURE OF TRANSMISSION Telephony.
WAVELENGTHS 170. 190. 440
DATE FIRST HEARD 28. 4. 23
INSTRUMENT SETTINGS for 190 m. 30 ATC. Stud 2. 15 CCC Stud 3 H.F. Stud 4. Condenser 10

REMARKS Broken speech. Slight hum. Tuning wanders. ? Grid modulation.

Specimen of Record Card for compiling Index of Experimental Transmitting Stations.

Notes

2 LO Broadcasts Glasgow Concert.

Those who listened-in after the usual broadcast programme on Monday, April 16th, were able to hear speech and music with surprising clarity from the Glasgow broadcasting station. **2 LO** announced a period of testing and it was only at the conclusion of several musical items that listeners were informed that they had been hearing **5 SC.** Transmission was effected by land line from Glasgow to London, and thence by wireless on the ordinary 369 metres wavelength.

Proved.

To demonstrate that the experimental transmissions from **2 DY** on 200 metres should not cause interference with the broadcasting on higher wavelengths, a test was arranged, not of course during broadcasting hours, but during the experiments by **2 LO** above referred to, after 11 p.m. on April 16th. The signals from **2 LO** were received on an aerial alongside the transmitting aerial while the transmitter was in operation. The received telephony was fed to the modulator valve of the transmitter, and thus the broadcasting was retransmitted on 200 metres. No special rejector circuits were made use of in the receiving equipment, loose coupling being sufficient to dispose of the 200 metre signals and permit of the reception of those on 369 metres, only a few yards away from the transmitting equipment.

The British Thomson-Houston Co., Ltd.

We are advised that through a regrettable error the price of head-telephones advertised by the above firm in our issue of April 14th, was wrongly given as £1 10s. instead of £1 12s.

Nauen increasing its Power.

Extensive changes, it is reported, are now in progress at Nauen with the object of increasing the power and flexibility of the station. Separate antennæ are being constructed for the American, Asiatic, African, and the two European services. Special preparations are being made for the new Buenos Aires service, which is to be opened for public communication in the course of a few months. Nauen will work with the station at Monte Grande, near Buenos Aires, which is to be maintained and operated by a combination of English, French, German and American radio companies.

The German Radio Organisation.

Since the war Germany has been strenuously occupied in building up a remarkably efficient radiotelegraph and telephone system. The German Post Office station at Koenigswusterhausen, near Berlin, transmits to London, Budapest, Sofia and Sarajevo, and its receiving station at Zeylendorf makes up the return circuit. Norddeich, on the coast, completes this system, which is known as the Main Stations group (Hauptfunkstellen). Although communication is maintained with foreign cities mentioned, the Main Stations group operates principally within Germany and there exists an elaborate network of wireless communications, comprising "feeder" stations and "simple" stations. These link up the towns of Dortmund, Breslau, Dusseldorf, Frankfort-on-Main, Hamburg, Hanover and many others.

Unauthorised Transmitters?

2 MG (Mr. C. Creed Millar, Arndene, Bearsden, near Glasgow), reports that his call sign is being used by an unauthorised transmitter in Yorkshire. The district is known, and our correspondent states that unless this practice ceases immediately the matter will be placed in the hands of the proper authorities.

Letters have recently been received from the North of England by Mr. J. Pigott (**2 WA**) of Manor Farm, Wolvercote, near Oxford, stating that excellent telephony has been received from a station giving the call sign **2 WA.** As Mr. Pigott has not been transmitting for some time, he assumes that some other transmitter is using his call letters or not pronouncing his own sufficiently clearly. Should this note catch the eye of the person involved, Mr. Pigott will be pleased, on hearing from him, to forward the reports received.

"Mopping up" the music. An unpretentious aerial and a Burndept Ethophone V provide entertainment for the punter.

Powerful Mexico Radio Station.

It is reported from Mexico that the great wireless station at Chaputecpec will probably open shortly. This station is intended for communication with New York, Berlin, London and Lyons.

Crystal Reception in Ayrshire.

Good reception of **2 LO** (London), **2 ZY** (Manchester), and **5 IT** (Birmingham) on a crystal receiver is reported by Mr. Stanley Gilderthorpe, of Arrow View, West Kilbride, Ayrshire. This feat was recently achieved during temporary lulls in the programme of the Glasgow station. The fact that the only valve station within four miles is a B.B.C. product precludes the possibility of assistance by local oscillations.

Air Ministry Station in Guernsey.

The Air Ministry have taken over from the P.O. the wireless station at Fort George, Guernsey.

New Wireless Societies.

A wireless society embracing the West Central district of London is being formed and prospective members should communicate with Mr. S. Hex at 12, Regent Square, W.C.1.

Bearing the name of "The Lewes and District Radio Society," a society has recently been formed. The Hon. Secretary, Mr. J. T. Carvill, of 16, Grange Road, Lewes, will be pleased to hear from persons in the district interested.

Do you hear American Radio 2 BQU ?

Mr. Herman Kuch, of Bertha Place, Grymes Hill, Staten Island, New York, whose call sign is given above, would be very glad to receive cards from British amateurs who hear his transmissions. Mr. Kuch, who states that he uses 10 watts, was heard both in England and France during the Transatlantic Tests. **2 BQU**, which is situated on the Atlantic coast, has also been heard on the Pacific shore and in Canada and Porto Rico.

Where Can I Buy ?

Where can I buy resistances, condensers, or other components ? A question often asked by those starting in wireless experimental work.

Complete information on this subject is contained in the "Year-Book of Wireless Telegraphy and Telephony," 1923 edition, in a Directory of Manufacturers and Factors of Wireless and Allied Apparatus, providing ready reference under classified headings to any wireless want.

Ornamental Loud Speakers.

Probably realising that the average loud speaker is nearer technical than aesthetic perfection, Messrs. The Western Electric Co., Ltd., have produced a range of these instruments in very tasteful designs. These are illustrated in an equally artistic booklet we have received, and the designs are as follows:—Chinese Pagoda, Peacock, Eastern Spiral, Nasturtium, Sunflower, Chinese Dragon, Carnival and Grape Vine.

The Two-Valve Gecophone.

We have received from The General Electric Co., Ltd., a copy of leaflet No. BC.2940, which, in addition to a description in colour of the Gecophone two-valve cabinet listening-in set, contains a selection of unsolicited testimonials from satisfied customers. From both Ayrshire and Aberystwyth music broadcast from New York has been received, and **2 LO** seems to be picked up in any part of Scotland by the two-valve set. Copies of this leaflet can be had on application to Magnet House, Kingsway, or from any of the Company's numerous branches and agencies.

Latest "Victor" Instruments.

An attractive folder containing illustrated particulars of the latest "Victor" range of wireless instruments has been issued by Messrs. Victoria Electrical (Manchester) Ltd., of 1, 3 and 5, Chapel Street, Salford. A wide variety of valve and crystal sets is offered, and many useful accessories are also included.

Catalogues, etc., Received.

Readers' Guide—City of Norwich Public Library. Contains a list of extensive additions to the number of books in the library on wireless telegraphy.

Books Received.

Comment entendre chez soi la T.S.F. By Alfred Soulier. (Paris : Librairie Garnier Frères, 6, Rue des Saints-Pères. Pp. 91. Price 3 francs.)

Wireless Telephones and How They Work. By James Erskine-Murray, D.Sc. (Crosby Lockwood & Son, Stationers' Hall Court, Ludgate Hill, E.C. Pp. 84 + viii. Price 4s.6d. nett.)

Correspondence.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—It may be of interest to the undermentioned amateurs to hear that their transmissions are coming in very well in S.W. London.

Reception was generally accomplished on two valves (1 L.F.), but any number up to four could be employed.

The following English amateurs have been received this year :—

Call.	Date.	Str.	Reception. H.F.	H.F.	Rect.	L.F.	L.F.	Remarks.
5 JP	11.2	R 4	—	—	+	—	—	Rather faint and subject fading.
2 LG	—	R 5	—	—	+	+	—	Working to **2 KF** London (0·2 amps).
2 AW	v/dates	R 5	—	—	+	+	—	Working **2 JP**, **8 AB**, etc.
2 JZ	"	R 5	—	—	+	+	—	
2 JZ	"	R 7	+	+	+	+	—	Speech audible, telephones off.
2 PC	6.1	R 5	—	—	+	+	—	
2 RB	v/dates	R 5	—	—	+	+	—	
2 IN	22.1	R 6	—	—	+	+	—	Calling **2 OD**.
2 NA	v/dates	R 3	—	—	+	+	—	Subject to complete fading.
2 AV	30.1	R 6	—	—	+	—	—	Very clear and steady C.W.
2 JO	10.2	R 5	—	—	+	+	—	
2 JF	11.2	R 5	—	—	+	+	—	

The following French amateurs have been received this year :—

8 BM	v/dates	R 8	—	+	+	+	+	
8 BF	22.2	R 4	—	—	+	+	—	
8 AB	23.1	R 4	—	—	+	—	—	
8 AB	23.1	R 7	—	—	+	+	—	
8 AB	23.1	R 8	—	—	+	+	+	
8 LBC	—	R 3	—	+	+	+	+	Very faint and subject fading.

The following Dutch amateurs have been received this year :—

PCII	—	R 6	—	—	+	+	—	
OMX	v/dates	R 6	—	—	+	+	—	
OBS	11.2	R 6	—	—	+	+	—	Working with **8 AB**.

All these receptions took place, with the exception of one or two, during broadcasting hours, when the London amateur stops transmitting and leaves the ether quiet for long distance working.

It would be interesting to hear the power, radiation, etc., of some of the above stations.

There is one station received which appears to be of Spanish origin, with call letters **8 ÑO**. This station was heard during the recent Transatlantic Tests sending "CQ," and was received a few nights back using one stage of H.F. followed by one stage L.F.

It appears that the short wavelength, i.e., 200 metres approx., has much to recommend it for long distance low power transmissions.

Yours faithfully,
A. G. Wood.

[It is always of interest to operators of transmitting stations to have reports on the strength of signals, etc., by distant receiving stations.—Ed.]

To the Editor of The Wireless World and Radio Review.

Sir,—Possibly several of the amateurs whose calls are undermentioned would be interested to know that their signals have been read and "logged" at my station, which consists of an experimental single-valve set. I shall therefore be very grateful if you will publish this letter. The list of amateurs is given herewith :—2 DF, 2 DX, 2 SZ, 2 SP (?), 2 SH, 2 SQ, 2 OM, 2 ON, 2 OD, 2 OF, 2 AN, 2 AO, 2 AW, 2 BZ, 2 QS, 2 QN (Spark), 2 QQ, 2 FN, 2 FU, 2 FF, 2 FQ, 2 PU, 2 CO (Spark), 2 WY, 2 YQ, 2 KT, 2 KF, 2 TO, 2 TV, 2 TA, 2 JF, 2 JP, 2 JA, 2 NM, 2 NF, 5 LC, 5 GL, 5 CV, 5 BV, 5 NN, 5 QV, 5 DP, 5 WR, 5 HY, 8 AB, 8 XY (8 BM), O DV, O NX, O NY, O MX, PCII.

The aerial used is a twin 50 ft. inverted L; average height 23 ft., and very badly screened.

I remain,
F. R. W. Strafford.

Dovercourt, Essex.

O = Numerical.

Forthcoming Events

THURSDAY, APRIL 26th.

Thames Valley Radio and Physical Association. At 8 p.m. Lecture: "The History of Radio," by Mr. G. G. Blake, M.I.E.E., A.Inst.P.

Radio Society of Birkenhead. Open Meeting and Soirée.

Hackney and District Radio Society. Informal Meeting.

Stoke-on-Trent Wireless and Experimental Society. Lecture: "Faults," by Mr. A. Whalley (member).

Wireless and Experimental Association. Public Demonstration of Wireless Reception at Central Hall, High Street, Peckham.

South Shields and District Radio Club. Wireless Exhibition in Congregational Hall, Ocean Road. (From April 24th to April 28th inclusive.)

FRIDAY, APRIL 27th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Dept. of Applied Science, St. George's Square. Practical Demonstration.

Leeds and District Amateur Wireless Society. Lecture: "WQK, MSK, SUC and 2 LO on a Single-Valve Indoor Aerial Set," by Mr. D. E. Pettigrew (Hon. Sec.).

Belvedere and District Radio and Scientific Society. Radio Dance.

Fulham and Putney Radio Society. At Fulham House, Putney Bridge. Demonstration on Making a Single-Valve Panel with simple tools, by Mr. J. W. Dewhurst.

Radio Society of Highgate. At 7.45 p.m. At the 1919 Club, South Grove. Lecture: "Construction of a Single-Valve Receiver," by Mr. L. R. Rowlands.

MONDAY, APRIL 30th.

Ipswich and District Wireless Society. At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. B. Weston.

TUESDAY, MAY 1st.

Plymouth Wireless and Scientific Society. At 7.30 p.m. At Plymouth Chambers, Old Town Street. Ordinary Meeting.

THURSDAY, MAY 3rd.

Hackney and District Radio Society. Radio Demonstration at Y.M.C.A. Gymnastic Display.

BROADCASTING.

GREAT BRITAIN.

Regular evening programmes, details of which appear in the daily Press, are now conducted from the following stations of the British Broadcasting Company :—

London	2 LO	369 metres.
Birmingham	5 IT	420 „
Manchester	2 ZY	385 „
Newcastle	5 NO	400 „
Cardiff	5 WA	353 „
Glasgow	5 SC	415 „

FRANCE.

Eiffel Tower. 2,600 metres. 12.15 a.m. weather reports (duration 10 mins.) 7.20 p.m., weather reports and concert (duration about 30 mins.) 11.10 p.m., weather reports (duration 10 mins.).

Radiola Concerts. 1,780 metres, 6.5 p.m. news; 6.15 p.m. concert till 7 p.m.; 9.45 p.m. news; 10 p.m., concert till 11 p.m.

L'Ecole Supérieure des Postes, Télégraphes et Téléphones de Paris. 450 metres. Tuesdays and Thursdays, 8.45 p.m. to 11 p.m. Saturdays, 5.30 p.m. to 8.30 p.m.

Lyons (YN). 3,100 metres, 1·5 kW. 11.45 a.m. to 12.15 a.m. daily (Sundays excepted). Gramophone records.

BELGIUM.

Brussels (BAV). 1,300 metres, 1 kW. Sunday, Tuesday and Thursday, 7 p.m.

HOLLAND.

PCGG. The Hague, 1,050 metres, Sunday: 4 to 6.40 p.m., Concert. Monday and Thursday: 9.40 to 10.40 p.m., Concert. (Monday concerts are sometimes given on 1,300 metres, notice of this being given on the previous Sunday.)

Accumulators and H.T. Batteries—3.

By L. F. Fogarty, A.M.I.E.E.

In the last instalment under this heading the Author dealt with the Maintenance of Accumulators used in Wireless Reception. In this article he describes Charging Arrangements and the Construction and Care of Dry Cells.

(*Concluded from page* 86 *of previous issue.*)

Accumulators must be charged from a source which always sends the current in one direction. Alternating current which reverses its direction many times per second is useless for this purpose.

It is to-day a very common practice to charge small accumulators direct from the electric light supply, and wherever this latter is given by means of continuous current such arrangements are convenient, but very wasteful, still they are reasonably safe if proper precautions are taken.

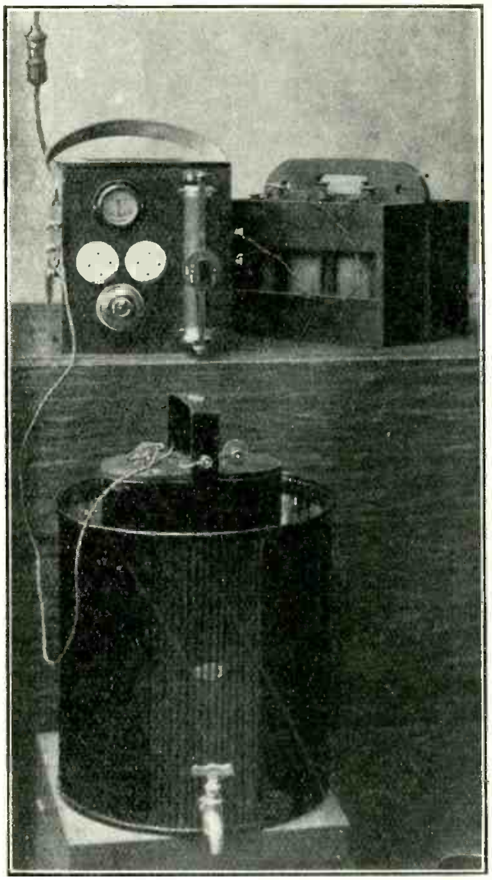
In addition to the many devices sold for indicating polarity, it is always easy to ascertain which of two wires is positive, by connecting them to two small strips of clean lead dipped into a weak solution of sulphuric acid, as you will remember that I previously stated that the wire connected to the lead strip, which turns brown, is always positive, and therefore must always be connected to the accumulator terminal corresponding to the brown plates forming the battery.

The accumulator battery to be charged should be placed on a clean dry board, and connected to the charging terminals, as mentioned.

The resistance is then moved to the "all in" position, and the current switched on, when the amount flowing will be indicated by the ammeter, and may be adjusted to any suitable value by regulating the resistance by whatever means provided.

A good many persons prefer to use lamps instead of wire wound resistances, but whilst these have the advantage of being perhaps cheaper, and of indicating that the board is in use, they have the disadvantage of being fragile, and are not usually acceptable to the electric light supply companies, when the consumer claims power at the lower rate.

The arrangement shown is in very common use, but it is important to bear in mind the possibility of electric shock if by chance any of the live parts should be touched whilst the main switch is closed. Care must therefore be exercised to stand on some insulating substance when handling accumulators charging in this manner. An alternative, and much more economical method is to install a small rotary convertor, or motor generator, having two separate windings, one of which takes current from the mains, and runs the machine as a motor, whilst the other winding has current generated in it, due to its rotation, and delivers energy at a much lower voltage, suitable for accumulator charging purposes. In this way the amount of energy taken from the mains is only slightly in excess of that actually put into the accumulator, whereas in the other method more commonly adopted, we frequently find cases where only 3 per cent. to 10 per cent. of the energy consumed is actually put into the battery.



"Wireless World" Photo.

Fig. 21. *The Electrolytic Rectifier with switchboard and current regulator connected to a lamp socket accumulator battery.*

Unfortunately, motor generators are rather expensive, and unless the amount of charging work to be done is sufficient to warrant the cost they do not pay to install, for obviously the machine stands idle the greater part of the year.

Where the house supply is given by means of alternating currents, the position is different, because such current cannot be used directly for accumulator charging. Fortunately, however, there are a number of devices available known as rectifiers, and whose function it is to convert the alternating current into a series of uni-directional impulses, quite suitable for accumulator charging, and in some cases for other continuous current processes.

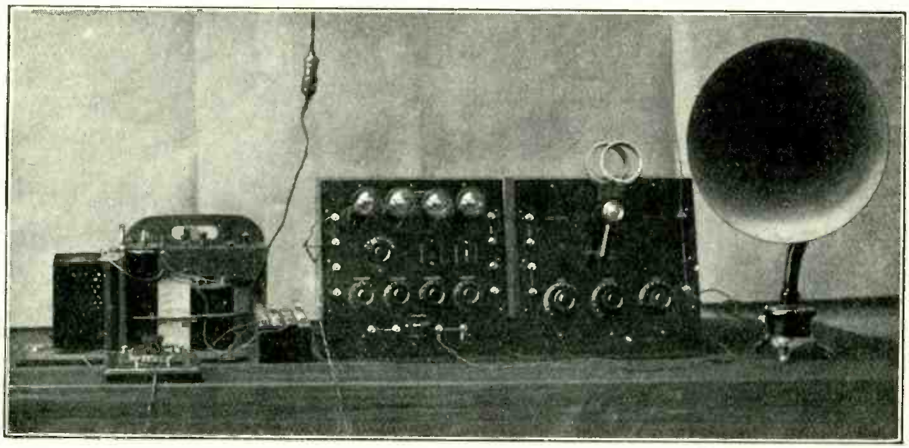
Amongst the numerous kinds available, there are rotary, vibratory, mercury-vapour, tungar, and electrolytic rectifiers.

It is not possible here to treat in detail all the various types mentioned, and I must therefore apologise for dealing with, in the present instance, one type only. This is of the electrolytic kind, and an example is shown in Fig. 21 connected up to an accumulator battery.

sal ammoniac and water, together with other ingredients, according to the maker's ideas, and with a view to securing that the paste does not dry too quickly, and that the cell has the maximum of life. An enormous amount of experimental work has been done by the leading makers to attain the present degree of perfection.

In a similar way to the accumulator, dry cells give out electrical energy at the expense of chemical change, for as soon as the external circuit between the carbon and the zinc is closed, the sal ammoniac reacts with the zinc, and the latter is consumed at a rate proportional to the electrical energy given out, and hydrogen is liberated near the carbon electrode, which latter would soon become covered with a film of gas bubbles, and the output of the cell would diminish were it not for the manganese dioxide, which has the property of absorbing the latter and allowing the cell to continue to deliver a steady current.

The complete cell is finished off by fitting it with a cardboard cover, out of which projects the termi-



"Wireless World" Photo.

Fig. 22. The Electrolytic Rectifier connected to the house current supply and arranged to feed rectified plate current to the four-valve receiver-amplifier.

The same principle may be utilised to rectify high voltages, and to feed this rectified source direct to the plate circuit of receiving valves.

A rectifier specially arranged for this purpose, and connected to a four-valve set, and a loud speaker is shown in Fig. 22.

Dry cells are now made in an infinite variety of sizes and shapes, ranging from a tiny cell fitting into the top of a walking stick, to a large rectangular block for lighting and other technical purposes. It is, however, necessary to confine ourselves to a consideration of those types used in connection with radio work, at the receiving end.

Although there is considerable difference in the details adopted by the various makers of dry cells, they all have certain common features, such as a cylindrical zinc container, fitted with a terminal which forms the negative pole, and a concentrically placed carbon rod or plate, which forms the other.

Surrounding the carbon plate is placed a layer of manganese dioxide, and between this and the zinc cylinder is a thick paste or plaster made with

nals of the carbon and zinc, and filling in the top with pitch or bitumen, but some makers leave a small hole for ventilation, otherwise the gases generated within the cell would attain to considerable pressure, and the cell would bulge out and distort. The type of cell used for high tension batteries in radio being intended only for a very small output, does not need vents, and the cells are usually mounted in groups in boxes, filled in with paraffin wax—an excellent insulator. The batteries thus produced are made up into units of 15, 30, 45, 60, and 100 volts, and can be supplied with plugs or wire tappings at intermediate values.

Where two or three cells are used alone, as for bell or telephone circuits, high insulation is not very important, but when a sufficient number are used in series to give anything from 30 to 200 volts, greater care must be taken in this respect, and it is advisable that the units of a high tension battery be fitted in a box, with the terminals attached to well insulated supports, whilst if the cells stand on, and are separated from each other by a layer of waxed paper, a high degree of insulation will be attained, and a longer life will result, as compared with a similar battery used under slipshod conditions.

In exactly the same way as an accumulator, the voltage of a dry cell is dependent on the chemical compounds used, and therefore does not vary with size. A large dry cell is capable of a greater output of current than a small one, but if they are made of the same material and by the same method the voltage or electrical pressure between the terminals will be the same in both sizes.

When new, the average dry cell develops about 1·4 volts, which soon falls to about 1·3 and then remains fairly constant for the useful life.

The high tension battery of dry cells should be tested with a voltmeter from time to time, as unless the voltage available is equal to the requirements of the valves used, there will be a falling off in strength of the received programme.

It is not necessary to possess a voltmeter capable of reading the total voltage, but each cell or group of cells may be measured separately and the readings obtained added together to compute the total.

Some very useful voltmeters are made having two scales, one reading to 10 and the other to 100 volts.

Where expense is of primary importance a single instrument with a long scale reading to about 20 volts is very convenient, for the same instrument serves to measure the voltage of the accumulator as well as that of each section of the high tension battery.

When contemplating the purchase of such an instrument it is advisable to get a good one, preferably of the moving coil type, for then the indications can be relied upon as accurate. Furthermore, the voltmeter readings should always be made when the cells are actually discharging at the appropriate rate, for then we know the electrical pressure actually exerted by our batteries when doing their proper amount of work.

Unlike accumulators, dry cells cannot be recharged when exhausted, and must therefore be discarded and replaced. It is, however, possible to effect economies by making the battery from, say, 15-volt units, and having a good switch in circuit, so that they can be entirely isolated when not in use, and by replacing the worse units first.

After a high tension battery of this kind has been in use for some time the voltmeter will usually show that one or more of the units is giving a lower voltage than the others, but, providing that reception remains good, *nothing* need be done. If, however, the signal strength falls off, the worn out sections should be replaced, or possibly another 15-volt unit added in series will rectify the trouble.

Marconi *v.* Mullard.

PROCEEDINGS BEFORE THE COURT OF APPEAL.

IN the original case heard before Mr. Justice Lawrence in July of last year, the Marconi's Wireless Telegraph Company, Ltd., sued the Mullard Radio Valve Company, Ltd., for damages for infringement of their rights in two patents, viz., (*a*) No. 28413 of 1913 granted to Marconi's Wireless Telegraph Company and Henry Joseph Round and (*b*) No. 126658 granted with the effective date of 1915 to Michel Peri and Jacques Biguet. The defendants counter-claimed that the patents in question were invalid for want of novelty and subject-matter.

It was held by the High Court that the Mullard valve was not an infringement of the Marconi patents, but that these were nevertheless good patents, and a certificate of their validity was granted.

An appeal was entered by the Marconi Company against this decision with a cross appeal on the question of validity by the Mullard Company. The case was heard before the Master of the Rolls and Lords Justices Younger and Warrington. The hearing extended over several days towards the end of last January and the beginning of February. Judgment was reserved and was finally issued on March 23rd.

Mr. Hunter Gray, for the Marconi Company, laid most emphasis upon the Round patent, which, he claimed, was of far-reaching importance. Before the Round invention there was no record of the use of a cylindrical plate or grid in a three-electrode valve. The only known types of such, *i.e.*, those of De Forest and Von Lieben, utilised a *flat* open-meshed member as a grid, and a similar shape for the plate anode.

The actual form of words used on the patent claim was as follows :—" A vacuum tube containing a hot filament, a grid *formed as a closed cylinder completely surrounding the filament*, and a third electrode in the form of a cylinder surrounding the grid."

Counsel asked the Court not to interpret the italicised words of the claim in their strictly literal sense. It was obviously impracticable to manufacture a grid with closed sides, because that would not allow the electrons to pass through to their goal (the plate), nor was it intended to shut in the ends of the grid so as to encase the filament as in a box.

What they were intended to convey was that the filament was completely surrounded by the grid in the " electrical " sense. In other words the grid constituted an " electrical control " which was effective on all sides of the filament. An open spiral of wire served this purpose and fell within the scope of the patent. Counsel claimed that any three-electrode valve having a spiral grid and cylindrical plate infringed the patent rights of his clients.

In order to support this plea Mr. Hunter Gray gave an interesting account of the defects of the early valves and of the problems which Captain Round solved by means of the invention now in question.

The modern " hard " valve was unknown at the time when the Round patent was filed. The effect of the residual gas contained in the audion or " soft " type of valve was prejudicial to the steady working of the appliance. Further, the use of the older form of flat plate or anode was inefficient. In the first place collisions between the flying electrons and the free molecules of contained gas resulted in the production of positively-charged ions. In the second place the flat plate, being comparatively small in area, failed to collect all the electrons emitted from the filament. Many of these, in consequence, lodged upon the inner walls of the glass tube and set up a strong negative field in the interior of the vessel. Besides representing so much "wasted energy" the negative charge so formed reacted upon the normal grid potential. A further complication followed from the presence of the positive ions previously alluded to. In order to overcome these sources of irregularity a constant readjustment of the grid potentiometer was found to be necessary.

By making his grid and plate cylindrical in form, Captain Round effectively shielded the inside surface of the tube from electrification, and so prevented the effect of that electrification on the grid potential. The cylindrical grid further controlled all the electrons in their passage towards the plate, and protected the filament from disintegration through the intermittent bombardment of positive ions.

The invention was of the first importance and Counsel appealed to the Court not to let the inventor be deprived of his rights by those who sought to obtain the same results by an arrangement which lay within the scope of the invention contained in Captain Round's specification.

As regards the second patent (Peri and Biguet), this covered the well-known "French" valve in which all the electrodes were mounted in a common "stub" at the base of the valve. The defendants had utilised the same essential features in making the Mullard valve.

Sir Duncan Kerley, for the Mullard Company, alleged that Captain Round's invention was wholly directed to the solution of the particular problems met with in the case of "soft" valves. The Mullard valve was "hard." There were no positive "ions" to be dealt with, and the Round invention had no point of value in connection with it.

Moreover, Captain Round was limited to the form of words he chose to employ in his patent specification. He claimed a grid formed as a "closed cylinder completely surrounding the grid" and he could not go outside them. His clients employed an open spiral of wire as a grid, and not a closed cylinder.

So far as the "French" patent was concerned, it related only to a precise combination of well-known parts, and his clients' construction differed from it in many respects. Their valve lay well outside the narrow scope covered by the Peri-Biguet specification.

In delivering judgment, the Master of the Rolls said that of the two Marconi patents concerned, that of Round was by far the more important. Peri and Biguet's patent was limited to a particular construction of narrow scope which did not cover the Mullard valve.

As regards the Round specification the only point of difficulty lay in the precise construction to be placed upon the form of words used in describing the grid. The Court had come to the conclusion that the words of the claim intended to cover an arrangement in which the grid, at least, was made as a cylinder "closed" in the ordinary physical or geometrical sense. The plaintiff's contention that the grid must be closed only in the "electrical" sense could not be accepted. No doubt the arrangement described by Round was of great importance in the days when "soft" valves were in general use, but it was of less value now that "hard" valves were the rule. The appeal must therefore be dismissed.

It was held that the validity of the patents did not come into question, and the certificate given by the Court below accordingly holds good.

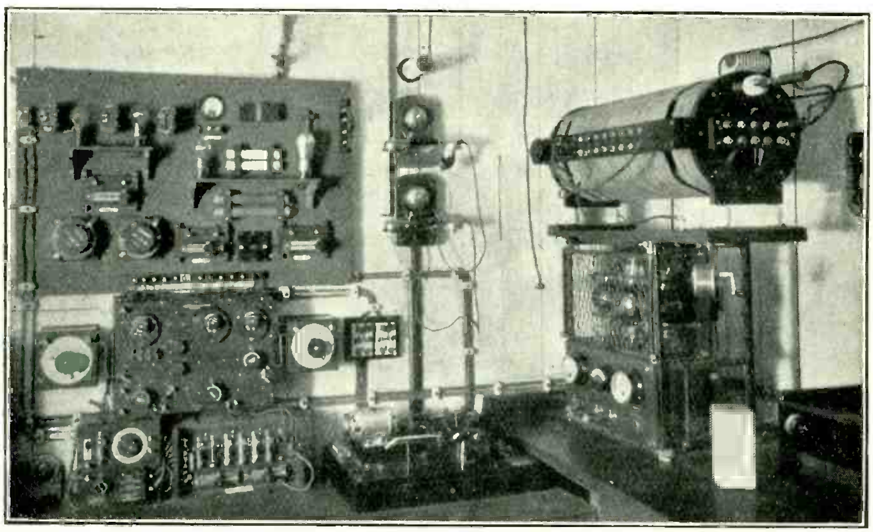


Photo: Marconi's W.T. Co., Ltd.

The Wireless Installation of the S.S. Majestic, showing the apparatus for high speed working which has recently been installed.

The R.N.V.R. and its Wireless Sections

To the enthusiastic amateur, the wireless section of the Royal Naval Volunteer Reserve has unlimited possibilities.

The Admiralty, realising the great future Wireless has in the Navy, have fitted H.M.S. "President" (the Headquarters of the London Division) with the most up-to-date receiving and transmitting apparatus, and on board, under the tuition of experts, the telegraphists are taught wireless from first principles.

THE course of training offered by the R.N.V.R. is invaluable to the amateur who wishes to acquaint himself with some of the more difficult problems met with in wireless, especially to those who are of an experimental turn of mind and who wish to conduct experiments with their own sets.

In addition to the lectures on the technical side, buzzer work and Naval procedure is taught to enable the telegraphists to keep watches in the W/T office when afloat in H.M. ships for their annual training.

No doubt that, of the many thousands of R.N.V.R. men who were trained in wireless and signals during the war, a great number are members of the various wireless amateur societies, and to these men, especially those who are desirous of improving their knowledge and keeping in touch with the latest developments, the wireless section of the R.N.V.R. should appeal strongly.

Any prospective recruit who cares to visit H.M.S. *President* at Victoria Embankment, E.C.4 (between Blackfriars and Temple), between the hours of 7 and 9 p.m. on any Wednesday can be interviewed by the Wireless Officer.

There is, however, another side to the life in the R.N.V.R., which should appeal to men who are fond of the sea. That is, the week-end sailings arranged at frequent intervals throughout the summer months. These usually consist of four or five boats crews who sail down the Thames round Canvey Island, Southend, etc., for the purpose of racing and boating practice. These sailings are also arranged during the holidays.

Then again, any man of the R.N.V.R. may spend up to three months afloat in H.M. ships during each year of service, taking part in the spring, summer and autumn cruises, on full pay (according to rating) and separation allowances where necessary.

In addition to the Wireless and Signal branches, vacancies also exist in the following:

Engine-room Artificers, Electrical Artificers, Ordnance Artificers and Motor Mechanics. There are many vacancies in the Seaman branch.

Artisans, comprising Shipwrights, Joiners, Blacksmiths, Plumbers and Painters.

The terms of service are, briefly, as follows:—

(1) *Enrolment* for a period of four years.

(2) *Ages* - (*a*) Telegraphists, Signalmen and Seamen—18 to 24.
- (*b*) E.R.A.'s, E.A.'s, O.A.'s, Motor Mechanics and Artisans—21 to 28.

(3) *Drills* - (*a*) During first year of service, 40 drills.
- (*b*) Each subsequent year, 24 drills.

(4) *Service Afloat*—At least 14 days in each year (on pay) must be spent afloat in H.M. ships.

(5) *Bounties* - Up to £5 per year can be earned by regular attendance at drill.

All uniform provided free.

The drill night on board H.M.S. *President* is Wednesday from 7 to 9 p.m., and other nights can be arranged to suit individuals where required.

Further particulars of service can be obtained by writing to the Ship's Office, H.M.S. *President*.

Other Headquarters of the R.N.V.R. are as follows:—

Clyde and Leith.—Whitefield Road, Govan, Glasgow.
Bristol.—37, Jamaica Road, Bristol.
Mersey.—H.M.S. "Eaglet," Salthouse Dock, Liverpool.
Sussex.—5, Victoria Terrace, Hove.
R.N.V.R. Drill Hall, Eastbourne.
R.N.V.R. Drill Hall, Newhaven.
R.N.V.R. Drill Hall, St. Leonards.
Tyne.—H.M.S. *Helicon*, Newcastle-on-Tyne.
H.M.S. *Satellite*, North Shields.

Questions and Answers

"S.H." (Cheshire) *asks how many turns of wire should be wound for high frequency transformers to cover a wavelength range of* 300 *to* 3,000 *metres.*

Five transformers should be made, the smallest having 80 turns, and the others 150, 250, 350 and 450. The No. 38 D.S.C. wire is suitable. The exact numbers of turns cannot be accurately predicted, as we do not know the exact sizes of the formers, and the capacity of the receiver.

"G.A.S." (N.W.3) *wishes to construct a loose coupler and asks* (1) *For particulars of the winding and the position of the tappings.* (2) *At what points should dead end switches be connected. The tuner is required to cover a wavelength range of* 300 *to* 3,000 *metres.*

(1) The former suggested is quite unsuitable. For the primary winding we suggest a former 4″ in diameter and 6″ long, wound full of No. 20 D.C.C. 19 tappings should be taken, and the tappings should be about equally spaced. We suggest you connect dead end switch points at the 5th, 10th and 15th tappings. The closed circuit winding may be 3″ in diameter and 6″ long, of No. 26 D.C.C., and 10 tappings should be taken to the 10 point switch.

(1) Without more information, we cannot say exactly why signals are not received unless you use reaction. It would appear that the circuit contains a large amount of resistance, and we suggest you go over all the connections and make sure that the insulation of the receiver is correct. The aerial insulation should be given attention, and the earth lead and earth connection should be examined to see that there is no high resistance at these points. All connections should be soldered. (2) We believe the telephone transformer is suitable for use in a valve receiver. (3) We do not think there will be any great gain in signal strength through the substitution of the bare copper aerial wire for a rubber covered wire. (4) We do not think the red vulcanite is so suitable as ebonite.

"H.S.A." (N.W.10) *refers to Fig.* 3, *page* 290, *June 3rd issue of "The Wireless World and Radio Review," and asks* (1) *What would be suitable values for the variable condensers.* (2) *What would be suitable values for the grid condenser and leak.* (3) *Which of the two types of proposed aerials will be most suitable.*

(1) The aerial tuning condenser should have a maximum value of 0·001 mfds., and the closed circuit tuning condenser 0·0005 mfds. The anode tuning condenser should have a maximum value of 0·0002 mfds. (2) The grid condenser should have a capacity of 0·0003 mfds. and the grid leak 2 megohms. (3) We suggest you use the insulators as shown in sketch "B" submitted. We suggest you use two large insulators in series at each end of the aerial, the insulators bei g connected in the supporting rope.

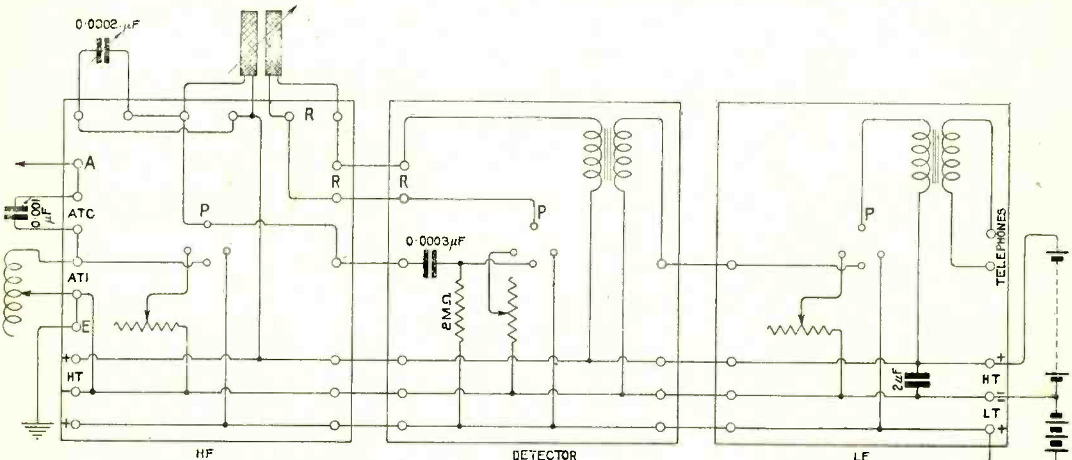


Fig. 1. **"J.H.W." (Cheltenham).** *The diagram gives the connections of a H.F. unit, a detector unit and a L.F. unit. The tuned anode method of H.F. amplification is used. The reaction coil is coupled to the anode coil. The aerial circuit is arranged with the tuning condenser and tuning inductance in series. A* 0.001 *mfd. condenser may be connected across the primary windings of both L.F. transformers.*

"J.H.W." (Cheltenham) *asks for a diagram of a three-valve receiver comprising one H.F., one detector and one L.F. valves, built on the unit principle.*

See Fig. 1.

"H.M." (Yorks) *asks* (1) *Why, with his receiver, no results are obtained unless reaction is used.* (2) *Whether a certain type of telephone transformer is good.* (3) *Is rubber covered wire better than bare copper wire for an aerial.* (4) *The panels are made of red vulcanite; is this material as suitable as ebonite.*

"NOVICE" (Warwickshire) *asks, with reference to the construction of a simple crystal receiver described recently in the columns of this journal, are the two basket coils connected metallically as in a variometer.*

The two coils are connected metallically as suggested. The circuit is as follows. The aerial coil is connected with the beginning of one of the basket coils; the end of that basket coil is connected with the beginning of the second basket coil, the end of which is connected with earth. We have therefore a simple series circuit comprising the aerial, the two coils connected in series, and the earth. The connections are so simple that you cannot go wrong. If the circuit does not tune to the wavelength you require with one coil placed partly on top of the other, the upper coil should be turned over, and its position then changed with respect to the underneath coil, and in this way the coupling is varied, and hence the inductive value of the two coils is varied.

"F.C." (Bristol) *refers to the diagram given on page 702, February 24th issue of this journal, and asks* (1) *Does each high frequency transformer require to be tuned with a variable condenser.* (2) *Is it possible for one to purchase a transformer with a reaction coil fitted.* (3) *The usual transformers purchased are marked I.P., O.P., etc. How should they be connected.* (4) *Will results be much affected if the condenser which is shown connected across the reaction coil is omitted, and if the cells shown in the grid circuit of the low frequency connected valves are omitted.*

(1) To obtain selectivity, the primary winding of the high frequency transformers may be tuned. Certain types of high frequency transformers, however, are self-tuned, and need only be variable by tappings. As suggested, the first high frequency transformer only may be tuned as desired. A suitable tuning condenser might have a maximum value of 0·0001 mfd. (2) We believe it is possible to purchase transformers of the plug-in type to which is fitted a reaction coil. The reaction coil simply consists of an ebonite former, to which is attached a handle which is mounted to a pivot, so that its position relative to the transformer is variable. The reaction coil should, of course, be quite separate from the high frequency transformer, and it should always be mounted so that the coupling between the reaction coil and the high frequency transformer may be varied. (3) The correct method of winding high frequency transformers depends very largely upon the method of winding and it is better to follow the manufacturer's instructions. If, however, the primary winding is wound on first and the secondary winding is wound on in the same direction, the terminal marked O.P. should be connected with plate, and the terminal marked I.S. connected with grid. (4) It is not absolutely essential to tune the reaction coil, but it is generally found that reaction is under better control when a small tuning condenser is used. With so many valves in circuit it is essential that cells should be connected in the grid circuit of the last valves as shown, otherwise amplification will not only be reduced, but the signals will be distorted.

"W.H.L." (Wilts.) *has a single valve receiver and asks* (1) *Whether the wiring is correct, and* (2) *Whether we can offer any suggestions for its improvement.*

(1) and (2) The wiring of the receiver is correct, but being only a simple detector valve receiver, the results obtained will not be very greatly better than the results obtained from a crystal receiver. No reaction is used. We suggest you add a high frequency connected valve if you wish to obtain greater signal strength. The method of adding high frequency connected valves is given in all issues of this journal.

"A.V.G." (Worcester) *submits particulars of several aerials which could be erected, and asks which arrangement would be best.*

We suggest you use the aerial 70 feet long and 30 feet high. A single wire aerial will probably give you better results than a multiwire aerial.

"R.A.H." (S.W.11) *asks* (1) *Whether we know of a book devoted to Control by Wireless.* (2) *What is the maximum power allowed by the Post Office for those who wish to transmit without a licence* (3) *Are the results obtained with the use of low temperature valves equal to those obtained when ordinary receiving valves are used.* (4) *What are the relative advantages of the various methods of coupling high frequency valves in your receiver.*

(1) We do not know of any book which deals with wireless control, though articles dealing with the subject are to be found in various electrical papers from time to time. (2) We do not think the Post Office allow anyone to transmit without a licence, irrespective of the power which it is proposed to use. (3) The results attained with low temperature valves are equal to those attained with the use of ordinary receiving valves, provided they are used in proper circuits. It is well known that the emission from the ordinary type of receiving valve is greatly in excess over that required for successive high frequency amplification. On the other hand, for low frequency amplification a good electron emission is required, because we are dealing with power in low frequency circuits. (4) The resistance capacity method of high frequency amplification is without doubt the simplest, and is very effective for wavelengths above about 2,000 metres. For shorter wavelengths the capacity of the receiver which acts as a shunt to the anode resistance assumes such importance that the resistance is no longer properly effective, with the result that the anode resistance in the anode circuit may fall from several thousands to several hundred ohms, with a corresponding decrease in amplification. For short wavelength work you may use either the high frequency transformer or the tuned anode method of coupling. In the case of the high frequency transformer we have two windings, which may be wound side by side, or they may be separated, and one or each of the windings tuned. In the case of the tuned anode method of high frequency amplification we have a coil now in circuit which is tuned to the wavelength of the signal, and the grid condenser and leak is used to couple the circuit with the input circuit of the next valve. It is apparent that it is much easier to make satisfactory tuned anode coils than tuned high frequency transformers, because in the former case we have only one winding to deal with, while in the latter case the two windings have each to be correctly proportioned. The results obtained so far as amplification is concerned are pretty much the same in each case, and on account of simplicity the tuned anode method is generally recommended.

D

"D.T." (S.E.22) *has wired a receiver according to the diagram given in the reply to* **"W.W." (Brighton)** *in the issue of November 11th, and has added one L.F. connected valve. He now wishes to add one high frequency valve with a switch so that the valve may be used when required.*

The diagram is given in Fig. 2, and the switch is connected so that the high frequency valve may be connected or disconnected as required. The reaction coil may be coupled with the tuned anode coil or with the closed circuit coil as required.

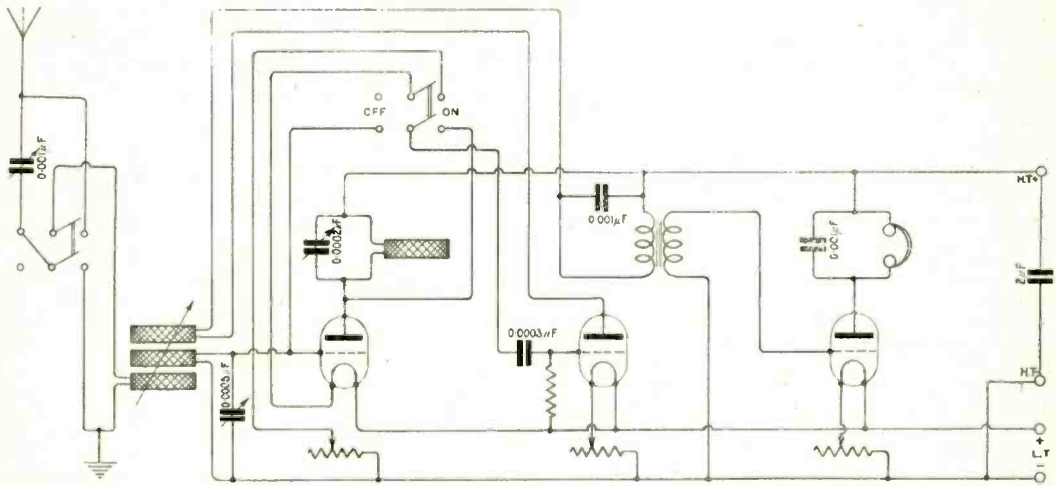


Fig. 2. **"D.T." (S.E.22).** *The diagram gives the connections of a three-valve receiver with one H.F., detector and L.F. valves. The tuned anode method of H.F. amplification is employed. A switch is provided to cut the H.F. valve out of circuit when desired.*

"S.B." (Lambeth) *asks (1) For a diagram showing how a detector valve and note magnifying valve are connected with a loose coupler. (2) Is the tuning of the set sufficiently fine to remove interference. (3) What voltage is required for Ora type valves.*

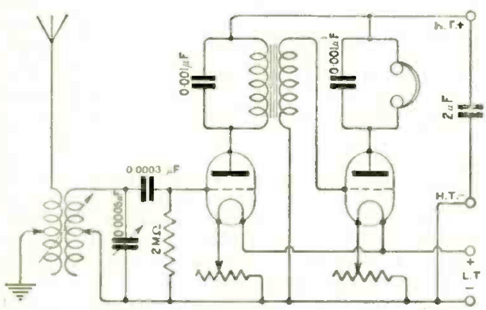


Fig. 3. **"S.B." (Lambeth).** *The diagram gives the connections of a detector and note magnifier with a loose-coupler. No reaction is used.*

See Fig. 3. (2) With careful adjustment you should be able to tune out interfering stations. (3) The filament requires approximately 4 volts and the anode requires about 45 volts.

"R.H.H." (Croydon) *asks (1) How he can reduce the noise which is heard in his receivers, and which he supposes comes from the broadcasting station. The noise is in the form of a continuous hum.*

The noise which you hear does not come from the broadcasting station, but is in all probability due to your receiver being located near power lines, which may, for instance, be either tramlines or telegraph wires, or the electric railway train. The noise may be induced, in which case the coils and intervalve transformers are taking up the noise, or there may be earth currents if you have a long earth lead, with resulting audible frequency currents flowing in the aerial circuit. We suggest you go over the earth and make sure that the insulated wire which runs from the earth terminal to the earth proper does not make an earth connection at any other point. This lead should be as short as possible, and the earth connection itself should be well constructed. If you are making connection with pipes which have a long run before they enter the ground, we suggest you bury a sheet of metal, such as a sheet of galvanised iron, 2′ 6″ wide and 4′ long, in moist earth. To the sheet solder several copper wires, and to their common point solder the earth wire. If the hum is being picked up through induction, the only thing to do is to screen the receiver by encasing the whole receiver in a box which is lined with metal or metal foil. You can try connecting the transformer cores with various terminals—for instance, + H.T. or − H.T. or with earth.

"ANDREW" (London) *refers to a particular make of portable aerial, and asks whether the aerial is suitable for use in conjunction with a crystal receiver.*

We do not wish to discuss the merits of the various types of aerials manufactured, but we would say that if you have a crystal receiver it is essential that the best possible type of outdoor aerial should be employed, and we suggest you construct an outdoor aerial upon standard lines, and do not use any other arrangement.

"R.N." (Fulham) *refers to a description of a single valve receiver in a recent issue and asks* (1) *Should he expect to obtain the London broadcast transmissions using this receiver.* (2) *Could another variometer be substituted for the one given in order to obtain a greater wavelength range.*

(1) You should certainly hear the transmissions of the London broadcasting station with this receiver. (2) It is not necessary to use a larger variometer. We suggest the use of a tapped cylindrical coil connected in series with the variometer. The coil could be 4″ in diameter and 4″ long, wound full of No. 22 double cotton-covered wire, with twelve tappings.

"K.L.B." (Bradford) *asks* (1) *Why tuning is so difficult.* (2) *How can he prevent his receiver howling.* (3) *Is it necessary for the condenser to be connected across the reaction coil.*

(1) The reason why tuning is so critical is because the coupling between the aerial and closed circuit is so very loose. The closed circuit coil should be made smaller in diameter than the aerial coil, so that the coupling may be tightened. (2) The receiver will not generate oscillations so readily if the grid leak is connected between the grid and +L.T. instead of −L.T. Alternatively, a potentiometer could be connected across the filament battery, and the sliding band of the potentiometer connected with one end of the grid leak. Varying the position of the sliding contact will then vary the potential applied to the grid of the rectifying valve, and you will be able to readily control the receiver. (3) It is not always necessary to tune the reaction coil with a condenser, but if any difficulty is experienced in obtaining fine reaction adjustments, we suggest you tune the reaction coil with a variable condenser having a maximum value of 0·0002 mfds.

"FIXED" (Newark) *asks for a diagram of a three-valve receiver with one high frequency, one detector, and one L.F. valves.*

We would refer you to the diagram given in reply to **"H.G.S." (Leicester)**, page 678, in the issue of February **17th.**

"SHORTIE" (Erith) *has a transmitter which works on a wavelength of* 440 *metres, and now wishes to work on the band of wavelengths* 180 *to* 200 *metres.* (1) *What alterations to the aerial and loading coil are necessary.* (2) *How may the power supplied to the aerial be determined, and also the radiation resistance.* (3) *Why is it the transmitter will not oscillate when connected according to the diagram submitted.* (4) *What is the best side tone arrangement.*

(1) It will be necessary to reduce the dimensions of your aerial tuning inductance, and to connect a fixed condenser of small value in the aerial circuit. We suggest you connect a 0·0002 mfd. condenser in the aerial circuit to reduce the wavelength. The condenser should be built so that it will withstand the high potentials which will be generated. The aerial is suitable, though if you could raise it a little it would be an advantage. You would probably find a great increase in the aerial current if you used a cage type aerial. We would refer you to the article entitled "The Antennæ," which appeared in two recent issues. In the diagram submitted the 0·002 mfd. fixed condenser is shown connected across the supply leads. We think you would find it an advantage if this condenser were removed altogether, and the 0·0002 mfd. condenser connected in its place. When using the transmitter for radiotelephony, one should be careful not to connect condensers so that they are across the choke coil. (2) The resistance of your aerial may be determined by the methods given in the articles referred to in (1). The radiation resistance of the aerial cannot be measured, but may be calculated approximately. (3) With the circuit rearranged according to the sketch submitted, we think the reaction coil requires to be larger than with the old arrangement, and we suggest you rewind the coil, using 100 turns of No. 26 D.S.C. The connections are quite correct. (4) The best side tone arrangement is probably a condenser connected in the aerial circuit, across which the telephones are connected. Two or three condensers may be connected in series, and the telephones connected across one of them. As you require a 0·0002 mfd. condenser in the aerial circuit, we suggest the use of two 0·0004 mfd. condensers connected in series. A pair of telephones should be connected across one of these condensers.

"C.R.L." (Somerset) *asks for dimensions of basket coils which may be used for the reception of signals having a wavelength up to* 2,600 *metres.*

We suggest you use a number of basket coils in series. Each basket coil may be wound with No. 28 double silk-covered wire on a former 1½″ in diameter, with 13 spokes. The spokes may be 3/16″ thick. Each coil should be wound with 60 turns. If six of these are connected in series and tapping points taken from their connections, you will be able to cover the wavelength required when a 0·0005 mfd. tuning condenser is used. The coils should not be mounted touching, but should be separated about 1/10″ with a spacing washer.

"W.D.J." (Liverpool) *asks with reference to the article entitled "Making a Simple Crystal Receiver," is it correct that one is required to have a certain knowledge of wireless before an experimental licence will be granted, and on the other hand, if one purchases a broadcast licence, a receiver which bears the stamp "B.B.C." must be used.*

We suggest you apply for a licence, stating that you wish to construct a receiver which has been described in *The Wireless World and Radio Review.* We believe the Post Office is now issuing a third form of licence which will be granted to those who wish to construct their receiver. An experimenter's licence is of course only granted to those people who wish to conduct experimental work or to carry out some specific line of research work. A broadcast receiver is only granted to those persons who propose to use a receiver stamped "B.B.C." If you communicate with the Post Office there will no doubt be a little delay before a licence is granted, but we think you may be assured that eventually you will be granted a licence. It is well, of course, to make application before the actual construction of the receiver is commenced.

"J.H." (Yorks) (1) *Submits particulars of a bobbin which he proposes to use in the construction of a low frequency transformer, and asks for suitable windings.* (2) *Is the proposed construction for a high frequency transformer suitable.* (3) *Which of the two arrangements submitted is best.* (4) *With a two-circuit tuner, if* (a) *the two windings are connected in series, and the distance between the windings is varied, is a variometer action obtained*; (b) *if the two coils are in separate circuits, will a variation of tuning in one circuit alter the wavelength of the coupled circuit.*

(1) The bobbin is of suitable dimensions for an intervalve transformer, and we suggest you wind the primary winding with No. 42 S.S.C. wire to fill one-third of the bobbin. The secondary winding should be wound on top, and No. 46 S.S.C. wire should be used. For a telephone transformer we suggest you wind 6,000 turns of No. 42 S.S.C. wire for the primary, and 1,200 turns of No. 34 S.S.C. wire for the secondary. (2) The proposed arrangement for the construction of a high frequency transformer is suitable, although we suggest you wind the first two slots with 100 turns of No. 38 S.S.C. wire, and the remaining slots with 200 turns of No. 38 S.S.C. wire. One primary and one secondary should be wound in each slot. It is not necessary to connect switches so that the portion of the transformer not in use is completely disconnected. The transformer will cover the wavelength range desired. (3) We suggest the scheme sketched in your Figure "A" submitted. We suggest you wind a primary winding with No. 24 double cotton-covered wire, and the secondary with No. 28 D.C.C. wire. The reaction coil may be wound with No. 30 D.C.C. wire. The numbers of tappings suggested are correct. A dead end switch could be connected if desired. (4) Connecting the two windings of a loose coupler in series and then varying the position of one coil with the other coil will change the total inductance of the two windings, and therefore a variometer action is obtained. It is possible to tune your receiver in this manner. If the two coils are connected in separate circuits, changing the wavelength of the circuit with which one coil is connected will slightly vary the wavelength of the coil connected in the second circuit, and therefore another small tuning adjustment should be made.

"E.J.C." (E.18) *asks* (1) *With reference to the Fig. 4 in the issue of "The Wireless World and Radio Review" of February 17th, will the particulars, inter-valve and telephone transformers, given in reply to* **E.D. (Belgium)**, *be suitable for use in conjunction with the receiver given in Fig. 4.* (2) *Are 1,000 ohm telephones suitable.* (3) *Is the 2 megohm resistance shown in the diagram a potentiometer or a grid leak.* (4) *What will be suitable dimensions for coils for use when receiving short wavelength signals.*

(1) The values given in reply to **E.D. (Belgium)** are quite suitable for use in your case. (2) We do not recommend the use of 1,000 ohm telephones, especially when they are to be connected directly in the anode circuit of the valve. We suggest 4,000 ohm telephones. (3) The 2 megohm resistance given in the diagram is a grid leak, and should be purchased. It need not be variable. (4) We suggest you use an aerial coil equivalent to a No. 75 honeycomb coil. The closed circuit would then be a No. 50, and the reaction coil No. 35.

"W.K." (Lee, S.E.12) *asks* (1) *Why, with two basket coils which are of equal dimensions he is able to pick up the* **2 LO** *transmissions when the coils are separated, but the transmissions cannot be heard when one coil is placed close to the other.* (2) *How does one identify stations which are sending out signals.*

(1) When two coils which are connected in series are held together the magnetic field of one coil interlinks with that of the other coil. If the two coils are so placed that the magnetic fields assist each other then the inductance of the coils will be in excess of that of the sum of the two coils. If the coils are placed so that they oppose one another then the resultant inductance will be less than the sum of the separate inductance. Changing the inductance in circuit in this manner naturally changes the wavelength. (2) We suggest you purchase a copy of the "Year-Book of Wireless Telegraphy and Telephony," price 6s. (office of this journal). It will be found that the call signs of the transmitting stations are included in the list of transmitting stations in the book.

"W.N.S." (Southsea) *submits particulars of his receiver, and asks whether we can suggest why it is so difficult to tune in signals on various occasions.*

We consider you have a loose connection in the receiver. We suggest you examine the receiver and test out each portion and make sure that there is no disconnection in any of the windings. In addition, the grid leak should be examined, as very often the grid leak will cause a good deal of trouble. The connections with moving parts of the receiver, such as the tuning condensers, may be faulty. We suggest you examine this to make sure they are in good condition.

NOTE.—*This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules:—* (1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* **The Wireless World and Radio Review,** *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) **Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.** (7) *Four questions is the maximum which may be sent in at one time.*