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"THE RED HERRING."

It is a matter of considerable surprise to us that, in commenting upon the Wireless Bill, the daily Press should have paid so much attention to the clause relating to the right which may be exercised by the Law to institute a search where there is good reason for believing that an unlicensed wireless station has been installed or is in operation. To draw so much attention to this point is but to accentuate the danger of overlooking other sections of the Bill which are of a far more serious character.

In a recent editorial we pointed out that the Postmaster-General, in assuming responsibility for controlling wireless, takes on at the same time the task of seeing that the control is effective, and that it is sufficiently so to protect the peaceful user of wireless apparatus from malicious interference by other users. If the Postmaster-General is to have such control (and obviously it must be vested in some authority), it is only reasonable that he should have facilities for bringing to book those who disregard his authority by installing apparatus which is unlicensed.

We have no particular quarrel with that clause, though all of us would naturally prefer that "pirates of the ether" did not exist, and that the moral status of users of wireless, as a whole, was such that no occasion should arise for the right of search to have to be put into force.

As to the Bill itself, the amateur has reason to feel very satisfied with the amount of opposition which has been aroused to its quiet passage through the House. There seems now to be every probability that attention will be called to the clauses which in our editorial comments of last week were referred to as obnoxious both to the interests of the amateur and experimenter and to the progress of the development of wireless in general.

We note with satisfaction that the Institution of Electrical Engineers has addressed a letter to the Postmaster-General objecting to the pushing forward of the Bill without adequate opportunity being given for a proper discussion on the question of how it would affect wireless development and wireless interests generally. On another page in this issue we reproduce the text of this letter.

Those amateurs in particular who are interested in transmission will recall the objections which were raised to a surprising restriction which some time ago was included in the terms of the permits to transmit, issued by the Postmaster-General. It was expressly stated that transmissions must not extend beyond the frontiers of Great Britain and Northern Ireland. Such an absurd restriction was at once disputed by amateur organisations, and, in point of fact, the terms were subsequently modified. It should be remembered, particularly in the light of this instance, that if the present Bill goes through, no amount of subsequent objection to regulations made by the Postmaster-General is likely to be of any avail, because those regulations, when once they have slipped through Parliament, will assume the force of Law.

For some years now the Radio Society of Great Britain and amateurs throughout the country have recog-

CONTENTS.

nised that sooner or later there was bound to come a fight for existence, because it was realised that the amateur was not welcomed by other users of wireless. The present Bill has constituted the ultimatum to the amateur, and it is up to everyone who is interested in maintaining freedom for experimental work to ensure that the Bill does not succeed. If the clauses in the present Bill had attacked the interest of the amateur alone, it might have been a very difficult matter to arouse sufficient opposition, but, fortunately, the Postmaster-General has gone further and has encroached upon the interests of many other sections concerned in wireless or in apparatus associated with the science. This has done much to strengthen the amateur's position, and will materially assist him in the commencement of the struggle.

Whilst we feel satisfaction at the stir which has been aroused in connection with the Bill, we must not "rest on our oars," so to speak, and assume that the battle is won. This is by no means the case, and from now on until the object is achieved every amateur should do his part in bringing to bear what influence he can in assisting to prevent the signing of what would, in point of fact, constitute his death warrant.

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THE SUPER-HETERODYNE RECEIVER.

IN the present issue is given the design for a super-heterodyne receiver, which we are sure will be of very great interest to our readers. The principles underlying the operation of this system of reception have been discussed theoretically in recent numbers, and, judging by correspondence which we have received, the articles have aroused a great deal of interest and a demand for a description of a complete set.

There are one or two points which make this system of reception unique in comparison with any other of the known methods which may be adopted. For instance, the selectivity of a super-heterodyne is achieved by employing an arrangement quite distinct from other receiving circuits, and the enormous degree of selectivity which can be obtained is probably not realised by the average amateur until he comes to reason out for himself the principle of operation. By way of illustrating what is meant, one can take an example. Suppose we desire to receive on a wavelength of 100 metres, which corresponds to a frequency of 3,000,000 cycles. If our tuner is adjusted to this frequency and the oscillator to 3,050,000 cycles, the intermediate frequency will be 50,000 cycles, corresponding to a wavelength of 6,000 metres. We can now see what will happen if a signal which is tuned to 99 metres, or one meter difference from the station desired, reaches the aerial. Here the oscillator frequency will remain at 3,050,000 cycles, whilst the interfering signal will be 3,030,300 cycles, and, therefore, the intermediate frequency resulting from the two will be 19,700 cycles, corresponding to a wavelength of 15,000 metres. Now it is not necessary for the intermediate frequency stages to be more than moderately selective for it to be possible to discriminate between 6,000 and 15,000 metres, and yet we find that we can get selectivity of this order with a difference of only one metre between the two signals received. By shielding the intermediate stages—that is to say, those operating on the longer wavelength—risk of direct picking up of stations on that wavelength can be overcome. In addition, the simplicity of control is probably greater than it is possible to get with other types of receivers with anything approaching the same efficiency.

Many persons appear to be under the impression that the super-heterodyne system of reception is unsatisfactory for telephony, and that pure speech and music cannot be reproduced by this method. It can be shown theoretically that such is not the case, but that one can expect to obtain quality equal to that obtainable when other systems of reception are employed. The set described in this issue by W. James has given the most excellent results on test, and the design is put forward with the utmost confidence that readers will be agreeably surprised at the results which can be obtained with such an arrangement.

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THE CLASSIFICATION OF VALVES.

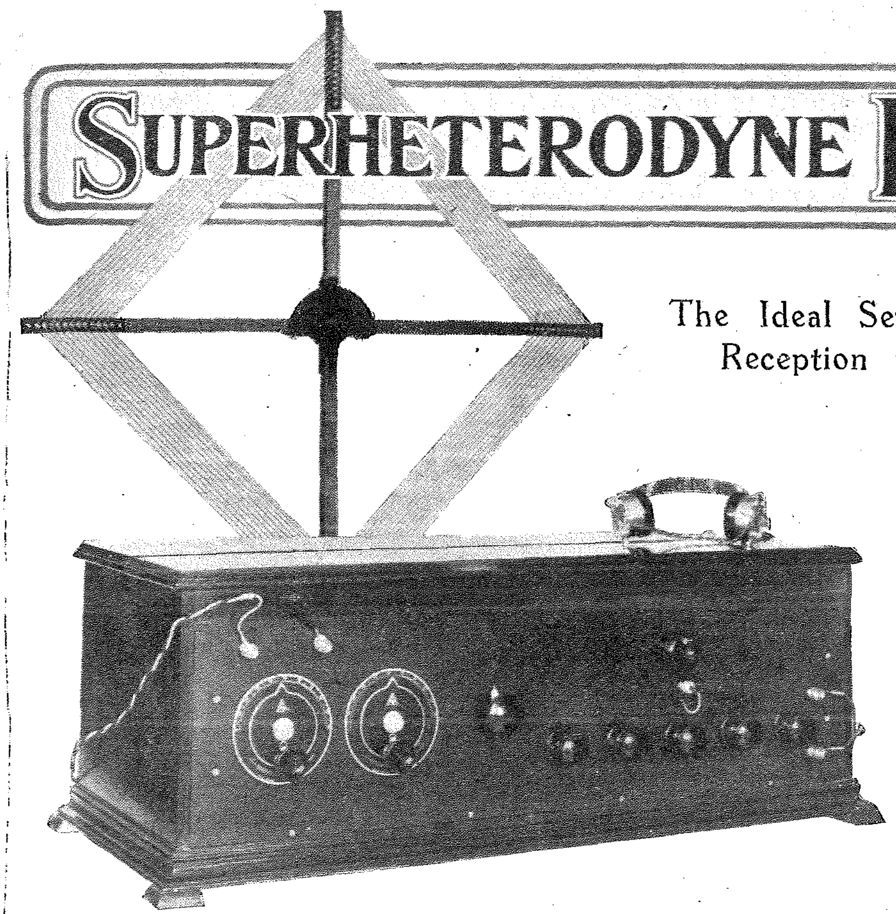
SO rapid has been the advance in development of wireless reception that we have to-day quite a multitude of different types of valves, each one having been designed for some specific purpose and to meet specialised requirements. In the matter of prices of valves, there are some surprising anomalies, apart from the fact that we believe, as we emphasised editorially some months ago, that the average price of valves to-day is far in excess of what it should be, particularly in view of the enormous increase in production and consumption.

But the point which we wish to refer to here is that the average user of valves to-day is often unable to pick out the valve most suitable for his purpose without having to make a great many enquiries beforehand. In our contemporary, "The Wireless Trader," a suggestion is put forward which, whilst it is there intended to appeal principally to the valve manufacturers themselves, is of equal importance to the general user. The comment in question points out that whilst several of the important makers of valves put on the market types with practically identical characteristics, yet they have not systematised the classification in any way, and many similar valves have quite different and misleading key letters.

We have, for instance, "B." for the B.T.H. valves, "D.E." for the Marconi-Osram, and "D.F.A." for Mullards. A type of valve, for example, which is used for power purposes, taking 0.25 amperes at 5½ to 6 volts, we find classified as "B.4," "D.E.5," or "D.F.A.1" respectively, by the different makers, whilst the dull emitter 60-milliampere types of the same makes are classified as "B.5," "D.E.6," or "D.O.6."

It seems a pity that the valve manufacturers, who must already collaborate in policy to a certain extent, do not adopt some more useful system of classification. It would enable the user to recognise the type of valve at once and differentiate between one class and another. It is suggested that the classification could, at the same time, serve the additional purpose of indicating the characteristics of the valve; thus a valve designed for 6 volts and taking 0.25 ampere might be described as "Type 625," and it is also suggested that a letter following the figures might be used to give an approximate indication of the amplification factor of the valve.

SUPERHETERODYNE RECEIVER



The Ideal Set for Long Range Reception with Selectivity.

PART I.

This receiver employs seven valves, and was designed to have the maximum usable sensitivity. Although there are only two tuning controls, the selectivity is such that stations having a wavelength a few metres apart may be separated with ease. The factor which decides whether a station will be heard or not is simply the ratio of its strength to that of atmospheric and other noises. The set is fairly easily constructed, and the wiring, as shown by the large diagram printed on a separate sheet, is straightforward.

By W. JAMES.

THE principles underlying the design and operation of super-heterodyne receivers have been fully dealt with by the writer in recent[1] numbers of *The Wireless World*, but perhaps it is advisable to note here a few of the main points.

In the first place, the reader will know, either by actual experience or by repute, that it is extremely difficult to employ effectively several stages of high-frequency amplification to magnify short wavelength signals. By "short wavelength" is meant the broadcast band of wavelengths and below, or, say, those lower than 600 metres. The difficulty is to secure a reasonable degree of amplification and selectivity with stability and ease of operation. If the set is to be effective, it is usually necessary to employ circuits which may be sharply tuned to the wavelength of the signals to be magnified; then the difficulty of tuning so many circuits is experienced, and usually the amplifier oscillates unless the controls are very skilfully handled.

The instability is largely due to the stray couplings in the amplifier, and of these probably the self-capacity of the valves and the capacity of the wires and components are mainly responsible. The effect of these capacities becomes more important as the wavelength is reduced, because the current which passes through a condenser increases directly as the wavelength is reduced; hence the feed back or reaction effect increases inversely with the wavelength.

Secondly, it is a fairly easy matter to design an amplifier to magnify relatively long wavelength signals, say those between 2,000 and 10,000 metres. The circuits of the amplifier may be sharply tuned if the number of controls is not objectionable, or couplings of the aperiodic or semi-aperiodic type may be employed, and still a reasonable degree of amplification and selectivity be obtained. The problem is enormously simplified when the amplifier is to operate on one wavelength only. Then the circuits can all be adjusted to give maximum amplification on that wavelength, and by attending to the design the selectivity of the amplifier as a whole may be made as required. Reaction may then be introduced without fear of producing an instrument which is erratic in its behaviour and difficult to control.

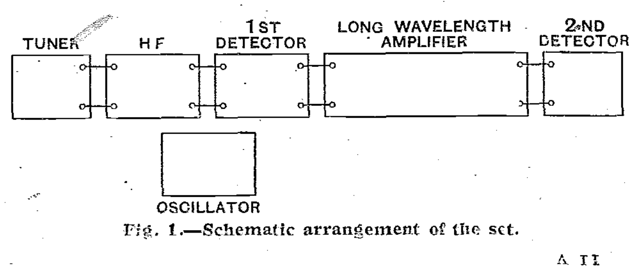
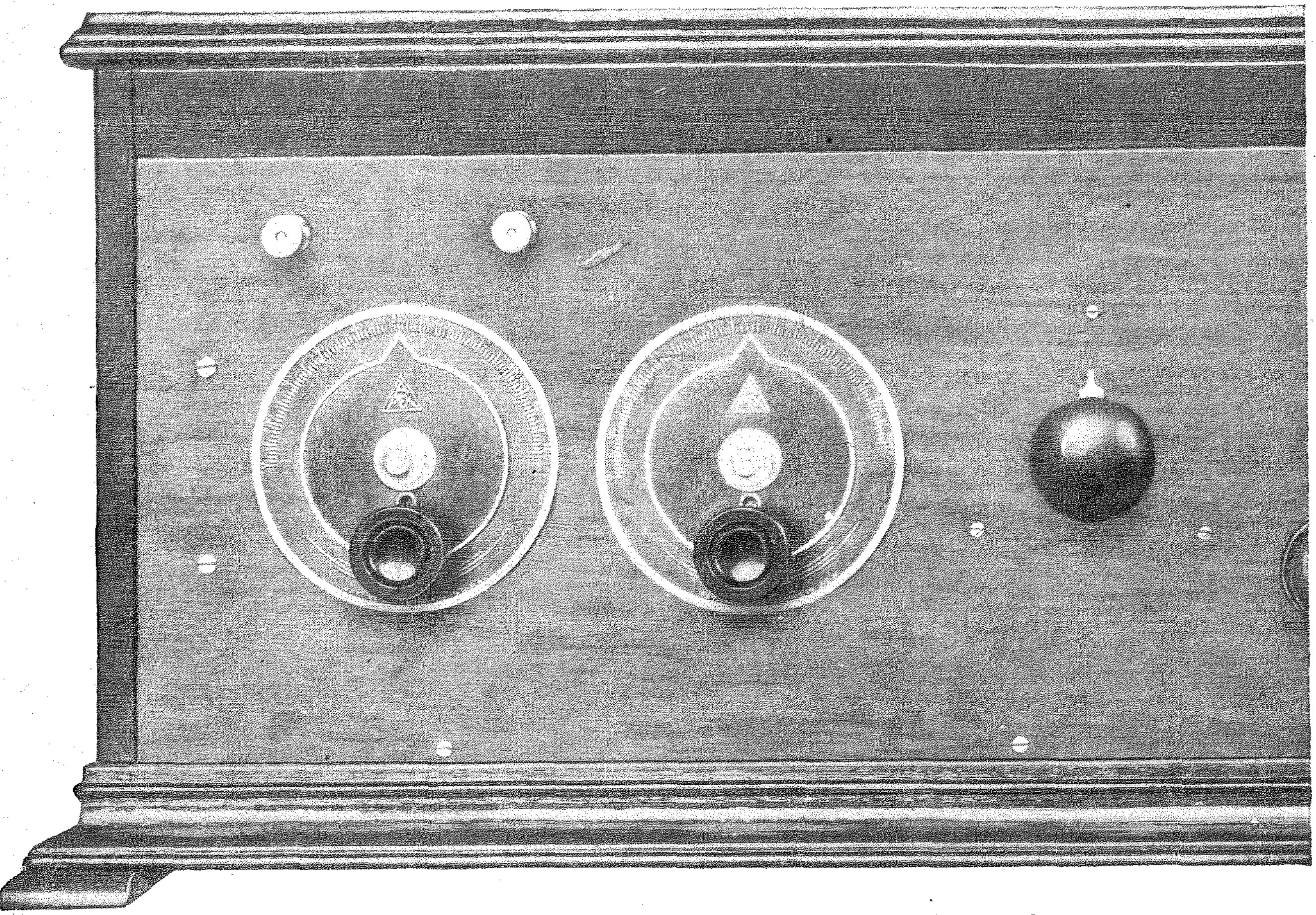


Fig. 1.—Schematic arrangement of the set.

[1] *The Wireless World.* December 31st, January 7th, 14th, 21st, and 28th.



The super-heterodyne receiver contains a device for changing the wavelength of the incoming short wavelength signals into long wavelength signals, so that they may be effectively amplified by a carefully adjusted long wavelength amplifier. The principle of the receiver illustrated here may be followed by referring to the schematic diagram of Fig. 1. Incoming signals are selected by the tuner, which may consist simply of a frame aerial and tuning condenser, or an open aerial and a coupled circuit, and are passed to the first valve, which operates as a H.F. amplifier. This valve is coupled to the first detector through an untuned transformer.

Coupled to the grid circuit of the first detector is an oscillator which may be adjusted to deliver oscillations of the required wavelength to the grid of the detector. In the grid circuit of the detector, therefore, we have two oscillations—those representing the incoming signal which we wish to amplify, and those due to the local oscillator.

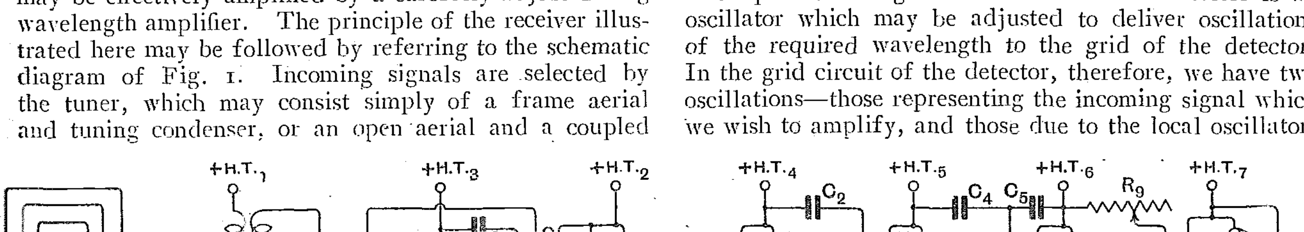
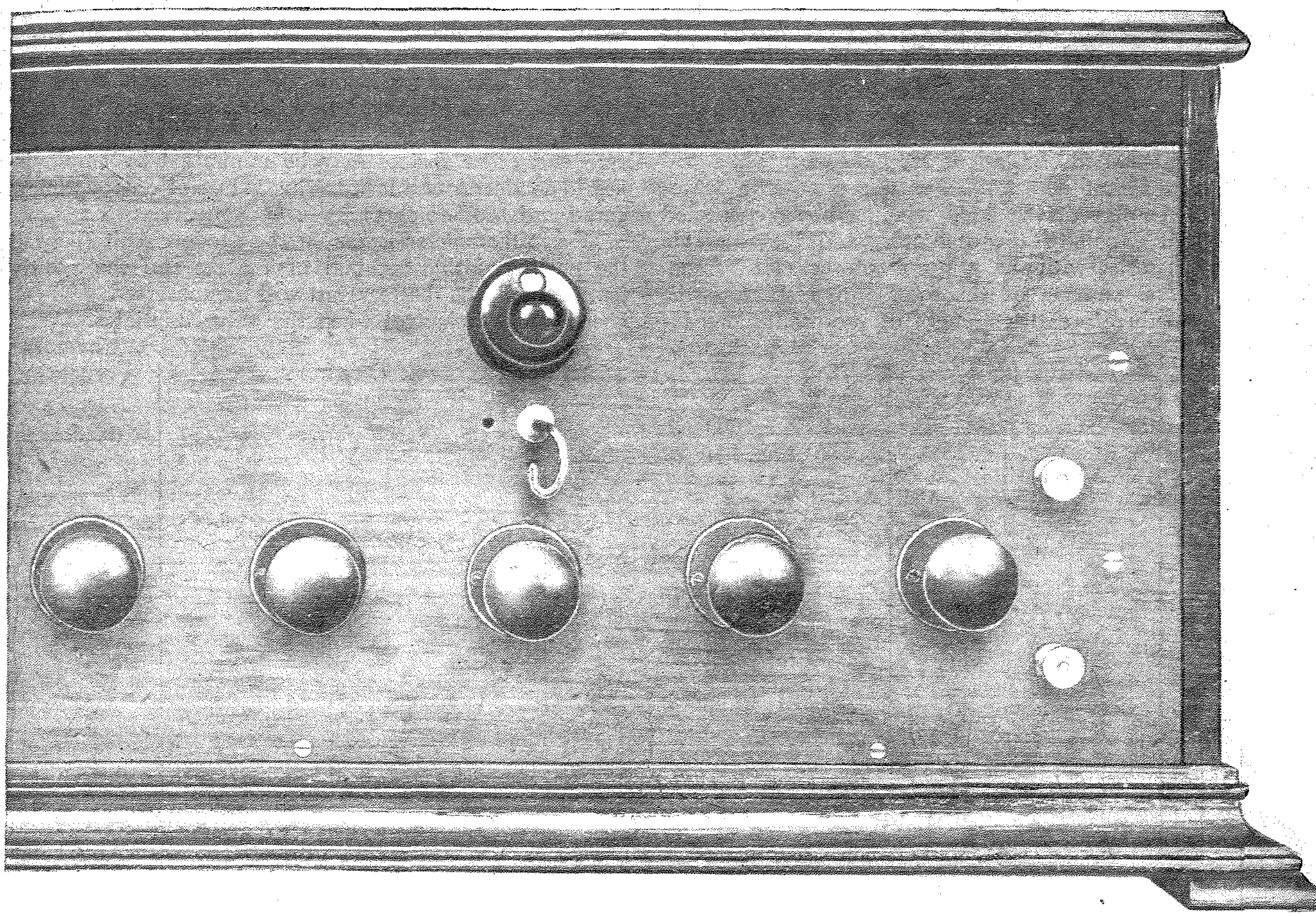


Fig. 2.—Connections of the receiver. A, B = terminals for frame aerial or tuner; C_F = 0·0005 mfd. tuning condenser; T = untuned H.F. transformer; C_O = 0·0005 mfd. tuning condenser; G, E = coils of oscillator; L, L_1, L_2, L_3 = coils of anode circuits of long-wave amplifier; C, C_7 = tuning condensers (fixed condensers); C_8, C_9 = grid condensers; R_1, R_2, R_3, R_4 = grid leaks; C_1, C_2, C_3, C_4, C_5, C_6 = 1 mfd. condensers; R_9 = regulating resistance.



By adjusting the oscillator to a suitable wavelength, or frequency, the effect produced will be to set up oscillations of a different wavelength in the anode circuit of the detector. Thus, if the incoming signal has a wavelength of 300 metres, or a frequency of 1,000,000 cycles per second, and the oscillator is set at 1,060,000 cycles, the currents flowing in the anode circuit of the first detector will have a frequency of 60,000 cycles, or a wavelength of 5,000 metres.

If the oscillator is set at 1,150,000 cycles, the wavelength of the currents produced is 2,000 metres.

These currents are then magnified by the long wavelength amplifier, and finally rectified by the second detector and passed through the telephones or a note magnifier as desired.

The theoretical connections of the receiver are given in Fig. 2. It will be seen that seven valves are employed. The first valve, V_1, is the high-frequency amplifier; V_2, the first detector; O, the local oscillator; V_3, V_4, and V_5 the valves in the long wavelength amplifier, and V_6 the second detector.

The Amplifier and First Detector.

Probably the most important part of a super-heterodyne receiver is the tuner and first detector. No reaction is employed to sharpen the tuning of the tuner, hence it is important so to design the circuit that reasonable selectivity is obtained. If an ordinary valve detector with grid condenser and leak is connected to a tuner, the selectivity is reduced because of grid current; hence it is desirable to employ the anode method of rectification, to give the grid of the detector a normal negative bias, and to adjust the anode voltage to a suitable value.

Maintaining Selectivity.

The advantages of employing a stage of H.F. amplification between the detector and tuner are briefly that the tuning is made sharper; *i.e.*, the selectivity is improved, the tuning of the tuner is not affected by adjustment of the oscillator, and currents from the local oscillator do not flow in the aerial circuit. An additional advantage, of course, is that the signal is amplified before it reaches the first detector. The degree of amplification, however, is not very great; probably it varies between two and three over the wavelength (250-550 metres) for which it is designed. A dry cell, B_1, is employed to give the grid of the amplifying valve a negative bias.

Aperiodic high-frequency transformers work best when valves of the low capacity class are employed; hence the writer uses a D.E.V. as the amplifier, and a D.E.Q. for rectification. These valves require a filament heating current of about 0.25 ampere at 3 volts, and as the remaining valves employed in the set are of the 6-volt class, the D.E.V. and D.E.Q. are connected in series and controlled by a single rheostat. Another type of valve that has a low capacity is the D.E.3, which takes a filament current of 60 milliamperes at 3 volts; two valves

Superheterodyne Receiver.—

of this class could therefore be employed in series. If other valves are used they should be connected in parallel in the usual manner, but the writer wishes to emphasise the advantages to be derived by employing low-capacity valves as the amplifier and first detector.

Locally generated oscillations are induced into the grid circuit of the first detector. For this purpose a vario-coupler is employed, the fixed winding being connected in the grid circuit of the oscillator, and the rotatable winding in series with the grid coil of the H.F. transformer. The position of the rotor with respect to the stator, and therefore the strength of the oscillations induced into the grid circuit, may be varied by turning a knob fastened at the shaft of the rotor.

The Oscillator.

The oscillator has a tuned grid circuit comprising a plug-in coil G in series with the stator winding of the vario-coupler and a variable condenser C_0. Coupled to the grid coil is another plug-in coil E, connected in the anode circuit of the valve. This coil should be connected in a particular way; no oscillations will be produced if the connections are reversed. A D.E.5 valve with an anode voltage of 30 is employed, and the grid return wire connects to the negative side of a single dry cell, B_2, making the grid bias about 1½ volts negative. This valve has a separate anode battery, and its own filament rheostat.

Wide adjustment of the rheostat changes the wavelength of the oscillations generated, but this does not matter, as the rheostat is usually tuned to a point where the filament temperature is normal, and slight variations from this position do not produce a noticeable change in the wavelength. The effect of the changes in filament temperature and other factors may be minimised by employing a grid condenser and leak having values of 0.00025 microfarad and 100,000 ohms.

If a milliammeter is put in the anode circuit (between the positive H.T. terminal of the set and the positive terminal of the battery) it will be observed that the anode current changes when the valve oscillates. When a No. 50 coil is used in the grid circuit and a No. 75 coil in the anode circuit, the anode current increases when the valve oscillates (no grid condenser and leak being used). The value of the anode current is usually not the same for all settings of the condenser tuning the grid circuit; in the writer's set the anode current is a maximum when the condenser is set at its maximum value, and falls off as the capacity is reduced.

A 1 microfarad condenser, C_1, is connected across the anode battery of the oscillator.

The High-Frequency Amplifier.

There are three stages of high-frequency amplification, and the tuned anode method of coupling is employed with D.E.5B. valves. These valves have an amplification factor of 20, an impedance of 30,000 ohms, and

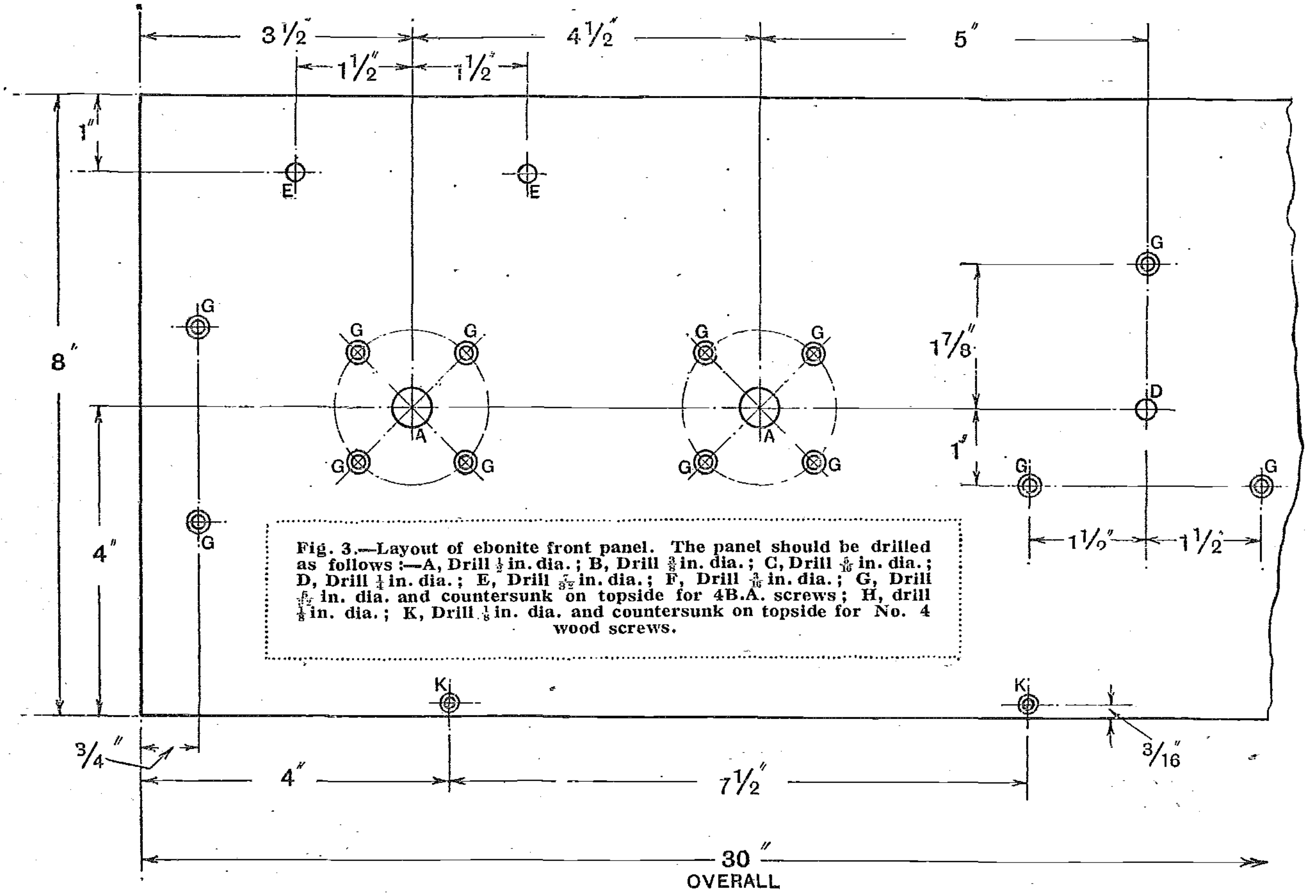


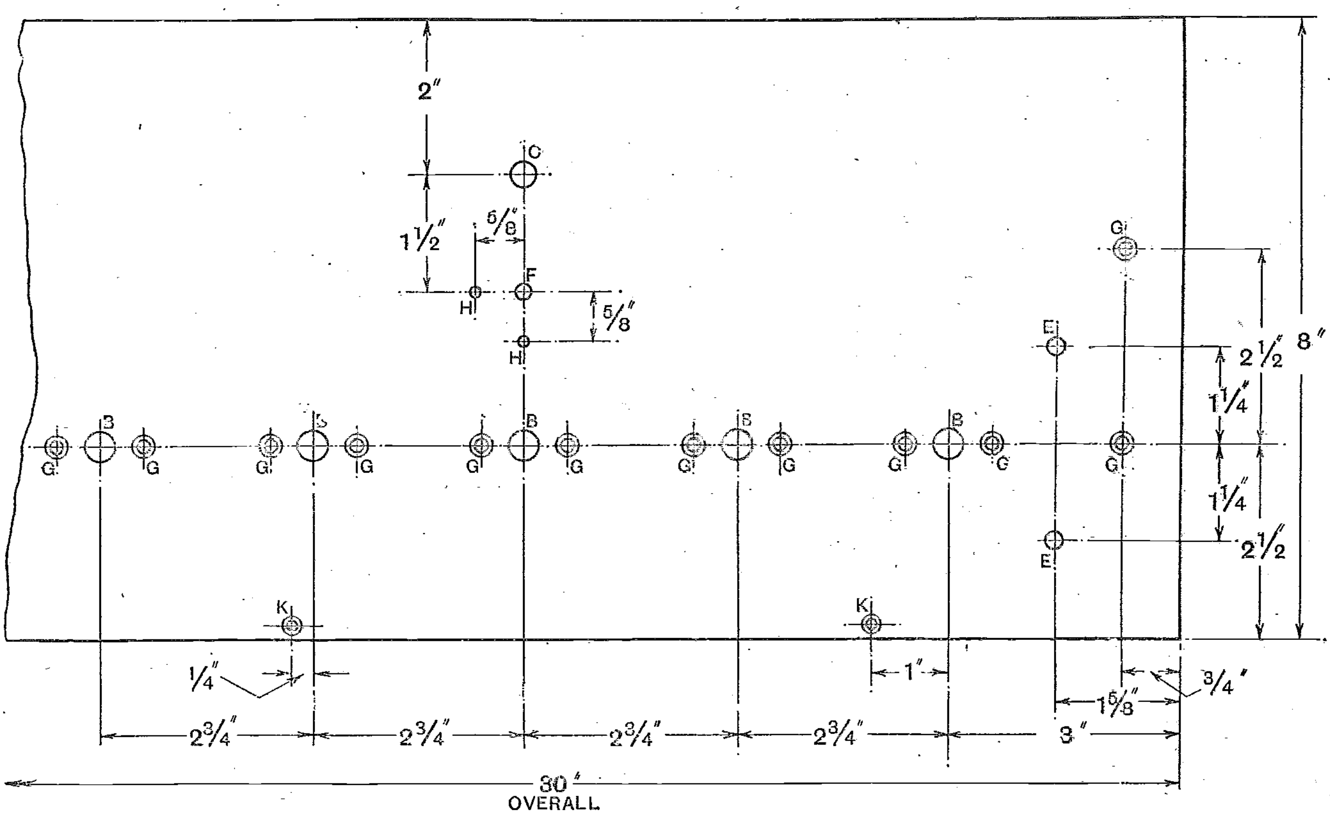
Fig. 3.—Layout of ebonite front panel. The panel should be drilled as follows:—A, Drill ½ in. dia.; B, Drill ⅜ in. dia.; C, Drill 5/16 in. dia.; D, Drill ¼ in. dia.; E, Drill 7/32 in. dia.; F, Drill 3/16 in. dia.; G, Drill 5/32 in. dia. and countersunk on topside for 4B.A. screws; H, drill ⅛ in. dia.; K, Drill ⅛ in. dia. and countersunk on topside for No. 4 wood screws.

Superheterodyne Receiver.—
require a filament current of about 0.25 ampere at 6 volts. Valves of this class have a high internal capacity; hence some difficulty would be experienced in securing a high degree of amplification with stability if the amplifier were adjusted to too low a wavelength. Tests proved that high amplification and ease of operation could be secured at about 7,000 metres; hence the amplifier circuits were all adjusted to about this wavelength.

It should be remembered that the long-wave amplifier does not require to have every stage sharply tuned, but that a carefully tuned circuit (often called a filter) should be employed somewhere in the amplifier. In this set the sharply tuned circuit is connected in the anode circuit ful long-wave Morse Stations. The anode coils and their condensers in this set are housed in metal boxes.

The H.F. stages are coupled through grid condensers (C_8) and leaks (R_1, R_2 and R_3), having values of 0.005 microfarad and 1 megohm respectively, and the grid return wires are connected through a single dry cell (B_3) to the sliding contact of a potentiometer. Thus the normal potential of the grids may be adjusted to suit the value of anode voltage applied to the valves.

A variable high resistance R_9 is employed to give control of the volume. When signals are too loud, this resistance may be connected across the tuned anode circuit of the last valve by putting a Clix plug into a socket, and the volume reduced by adjusting the resistance. This resistance also acts to control the degree of regeneration;



of the first detector; the three other circuits have coils wound with finer wire, and much smaller tuning condensers are employed.

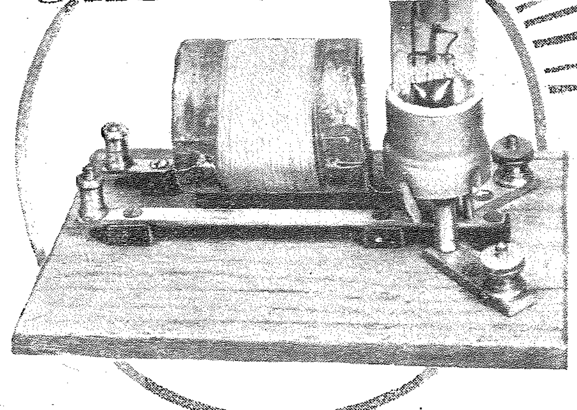
The sharply tuned circuit, C, C_7, L, consists of a No. 400 Burndept coil (L) shunted by a 0.001 fixed condenser (C_7), and a 0.0002 Marconiphone fixed condenser (C). The Marconiphone condenser is of the tubular type, and consists of a brass tube having a covering of mica, and an outer layer of tinned copper wire. Its capacity may be altered by adjusting the number of turns of wire, and it forms a very handy "variable" condenser. One of these condensers is connected across each of the anode coils, and adjusted to bring each anode circuit into resonance.

It is necessary to screen the coils of the H.F. amplifier, or interference will probably be experienced from power- when the filament current and the value of anode and grid voltage are such that the set is oscillating, the value of this resistance may be reduced to a point where the set stops oscillating. Normally, of course, when searching, the filament rheostat is adjusted to such a point that the set is just not oscillating.

The Panel.

The panel is of ebonite, measuring 30in. × 8in. × $\frac{5}{16}$in., and mounted on it are the two tuning condensers, the vario-coupler, four filament resistances, the potentiometer, the adjustable high resistance, four terminals (two for the frame aerial or tuner and two for the telephones), and a Clix socket and plug. These are arranged as indicated by the photographs and the drawing of the panel. Full constructional details will be given next week.

The VALVE as an AMMETER



Describing Three Methods of Measuring High-frequency Currents.

Those who have attempted to measure H.F. currents with the ordinary hot-wire type of ammeter realise how difficult it is to obtain satisfactory results. To them the methods of measurement described below will be of special interest.

By A. CASTELLAIN, B.Sc., A.C.G.I.

A VALVE may be used to measure high-frequency currents in at least two ways, namely, by measuring the voltage drop, by means of a valve voltmeter, across a suitable resistance which is carrying the current to be measured, and by passing the current through a valve filament and measuring the resulting emission of electrons.

In the first method the resistance must, of course, be non-inductive and non-capacitive and be accurately known, which entails the resistance being of fine, straight wire or group of wires in a symmetrical form.

The Valve Voltmeter.

The valve voltmeter, which has already been described in *The Wireless World*,[1] has for ordinary purposes a useful range of 0.5 – 3 volts, so that a value of resistance must be chosen which will give a voltage between these values for the expected current.

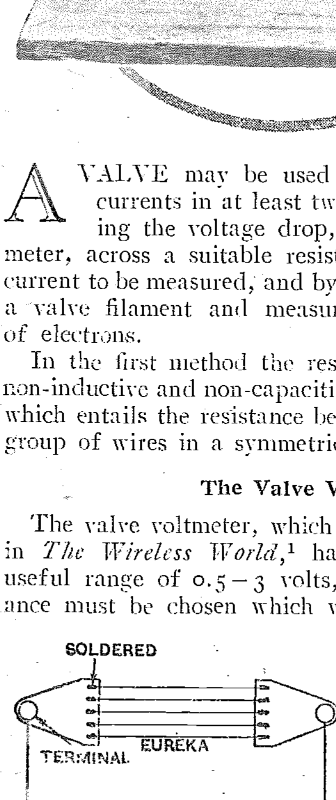


Fig. 1.—A resistance suitable for H.F. work.

Thus, if the current to be measured is between 0.5 and 1.5 amperes, a suitable resistance is about 2 ohms, and could consist of a group of fine Eureka wires in parallel, as shown in Fig. 1.

The reason for making the resistance of fine wire is to get a resistance whose value is very nearly constant over a large frequency range, so that the instrument can be calibrated at low frequency—50 cycles, say—and the calibration relied on at high frequency to be reasonably accurate—at any rate, to be more so than the usual metal-cased hot-wire meter.

The drawbacks to this method of current measurement may be summarised briefly thus :—

(1) The voltmeter is a fairly bulky instrument with its batteries—much more so than the usual hot-wire meter—and therefore the resistance must be inserted at a point in the circuit which is at earth potential. (This applies to most H.F. current instruments.)

(2) This method is not suitable for measuring small H.F. currents, as the resistance which would have to be inserted is usually many times the resistance of the rest of the circuit, and thus the original current would be considerably reduced.

Of course, there are cases in which an extra 100 ohms or so will not matter, and when this is the case currents of the order of 5 milliamperes may be measured by this method.

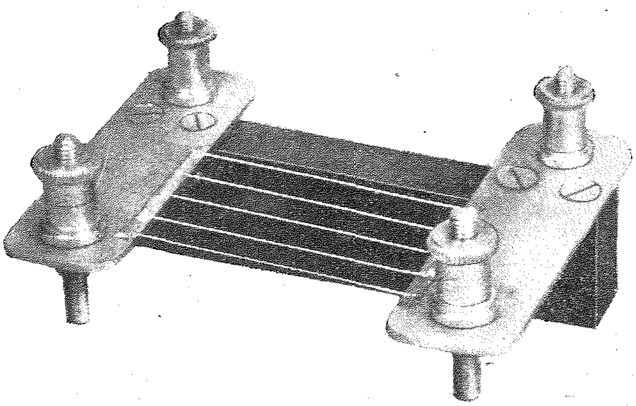
Usually, however, the ideal to be aimed at is an instrument whose presence does not affect the circuit conditions.

The advantage is that consistent results may be obtained, chiefly as the recording meter is a moving coil instrument.

This advantage will be appreciated by those who have had much to do with hot-wire ammeters.

The Valve as an Ammeter.

The second method consists in passing the current to be measured through the filament and measuring the resulting emission. For this a valve with only two electrodes is required, as in Fig. 2, or an ordinary valve may be used by joining the grid and plate.



Photograph of the resistance unit sketched in Fig. 1.

[1] September 24th issue, 1924.

The Valve as an Ammeter.—

The calibration curve of the ammeter will be the usual constant plate potential diode characteristic, Fig. 3.

The author has found that by using no external potential on the plate, this calibration curve is very nearly a straight line for quite a large range of filament current. The calibration curve of a Mullard ORA valve on 144 cycles is given in Fig. 4; the useful range is 0.4 to 0.62 ampere, which is quite a large range for a valve filament.

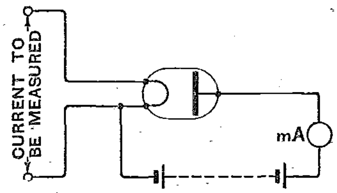


Fig. 2.—Using the valve as an ammeter.

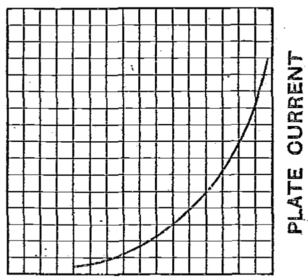


Fig. 3.—Characteristic curve of the valve connected as in Fig. 2.

As a remote indicating ammeter, the instrument is extremely useful. The valve may be put in the aerial circuit at a point of earth potential, and the plate milliammeter fixed on the operating table—the connection being by ordinary lighting flex.

A small choke as shown in Fig. 5 may be useful if the valve cannot be put exactly at a point of earth potential.

The range of the milliammeter should be from 0 to 2.5 *mA*, and the instrument may conveniently be calibrated from the 50 ~ mains by comparison with a moving iron meter.

The chief disadvantages of the method are :—

(1) Comparatively large resistance of the valve filament—about 7 ohms, and

(2) Small range and danger of burning the valve out with small overload.

Measuring Small H.F. Currents.

By heating the filament initially from an L.T. battery so as to get a small measurable emmission, it is possible to measure H.F. currents of the order of a few milliamps. by superimposing them on the steady current.

It is, of course, necessary that the H.F. currents pass only through the filament and not through the filament heating battery, and therefore chokes suitable for the frequency in use must be put in the battery leads, Fig. 6.

These chokes must be able to carry the steady filament current of perhaps half an ampere, and must also be suitable for the frequency at which the instrument is calibrated.

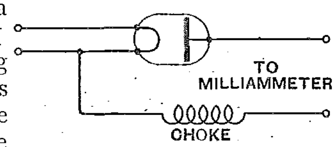


Fig. 5.—A valve ammeter with a H.F. choke connected.

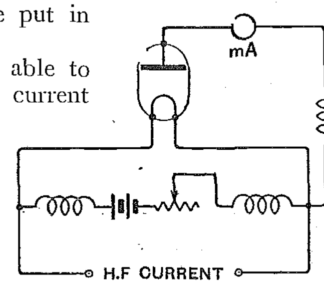


Fig. 6.—Method of using the valve for measuring small H.F. currents.

If some such instrument at a Duddell thermoammeter is available, the meter may be calibrated at the frequency at which it will be used, otherwise it must be calibrated at commercial power frequencies, which means that L.F. chokes must be used in series with the H.F. ones shown.

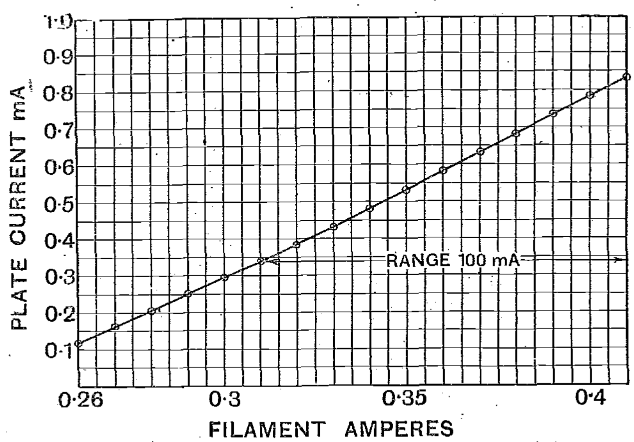


Fig. 7.—A calibration curve for the arrangement of Fig. 6.

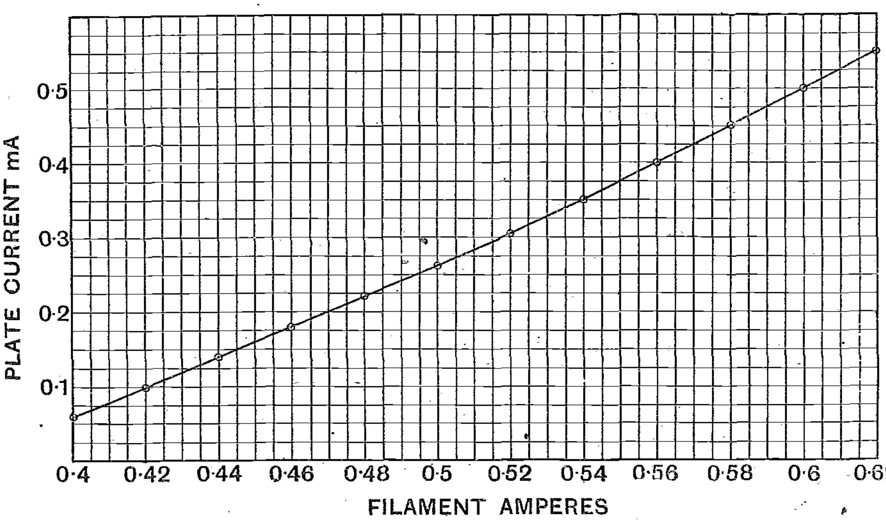
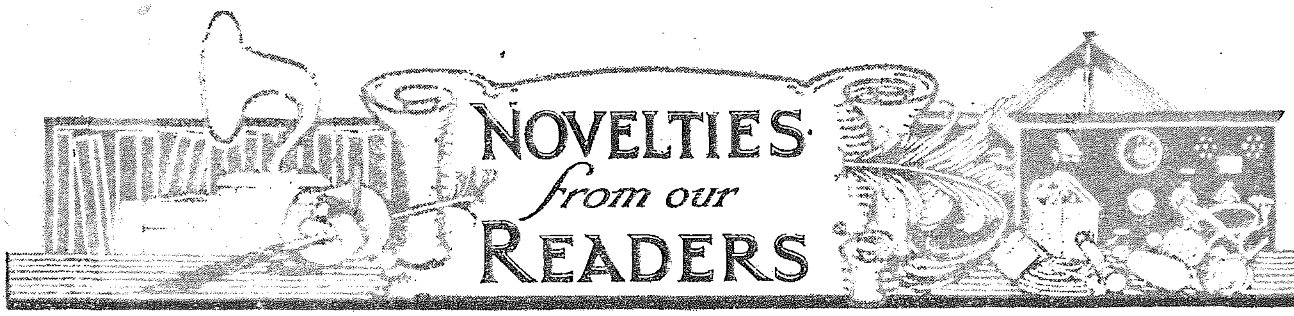


Fig. 4.—Characteristic curve when a Mullard ORA valve is used.

A 50 ~ L.F. choke to carry $\frac{1}{2}$ ampere is a bulky thing and forms the greatest disadvantage to the method. Calibration curves for such a meter are shown in Fig. 7.

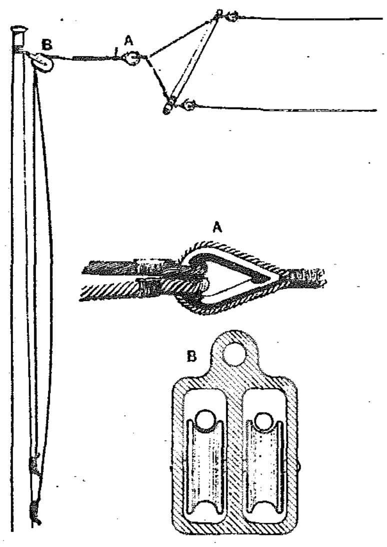
In conclusion, both these methods of H.F. current measurement are worth investigating by the amateur, as they give much more consistent and reliable results at high frequencies than the usual metal-cased hot-wire ammeter.



A Section Devoted to New Ideas and Practical Devices.

SAFEGUARDING THE AERIAL HALYARD.

The amateur usually feels a little uneasy concerning the durability of the halyard rope used for raising the aerial. Should it give out, the mast must be lowered to restore the new rope, and for this reason it will no doubt be found advisable to use a double pulley (B) and halyards of both rope and light flexible wire (A).



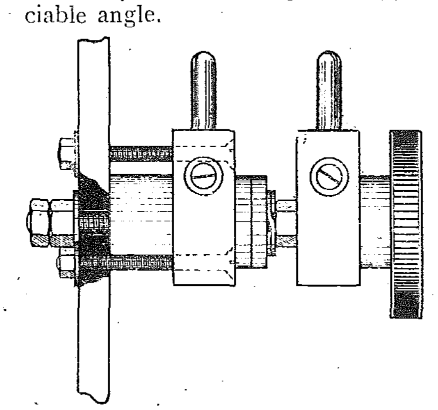
A double aerial pulley with halyards of both rope and flexible wire will overcome the trouble which might arise as a result of a broken rope.

The rope will normally take the strain, whilst the flexible wire is always available should the rope give out.—H. H.

oooo

MAKING A TWO-COIL HOLDER.

When a coil holder is constructed so that the extent of coupling between the inductances is reduced by moving one out of the plane of the other, it is essential to embody some form of gearing in order to provide the necessary critical adjustment. If the inductances swing one over the other, however, a critical degree of coupling is always obtainable, although the coils may rotate through an appreciable angle.



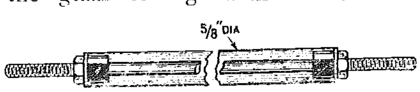
Constructional details for making a simple two-coil holder.

Coil holders of this latter type may be easily constructed. The drawing given here includes all necessary details, and can easily be worked to, making use of small component parts which can be purchased quite cheaply. —C. P.

oooo

AN EFFICIENT LEADING-IN TUBE.

A glass tube is made use of for insulating purposes, and is best procured as a boiler gauge glass which may be about $\frac{5}{8}$in. diameter and from 15in. to 16in. in length. The price of such a tube should be less than 1s. A piece of $\frac{1}{4}$in. threaded brass of sufficient length to extend about $1\frac{1}{2}$in. at each end is clamped on to the glass tubing with brass nuts



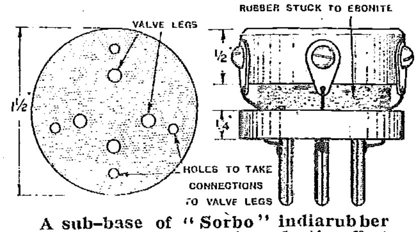
An efficient leading-in tube constructed from a boiler gauge glass.

and washers, and held central by means of two ebonite or wooden bushes. It is advisable to insert small indiarubber washers under the clamping nuts to relieve the glass of the strain which occurs in tightening up. This type of leading-in tube presents a very low capacity to earth, owing to the fact that the conductor is liberally air spaced. The writer has had a lead-in of this type in use for over twelve months now, and has found the boiler glass to be exceptionally strong and easily capable of taking the strain of a taut lead in.—L. A.

oooo

NON-MICROPHONIC VALVE HOLDER.

In a multi-stage amplifier, provision must be made to mount the valves and particularly those in the early amplifying stages, so that they will not be susceptible to vibration. The use of a metal spring method for supporting the holder is not very effective, for it is readily apparent that springs, although absorbing vibrations



A sub-base of "Sorbo" indiarubber will eliminate the microphonic effect due to mechanical vibration.

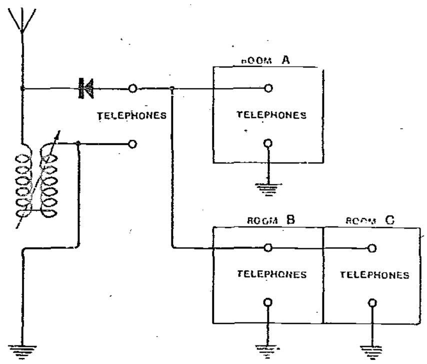
of low mechanical frequency, will not resist the vibration of high note frequency.

Soft indiarubber or "Sorbo" sponge is excellent for taking up vibration of this sort, and a simple method of mounting is shown. The valve holder is of the well-known Bretwood type, and the lower piece, carrying valve pins, is made up from $\frac{3}{16}$in. ebonite. Flexible connections should be short and strong, so that when a valve is withdrawn the indiarubber will not become pulled away from the ebonite. Elastic glue or Chatterton's compound should be used for attaching the indiarubber pad.—S. L.

o o o o

EXTENDING THE TELEPHONES ON A SINGLE WIRE.

While the receiving set may be installed in a position where it can be operated and experimented with by the amateur, it is often desirable to run extension leads for listeners in other rooms. If the receiving set is a simple one, consisting of a tuned aerial circuit and a crystal, it is only



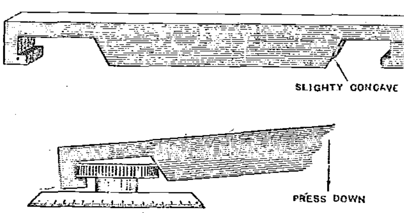
Extending the telephone circuit by means of a single wire.

necessary to run one well-insulated wire from room to room. Connections to the telephones are, of course, picked up from this wire, and any local earthed point such as a gas bracket.—W. E. S.

o o o o

AN EXTENSION HANDLE.

A great aid in obtaining a critical movement to condensers and variable inductance dials is to employ an extension handle. Many suggestions have been put forward for obtaining a good grip on the milled knob, though usually possessing the defect of making use of some rigid form of fixing which cannot be readily removed, and as a result may sweep across the instrument panel fouling other components.



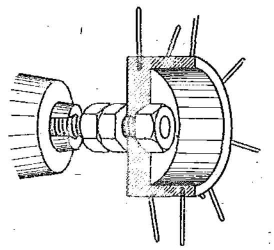
Ebonite extension handle for obtaining critical adjustment of instrument dials.

Constructed from ebonite, this extension handle can be placed in position without the tightening of screws or other attachments, immediately obtaining a good grip on the knob. Both ends of the handle are cut away so that provision can be made for applying it to knobs differing in size.—W. J. S.

o o o o

A LATTICE COIL FORMER.

The method of winding lattice coils on pegs inserted around a small cylinder is not always straightforward, owing to the difficulty of finding a suitable former.



The stopper of a paste bottle makes a good former for winding lattice coils.

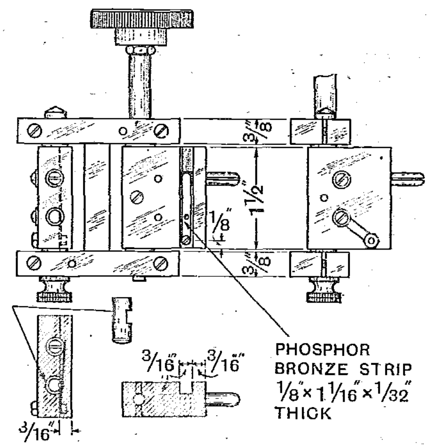
The writer noticed that the wooden cap of a paste bottle is most suitable for the purpose. The wire is carried by means of panel pins carefully driven into holes round the outer face. A small bolt is inserted into the centre hole, and may be rotated by holding the stem of the bolt in the chuck of a small hand brace, the body of which may be clamped in the vice.—J. L. W.

o o o o

A SELF SHORT-CIRCUITING COIL HOLDER.

The use of a reaction coil is rarely necessary when receiving from a local station. It is, in fact, often desirable to short-circuit the reaction coil holder in order to prevent any tendency the receiver may have to self-oscillate, and which gives rise to some degree of distortion. Many experimenters provide a short-circuiting socket, so that when the reaction coil is removed the plug and socket of the holder can be connected through.

This may be accomplished automatically by the use of a coil holder fitted with a small spring contact. The side of the holder is cut away so that a small spring blade can be inserted. When the plug which is attached to the coil is driven into the coil holder socket, the spring is forced back by coming into contact with the small projection which penetrates through a slot in the side of the



Coil holder with reaction short-circuiting spring.

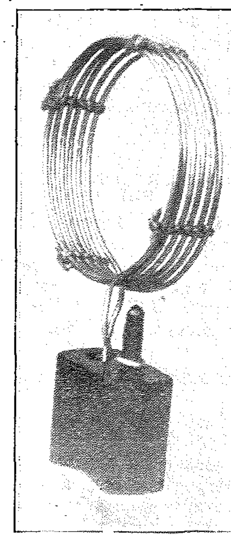
socket. The spring normally rests across the plug and socket and short-circuits them, but when a coil is fitted into the holder the short-circuit is removed.—H. H.

o o o o

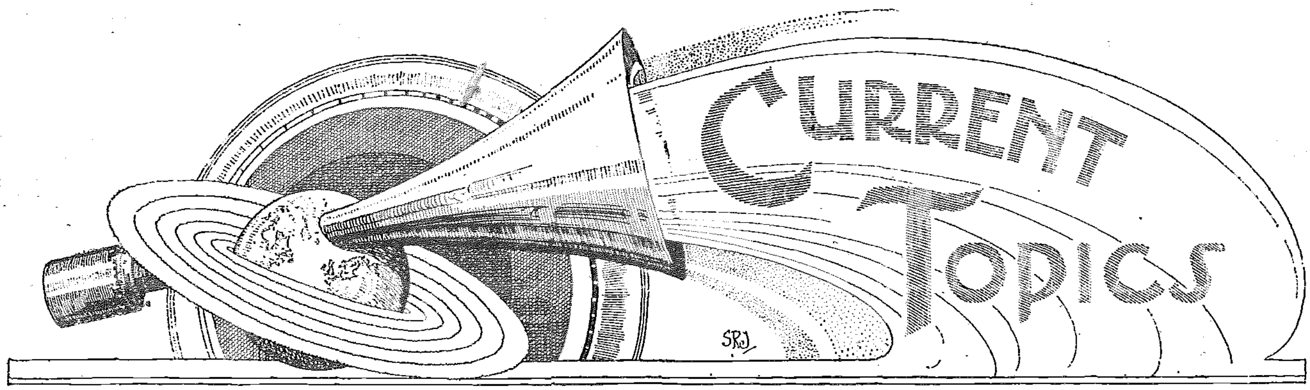
LOW LOSS COIL.

Many attempts have been made to construct coils with a minimum of solid dielectric material to give efficient reception on short wavelengths.

A rigid coil can be constructed by shaping the turns to the required diameter by winding the straightened wire on a cylindrical former and binding in position with an interlacing of thin string. The string is not knotted between the turns, but merely threaded over and under, returning on the other side of the wire. Connection is easily made with the coil holder by terminating one of the ends in the form of a loop, bending the other back to a "V" shape.—A. R.



A six-turn low loss coil suitable for tuning the aerial circuit to very short wavelengths.



Events of the Week in Brief Review.

RELAY STATION ON BOARD SHIP.

The Copenhagen Broadcasting Station has installed a relay plant on board the s.s. "Aalborghus," which retransmits the main station's 775-metre transmissions on 445 metres. This novel relay station operates on Tuesdays, Thursdays, and Saturdays, when the vessel is lying in Aalborg harbour.

oooo

FRENCH AMATEUR BROADCASTING STATION.

Discontent has long been prevalent in the South of France owing to the absence of broadcasting stations in that area. Amateurs have now filled the breach, however, with the installation of a broadcasting station at Mont de Massan, operated by the Landais Radio Club.

At present transmissions are carried out on Wednesdays only, on a wavelength of 365 metres, between 8 and 10 p.m. The station has been heard all over the North of Spain and has been reported over a radius of 375 miles.

oooo

ONE SET PER FIFTEEN PERSONS.

In the Borough of Queens district of New York it is estimated that there is one broadcast receiver for every fifteen persons. This is believed to be the record, even for America.

oooo

NO BROADCASTING IN BRAZIL.

Brazil still prohibits radio transmitting stations except in extreme cases. In the hope of removing the ban, a number of citizens in Bahia have organised an association which will petition the Government to permit the erection of broadcast stations.

oooo

CANADA AND IRAQ.

Major W. E. Borret (Canadian 1DD) of Halifax, Nova Scotia, has succeeded in obtaining a two-way connection with GHH1 of Mosul, Iraq.

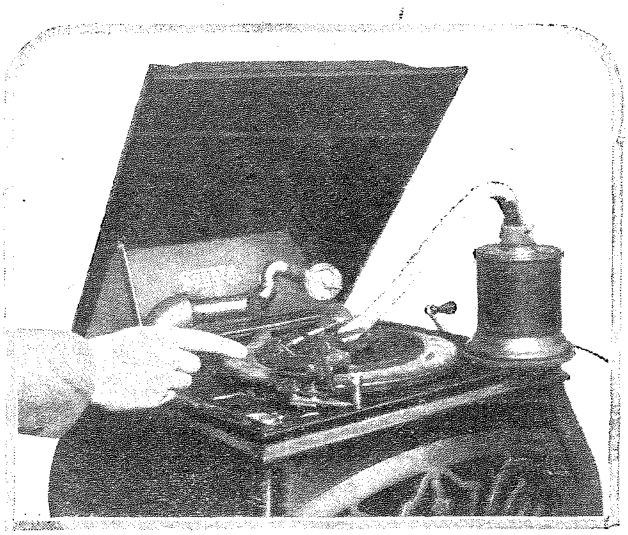
FRENCH AMATEURS AND AMERICAN JARGON.

Dr. Pierre Corret, the well-known French amateur transmitter, bitterly laments the growing habit among French amateurs of copying American radio jargon. Not only are they using "f b," "o m," "73s," and similar expressions in their international communications, he states, but they are employing these abbreviations in transmissions between each other.

oooo

NEW BROADCASTING STATION IN HUNGARY.

Under the call-sign HAR, a new broadcasting station is now ready for service at Szekesfehervar in Hungary, and will be under the control of the Budapest Central Telegraph Bureau. No schedule of transmissions is yet available.



A BROADCAST RECORDER. An ingenious instrument, patented in America, which provides a wax record of broadcast speech and music. The operating principle is evident from the photograph.

oooo

£850,000 FOR B.B.C

The total number of annual wireless licences issued from November, 1922, states the Assistant Postmaster-General, was, up to the end of January, about 1,942,000, including the renewals of expired licences. Of this total about 1,200,000 are now current. The total revenue collected amounted to £1,108,000, of which £850,000 accrues to the British Broadcasting Company.

oooo

MORSE RECORD CHALLENGED.

The annual morse code speed contest for both professional and amateur radio operators is a feature of the fifth annual radio show now being held in New York under the auspices of the Executive Radio Council, Inc., and the A.R.R.L. Hudson Division Convention. The Morse record of 60 words per minute, established at last year's exhibition by A. E. Gerhard, is expected to be hotly challenged.

oooo

WIRELESS-CONTROLLED FLIGHT.

Arrangements have been completed for a remarkable flying demonstration to be made at the Istres Aerodrome this month, states a Paris correspondent of the *Daily Telegraph*. An aeroplane without any human being on board is to be sent up, make a flight of 200 kilometres, and land again in the aerodrome, the whole flight being controlled by wireless signals from the ground.

The system has been perfected by M. Max Boucher, and the demonstration will be in a fulfilment of a contract made with the Under-Secretary of Air.

oooo

WIRELESS AND SEA FOGS.

The radio fog-signal station as a factor in safety of life at sea has received high commendation from mariners in American waters, according to the latest report of the U.S. Commissioner of Lighthouses. Several additional radio fog-signal stations have recently been established for the benefit of American shipping.

ESPERANTO BROADCASTING STATION

Nearly all Europe will be able to listen to Esperanto programmes when the station now being planned by the Esperantists becomes an actuality, states a Continental correspondent. The station will be erected at the summit of one of the hills above Geneva, and its programmes will be intended for Great Britain, Germany, Austria, Switzerland, Italy, France, and Spain.

It is thought probable that the station will be in operation by the early summer.

oooo

SIGNALS FROM BELGIAN ARMY OF OCCUPATION.

The many readers who have reported the reception of 1CF may be interested to learn that this station is apparently operated by members of the Belgian Army of Occupation at Crefeld, in Germany. QSL cards should be addressed to Jacques Heynen, Operateur du Station Radio 1CF, Armée Belge d'Occupation, Crefeld, Germany. This information is kindly supplied by Mr. Edington Sutton, of Wimbledon, who has heard 1CF on one valve, working on 85 metres.

oooo

2LO TESTING.

Preliminary transmission tests with the new equipment commenced on February 27th, in the intervals in the regular programme from the old station. It is now evident that no change is to be predicted in the wave-length of the London station.

oooo

A LETTER FROM A 3BQ.

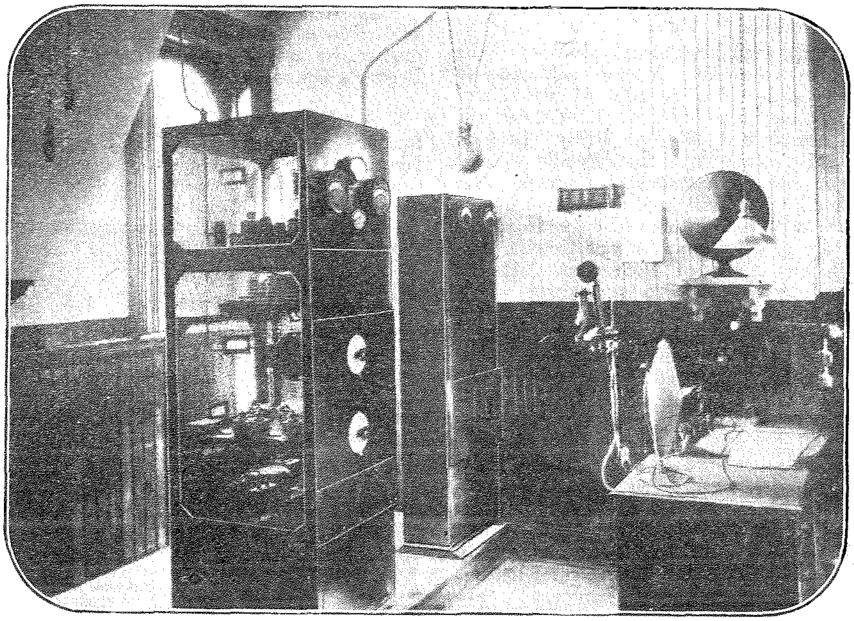
"I do hope it gave you the same thrill to work me that it gave me to work you." Thus writes Mr. Max Howden, the Australian amateur 3BQ, in a letter to Mr. E. J. Simmonds (2OD) confirming their epoch-making exchange of signals on November 13th. In the course of his letter, Mr. Howden remarks that 2OD's signals were perfectly audible through heavy atmospherics; indeed, the stronger the static the stronger were the signals.

3BQ employs a Philips Z4 transmitting valve, with a potential of 1,400 to 1,500 volts, the plate current being about 100 milliamperes. His excellent aerial might well provoke the justifiable envy of many Britishers. It consists of a 50ft. five-wire cage suspended between two 80ft. masts a hundred feet apart. The lead-in, which is taken from the middle, and is of the tapering five-wire cage type, is 75ft. long.

oooo

WIRELESS IN TURKEY.

Turkey's reputation as a radio nation has been vigorously defended by a correspondent to *La T.S.F. Moderne*, who replies to an open letter in that journal in which it had been stated that not one receiving set was to be found in all Turkey. This correspondent, who writes from Turkey, states that he himself owns a super-heterodyne receiver and many of his friends are radio enthusiasts. Two of the cinemas in Constantinople are equipped with powerful broadcast receivers and capable of picking up Rome, Prague, Moscow, and many other distant broadcasting stations.



BROADCASTING FOR THE RAILWAY PASSENGER. To relieve the tedium of long journeys, the Canadian National Railways not only include broadcast receivers on their Trans-Continental expresses, but have established a unique chain of nine broadcasting stations at intervals along the route. Our photograph shows a typical transmitting room in one of these stations. The transmitting valves can be seen on the left.

oooo

NEW POLISH BROADCASTING STATION

An experimental broadcasting station at Warsaw, employing a power of about 1 kilowatt, is transmitting irregular programmes on a wavelength of 385 metres. The controllers of the station, Polskie Towarzystwo Radiotechniczne, are one of the Associated Marconi Companies. British amateurs should listen for the station between 5 and 6 p.m., G.M.T.

oooo

FRENCH "R" SIGNS.

British amateurs should not be surprised if they receive QSL cards with the call sign R and a number. These call-signs are entirely unofficial, and are issued for reference by the French wireless paper, *l'Antenne*, and are for receiving sets only. The issue of these numbers ensures that transmitters have a large number of amateurs willing to cooperate in any experiments and willing also to give details at any time as to the reception of any station transmitting on short waves. The possessors of these numbers are scattered over France, Belgium, and Tunisia.

oooo

2KD.

Messrs. Denison Bros., of Halifax, who own the above call sign, believe that owing to mispronunciation other call signs are being mistaken for theirs, with the result that they have been flooded with reports regarding their supposed transmissions on 440 metres. As 2KD is not operating on the 440-metre band, these reports cannot, of course, be replied to.

oooo

THE PARIS INTERNATIONAL AMATEUR CONFERENCE.

As announced in our columns last week, the first International Congress of Radio Amateurs will be held in Paris from April 14th to 19th. Actually two important events will be taking place simultaneously, these being the Congress of the International Wireless Committee and that of the International Amateur Union. The two bodies will, however, hold joint meetings on each of the days, after each of which they will adjourn to carry on their respective discussions.

Probably the most important meeting will be that held on Thursday, April 16th, when both bodies will discuss international regulations regarding wavelengths, particularly in relation to amateur telegraphy and telephony. The concluding meeting, to be held on Sunday, April 19th, will take the form of a "Radio Rally." Among the interesting subjects included on the agenda of the meetings of the Committee are the rights of the transmitter and the receiver, State control, authors' broadcast rights, and relations between broadcasting stations and the Press.

Full particulars regarding the fees for attending the Conference should be applied for without delay to Secrétarial Général des Congrès, 2, rue de l'Echandé-St-Germain, Paris, 6e. Information regarding special travelling facilities and accommodation can be obtained on application to Bureau Central de Voyages, "Exprinter," 2, Rue Scribe, Paris, 9e.

AMERICAN AMATEUR IN OFFICIAL TESTS.

Official confidence in the abilities of the wireless amateur is demonstrated in America by the request of the Navy Department that Mr. F. H. Schnell, of the American Radio Relay League, should accompany the Pacific Navy during its forthcoming manœuvres. Mr. Schnell, who will assist in short wave tests, will be on active duty from the middle of April until about October 1st, with the rank of lieutenant. He is installing a short wave transmitter, which will be employed in conducting tests in the regulation Navy sets. Mr. Schnell's station, with the call-sign NRRL, will operate on a wavelength of 54 or 55 metres, and he will also take with him two transmitters for personal use on 20 and 40 metres.

oooo

U.S. AMATEURS' TRANSMITTING CONTEST.

In strange contrast to the British official ruling that transmitters may only send messages of an experimental nature, the American "brass-jammers" are urged to transmit as many and varied messages as possible. A stimulating contest has just been arranged by the American Radio Relay League in which the amateur who handles the greatest number of radio telegraph messages for three consecutive months will receive a valuable plaque, suitably engraved with the name of the winner. The contest will begin this month.

ATMOSPHERICS.

"Be slick and get your radio licence. See the proposed regulations," says a Nottingham paper. We are not aware whether its readers have yet instituted an action for libel.

Thousands of wireless "pirates" are said to have closed down in a fit of pique during the recent broadcasting of "The Beggar's Opera."

oooo

The righteous outcry against the Postmaster-General's Wireless Bill confirms our belief in the home as a unit of resistance.

Mr. F. H. Schnell, of the American Radio Relay League, who is to assist the Pacific Fleet in short-wave wireless experiments.

Children get pretty stamps for attending Sunday school and American "radio fans" for hearing distant stations. In the children's case personal attendance is necessary, but the Transatlantic enthusiast need only study the advertised programmes and trust to luck.

The proposal that corks should be placed on aerials to save bird life has been greeted with enthusiasm in Scotland. We understand that aerials are being lengthened to accommodate as many superfluous corks as possible.

ITEMS FROM THE TRADE.

A reduction in the price of headphones is announced by Siemens Brothers and Co. Their double headphones are now obtainable at 20s., and this price holds good for any of the usual resistances, viz., 120, 2,000, and 4,000 ohms.

oooo

The D.P. Battery Co., Ltd., Bakewell, Derbyshire, have appointed Messrs. Kalsall and Parsons, 19, Blythwood Square, Glasgow, as their agents for Scotland, in place of Mr. William Scott, who has relinquished the agency, which he has held for so many years. Messrs. Kelsall and Parsons will deal with all types of D.P. storage batteries, including their well-known "Kathanode" electric vehicle batteries.

oooo

Mr. Herbert G. White, A.M.I.E.E., who has been associated for the past fourteen years with Messrs. Gent & Co., Ltd., has now been appointed Chief Engineer of the Wireless Department of Messrs. C. A. Vandervell & Co., Ltd., Acton, London, W.3.

oooo

The Directors of Brown Brothers, Ltd., regret to announce that the sudden death occurred on Saturday, February 14th, of their colleague, Mr. J. S. Brown, who was one of the original managing directors of Brown Brothers Ltd.

Mr. Brown retired from active work over five years ago, but continued to take an interest in the affairs of the Company as an ordinary director.

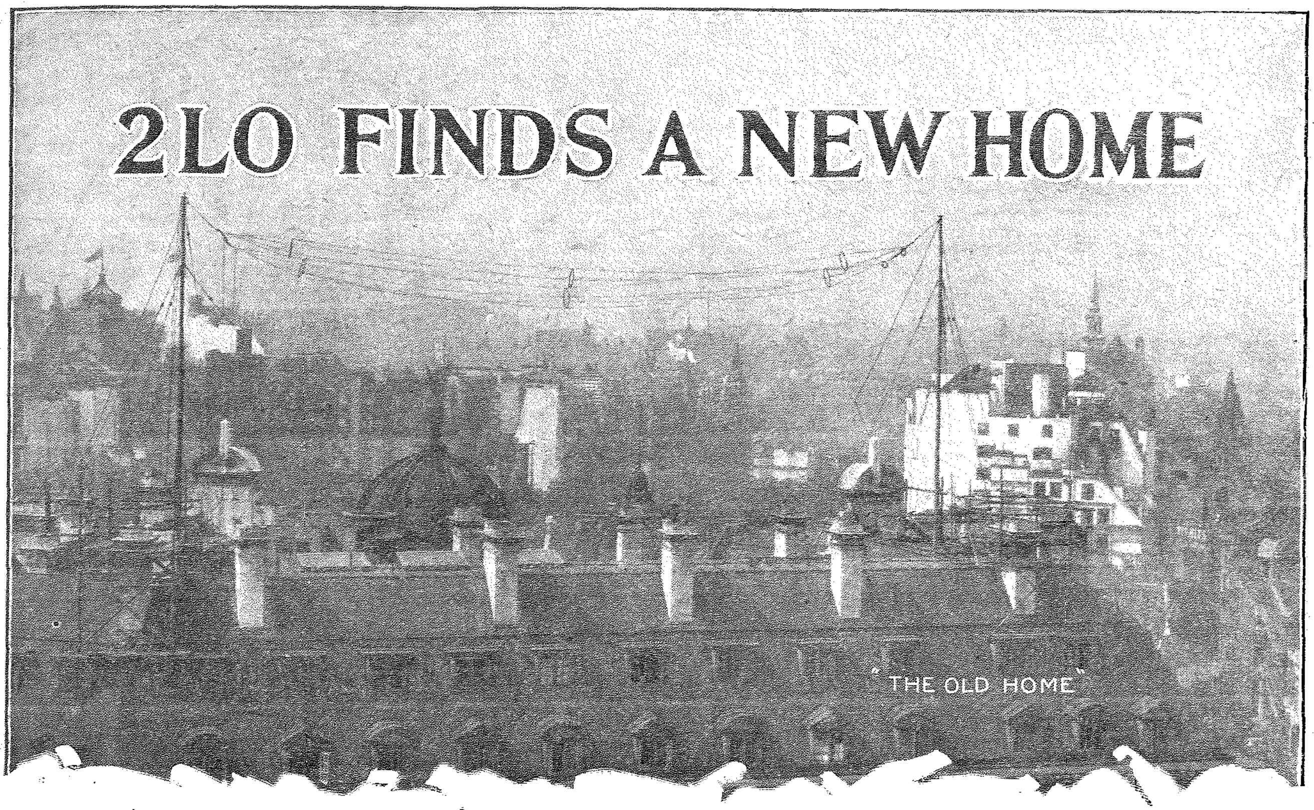
THE WIRELESS BILL.

An Independent Statement of Opinion.

An unbiassed statement of opinion upon the Postmaster-General's Wireless Bill appears in the leader columns of our contemporary, *The Electrician*, for February 20th. As this statement may be considered as representing the opinion of the average professional electrical engineer, we print it below for the benefit of our readers.

"The Bill to re-enact and amend the present law relating to wireless telegraphy which was presented by Sir William Mitchell-Thomson in the House of Commons last week," say the writer, "has given rise to a good deal of criticism. Some of this is unjustified, the remainder rests on a firm basis. The arguments which come under the latter heading are mainly directed to the wider control it is proposed that the Post Office should be given over 'the installation and working of apparatus for using etheric waves for the purpose of the sending or receiving of energy without the aid of any wire . . . as they apply to the installation and working of the apparatus for wireless telegraphy.' This control is to apply continuously and not only 'in an emergency.' It is intended, in fact, to legalise the attempts to limit the work of experimenters and amateurs, which we have already criticised and which the Radio Society of Great Britain has done good work in trying to neutralise. It may well be argued that some authority in this country should have control over wireless operations. Experience in the United States bears that out. But it may be argued with even greater force that that control should be flexible and not excessive, for radio-communication is a young science and a still younger industry, and anything that tends to check its progress should be avoided. It is from this point of view that the new proposals must give rise to anxiety. The penalties for the unlicensed use of broadcasting equipment leave us cold, and something may also be said for giving the right of search. But when it is proposed that the Post Office should have the absolute choice as to who should experiment and about what he should experiment it is another matter. As Dr. Eccles recently pointed out, this choice is already made in an arbitrary and unintelligible way. It is, for instance, impossible to expect an experimenter to say what his results will be before he undertakes his research, or for guarantees that this or that arrangement of equipment shall solely be used. Yet that might easily be the result of the proposed supervision. Again, the regulations made by the Postmaster-General are not to be laid on the table of the House, and there will therefore be no right of appeal or public control. The powers asked for are, in fact, too autocratic, and we hope that they will be carefully scrutinised during the passage of the Bill through Parliament. For though much of the power that the Post Office desire may be necessary, the methods by which it is proposed to acquire it are very questionable. We are glad to learn that the Post Office do not desire to penalise the experimenter."

2LO FINDS A NEW HOME



Improvements at London's Broadcasting Station.

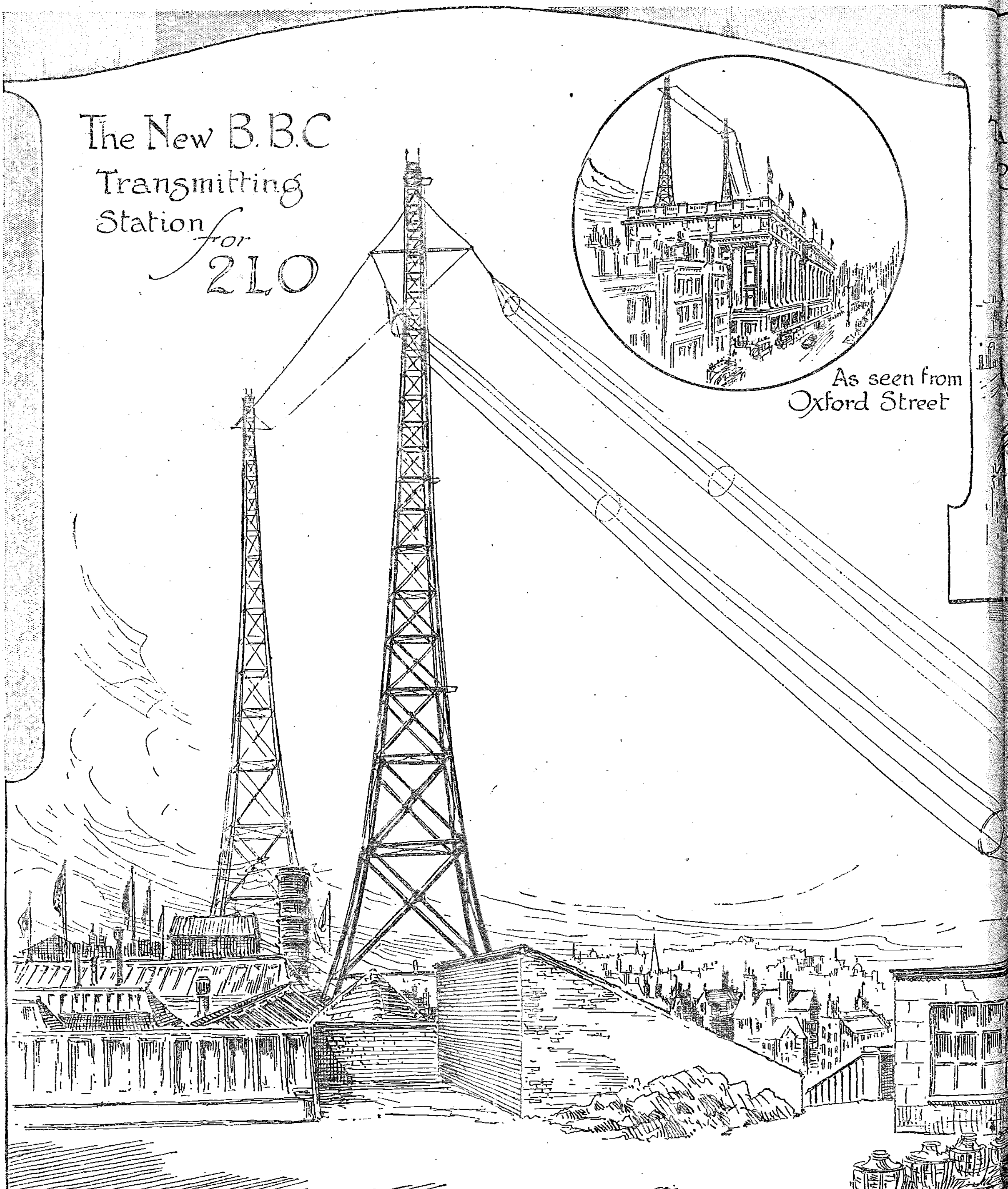
A NEW phase in the progress of British broadcasting is shortly to be entered upon with the forthcoming closing down of the present 2LO station at Marconi House. It will be remembered that broadcasting in this country on a commercial and regular basis started with the operation of the 2LO station in London. It was here that most of the experimental work was done in connection with the development of broadcasting equipment as at present installed in many of the British stations. Looking back over the period of the three years that the station has been in operation, it is at once apparent that enormous progress has been made in the design of radio telephony equipment, reflecting great credit on British engineering skill. Much advance has been made in the study of speech distortion as applied to both wire and wireless work, and a better understanding on the methods to be adopted to maintain musical quality has probably been revealed during this period than from the time when sound vibrations were first studied.

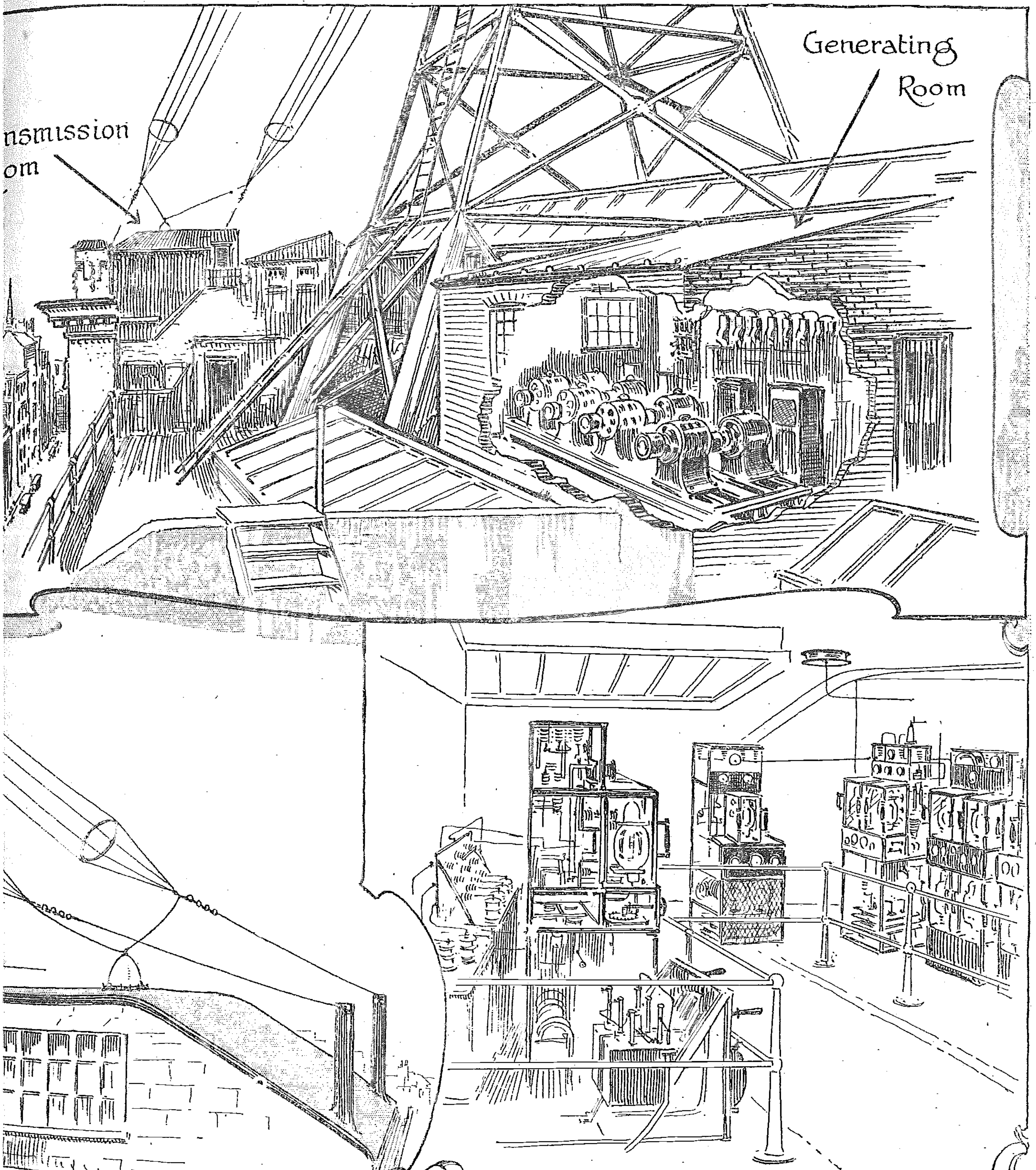
2LO's Development.

Old 2LO in its earliest form in November, 1922, was composed of component apparatus almost indiscriminately arranged and wired up in a manner of which an amateur would almost be ashamed. It rapidly progressed, however, to the "frame" arrangement, which was, of course, the forerunner of the present-day designs. The studio in those days was installed in a little used kinema theatre on the top floor of Marconi House, while the microphone was of the ordinary Post Office type clamped to a vertical stand. Contrast this with the present sumptuous accommodation at Savoy Hill! The now well-known A and B amplifiers were then not thought of, and little did one foresee the advent of the "S.B." room, resembling, as it does, a modern telephone exchange.

The New Equipment.

The new station has been erected on the roof of the Selfridge building in Oxford Street, a site which was found only after considerable difficulty, owing to the unsuitability of many structures to carry the enormous weight of the towers used to support the aerial. The towers are 125ft. and 135ft. in height, the difference being due to the fact that one stands upon a raised portion of the roof, giving a height above the roadway of approximately 250ft. They are of the lattice type, and entirely self-supporting, without the use of guy wires. Each base occupies a space of 20ft. square, whilst the tops are 2ft. square. The design is the work of Mr. S. Bylander, who incidentally is responsible for the design of the steel work employed in the Selfridge building. The work of erection has been carried out by the Teeside Bridge and Engineering Co. A two-wire aerial is to be used with wires spaced 15ft. apart, and two cage lead-ins will connect up with an insulator in the roof of the apparatus room. The aerial wire is composed of nineteen strands of No. 16 bronze, and is an exceedingly heavy


The New B.B.C
Transmitting
Station for
2LO
As seen from
Oxford Street



A Peep in the Transmission Room

2LO Finds a New Home.—

conductor. The halyards for raising the aerial pass right over the tops of the masts, pulleys in line being arranged on either side. Strings consisting of eight shackle insulators separate the aerial from the spreaders, whilst other chains of insulators are inserted at intervals along the aerial, so that its length can be regulated. The station will probably start working using only the leading-in wires, and sections of the large aerial will be introduced when tests have been made as to the proportioning of the tuning circuits to provide efficient excitation.

Guarding Against Breakdowns.

The apparatus is housed in a building which has been specially erected for the purpose. The circuit and equipment employed are entirely standard, and make use of the master oscillator system, modulation being obtained by the choke control method. Much of the apparatus is duplicated to guard against breakdowns and to facilitate maintenance.

A portion of the apparatus room is divided off for the accommodation of the accumulators used for filament heating of the oscillator and modulator valves. Two banks of eleven cells are employed having a capacity of 800 ampere hours. The charging switchboard is, of course, accommodated in the apparatus room, and controls machines installed in another building.

The High Tension Supply.

The high tension plate potentials for the transmitter are obtained by stepping up single phase alternating current at a frequency of 300 cycles, the input being at a potential of 500 volts and the transformer output potential 10,000 volts. After rectification a normal output of 800 m.a. is obtainable at a potential a little below the output of the step-up transformer.

The lines from the studio at Savoy Hill terminate on strips of jacks, so that by means of plug connections the various circuits can be picked up.

The machines installed in the power house are direct coupled motor generator sets running from the supply mains and giving outputs for accumulator charging and for stepping up to the high potentials for the rectifier.

The installation of the equipment is now rapidly nearing completion, and the preliminary tests to be made from this station are to be carried out almost immediately.

CALLS HEARD.

Extracts from Readers' Logs.

Cobham, Surrey. (To Jan. 8th.)

American:—5HL, 5LH, 5LUS, 5UC, 6CCB, 6EW, 7NS, 8ABS, 8ADA, 8AFM, 8AKJ, 8ALY, 8AR, 8ARB, 8AT, 8AWQ, 8AWX, 8BAL, 8BLC, 8BN, 2BNH, 8CE, 8CED, 8DAL, 8DM, 8DOO, 8ES, 8GZ, 8HM, 8JQ, 8KYI, 8MC, 8NB, 8RY, 8SSC, 8TR, 8UF, 8UQ, 8VQ, 8XAV, 8XB, 8XR, 9BCJ, 9BMX, 9BHT, 9BHY, 9BV, 9CCM, 9CJC, 9DMJ, 9DQ, 9EBH, 9EKY, 9ELD, 9EP, 9JC, 9MM, 9TT, 9VZ, 9XAX.

(0-v-1; Reinartz.) E. J. Martin.

Smethwick, Staffs. (50-200 metres.)

British:—2KF, 2JU, 2PY, 2TI, 2TK, 5LP, 6BBC. *Dutch:*—0AZ, 0NI, 0RE. *Finnish:* — 2NM. *Belgian:* — 4ALS. *French:*—8AB, 8AP, 8BV, 8CA, 8CU, 8DM, 8DU, 8EN, 8FI, 8FK, 8FU, 8GI, 8GK. *Swiss:*—9BR. *American:*—8CCR, 4IO, 4EQ.

Ralph H. Parker (2KK).

Newcastle-upon-Tyne.

British:—2GM, 2LZ, 2UV, 2GB, 2KZ, 2WY, 2WJ, 2DX, 2NB, 2MA, 2IH, 2MX, 2BY, 2GW, 2PY, 2VW, 2TF, 2KU, 2GY, 2AW, 2FN, 2GO, 2HF, 2TA, 2TU, 2AS, 2KW, 2AWO, 2IN, 2VQ, 2OA, 2CC, 2AMG, 2XG, 2FM, 2CQ, 2CA, 2MG, 2WA, 2II, 2RB, 5NH, 5NN, 5CC, 5QV, 5RB, 5WI, 5OX, 5WV, 5NW, 5MA, 5PF, 5SU, 5TZ, 5CX, 5IK, 5BH, 5UL, 5FJ, 5OO, 5LS, 5GF, 5PD, 5XN, 5QG, 5VD, 5SZ, 5ID, 5FS, 5LF, 5OK, 6KK, 6FG, 6QR, 6AA, 6QB, 6GM, 6RQ, 6AL, 6WI, 6GH, 6FA, 6YB, 6RW, 6MP, 6GW, 6US, 6TE, 6AB, 6UW, 6XJ, 6LJ, 6UD, 6VU, 6RY, 6NF, 6ZX, 6AH.

F. Thompson.

Smedslätten, near Stockholm.

British:—2CC, 5MO, 5UQ, 6ZG, 6LJ. *French:*—8EM, 8LBR, 8AB, 8GO, 8BF, 8SM, 8HSM, 8SSU, 8GM, 8EU, 8BA. *American:*—1GV, 1ERI, 1CMP, 1CAB, 1BGQ, 1KC, 1BHW, 1RK, 1AWW, 1XAM, 1XAV, 2AFW, 2BSC, 2MU, 2BY, 2AG, 2BRC.

(0-v-1; Reinartz.) B. Fredén.

Lists submitted for publication in this section should be as short as possible. They should contain only calls heard within the previous fortnight and believed to be of reasonably distant origin. Compliance with these conditions will considerably enhance the value of the section from all points of view.

Northampton. (To Jan. 19th.)

British:—2AHH, 2AWO, 2BO, 2BZ, 2CC, 2DX, 2FM, 2FN, 2FU, 2GG, 2HF, 2IL, 2KW, 2LZ, 2NB, 2QR, 2TA, 2UY, 2VG, 2VS, 2WD, 2WJ, 2WY, 2XG, 2XH, 2XP, 2XY, 2YR, 2YV, 2YX, 5AK, 5GS, 5IY, 5LB, 5LU, 5LS, 5MA, 5MO, 5NN, 5OM, 5PZ, 5RB, 5QV, 5SI, 5SZ, 5TZ, 5UL, 5YW, 6FG, 6GH, 6KK, 6NF, 6QB, 6RM, 6UB, 6XG.

(0-v-0 and 0-v-1) (frame aerial.)

P. H. Brigstock Trasler.

Nice, France.

British:—2AWO, 2JF, 2OA, 2TF, 5KM, 5QV, 5SZ, 6FQ, 6TD.

(1-v-0.) Leon Deloy.

Broadstone, Dorset.

American:—3AB, 3AD, 3ADB, 3AFS, 3AJ, 3ALX, 3APV, 3BDO, 3BQ, 3BTA, 3BVA, 3CK, 3HG, 3HH, 3HS, 3LG, 3WB, 3YO, 4FZ, 4IO, 4KL, 4KW, 8ABM, 8ABS, 8ADG, 8ADL, 8AGO, 8AMR, 8BBF, 8BGG, 8CEI, 8CUK, 8DOO, 8JQ, 8MC, 8RV, 8TR, 8TT, 9BHT, 9HN, 9ZT. *Canadian:*—1DQ, 2BN, 3WZ.

(1-v-1.) J. F. Metcalfe (2AHX).

Ilford.

British:—2BR, 2CC, 2FK, 2FP, 2HF, 2KT, 2KW, 2KZ, 2PX, 2RB, 2RY, 2WJ, 2YT, 5AC, 5AU, 5DY, 5GA, 5LI, 5MA, 5MO, 5OK, 5PU, 5PZ, 5QJ, 5WN, 5XN, 6GH, 6HC, 6LJ, 6UT, 6VX.

(0-v-0 and 0-v-1.) John Lion.

Margate.

British:—2AYP, 2CC, 2FP, 2KU, 2MA, 2TU, 2VD, 2VG, 2XY, 5FT, 5ID, 5LS, 5QJ, 5RR, 5RZ, 5TZ, 6AL, 6KK, 6RM, 6UT, 6XJ.

(0-v-1 and 0-v-2.)

Arthur O. Milne.

Cambridge. (Jan. 19th-Feb. 5th.)

British:—2AUC, 2AUL, 2GK, 2TA, 2XSS, 5AC, 5HA, 5LS, 6GH, 6NF, 6RMG.

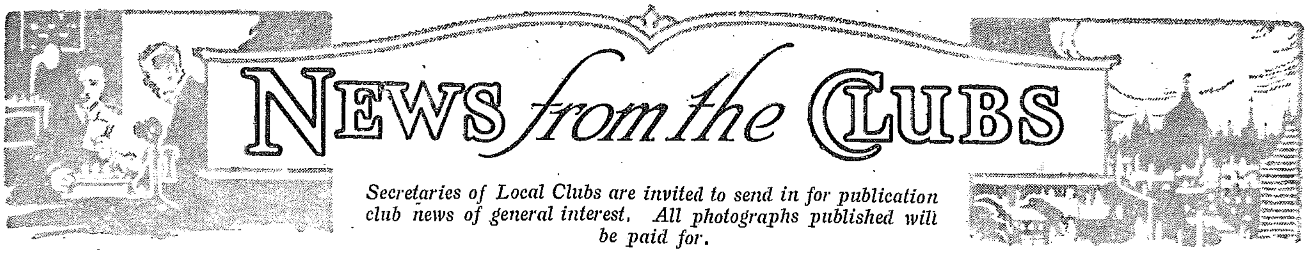
(0-v-1.) F. G. Turner (2ANO).

Chiswick, London. (During January.)

Swedish:—SMYV, SMYY, SMXX, SMZS. *Italian:*—1ER, 1FP, 3MB, 3YU. *Swiss:*—9AA, 9AD, 9BR, 9RA, 9LA. *Belgian:*—2SP, 4AS, 4AU, 4BA.

(0-v-1 and 0-v-2.)

H. and L. Wilkins.



NEWS from the CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Kensington Radio Society.

The society's February meeting took the form of a discussion on the merits of various methods of H.T. supply. Captain Tingey opened in favour of accumulators, Mr. H. E. Hall following with his experiences with D.C. mains. Mr. Maurice Child concluded with remarks on the value of primary cells, mainly of the Leclanché type. The attendance at the meeting was large, and the many questions fired at the speakers proved that the subject was one of great interest.

Hon. secretary, Mr. Herbert Johnson, 36, Cromwell Grove, W.6.

New Society at Crewe.

A radio society has been formed under the title "Crewe and District Radio Society," and the first meeting, held on February 11th, augured well for the success of the new venture. The society is honoured by the patronage of His Worship the Mayor (Councillor J. Cumming, J.P.). The president is Mr. E. Sims-Hildich. Applications from prospective members are warmly welcomed, and should be addressed to the hon. secretary, Mr. Rupert Peach, 84, West Street, Crewe.

Radio Society of Highgate.

At an extraordinary general meeting held on February 10th the chairman announced that the committee had accepted with regret the resignation of Mr. J. F. Stanley from the position of honorary secretary. Mr. F. J. W. Squire was unanimously elected to fill the vacancy.

An instructive talk on the construction of a low loss short wave receiver was then given by Mr. Wise, this subject having roused keen interest among the members. The speaker laid great stress on the importance of careful construction, maintaining that slipshod assembling was the chief cause of unsatisfactory results in short wave work.

Hon. secretary: Mr. F. J. W. Squire, 31, Harvey Road, Hornsey, N.8.

Maidstone and District Radio Society.

The society's second annual meeting, held on January 30th, revealed a satisfactory year's work, which had included the organisation of a second annual wireless exhibition, a successful "junk sale," and the provision of numerous lectures and demonstrations for the benefit of members. The society also claims to have done valuable education work in the elimination of the oscillation nuisance in the district.

The treasurer's report showed a sound financial position, with a membership of 70, which shows signs of increase in the near future. With the object of augmenting the strength and influence of the society, the annual subscription has been reduced from 10s. to 5s., and for junior members to 2s. 6d. An excellent syllabus has been prepared for the remainder of the session, and applications for membership should be addressed to the hon. secretary at "Romleigh," Postley Road, Maidstone.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 4th.

Institution of Electrical Engineers (Wireless Section).—At 6 p.m. (refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Current Transformer Methods of Producing Small Known Voltages and Currents at Radio Frequencies for Calibrating Purposes." By Mr. D. Dye, B.Sc. Lecture: "The Measurement of Frequency and Allied Quantities in Wireless Telegraphy." By Lt.-Col. K. E. Edgworth, D.S.O., and Lieut. G. W. N. Cobbold, R.E.

Golders Green and Hendon Radio Society.—At 8 p.m. Lecture: "Short Wave Reception." By Mr. J. E. Nickless (2KT).

Radio Research Society, Peckham.—Lecture: "Super-regeneration."

Manchester Radio Scientific Society.—Lecture: "Short Wave Receivers." By Mr. R. P. Derbyshire.

North Middlesex Wireless Club.—At 8 p.m. At the Shaftesbury Hall, Bowes Park, N. Annual general meeting.

THURSDAY, MARCH 5th.

Luton Wireless Society.—At 8 p.m. At Hitchin Road Boys' School. Lecture: "Waves and Wave Characteristics." By Mr. J. W. Tomlinson, A.M.I.C.E.

Derby Wireless Club.—Short Wave Working, with demonstrations. By Mr. Kirk, Mr. Taylor, and others.

Radio Society of Highgate.—At 8 p.m. At the 1919 Club, South Grove. Sale of apparatus.

FRIDAY, MARCH 6th.

Inland Revenue Radio Society.—Ordinary Meeting.

North Middlesex Wireless Club.

When the novelty of receiving speech and music by wireless has worn off, the serious experimenter begins to turn his attention to increasing the range and selectivity of his set. How this object can be achieved was described by Mr. J. H. Forbes, lecturing before the club on February 4th. The lecture was entitled "Supersonic Heterodyne Circuits," and was mainly devoted to an account of the lecturer's own experience in operating circuits of this type. The main outlines of the theory of supersonic heterodyne were given, sufficient to demonstrate how such an arrangement gets over the difficulty of the inefficiency of high frequency amplification on short wavelengths. Hon. sec., Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

TRANSMITTING NOTES.

Power Line Leaks.

U.S. and Canadian amateurs have been complaining bitterly of atmospherics, and there also appears to be a bad epidemic of power line leaks, with the result that reception in America has not been of the best.

New Short Wave Facilities?

Of paramount interest at the moment are the short waves in the region of 20 metres. The writer has received several reports of reception on these short wavelengths during daylight on both sides of the Atlantic; instances are furnished by 2LZ, who logged 1XAM at 3 p.m. on Sunday, February 22nd, and Mr. Walker, of Leicester, who logged U1CK on 20 metres on the same afternoon. British transmitters will be glad to hear that there is every likelihood of their being granted the waveband between 20 and 50 metres, but they are specially asked not to use for the present any wavelength for which they are unlicensed.

An Error.

An obvious slip occurred in these notes last week. NKF transmits at 14.00 (GMT) on 54 metres.

High-Power Licences.

There is every indication that we shall be able to establish daylight communication with the U.S. and Canada in the near future, and transmitters will be glad to learn that there is every chance of their having their high power licences renewed after April 15th.

Stamped Addressed Envelopes, Please!

The writer specially requests his correspondents always to enclose a stamped addressed envelope when writing for information. Otherwise it is impossible to answer all the numerous letters and cards which are sent in. All reports should be in triplicate, particularly those dealing with transoceanic reception, as one copy has to be forwarded to the A.R.R.L., one is used for office purposes, and the other is filed.

The Paris Conference.

Arrangements are being made for British representatives to leave London for Paris on the morning of April 13th. All those anxious to go and who have not sent in their names should communicate with the writer at once, or not later than March 15th.

Gerald Marcuse (2NM),
Hon. Secretary, T. & R. Section, Radio Society of Great Britain,
53, Victoria Street,
London, S.W.1.

THE EXPERT.

His Ascent from Obscurity to Fame.

By HIMSELF.

UNTIL recently, I was comparatively unknown; so much so that even people living in the same street and catching the same trains every day passed me without recognition. But six months ago I made a wireless set.

I had no ulterior motive. I thought only of having a little music in the evenings, and at first I did get it—but very little.

But I was and am enthusiastic. I bought books on wireless, erected a heavy pole in the garden, nearly estranged my wife by neglecting her in the evenings, bought a couple of valves, and once, in a moment of forgetfulness, drew a circuit diagram on the tea-cloth. A very good circuit it was, too.

An Enthralled Neighbour.

Soon afterwards I invited the man next door to come to listen-in. I remember my wife slammed the door so hard as she went out to the pictures that she upset the crystal detector; but my neighbour was enthralled, and a week later I helped him to rear a pole in *his* garden. Not only that, I connected up his apparatus for him and gave him some pointed but useful advice about his earth. That is how it began.

In the subsequent few weeks I had the pleasure of supervising the installation of sets in no less than seven homes in this street, and one evening a man, living four roads away, called, and was good enough to say that he had heard of my wireless and asked me to call and give an opinion on his own set.

Nearly every night boys came here with messages. "Please, sir, would you come round to look at the wireless, as my sister wants to listen to the Savoy and it won't go, and Mother says Father's an old fool and doesn't understand it."

But I think that to-day my fame has reached its zenith. On the way to the station this morning I passed two men and distinctly I heard one of them say: "There goes The Expert." Another thing.

Over the road in the big house lives a man whom I have always wanted to know. He has a small car and is friendly, I believe, with one of my Directors. His gardener came over this evening and said: "Please would you come to see Mr. Jameson's wireless. Three valves have fused and the battery's all bubbling up!" It looks like my chance. Apparently some ignoramus has connected up the high tension battery in mistake for the low.

AN INTERESTING NEW VALVE.

"Receptor" Dull Emitter.

MESSRS. F. J. BROWSE, 56, Broad Street, Shaftesbury Avenue, W.C., have forwarded to us for a test a sample Receptor dull emitter valve. This valve, which presents a well-finished and neat appearance, is another addition to the 60 milliampere class, and is rated as follows:—Filament volts, 3-3.5; filament current, 0.06 ampere; anode volts, 20 to 100. The figures obtained on this sample valve are given in the following table.

RECEPTOR DULL EMITTER.

Maker Unknown.

Filament volts 3.0. Filament amps. 0.069.
Emission (total) 6.0. Filament efficiency 31 milliamperes per watt.

Plate volts.	Plate current at zero grid Volts.	Grid bias.	Plate current.[1] Milliamperes.	Magnification factor.	Impedance. Ohms.
40	0.82	—1	0.62	5.9	25,500
60	1.8	—2.5	1.1	6.0	24,000
80	2.8	—4	1.55	6.2	21,000
100	4.0	—6	1.92	6.2	21,000

[1] Plate current when grid is given bias of column III.

At the lower limit of filament voltage the current is slightly above the rated value, the emission, 6 milliamperes, being that required for general usage. At the top filament limit 12.2 milliamperes total emission was obtained, but at this figure the emission would probably soon fall off, and all our tests were carried out with a filament voltage of 3.

The magnification and impedance figures given in the table suggest that this valve should perform satisfactorily in any part of a receiving circuit, giving, perhaps, slightly better results when used on the L.F. side.

Tested first as a high frequency amplifier the results obtained were good; 40 volts H.T. is about right, although a value slightly above or below will not materially affect the results. The same remarks apply when the valve is used as a detector in conjunction with a .00025 mfd. grid condenser and 2 megohms grid leak.

The valve was next tried in the L.F. amplifier, and here, as we expected, it gave the best performance. Connected in the first stage we found 60 volts plate potential in conjunction with a grid bias of -3 quite suitable. When used in the second stage we increased the plate potential to the maximum of 100 volts, at the same time augmenting the negative grid bias to 6 volts. So arranged, sufficient power was obtained to operate a small loud-speaker quite satisfactorily, the quality of the reception being all that could be desired.

The Receptor dull emitter is a valve well worth the attention of the amateur.

BROADCAST BREVITIES

NEWS FROM THE STATIONS.

The Tuning Note.

The B.B.C. Tuning Note is the subject of much correspondence. General opinion is that the new Note is pleasanter than the old one, but that it might be made pleasanter still if a familiar tune could be played.

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To Echo or Not to Echo?

The B.B C. experiments on Echo still continue, and a large number of reports have come in saying that the increased echo due to the change in the draping of the studio is noticed, and the correspondents consider there is now too much echo. It is quite evident that it is going to be a very difficult job pleasing people with regard to the echo in studios

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The Nerve Centre.

Captain Eckersley has an article in a contemporary called "The Nerve Centre of Broadcasting." Some people who have listened to his Topical Technical Talks think that he is the nerve centre of broadcasting.

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A Cambrian Concert.

The Welsh people are getting very excited because the St. David's Day proceedings in the Welsh Tabernacle at King's Cross are to be broadcast from London. In addition to an address by the Arch Druid—who, by the way, is an uncle of one of the most charming members of the B.B.C. staff—there will be a concert by members of the London Welsh Choir, which has on previous occasions been heard from 2LO, notably when the "Comedy of Danger" was broadcast, when Mr. Madoc Davies and other Welsh singers took the parts of the miners singing at the time of the disaster.

No Time for Work?

The B.B.C proposes to run programmes practically continuously from 3 p.m. to 11 p.m. every day. It reminds one of the old story of the Scotsman who came to London and examined the menu at his hotel. "Breakfast from 8.30 till 11.30. Lunch, 11.30-3.30. Tea, 3.30-6.30 Dinner, 6.30-9.30." He summoned the waiter and said, "Here, young man, what time do you get to see the scenery?" If it is possible to listen from 3 till 11 o'clock every day, some wireless enthusiasts will have no time for work.

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Microphonic Mice.

A moving incident is recorded from Sheffield where mice chewed the moving coil of a microphone, with the result that the transmission was interfered with. A Leeds correspondent suggests that perhaps it is those same mice that have chewed up all the missing licences in Sheffield.

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Glasgow's Birthday.

Glasgow celebrates its second birthday on Friday, March 6th. It is a hefty youngster for two. Appropriate enough, the band of the Highland Light Infantry will contribute to the programme.

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Relay Station Demands.

Amongst the places which have asked for broadcasting stations from time to time are Inverness, Leicester, Brighton, Norwich, Eastbourne, and Rhyll (North Wales). The attitude of the B.B.C. to demands for new relay stations is that it has come to the end of its relay policy until the Daventry Station is functioning. When it is known definitely how much of the country is served by Daventry, then they will have to consider the position of any areas that are still deaf.

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Interference with Plymouth.

Apparently Plymouth has good reason to regret the absence of some international understanding about the distribution of wavelengths. During the past few weeks the area of the three towns has been afflicted by a tremendous amount of interference from continental broadcasting stations. The station engineers have been listening specially to detect causes, and broadcast listeners have been very prompt in supplying useful data to assist investigations. A certain amount of data has been secured, and efforts are being made to remove the cause of the trouble.

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A Continental Handicap.

Of course the problem is fairly complicated for the reason that continental broadcasting is not organised centrally as is the case with British broadcasting. Stations work on their own, and sometimes they communicate less with one another than they do with the B.B.C. A position of this kind lends itself to the temptation to "blame the other fellow."

It is quite obvious that the international position will have to be cleared up before very long, and it is hoped that some results will be achieved by the International Conference which the B.B.C. is trying to convene in London during the present month.

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5XX in America.

The Radio Corporation of America has reported that 5XX is being received on the other side of the Atlantic well enough to relay, and an early attempt is to be made to carry this out.

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Broadcasting from British Ships.

The Transatlantic liners under the American flag are developing broadcasting. The "Leviathan," for instance, operates a regular service and receives special transmissions from the American side when in mid-Atlantic.

The British Mercantile Marine appears to be lagging behind in this, and the complaint is made that the Post Office definitely discourages the idea.

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Is the B.B.C. Opulent?

The recent announcement that the Post Office had handed over £800,000 to the B.B.C. between 1922 and the end of 1924 has created the impression in certain quarters that the B.B.C. is fabulously wealthy, and has a large margin for development.

This, the company state, is not the case, but that in point of fact the only profits that can be paid are restricted by Act of Parliament to 7½ per cent. on the original £60,000 capital provided by certain wireless manufacturers. The balance of the money has been absorbed by the enormous capital expenditure required in setting up twenty-one stations, and in creating and operating an adequate service.

The Salary Bill.

It is perhaps worthy of note that the salary bill of the twenty-five permanent orchestras is to the order of £100,000 per annum. The capital cost of a main station is about £10,000. Expenditure has been directed throughout to increasing the potential number of listeners of moderate means.

Whereas the B.B.C. was under contract to provide eight main stations only, it has actually provided nine main stations and ten relay stations.

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Broadcasting and the Theatres.

It is good news that the negotiations between the B.B.C. and the theatrical industry are making progress. No purpose is served now in raking up past controversy. The essential fact is that the entertainment industry has at last realised that broadcasting must be accepted as a permanent and growing force in the community, and that no artificial barrier can be put in the way of its expansion.

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Market Prices.

The broadcasting of market prices has been subject to a further rearrangement as regards the day. Until March 19th next these prices will be given out to all stations on Thursdays at 6.35, but from March 19th they will be read fortnightly on Thursdays at 6.35, and will be followed by the Ministry of Agriculture's Fortnightly Bulletin, which is at present broadcast on alternate Fridays.

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FUTURE FEATURES.

Sunday, March 8th.	
London and 5XX, 3 p.m. ...	Organ Recital, relayed from the National Institute for the Blind.
Birmingham and 5XX, 9 p.m. ...	The Opera "Pagliacci" (Leoncavallo). S.B. to other Stations.
Cardiff	Symphony Concert, relayed from the Park Hall.
Manchester, 3 p.m.	Chamber Music: The Catterall Quartet.
Newcastle, 3 p.m.	Recital of Ancient Hebrew Melodies.
Aberdeen, 9 p.m.	Oratorio: "The Crucifixion" (Stainer).
Monday, March 9th.	
London and 5XX, 7.30 p.m. ...	Symphony Concert, conducted by Percy Pitt.
Bournemouth, 7.30 p.m.	Wagner Evening.
Newcastle, 7.30 p.m.	The Dance Music Tradition:—Elizabethan, Restoration, Georgian, Victorian, and Present Day Dances.
Tuesday, March 10th.	
5XX, 7.30 p.m.	"Evening Standard" Concert.
Liverpool, 7.30 p.m.	The Liverpool Philharmonic Society's 10th Concert.
Wednesday, March 11th.	
Cardiff, 7.30 p.m.	"Tannhauser" (Wagner).
Belfast, 7.30 p.m.	Symphony Concert.
Hull, 7.30 p.m.	"The Dream of Gerontius" (Elgar).
Thursday, March 12th.	
All Stations, 8 p.m.	The Musical Miracle Play, "The Pilgrim's Progress." Relayed from the Royal Opera House, Covent Garden.
Friday, March 13th.	
Aberdeen, 8 p.m.	"An Hour with Elgar."
Glasgow, 7.35 p.m.	"Scots Night."
Saturday, March 14th.	
London, 8.30 p.m.	"A New Feature by Old Friends."
Bournemouth and 5XX, 8 p.m. ...	"Pictures": Well-known paintings brought to life.
Aberdeen, 7.30 p.m.	The Catterall Quartet.

Pen and Tongue.

There are two sides to the question as to whether or not famous authors should broadcast. Some of them, like Mr. George Bernard Shaw, are such excellent speakers that they quite enhance their own works by an appreciation and understanding that no outsider could command, but there are others who are famous authors but who—to put it mildly—are not graced with the gifts of speech.

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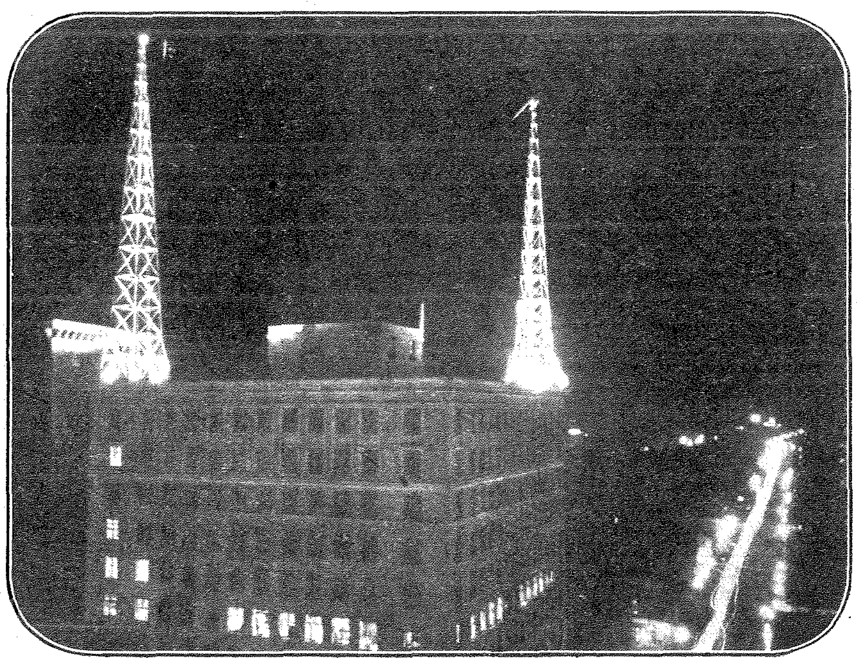

BROADCASTING IN AMERICA. A flood-lighting effect on the antennæ at WHH, the broadcasting station at Des Moines, Iowa. The aerial arrangement is not unlike that at the new 2LO.

Birmingham's Spring Clean.

The engineers at 5IT recently carried out a spring cleaning of the giant aerial at Summer Lane. When the aerial was lowered it was found that nearly an eighth of an inch of soot had collected on the insulators and wire. The aerial, which was of the six-wire sausage type, was replaced by one of four wires, and the hauling into position between the two chimney stacks of the Summer Lane Power Station of the Birmingham Corporation took some time as they are 210 feet high. Some idea of the weight of a broadcast transmitting aerial can be gained when it is stated that each of the insulators on the aerial—there are nine—weighs 10 lb., while the swivel shackles, two in number, weigh 20 lb. each.

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Land Line to Cathedral.

On Sunday, February 22nd, the Birmingham Station relayed its first service from the Birmingham Cathedral Church, the preacher being Bishop Hamilton Baynes. For a considerable time past the station had been seeking permission to carry a telephone line to the island site on which the church stands, but since the city bye-laws forbade an overhead wire over the thoroughfare special permission had to be obtained before the line could be laid through the graveyard which surrounds the church.

THE BUZZER WAVEMETER.

A Tuned Circuit, when excited by means of a Buzzer, affords a method of studying the factors governing Wavelength. The properties of such a circuit are discussed as applied to the design and operation of the Wavemeter.

By R. D. BANGAY.

A TUNED buzzer is an instrument for providing an artificial signal on any desired wavelength for the purpose of testing or tuning the circuits of a receiver. It is one of the most useful instruments to possess as an adjunct to any receiving set, and is indeed an essential part of the equipment of anyone experimenting with receiver circuits.

A tuning buzzer consists essentially of a closed oscillatory circuit in which provision is made to energise the circuit, i.e., to cause it to oscillate at its own natural frequency by means of an electrical buzzer. The buzzer itself is not in any way "tuned," in the wireless sense of the word; it merely forms a convenient method of automatically supplying energy to the tuned circuit at frequent intervals.

The method adopted for energising the oscillatory circuit is a very simple one. Suppose we set up a simple closed oscillatory circuit consisting of a condenser C and of an inductance L, as illustrated in Fig. 1. This circuit has, of course, a natural frequency or wavelength of its own depending upon the capacity of C and the inductance of L.

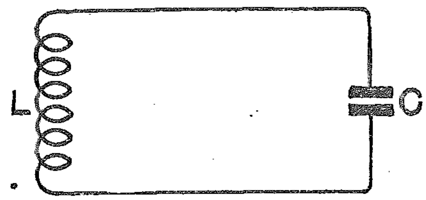


Fig. 1.—A tuned circuit having a coil with inductance L and a condenser with capacity C.

Electrical Oscillations.

Now, suppose we connect some outside source of supply, such as a battery, across the inductance, as shown in Fig. 2, where B is the battery. Immediately this circuit is completed, a current flows through the circuit B-L, as indicated by the arrows, which quickly grows and reaches a steady value depending purely upon the resistance of the circuit. When the battery is first connected to the circuit, however, it will take a short period of time for the current to reach its normal value owing to the electrical inertia of the inductance L; and it is during this time that energy is being stored up in the inductance, just as energy is stored up in a moving train when the latter is getting up speed.

Now, suppose that the circuit B-L is suddenly interrupted by opening the switch X, as illustrated in Fig 3. The current flowing in the inductance is now deprived of its driving force, but it still retains the energy stored up during the growing period. This energy tends to continue the flow of current which, being unable to pass back to the battery, now flows into the condenser C, charging the latter up until the E.M.F. exerted by the condenser reverses the direction of the current, which then flows back

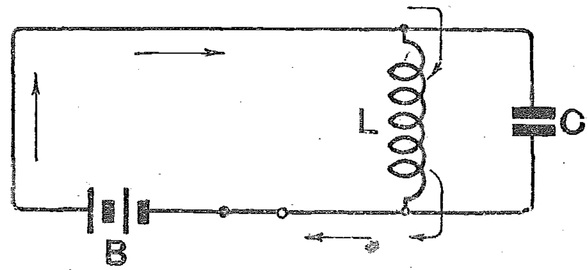
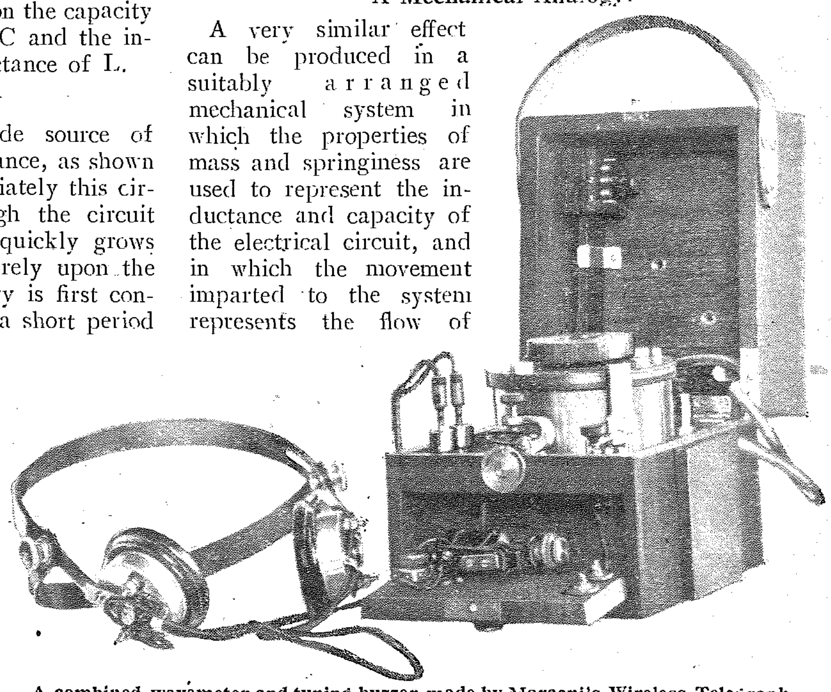


Fig. 2.—The circuit of Fig. 1 to which has been added a battery B.

through the inductance, charging the condenser up in the reverse direction. This sequence of events repeats itself, the current oscillating backwards and forwards at the natural frequency of the circuit, but with gradually diminishing amplitude, until all the energy originally imparted to it has been absorbed in resistance and other losses. Thus it will be seen that every time the circuit B-L is completed and interrupted, a group of damped oscillations is induced in the oscillatory circuit.

A Mechanical Analogy.

A very similar effect can be produced in a suitably arranged mechanical system in which the properties of mass and springiness are used to represent the inductance and capacity of the electrical circuit, and in which the movement imparted to the system represents the flow of



A combined wavemeter and tuning buzzer made by Marconi's Wireless Telegraph Co., Ltd. The inductance coil is wound on a square former mounted in the lid with tappings for different wave ranges.

The Buzzer Wavemeter.—
current in an electrical circuit. The momentum of a moving mass thus represents the energy stored in the inductance when current is flowing through it. Such a system is illustrated in Fig. 4, where the weight W (representing the inductance L) is attached to the end of a

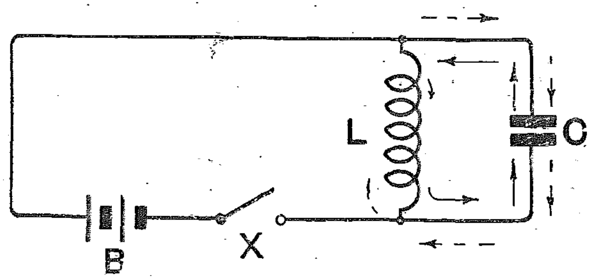


Fig. 3.—A tuned circuit with a battery B and switch X.

light spring S (representing the condenser C). Just as the electrical circuit has its own natural frequency depending upon the capacity of C and the inductance of L, so has this mechanical system a vibratory frequency depending upon the weight of the mass W and the springiness of the spring S, and is capable of vibrating, as indicated by the dotted outlines in Fig. 4.

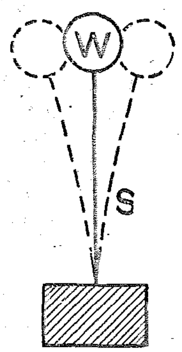


Fig. 4.—A mechanical analogy in which the weight W represents the inductance and the spring S the condenser.

Suppose now we impart a steady movement to this mechanical system by moving it bodily in the direction shown by the arrow in Fig. 5; this represents the steady flow of current through the inductance in the electrical circuit when the battery B is connected to the inductance. If, then, we suddenly interrupt this movement of the mechanical system, as shown, for example, in Fig. 6, by bringing it up against a stop X, it will be found that, although the steady movement is arrested, the weight W, by reason of its momentum, tends to continue its movement, which it does by bending the spring S until it occupies the position shown at W^1 in Fig. 6. When a balance of forces is reached, the spring immediately flies back carrying the weight with it, producing a vibratory movement of the system between the positions W^1 and W^2 at the natural frequency of the system, which gradually diminishes until the energy is expended in friction and other losses

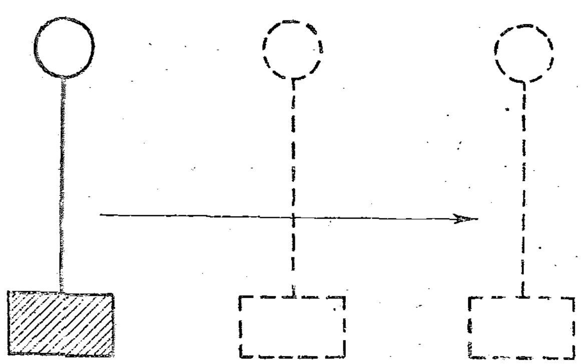


Fig. 5.—Representing the charging of the circuit of Fig. 3.

Returning once more to the oscillatory circuit shown in Fig. 3, it will be clear that each interruption of the battery circuit only induces a single group of damped oscillations. In practice, these will only occupy a very short space of time.

The Complete Circuit.

If the oscillatory circuit is brought near the circuits of a receiver, each group of oscillations thus generated will produce only a single click in the receiver telephones. It is therefore desirable to provide some means of automatically making and breaking the battery circuit at frequent intervals while the receiver circuits are being tuned in, thereby producing a series of clicks or a musical note like

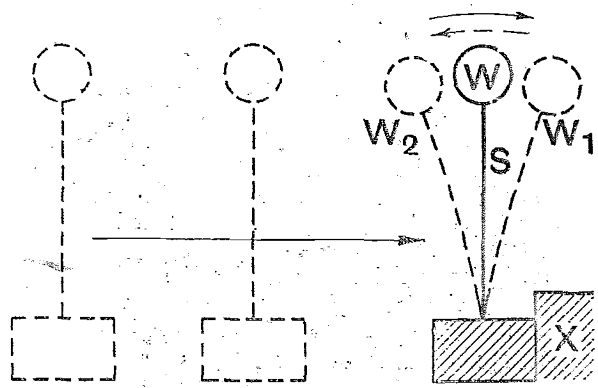


Fig. 6.—The charging ceases when the system reaches stop X, which is equivalent to opening the switch X of Fig. 3.

a spark station signal. This is accomplished by the buzzer, which can be so arranged that the current which operates the buzzer magnets also energises the inductive winding of the oscillatory circuit.

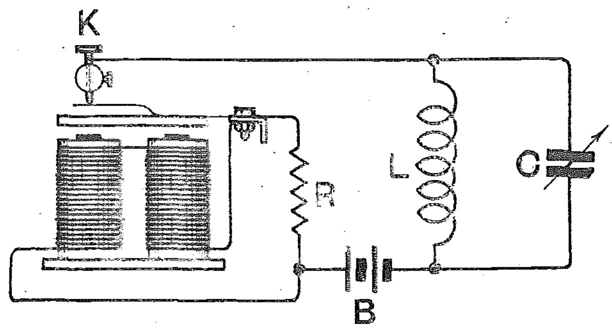
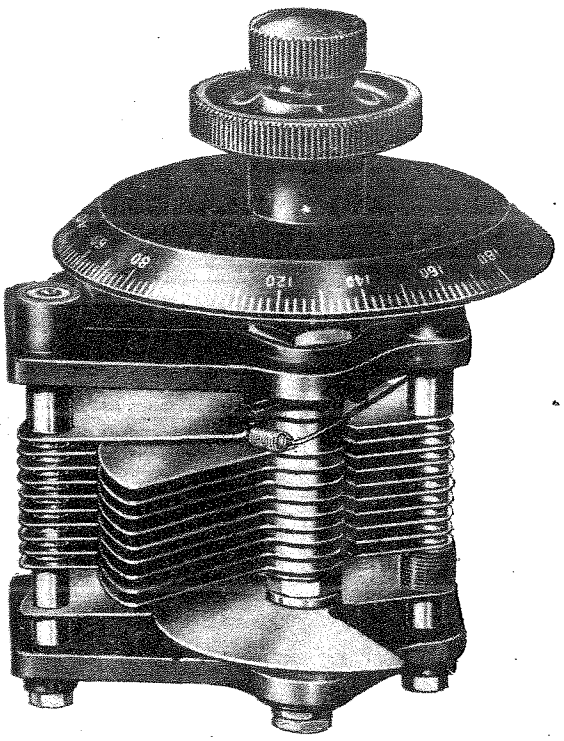


Fig. 7.—Connections of a complete tuned buzzer.

The connections for the circuit are illustrated in Fig. 7 It will be noticed that a resistance R is connected across the magnet coils. This resistance is of vital importance to the operation of the buzzer, because, owing to the high inductance value of the magnet coils, which is many hundreds of times greater than that of the oscillatory circuit, a considerable amount of energy is stored in them when the circuit closes. Unless a path is provided across the magnet coils in which this energy can be absorbed when the circuit is interrupted, a spark will be created at the buzzer contacts K. If this is allowed to occur, the energy in the inductance L will also dissipate itself in

The Buzzer Wavemeter.—

the spark instead of charging up the condenser C, as described above. It is therefore essential to connect a resistance across the magnets as shown. This resistance should be wound non-inductively, and should be of such a value as to prevent any sparking whatever at the contacts. In practice, the actual value of the resistance will depend upon the design of the buzzer and the voltage of the battery. A resistance of about 5 ohms will be found approximately correct for most buzzers. The higher the note of the buzzer, the easier it is to tune the receiver to



Square law condenser made by The Sterling Telephone and Electric Co., Ltd., showing unsymmetrical shape of vanes.

the signal produced, but it will generally be found that the very high note buzzers are somewhat troublesome to adjust, especially when the magnet coils are shunted with a low resistance as described.

The Components Employed.

The next point to consider is the construction and calibration of the oscillatory circuit itself. The natural wavelength of any circuit can be found from the formula $\lambda = 1885\sqrt{C \times L}$ where λ is the wavelength in metres, C the capacity in microfarads, and L the inductance in microhenries. Obviously, therefore, we may vary the wavelength by altering either the capacity or the inductance of the circuit, or both. For convenience of calibration, it is, of course, desirable to have only one continuously variable factor, but the range of wavelengths obtainable in this way can be extended by varying the other factor in suitable steps. A calibration curve can then be drawn for each step.

Thus, if the circuit consists of a fixed inductance and a variable condenser of such values that the variation of the condenser enables a range of, say, 300-1,000 metres to be obtained on the circuit, this range can be extended upwards or downwards by replacing the inductance coil with one of larger or smaller value. For example, it might be replaced by one which, with the same variation of the condenser, will give a wave range of, say, 800-2,500 metres.

Generally speaking, a much greater variation can be obtained with the standard variable condenser than with a variable inductance of the variometer type. For this and other reasons, it is usual to make the capacity the continuously variable factor in a tuning buzzer circuit and to use this in conjunction with suitable fixed inductance coils, which can be chosen by reference to the lists issued by all the principal manufacturers. An economical condenser unit to employ is one having a maximum capacity of .001 mfds., and with a scale marked in degrees.

Standard and Square Law Condensers.

Variable condensers can be obtained in two distinct types commonly known as the "standard" condensers and the "square law" condensers. The standard condensers are provided with symmetrical plates, and the capacity of the condenser is approximately proportional to the scale reading. Thus, if the scale is marked in degrees from 0 to 180 degrees, and the maximum capacity of the condenser is .001 mfd., each 10 degrees scale reading represents .000055 mfd.

The square law condensers are also provided with uniformly divided scales, but have specially shaped vanes (see photograph), so arranged that the active surface between the plates increases more and more rapidly for each degree of movement as the knob is turned. In fact, the capacity follows the law of squares, so that twice the scale reading on the condenser represents a capacity four times greater.

The curves in Fig. 8 illustrate the capacity A of a standard condenser, and B of a square law condenser for different scale readings. It will be noticed that in both cases the condensers have a certain amount of minimum capacity when the scale reading is zero. This is known as the "zero capacity" of the condenser, and is due to the self capacity of the vanes and to the mutual capacity between the two sets of vanes edgewise. Its value is usually very small, about 5 per cent. of the maximum capacity of the condenser, but it has an important effect on the calibration of the circuit when the condenser is adjusted to the smaller values, as we shall show later.

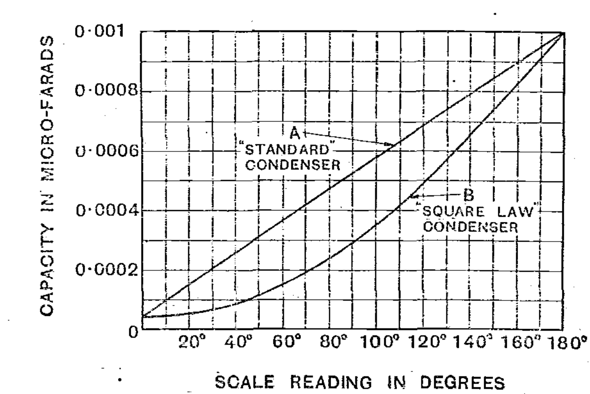


Fig. 8.—The capacity of a standard condenser (A), and a square law condenser (B) for different scale readings.

The Buzzer Wavemeter.—

The object of the square law condenser is to improve the shape of the calibration curve of the circuit of which it forms a part, *i.e.*, the wavelength against the scale-reading curve. The wavelength, as indicated by the formula, is proportional to the square root of the capacity. Consequently, if the inductance remains constant, as in the case under consideration, and if *the capacity is increased in equal* steps for each degree of scale reading, as it would do with a standard condenser, the wavelength will increase in gradually diminishing steps, *i.e.*, in the ratio of $1, \sqrt{2}, \sqrt{3}, \sqrt{4}$, etc., and the calibration curve will start with a steep slope and gradually flatten out. If, on the other hand, *the capacity is increased in gradually increasing steps, i.e.*, in the ratio of $1, 2^2, 3^2, 4^2$, etc., for each successive degree of scale reading, the wavelength of the circuit will increase uniformly, and the wavelength curve of the oscillation circuit will take the form of a straight line.

Effect of Circuit Capacity.

A perfectly straight line, however, is only obtained if the *total capacity of the circuit* varies in ratio to the square of the scale reading of the condenser. In practice, there are two factors which interfere with this; firstly, there is the zero capacity of the condenser already referred to, and, secondly, there is the self capacity of the inductance coil itself. The sum of these two values may be termed the "circuit capacity."

The zero capacity of the condenser is usually about .00004 mfd., but the self capacity of the inductance coil may quite easily be equivalent to a value several times greater than this. In order to maintain as far as possible the straight line characteristic of the wavelength curve when using a square law condenser, it is essential to employ a coil of very low self capacity. An inductance consisting of a single layer wound on either a square or round former is the best. The equivalent self capacity of a coil wound in this way, and having an inductance of about 300 microhenries, can be brought down to about .00003 mfd.

The magnitude of the circuit capacity is, of course, small compared with the *maximum* value of the condenser, and will not, therefore, seriously affect the upper portion of the calibration curve. On the other hand, as the value to which the variable condenser is adjusted is reduced, the effect of the circuit capacity is more and more pronounced and becomes noticeable in the bend of the lower part of the curve. It will, of course, be understood that this capacity effect does not in any way affect the efficiency of the instrument. It merely reduces the advantages of using a square law condenser by introducing a bend in what would otherwise be a straight line calibration curve. It also reduces the total range of wavelengths which can be obtained with a given variable condenser. In the case of a circuit tuned by means of an ordinary standard condenser, the effect of the circuit capacity is to flatten out the bend in the lower part of the curve.

The calibration curves of four examples are shown in Fig. 9, which illustrates the effect of circuit capacity on the shape of the curves. The circuit capacity in the case of curve A is .0002 mfd.; that of the curve B, .0001 mfd.; and that of the curve C, .00005 mfd. The dotted line curve D is the calibration curve of the circuit when using an ordinary straight law condenser and assuming a circuit capacity of .0001 mfd. In all cases, the condenser has a maximum capacity of .001 mfd., but for convenience of comparison the inductances of the coils used in each case have been taken at such a value as to bring the maximum wavelength the same in each case.

The points O-X mark the limits between which, for all practical purposes, the curve may be taken to follow the straight line law. Therefore, when calibrating a circuit using a square law condenser, it is only necessary to take two readings anywhere on this part of the curve and to draw a straight line between them. This will give an approximately true calibration within the limits indicated in Fig. 9. But for the wavelengths below the point marked X, the curve must be plotted by taking a number of readings all along the scale. It will be noticed that this point corresponds to a scale reading on the condenser of 85° in the case of a fairly bad coil and 50° in the case of a good coil.

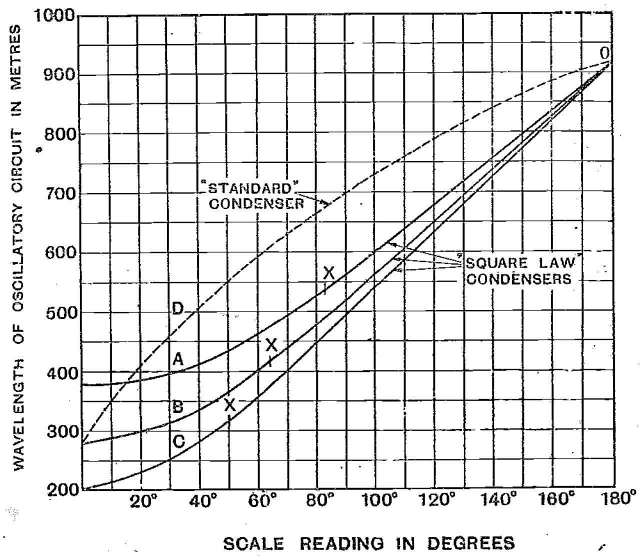


Fig. 9.—Calibration curves of four tuned circuits.

Calibrating the Circuit.

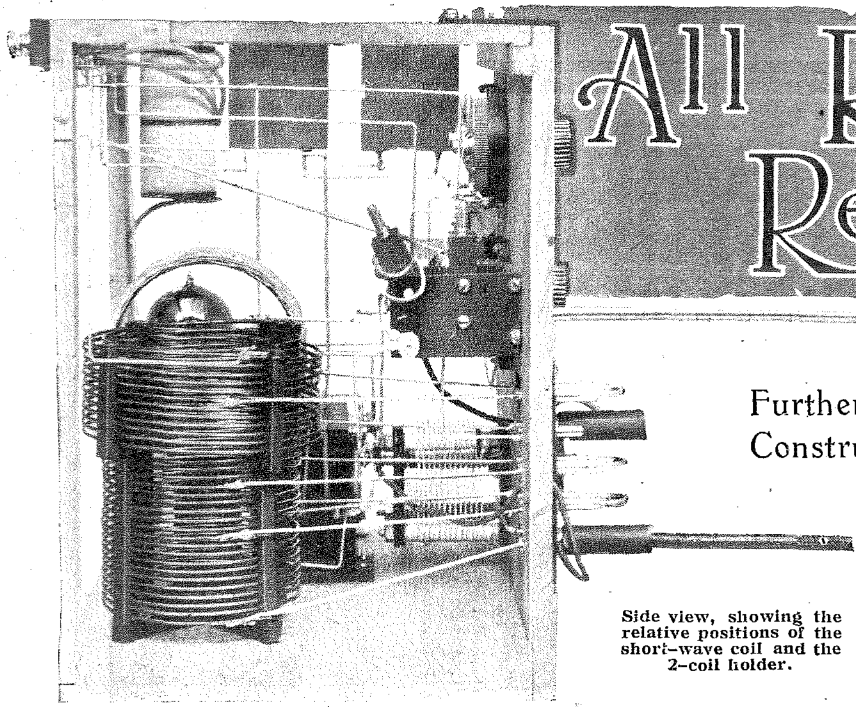
The method usually adopted by amateurs for calibrating a tuning buzzer is first to tune a receiver accurately to some known station whose wavelength can be ascertained from any of the various lists published from time to time in the radio periodicals. This should be done very carefully; if possible, with a coupled circuit receiver in which the coupling is reduced to the lowest practicable value. Then the tuned circuit of the buzzer is brought sufficiently near to the receiver to give weak signals. The buzzer circuit is then tuned to the receiver, the final adjustment of the buzzer circuit being made by taking the instrument far enough away from the receiver circuit for the signals to be only just audible when the buzzer is accurately tuned. The reading on the buzzer condenser scale corresponding to the wavelength of the signal to which the receiver was tuned gives one point on the curve, and the process is repeated with other stations whenever the opportunity occurs.

"THE RED HERRING."

THE UNLICENSED BIRDCAGE AERIAL.

Whilst the imagination of the public is being fired by comments in the daily press with the prospect of domestic scenes such as our cartoonist depicts above, there is grave risk that the really serious clauses in the new Wireless Bill may escape proper attention.

All Range Receiver.



Side view, showing the relative positions of the short-wave coil and the 2-coil holder.

Further Details for the Construction of the Set.

The circuit principle having been discussed in the previous issue, further instructions are given for making up the receiver which will tune down to wavelengths as low as 50 metres.

By F. H. HAYNES.

THE turns of the secondary circuit extend only as far as within $\frac{1}{4}$in. of the end of the coil, so that holes can be drilled through the ebonite uprights for securing with screws to small pegs of wood attached to the base. The diameter of the closed circuit can be carefully adjusted so that there is no convergence towards one end, and the ebonite supports stand perfectly upright. The primary winding, as explained earlier, remains in position by the grip which is obtained when the turns are tightened. Should the primary, however, be found to be loose after the coils are set up in position, a little melted shellac or elastic glue may be used to make the surfaces hold together. On no account use ordinary adhesives owing to their poor insulating properties, while the use of metal screws close up against the turns of the inductances must be avoided.

Assembling the Components.

The baseboard and front panel will be secured together and the supporting struts adjusted before attention is given to the assembling of the components. The woodwork must be dismantled, however, before the components can be fitted. It is advisable not to screw down the short wave coils until the position of the centre of the reaction inductance has been determined. If the plug-in coils are of the "Gambrell" or large "Igranic" types the position of the coil will be as given in the drawing showing the lay-out of the base. It is advisable, also, to check off the height of the short wave coils before making the hole in the front panel for attaching the coil holder. One hole fixing is used for attaching the coil holder, but it will probably be found that the bush supplied with the holder is of insufficient length for mounting on a $\frac{3}{8}$in. panel. Before drilling out the hole, therefore, a recess should be made in the front of the panel with a $\frac{3}{4}$in. carpenter's bit, so that the bush drops below the face of the wood. If a bit is not available, the job can probably be done with a chisel or sharp penknife.

The other components which have to be made up by the reader are the choke coils and holder for the V.24 valve. The latter is constructed from small cross-pieces of $\frac{1}{4}$in. ebonite carried on wooden battens. Suitable clips can be purchased, though it is not a difficult matter to prepare them from $\frac{3}{8}$in. bronze strip of about No. 26 gauge, taking care not to make the bends too acute. The choke coils are wound on an ebonite former about $1\frac{1}{2}$in. diameter and 3in. in length, each occupying half the winding space, and run on in the same direction. The inductance value is, of course, not critical, and a winding of 130 turns of No. 36 D.S.C. for each coil will prove effective.

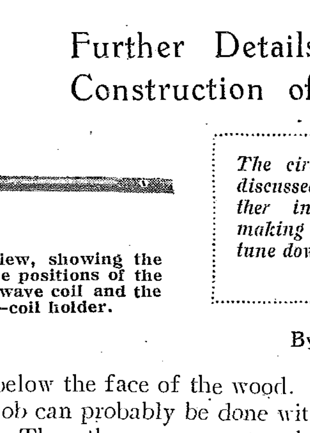


Fig. 5.—Constructional details of the V.24 valve holder.

The terminal strip is made to the entire width of the instrument, and in bridging the uprights assists in holding the frame square. For this reason three No. 4 wood screws are used at each end to give secure attachment. The strip carries nine equally spaced terminals, and their identity may be marked along the top of the strip by lettering with white enamel.

It is now standard practice in amateur work to use connecting tags under all screws and terminals, so that soldered connections can be made without overheating the

All Range Receiver.—
points of connection. Using No. 16 wire straightened by stretching, the leads are run as shown in the practical wiring diagram.[1] Coils should be inserted in all three holders while the wiring is being done, so that the leads may be run by paths which will not foul the inductances when the reaction coupling is adjusted.

The Aerial System.

For short wave reception the use of a counterpoise is strongly recommended, and may consist of three or four well-insulated wires, equal in length and branching out from a leading-in insulator to points a few feet above the ground at the far end of the aerial. In the circuit diagram a counterpoise is shown, but if an earth wire is used the connections must be amended as shown by the dotted lines.

A two-wire aerial 100ft. in length will usually be found too large for good reception on wavelengths below 100 metres, and much better results can be obtained by employing either a single wire or an aerial of not more than 60ft. in length. Although surprising results can be obtained on small indoor aerials, it is to be recommended that the aerial should be as high as possible, and great care must be taken with regard to the lead-in to avoid capacity leakage.

Operation.

When receiving on the short wave band of roughly 50 to nearly 200 metres, a plug-in coil is only inserted in the reaction coil holder. Using "Gambrell" type coils the sizes "A," "a" and "2a" as reaction inductances, the range can be covered, and if home-made coils are used it is worth while making up a set consisting of some three or four different values.

The circuit diagram shows a variable condenser connected in the lead between aerial and aerial terminal. This is necessary when using a large aerial, and should have an approximate maximum value of 0.0003 mfds., and in use may often be found to give the required results at almost a zero setting. Such a condenser will prove useful even with a small single wire aerial, for changes in its value when receiving on a given wavelength can be compensated for by altering the position of the tap on the aerial coil. This, in effect, gives a control over the extent of coupling between aerial and secondary circuits. For quick searching, however, the single tuning dial will give the required results, though a simultaneous adjustment of reaction coupling must be made.

The direction of reaction coupling is adjusted when the set is on test, and for this reason all four leads to the coil holder should be only temporarily made off.

[1] Supplement to *Wireless World*, 25th February, 1925.

By inserting the connecting links, and with the plugs free, tuning coils plugged in the holders will load up to broadcasting and higher wavelengths. It must not be overlooked that the circuit still remains a moderately loose coupled one, and provides a degree of selectivity which is becoming essential. Again, the use of the external condenser connected in the lead to the aerial, or in the case of the longer wavelengths, connected across the aerial and earth terminals, greatly assists in the process of tuning and gives improved selectivity.

The potentiometer will be found particularly useful for controlling the extent of oscillation, and a critical degree of damping can be obtained in the tuning circuits by regulating the potential applied to the grid.

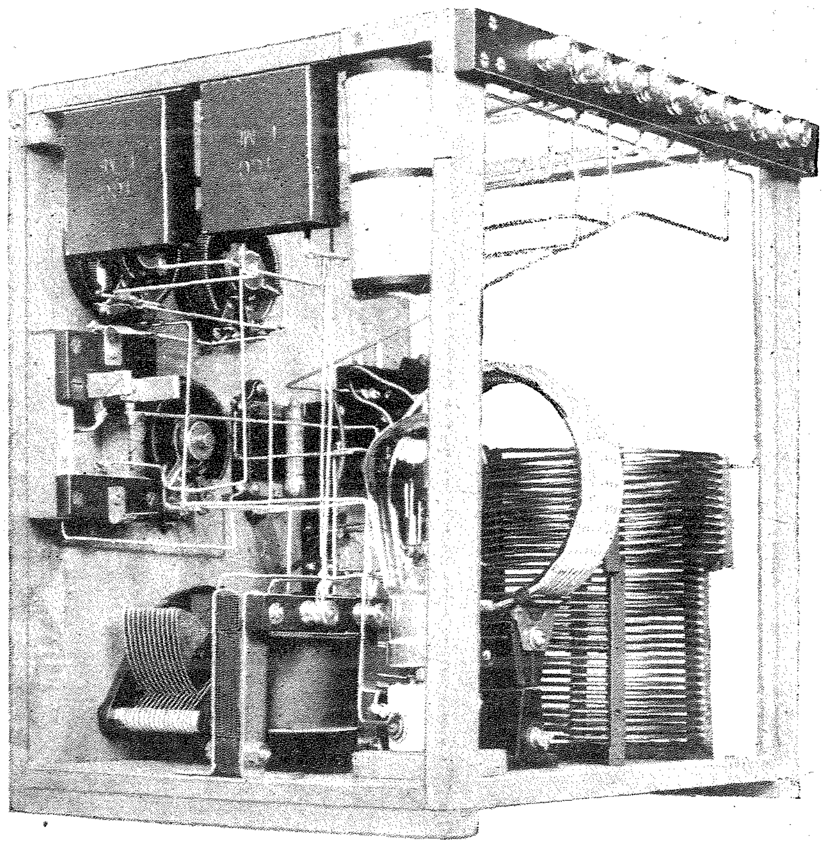
Results Obtained.

On the first brief test applied to the instrument, and using the short wave coils, the following American amateurs were received at good strength and read word perfect :—

1AMS, 1AQM, 1BLX, 1BWX, 2BM, 2BGB, 2BDE.

Dutch, French, and Swedish amateur stations were, of course, tuned in and read without difficulty.

On the broadcasting wavelengths most of the British stations were received when making use of reaction, whilst it was not only possible to bring in Madrid at good strength, but this station could be heard and easily identified on its second harmonic.



Rear view of the receiver showing details of the V.24 valve holder and the low frequency amplifying equipment. The choke coils are attached by means of a wooden plug to the framework, and the leads of the telephone terminals are taken from the middle of the former.

A Review of the Latest Products of the Manufacturers.

A DEVELOPMENT IN TELEPHONE RECEIVER DESIGN.

It has always been felt that there is a need for departure from the orthodox form of construction of headgear telephone receivers. In order to exclude outside noises receivers are invariably worn clamped tightly against the ears, and when signals are exceedingly weak the operator often grips them and forces them securely against the head. By so doing it is possible to more easily read weak signals, not only because outside noises are excluded, but a closed column of air is produced between the diaphragm and the ear drum. Receivers used in this manner, and in fact many of the standard patterns, give rise to headaches if worn for several hours on end, whilst in the absence of ventilation the diaphragm and even the mechanism of the receiver, after a while, become corroded.

A new type of receiver has now made its appearance on the market and is manufactured under the British patents of Messrs. Harry Morser and Co., of 94, Hatton Garden, London, E.C.1. The earpieces are fitted with caps made of a non-metallic material and shaped to the exterior outline of the ear. When in use this cap is made to fit over the ear, which is thus completely covered by the extension pieces. External noises are completely eliminated, whilst the ears are not flattened by pressure, for the grip is obtained not from tension set up by the head band, but by the grip of the extension piece round the outer ear.

The receiver is beautifully constructed, well finished and built to be as light as possible, the arrangement of the pole pieces being on orthodox lines.

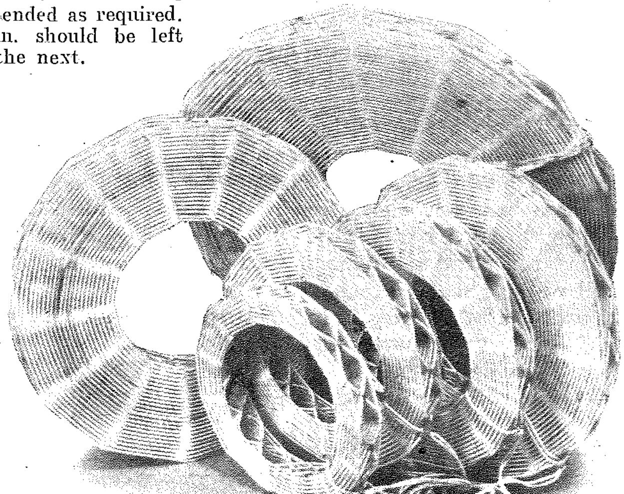
Attachment to the head is obtained by the ear cap instead of the clamping action of the headband.

ETHERON TUNING INDUCTANCES.

The Etheron coils are probably already well known among experimenters and are extensively used in the construction of inexpensive yet efficient amateur receiving sets.

Although wound in a very similar manner to basket coils, these inductances are remarkably robust, being held together by a stitching of silk. The high efficiency of these coils cannot be doubted, for the turns are almost air supported, and the small self-capacity is created almost entirely through a dielectric of air, whilst the concentration of the turns into small space ensures a high inductance value for the amount of wire used.

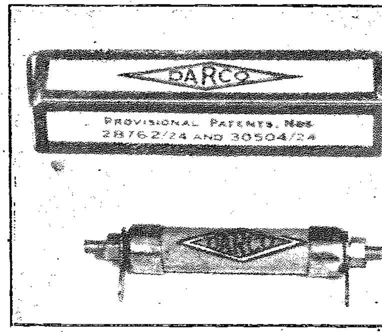
The range comprises six coils, suitable for use up to wavelengths of about 1,500 metres. By assembling two or more coils on a cardboard or ebonite former the wave range may be extended as required. A space of about $\frac{1}{8}$ in. should be left between one coil and the next.



A range of Etheron coils covering a wave range 265 to 1,320 metres, a product of Messrs. Listron Wireless Components.

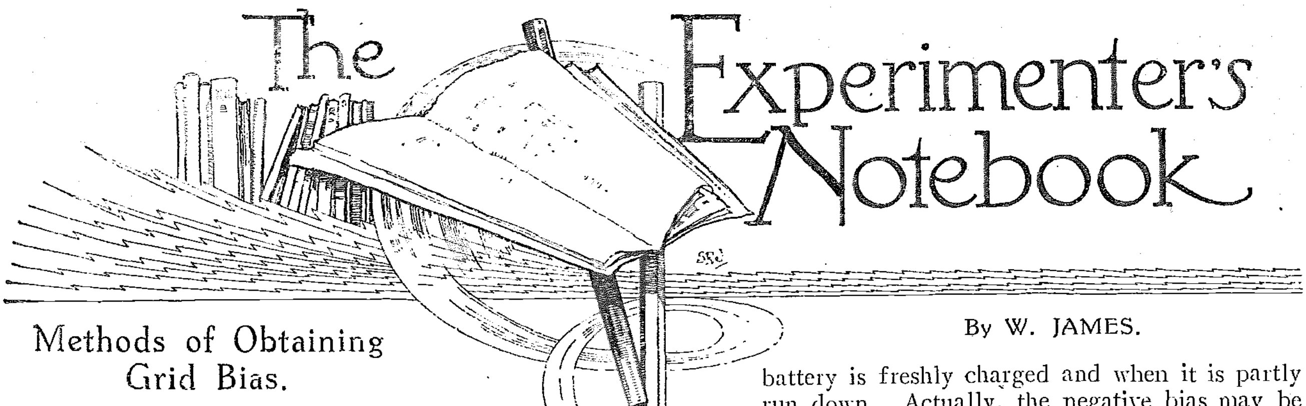
THE "DARCO" NEW PROCESS GRID-LEAK.

When the grid-leak is not used to directly bridge the condenser difficulty is experienced in picking up contact with its ends in order to join it up in an alternative position in the circuit. The leak is rarely employed connected across the condenser, and amateurs will welcome the introduction of a leak resistance which is fitted with small screw-end caps and tag connectors. It can, of course, be inserted, if required, in the clips usually provided on grid condensers, as the dimensions correspond with the types already on the market.



The Darco grid-leak, which is provided with screw and nut terminals.

A particularly reliable form of construction is adopted, the resistance consisting of a small strip of high resistance material critically adjusted as to length. Although the container is wax filled to guard against changes in the resistance value which might be brought about by the atmospheric conditions. There is little doubt that this new leak resistance will prove a boon to experimenters.



The Experimenter's Notebook

Methods of Obtaining Grid Bias.

By W. JAMES.

PERSONS having only an elementary knowledge of wireless reception are usually aware of the fact that it is essential to give the grids of all valves employed in a receiver a suitable normal voltage or bias if good quality is to be obtained. In particular, the grids of the valves employed as note magnifiers should have such a normal negative bias that the most positive portions of the signal do not reduce the grid voltage to more than about half a volt negative. Thus, if the peak voltage is 8 volts, the negative grid bias should be about 9 volts for safety.

The voltage of the signal to be applied to the grid of the last valve, which will satisfactorily operate a loud-speaker, depends, of course, on the type of loud-speaker and the type of valve connected to it. For ordinary household purposes a signal voltage of 6 to 9 is usually ample when a power valve such as the D.E.5, or an L.S.5, is employed; therefore, a grid bias of 7 to 10 volts should be used.

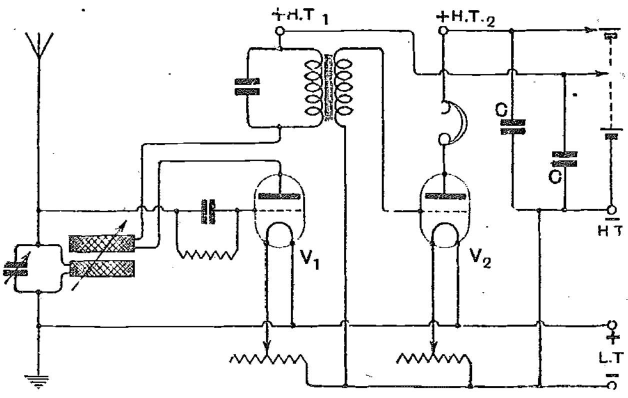


Fig. 1.—The grid bias is obtained by connecting the filament resistance of the note magnifier to the negative side.

There are several methods of obtaining a negative voltage for the grid of the valve, and these are shown in Figs. 1, 2, and 3. The connections are those of a two-valve set, although it should not be expected that voltages of the magnitude mentioned above will be available for operating the note magnifier.

In Fig. 1 the grid is negative by the amount of the fall in voltage over the filament resistance, which is connected in the negative side of the filament battery. The grid bias will, therefore, vary when the filament resistance is adjusted, and will be different when the filament battery is freshly charged and when it is partly run down. Actually, the negative bias may be of the order of 1 volt, depending entirely on the type of valve and the voltage of the battery.

This method is, therefore, not satisfactory, and should not be used, as in some instances—for example, when a D.E.R. or D.E.6 valve is heated from a two-volt battery—the grid bias is negative by a negligible amount.

A better and, in fact, the more usual method is to connect the filament resistance in the positive wire from the filament battery, and to employ a few dry cells (a grid battery) connected as in Fig. 2. The negative grid bias may then be given the proper value by connecting a suitable number of cells in series. It is the usual practice to employ a three-cell unit ($4\frac{1}{2}$ volts) in the grid circuit of the first note magnifier, and a 9- to 12-volt battery in the second stage.

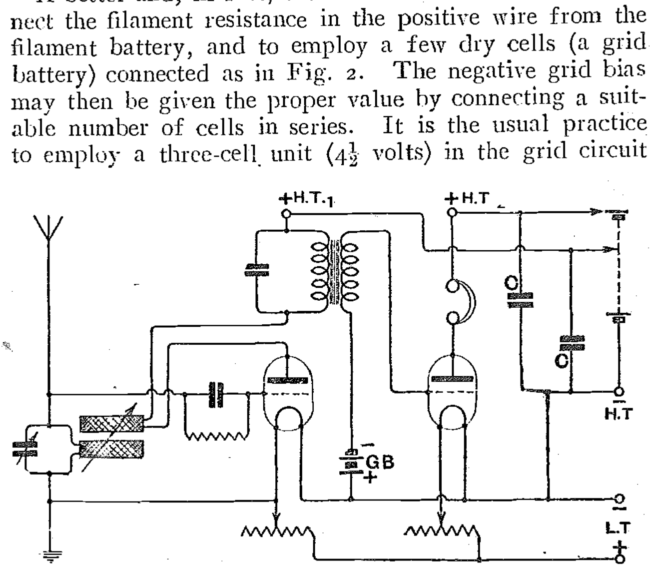


Fig. 2.—Grid cells, GB, are employed to give the grid of the note magnifier a suitable bias. Condensers C, of 1 or 2 microfarads, shunt the H.T. battery.

To avoid the troubles inherent in dry-cell batteries, the arrangement indicated in Fig. 3 is often employed.

A resistance R is connected between the negative terminal of the anode battery and the negative of the filament battery, and this is shunted by a condenser C_1 of large capacity, such as 2 microfarads. The anode current for both valves passes through the resistance. If the current is I amperes, and the resistance R ohms, the terminal marked −H.T. will be IR volts negative with respect to the negative terminal of the filament battery. For instance, if the anode current is 7 milliamperes, or 0.007 ampere, and the resistance is 1,000 ohms, the fall in voltage across it is 7 volts. Hence, when the secondary of the transformer is connected, as indicated in Fig. 3, the

The Experimenter's Notebook.—

grid of the second valve is normally negative 7 volts.

The condenser C_1 is essential, and is to prevent howling and noises; the speech currents pass through this condenser.

A wire having a high value of specific resistance, such

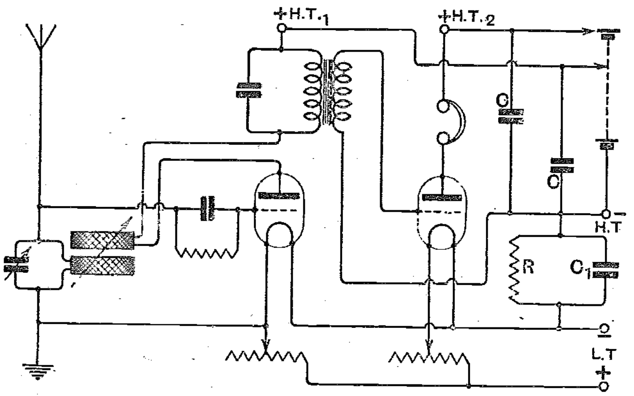


Fig. 3.—A special method of obtaining grid bias by means of a resistance R shunted by condenser C_1.

as Manganin or Eureka, should be employed in the construction of R. A suitable gauge of wire is No. 36, which for Eureka has a resistance of 14.8 ohms per yard.

The Flewelling Circuit.

The Flewelling receiver has a type of super-regenerative circuit with which a very high degree of amplification may be obtained, provided careful adjustments are made.

There are two usual circuits, illustrated in Figs. 4 and 5. In the circuit of Fig. 4 a frame aerial and tuning coil, L_1, are connected in series and tuned by condenser C_1. The usual grid condenser and leak, C_2, R_1, are employed, but the grid return wire, instead of connecting directly to the filament, as is usual, is joined to the combination of condensers and variable high resistance CR. In the anode circuit is a reaction coil, L_2, the telephones, and anode battery; a wire is taken from the top of the reaction coil to the bank of condensers.

These condensers should have a value of about 0.006 microfarad, and the variable high resistance be adjustable over a wide range. Some of the adjustable leak resistances on the market are satisfactory for use here;

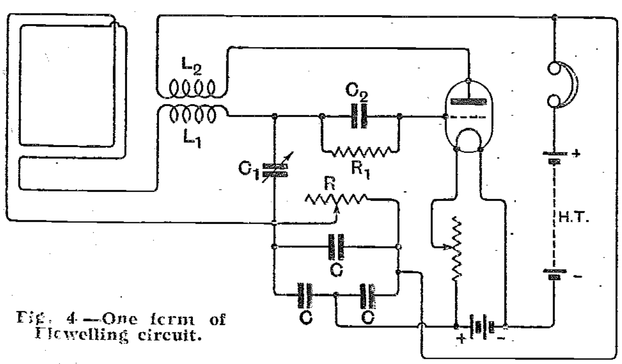


Fig. 4.—One form of Flewelling circuit.

the instrument employed, however, should be of a type which permits a delicate adjustment to be made.

In operation it will be found that with certain adjustments a high-pitched whistle is heard. For best results, further adjustments should be made to raise the frequency of the whistle to above audibility.

This circuit is a very tricky one to operate successfully, but when working properly remarkable results can be obtained. The adjustment of the reaction coil, L_2, and the variable resistance, R, are specially critical. Attention should also be given to the filament current and the anode voltage; these require somewhat careful adjustment.

A frame aerial should be employed, as strong oscillations are set up, which would be a nuisance if allowed to flow in an open aerial. Preferably make tests after broadcast hours, as even when a frame aerial is employed some interference may be caused.

A Modification.

The second circuit referred to is illustrated in Fig. 5, and is merely a modification of that of Fig. 4. Only one condenser, C, is employed, whereas three condensers are required with the arrangement of Fig. 4. The switch S, when put in position 1, converts the set to an ordinary single-valve reacting receiver. When the switch is put in position 2, the set is converted to one operating on the super-regenerative principle.

The grid condenser and leak are marked C_2, R_1, and the grid leak should be of a type which allows of critical adjustments.

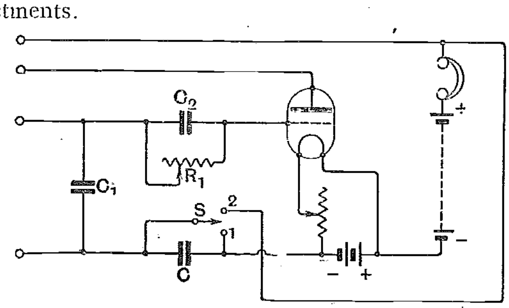


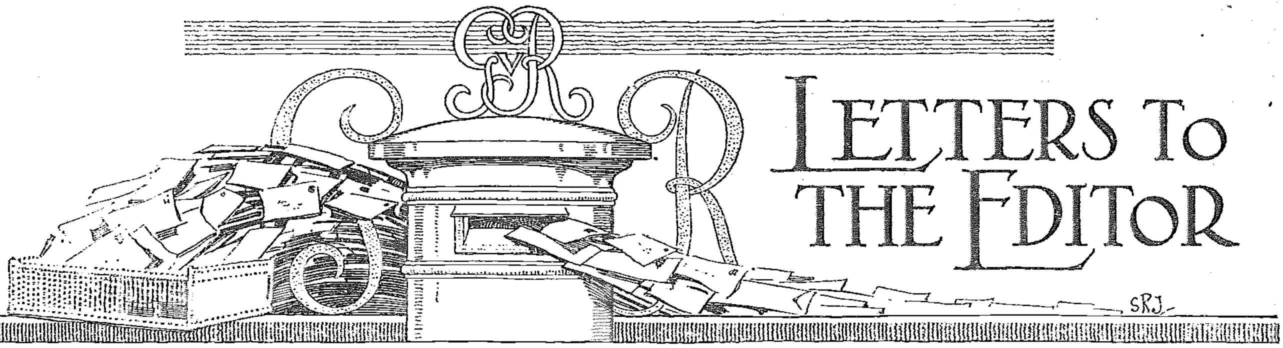
Fig. 5.—A modified Flewelling circuit.

This circuit is probably preferable to that of Fig. 4, as only one fixed condenser, C, is required, as against three, and, further, the set may be tested out in the ordinary way by putting the switch in position 1.

No reaction coil or aerial are indicated, but these are connected in the usual way.

TECHNICAL DICTIONARIES IN SIX LANGUAGES.

A dictionary giving technical terms in six languages is sufficiently rare to deserve comment and more especially is this the case in regard to a series of Illustrated Technical Dictionaries produced by Messrs. Lewenz and Wilkinson, of 25, Victoria Street, London, S.W.1. This series comprises 15 volumes, covering practically every branch of engineering and technology. The second volume embraces electrical engineering, and is divided into 15 sub-sections. Full particulars of these dictionaries are contained in an explanatory brochure, obtainable from the publishers direct.



The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, the "Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

THE OSCILLATION NUISANCE.

Sir,—In your issue of February 18th, Mr. Proctor-Gregg suggests there is only one way of reducing the oscillation nuisance, by providing more relay stations and fewer provincial programmes.

I do not think the scheme suggested would help matters much, because your correspondent seems to have forgotten the large number of Continental stations now working on the 300-500 metre waveband.

Mr. Gregg will find, if he enquires among his wireless friends, that a man with a one- or two-valve set is much more "bucked" if he gets hold of a foreign station, even though he may not understand the language.

It is the "romance of distance" with one valve instead of four that is the chief cause of the trouble, and no matter what the B.B.C. do, the distant stations of Germany, France, etc., will still be working to tempt the "distance getter."

Further, your correspondent says "some of the provincial items are often very mediocre, etc." What on earth *do* some people expect for 10s. per annum? On the whole the B.B.C. programmes are exceptionally good. If there are a few bad nights, surely we can't grumble when we get *at least* 365 concerts all for 10s.

The way to improve the quality of the fare provided is to make the "pirates" pay up, and quickly too.

Manchester. PERCY COX.

LONDON TO EDINBURGH WITH SIX WATTS.

Sir,—At 12 noon on Sunday, February 22nd, by pre-arranged schedule I called 2TF of Edinburgh with a measured input of 6 watts, *i.e.*, 300 volts 20 milliamps on C.W., and received a reply immediately. My radiation was .15, and 2TF reported signals weak but nevertheless readable.

2TF was received at my station at R6 to 4 on a seven-valve superheterodyne, while 2TF was using two valves in his receiver.

The test had been arranged with 2FN Nottingham acting as intermediary, but although 2FN and I were in communication I was able to work through to 2TF direct. After 2FN and I had got into touch by pre-arrangement 2FN switched on to speech, and parts of this were received on the loud-speaker, but disturbance was marked, and working continued on C.W. It was after this that I called 2TF, and received acknowledgment of reception of my signals.

I think that this is an exceptional range for such low power as I was using, *i.e.*, (six watts). The transmitting valve was an LS1, in an inductively coupled reversed feed back circuit.

I put a good proportion of my success down to the inductively coupled aerial circuit, and the wave being rendered absolutely steady, which is a considerable factor in reading a long-distance signal.

Wishing THE WIRELESS WORLD, to which I have been a subscriber since its inception in April, 1913, even greater success with the change in its domestic life.

19, Mendora Road, E. J. PEARCEY, 2JU.
Fulham, S.W.6.

TRANSATLANTIC RECEPTION RECORDS.

Sir,—I believe I have again made a record for the number of "Yanks" logged at one sitting. On February 1st, 1925, during 5 hours 6 minutes I logged 150 American stations. These included two 6's and some of every U.S. district except 7, although two 7's were heard but were found to be unintelligible, owing to their rotten "fists." RCB8 was received at great strength.

No doubt many more stations could have been logged, but I was too tired to remain up any longer.

Now comes a still more interesting fact. At about 12 *noon* on Sunday, February 1st, I received several Americans very faintly, including 1CMP, 2B (?) (I think 2BY), 1K (?) (perhaps it was 1KC, who is often on). Although only one call sign was truly logged, about twelve stations were heard, but were unreadable owing to jamming and noises due to traffic in the street.

I believe this also is a record, as it was then daylight *all* the way. The receiver used was 0-v-1, with only 20 volts H.T.

London, N.W.16. W. A. S. BUTEMENT (G6TM).

Sir,—Some of the following results may be of interest to your readers.

On Sunday, February 1st, we tuned in 150 U.S.A. amateurs in about 3½ hours on two valves. Five of these were in the 5th District. In the evening we logged 3BD Australia.

On Sunday, February 8th, we logged 50 U.S.A. amateurs in an hour and a half, including 5UK Louisiana, and 5SR Okla, and U2RK was received at ten o'clock in the morning.

In the evening we received Australian 3BQ on one valve and 3BD on two valves. F. C. and T. A. STUDLEY.

Harrow, Middlesex.

SPANISH AMATEUR TRANSMITTERS.

Sir,—With regard to the paragraph "Spanish DX restriction" in your issue of January 28th last, I am afraid you have been misinformed.

In the National Wireless Conference held last year by the authorities, I personally defended the unrestricted use by amateurs of all wavelengths below 120 metres, and this point was conceded and incorporated into the official regulations. Amateur transmitters are allowed a maximum input energy of 100 watts, though certain experimental stations under special specified conditions will be permitted to handle much larger powers.

On the whole, the conditions for the Spanish amateur compare favourably with those for experimenters in other countries, with whom I hope he will soon get into line.

Madrid. EL CONDE DE ALBA DE YELTES.

RECEPTION IN NORWAY.

Sir,—Norway is very often spoken of as the experimenters' happy hunting ground, so it may interest you to have the following list of broadcasting stations which were received on a two-valve receiver during two evenings. The set used was a "straight circuit"—one H.F. and one detector. Two pairs of 'phones were used, and the two listeners could speak the following languages between them—English, German, French, Swedish, Danish, and Spanish (only a little of the latter). I give you this information to enable you to see a check was obtained on all stations:—Cardiff, London, Manchester, Newcastle, Bournemouth, Glasgow, Belfast, Birmingham, Aberdeen, 5XX, Hanover, Munster, Breslau, Stuttgart, Leipzig, Konigsberg, Frankfurt, Munich, Berlin, Brussels, Hilversum, Amsterdam, Copenhagen, Lyngby, Ryvang, Stockholm, Göthenburg, Malmoe, Madrid, Zurich, and Vienna.

In addition, every English relay station has been received at one time or other. IVAR KOKKIN.

Oslo, Norway.

SAFEGUARDING OF BRITISH INDUSTRIES.

Sir,—Concerning the scheme proposed by the Government for safeguarding certain industries, we beg to state that we have extremely pronounced feelings in regard to this matter, as it is one of the very greatest importance to the radio industry. The writer has for some time been collecting information with regard to the highly serious position with reference to loud speakers and head phones which are coming from the Continent, particularly Germany.

Only yesterday a manufacturer called and handed to the writer a sample pair of head phones and offered to supply 20,000 from London stock at 4s. 0d. each. Two days previously a German manufacturer who had already sold 200,000 offered at 5s. 3d. In the same week an Italian instrument was quoted at 5s.

If some serious steps are not taken immediately we are convinced that the new industry which is being built up in this country and giving employment to tens of thousands of people who would otherwise be unemployed, will gradually be lost to the foreigner, thus involving the manufacturer who has embarked his capital in very heavy losses.

At the present moment, still taking head phones to support our argument, there are probably ten foreign instruments sold out of every twelve in this country. When one remembers that the British manufacturer shouldered the original financial burden which enabled broadcasting to become possible in this country—the Germans paid nothing—it will be seen that the radio industry has a very strong claim to rank as one of the proposed protected industries.

F. S. HOOKER, Director and General Manager,
C. A. Vandervell & Co. Ltd.

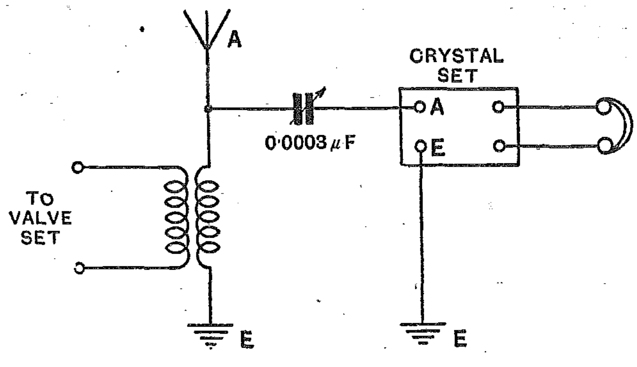
TWO STATIONS ON ONE AERIAL.

Sir,—Readers may be interested in the circuit given above, by which I tune in two stations on different receivers on the one aerial. As will be seen, this is practically a wave trap across the earth and aerial, and the signal in trap is rectified. Readers will notice I connect the aerial lead to the earth terminal of the crystal set, and run the aerial terminal of the crystal set to earth. The peculiarity about this is that when one tunes in, say Chelmsford, on 1,600 metres on the valve set, 2LO on 355 metres is increased in volume on the crystal set. The crystal set is an ordinary circuit with a basket coil, untuned, and costs about 2s. to make.

I should be pleased to demonstrate this any evening after 8 o'clock, the best evening, of course, being when Chelmsford is running a separate programme from London.

I may say that on Saturday, January 31st, I was receiving Glasgow from 5XX on the loud-speaker from the valve set at considerable volume, and in the same room headphones were being used on London with the crystal set comfortably, *i.e.*, the loud-speaker did not spoil the reception on headphones. As will be noticed, my valve receiver has loose coupled coils, *i.e.*, it is a valve-crystal reflex. When I am picking up Radio Paris on the loud-speaker, to cut out Chelmsford I insert another wave trap, and London comes through quite well on the crystal set, from which it appears to me that if the wave trap on Chelmsford had a rectifier in it, there is no reason why three stations should not be picked up from the one aerial. I have not tried this yet, however.

Stoke Newington, N.16. T. E. WEBSTER.



An arrangement employed by Mr. Webster to receive the transmissions from two broadcasting stations simultaneously on the same aerial.

CBS PROPOSES WORLD RELAY.

Sir,—In my two-way communication of February 1st with G2OD, the first between Argentine and Europe, I was using the third harmonic, two 50-watt tubes 203A, Hartley circuit with inductive antenna, 250 watts input, 1,000 volts on the plate, a wavelength of 68 metres, with a radiation of 0.7 amperes. 2OD's signals were very strong but difficult to read, owing to atmospherics.

I am confident that next autumn (April and May) communication with South America and Europe will be very easy.

In the coming months I shall endeavour to establish a relay round the southern hemisphere (South Africa, Australia, New Zealand, Buenos Aires). With this object in view I invite South African amateurs to listen for my *daily* transmissions to my son in Birmingham (England) at 00.00 to 00.15 GMT.

I shall listen for replies between 50 and 120 metres. During May, June, and July I shall call, increasing power, every night for fifteen minutes, listening another fifteen minutes at 22.00. At 10.00 GMT I shall endeavour to be heard by amateurs in Australia between longtitude 130° and 150° E.

I shall be glad to arrange any other tests from British possessions in the southern hemisphere.

C. BRAGGIO (Argentine CB8).

Calle Alsina 412, Buenos Aires,
Argentina.
Telegraphic address: Braggio, Buenos Aires.

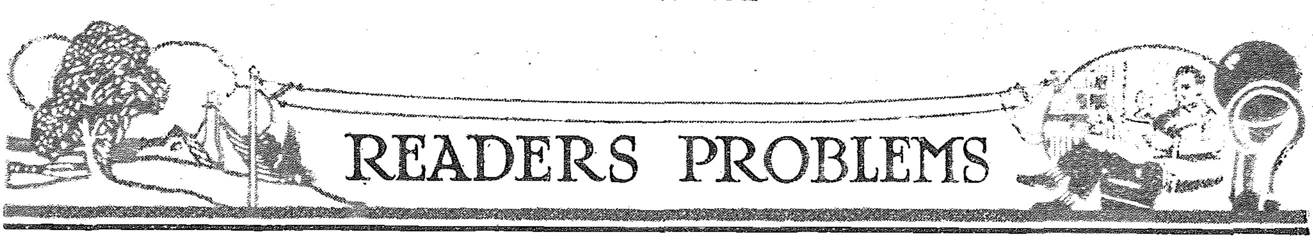
WIRELESS TELEGRAPHY AND SIGNALLING BILL.

Below we publish a letter addressed by the Institution of Electrical Engineers to the Postmaster-General on the subject of the new Bill.

Sir,—I am directed to inform you that the Council of the Institution of Electrical Engineers having had brought to their notice the provisions of the above Bill, which has only been published during the last few days, and being of opinion that there are new provisions in the Bill, as compared with the Act of 1904, which are likely to prove detrimental to the progress of wireless telegraphy, of radio science generally, and of other electrical matters beg to ask you to defer any immediate further proceedings with the Bill so that the Council may have time to give careful consideration to its provisions, which are of far-reaching importance, and an opportunity of submitting to you their representations thereon.

In view of the urgency of the matter, this letter is being communicated to the Members of the House of Commons and the Press.

I am, Sir,
Your obedient servant,
(Sgd.) P. F. ROWELL, Secretary.



READERS PROBLEMS

Readers Desiring to Consult the "Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

The Most Efficient Two-valve Set.

A CORRESPONDENT has asked us to give an opinion of what is the most efficient two-valve set.

The question as to which is the most efficient circuit to employ in a wireless receiver is a very far-reaching one, and is a point on which it is quite impossible to lay down any definite rule, since requirements differ so greatly. For instance, for the man desiring the maximum volume of sound from his local station, the particular two-valve circuit most suited to his purpose is probably a reflex embodying two transformer-coupled L.F. stages, whilst for the real distance seeker it is probably better to abandon the use of a reflex circuit. The range of choice really narrows down to 1-v-0 or 0-v-1, making full use of magnetic reaction in each case. It is an extremely debatable point which of these is the "best"; both, of course, are more suited to one purpose than another. Possibly, however, when all things have been carefully considered, it can be said that a two-valve set containing a detector valve with reaction on to the aerial, followed by one stage or transformer-coupled note magnification, will be found to give better all-round efficiency than any other. It will often be found that this set will give better results on distant stations in the hands of the ordinary amateur than if a high frequency stage is employed, owing to the fact that there are only two main controls, the reaction adjustment and the aerial tuning condenser. Provided that low loss condensers and coils are used, all B.B.C. stations should be received when using this circuit, under any conditions where a set containing an H.F. stage brings in these stations.

There are, of course, several varieties of two-valve circuits employing the super-regenerative principle, but the use of such circuits is not to be recommended in cases where consistency and reliability are a primary consideration.

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Obtaining Fine Control of Reaction.

IN many types of set employing a three-coil holder with the aerial, H.F. anode and reaction coils mounted thereon for obtaining delicate reaction effects, we have noticed that readers are by no means sure which is the correct method to connect these up. The coils should be so arranged that the bringing together of the aerial and reaction coils provide reaction effects in the ordinary manner, but the H.F. anode coil should be so connected that it acts in opposition to the reaction coil proper, and provides "reverse" reaction. In this manner a very delicate control over reaction is obtained. The manipulation of the coils for best results is a matter of practice, but if great difficulty is found, the H.F. anode coil may be moved back out of the sphere of influence of the other coils, and ordinary reaction effects obtained with the other two coils.

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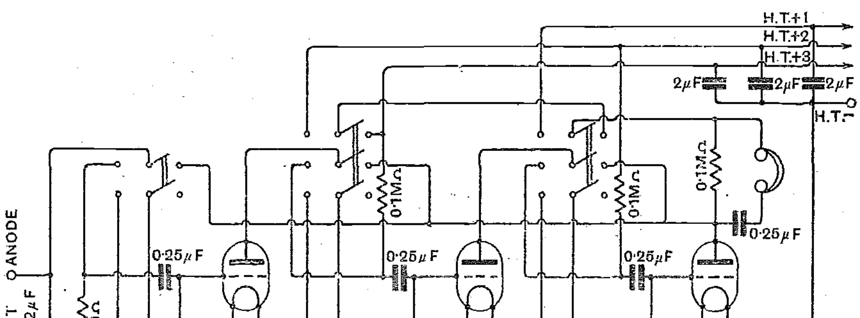
An Amplifier for High Quality Reproduction.

A READER requests us to devise an L.F. amplifier suitable for operating a large loud-speaker from his one-valve set, in which the maximum attention is paid to purity of reproduction combined with large volume, without having regard to the number of valves used. Switching is to be incorporated so that any number of valves may be used in accordance with requirements of volume.

Since our correspondent lays special stress on purity and volume irrespective of the number of valves used or value of H.T., we have used resistance-capacity coupling in this circuit. It is essential that the resistances be wire-wound, otherwise objectionable noises will emanate from the loud speaker. It is quite easy to obtain these components ready wound from manufacturers. They may be of 100,000 ohms resistance, and in connection with this, and also for particulars of anode voltages to be used, readers are referred to page 573 of the January 28th issue of this journal. The coupling condensers should preferably have a mica dielectric, and should on no account have a smaller capacity than 0.05μF. A filter circuit is included in the anode circuit of the last valve.

Potentiometer control of all grids is included in order to give a very fine adjustment of each individual value of grid potential. The first and second valves may have a high amplification factor, such as the D.E.5B., in order to build up signal strength, but the last valve should be of the power type having a large permissible grid voltage swing, such as the L.S.5. The 0.0002μF condenser across the input of the amplifier is for the purpose of bye-passing the H.F. component of the current flowing in the anode circuit of the detector valve. If it is made much smaller than the value indicated, difficulty will be experienced in getting the detector to oscillate, whilst on the other hand, if it is made much larger, signals will be weakened owing to its effect on the potential difference produced across the anode resistance of the first valve.



An amplifier for high quality magnification employing three stages of resistance-capacity coupling.

Methods of Resuscitation of Exhausted Dry Cells.

A READER having a number of exhausted dry cells which have been used on dull-emitters asks if any further use can be found for these, or whether they should be thrown away.

It will usually be found that long after they have ceased to be effective for supplying the filament needs of dull-emitters, these cells are quite capable of operating electric bells and similar devices. However, provided the zincs have not been unduly eaten away, they can be made to give further service in lighting the valve filaments.

The cardboard cover should be carefully removed (this is by no means a difficult job if the cell is heated), and then several holes made in the zinc with a gimlet. The cell should then be immersed for twenty-four hours in a jar filled with a dilute solution of sal-ammoniac, which can be prepared by dissolving a handful of sal-ammoniac crystals in a pint of warm water. At the end of this period the cell should be lifted out and allowed to drain. The cardboard cover can then be carefully replaced, and it will be found that the cell is capable of giving several more hours' service on the set. There is no need to leave these cells standing in the solution when in use, although if this is done, the second life of the cell will be considerably extended.

Another reader enquires whether it is possible to recharge exhausted high tension batteries from the electric lighting mains. This is, of course, impossible, since the action of a primary cell depends on the chemical consumption of zinc, and neither the consumed zinc nor the exhausted electrolyte will be restored by passing a current through in the reversed way to its discharging current. As a matter of experimental fact, however, it will be found that if an exhausted battery is treated in this manner for a few minutes and then removed and tested with a voltmeter, practically the full voltage of the battery would be registered as if the battery had been revived, but this "false" charge will disappear in the course of a few minutes.

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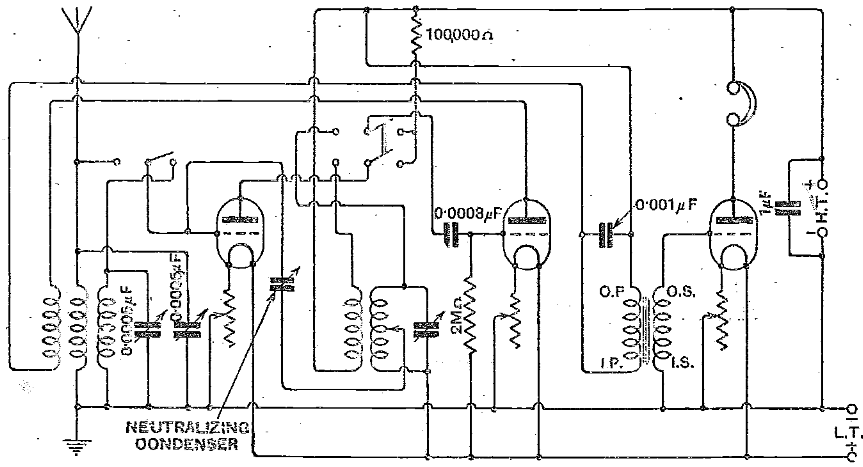
An Efficient Three-valve Circuit.

WE receive frequent requests from readers for a wiring diagram of a receiver employing the neutrodyne method of coupling, which is capable of tuning both to the lower B.B.C. and Continental stations, and also to Chelmsford and Radio-Paris by the usual switching arrangements.

A multiplicity of switches on the H.F. side of a neutrodyne receiver cannot be recommended, and it is far better to employ a plug in unit consisting of a correctly constructed neutrodyne transformer to cover these two bands of wavelengths. Unfortunately, however, it must be remembered that whenever valves or coupling transformers are changed in a neutrodyne receiver, it is necessary to re-neutralise the set. Whilst the neutrodyne method of coupling is almost an absolute necessity if efficiency is to be obtained using H.F. amplification on the broadcast band of wavelengths, it will be found that on longer waves it is possible to dispense with it and still obtain reasonable efficiency.

In the three-valve circuit which we give below it will be noticed that on the lower band of wavelengths neutrodyne coupling is employed between the H.F. and detector valves, and by the movement of a double-throw switch this is eliminated, and the resistance-capacity method of coupling is employed which will be found reasonably efficient for the reception of Chelmsford and other long wave stations. Whilst this circuit will be found to function well, it must not be thought that resistance coupling will give the same efficiency on Chelmsford's wavelength as will a stage of neutrodyne coupling. The impression seems to have gained ground that resistance coupling is the most efficient method that can be employed on wavelengths over 1,000 metres. This is not so, either from the point of view of voltage amplification, selectivity, or stability, but provided that care is taken in eliminating extraneous capacities across the resistance, it is possible to attain a higher degree of efficiency than is usually found in H.F. amplifiers employing this form of coupling.

In the circuit which we give, selectivity is attained by the optional use of loose coupling, which will be found quite stable, provided that the neutralising is correctly carried out.



A three valve receiver suitable for tuning over the ordinary broadcast band of wavelengths and also to long wave stations.

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Source of Filament Current for Dull Emitters.

A CORRESPONDENT has been using a one-valve reflex set for some time with a .06 type of dull emitter valve, and he has observed that using two ordinary dry cells, such as are used for the operation of electric bells, applied direct to the filament without any intervening resistances, he is enabled to use the set three hours nightly for about ten weeks before he finds it necessary to renew his battery. He proposes to build a four-valve set using this type of valve, and asks if he is correct in assuming that two of these cells will satisfactorily operate the set three hours nightly for two or three weeks.

In using dry cells for any purpose, it will be found that their useful life varies in inverse proportion to the rate at which they are discharged. If it be found that when operating a four-valve set a dry battery will last a given number of hours, it does not follow that it will last four times as long when operating a one-valve set. In point of fact, it will last a great deal longer than four times. The converse is equally true, and our correspondent will probably find that he has to renew his dry cells more frequently than he anticipates. Several cells may, of course, be connected in parallel in order to give a longer life, but this is not altogether satisfactory, since it will be found that interaction is likely to take place among the various cells due to inequalities in their construction. A far better plan is to have a separate pair of L.T. terminals for each valve, and to use separate batteries. It will then be found that the set will operate at its best both from the point of long battery life and maximum stability.

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A Common Fault in a One-valve Set.

WE have received quite a number of queries of late in which readers have been experiencing trouble with one-valve sets of the conventional type, they being unable to obtain any appreciable reaction effects without using a very large coil. In almost every case this has revealed itself as being due to the seemingly simple but all-important error of connecting the grid return lead to L.T. – instead of the L.T. + If this error is made when using modern valves it will be found that the set will be insensitive and productive of greatly reduced signal strength from even the local station

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CRYSTAL OR VALVE SETS FOR BROADCAST RECEPTION.

WE have recently had the opportunity of meeting one or two friends who have lately come to this country from the United States of America, and the conversations we have had prompt us to ask whether broadcasting in this country is being popularised on quite the best lines.

The policy of the Broadcasting Company has been to arrange the distribution of stations throughout the country, so as to ensure, as far as possible, that every district is served in such a manner that reception becomes satisfactory when a crystal receiver alone is used. The reason for adopting this policy is stated to be in order to put broadcasting within the reach of the poorest members of the community as well as the wealthy sections of the public. The intention is, of course, an excellent one, but it is doubtful whether it is going to lead to the same general satisfaction in broadcast reception which might result if the use of valve sets and loudspeaker reception were more generally advocated. Although in the United States of America in the early days of broadcasting crystal sets were sold very readily, the position to-day is very different, and the number of even elaborate sets disposed of far exceeds the sale of crystal sets. The result is that prices are falling steadily in America, and the increasing demand for apparatus has brought the cost of valve receivers down to a figure which places them within the reach of almost everyone. We believe that the same result could be achieved here, because it is unlikely that the interest of the public will always remain such that a crystal receiver will satisfy requirements. The tendency in America is illustrated again by the fact that the sale of loudspeakers exceeds the sale of head telephones, indicating quite clearly that the public there is weary of having to wear 'phones to listen-in to programmes, preferring a somewhat greater outlay in the initial cost of the equipment in order to have the advantage of listening-in in comfort to loudspeaker reproduction.

There is also another side to the question which is dependent upon the policy adopted in this country, and is responsible for the different state of affairs here and in the States. There, owing to the multiplicity of broadcasting stations each under separate control, there is a much wider variety of programmes, and the public can pick out the station they desire to listen to and change from one station to another perhaps several times in the course of an evening, in order to hear selections from the transmissions from various sources. Most of the receivers, with the exception of the really expensive ones in this country, have not been designed with very special consideration for the question of selectivity, whereas in America the selectivity of a receiver is the first point which the purchaser enquires about. One wonders whether we are not inclined in this country to pay too much attention to the quality of the broadcast transmissions and reception, and regard broadcasting as purely a means of pro-

CONTENTS.

viding high-class entertainment, because in so doing the particular enjoyment which the owner of a set derives from being able to change over from one programme to another is not catered for at all, the attitude of the broadcasting authorities here being apparently to discourage listeners from attempting to go further afield than their own local station. This is no doubt done with the object of trying to reduce the interference from oscillation, and it is this same attitude which is another reason for encouraging the employment of crystal receivers and catering for that type of reception rather than valve sets. But this policy is not helping the industry, and is, at the same time, robbing the listener of a very great proportion of the enjoyment which broadcasting can provide. There is really no reason why valve receivers should cause oscillation interference if they are suitably designed and intelligently handled, and we would like to see the use of valve sets, even though they may be more elaborate and somewhat more expensive, encouraged rather than that the public should be led to believe that they can get full satisfaction from broadcast reception with a crystal set, just because the power and distribution of the broadcasting stations in this country is such that crystal reception from the nearest station has been made possible almost anywhere.

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WHO CONTROLS THE B.B.C. ?

THE British Broadcasting Company has always been in a peculiar position. The circumstances under which it was brought into existence were peculiar. It has the distinction of being the only company of its kind in existence, and, therefore, one cannot draw comparisons between the B.B.C. and any other organisation, for the reason that no other organisation exists which is comparable to it. We have a high appreciation of the way the officials of the company have carried out their duties, and any criticism which may be inferred from what we may say here is not intended to be any reflection upon the individual work of the personnel of the company. We feel, on the other hand, that the sympathy of the public should be extended to those responsible for running broadcasting in this country because they are virtually in the position of having to serve not one interest, but several, and, unfortunately, these interests are sometimes conflicting ones.

The Broadcasting Company dare not do anything which might displease the Post Office nor even individual members of the Post Office personnel, for no one realises more than the officials of the B.B.C. themselves how dependent is the future existence of their company on the creation of a good impression with the Postmaster-General and those who are in the position of advisors to him.

Next we have the manufacturing interests, who regard the Broadcasting Company rather in the light of an organisation set up by themselves expressly for the purpose of fostering their industry and encouraging sales. Just how far the manufacturing interests do dominate the policy of the B.B.C. is probably only known to one or two of the principal representatives of both parties, but we believe it to be common knowledge that if anything is done by the Broadcasting Company which is likely to be prejudicial to the interests of the manufacturers, the Company is very soon reminded of the fact in terms intended to put the B.B.C. "in its place."

Then we have the great listening public who, now that the manufacturers' contributions to the upkeep of the Broadcasting Company have been discontinued, alone provide the revenue which goes to support the organisation and pay for the provision of the stations, their maintenance and the programmes all the year round.

The question naturally arises, "who controls the B.B.C. and whose interests must the company consider first?" On the face of it one would think that, if only in fairness to the individuals who have been entrusted with the carrying out of the broadcasting scheme in this country, some revision of the present conditions should be considered. In fact, one hesitates to criticise, even constructively, the policy of the company, because whenever one finds occasion to do so, there is always the feeling that probably it is force of circumstances rather than their own choice that has made the company act in the manner which prompts the criticism.

There is, in our opinion, far too much criticism being levelled at the efforts of the responsible officials of the B.B.C., whereas we would prefer to see such criticism diverted to the real source of the unsatisfactory state of affairs which is the actual scheme under which the B.B.C. has been constituted. The officials themselves have a most delicate situation to handle because they must of necessity steer, not a bold, but a middle course, always in fear that their craft will end upon the rocks if they do not exercise the utmost diplomacy in their dealings with the various interests controlling their destiny.

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THE SOCIAL SIDE OF THE RADIO SOCIETY.

THE Radio Society of Great Britain held its fifth annual dinner on Wednesday, March 4th, under the chairmanship of the President, Sir Oliver Lodge, F.R.S., supported by past presidents, Dr. W. H. Eccles, F.R.S., Admiral Sir Henry B. Jackson, K.C.V.O., F.R.S., and Mr. A. A. Campbell-Swinton, F.R.S. The dinner, which was held at the Waldorf Hotel, London, was preceded by a reception with a record attendance of members and their friends. The occasion was a very important one in the history of the Society, for it coincided with a more than ordinary degree of enthusiasm amongst the members. This has been brought about largely on account of the fact that the terms of the proposed new Wireless Bill have aroused even the most apathetic members to a degree of enthusiasm and interest which has, perhaps, never before been quite so pronounced in any period of the Society's existence.

We feel that much good would come of rather more frequent social events of this kind. The social side of the Society is, we think, a little neglected, especially when one remembers that the Society caters for the amateur in particular, and does not specialise so much in the interests of the professional wireless engineer. We would like to see efforts made to bring together more frequently the members not only of the parent Society, but also of all the affiliated societies, very much more frequently than is done at present.

ELIMINATING DISTORTION.

Construction of a Loud Speaker Set for Pure Reception

Reception with a minimum of distortion is rapidly becoming the aim of the listener. The receiver, of which full constructional details are here given, has been developed to give loud-speaker reproduction, maintaining as far as is possible the original sound quality of the transmitted modulated wave.

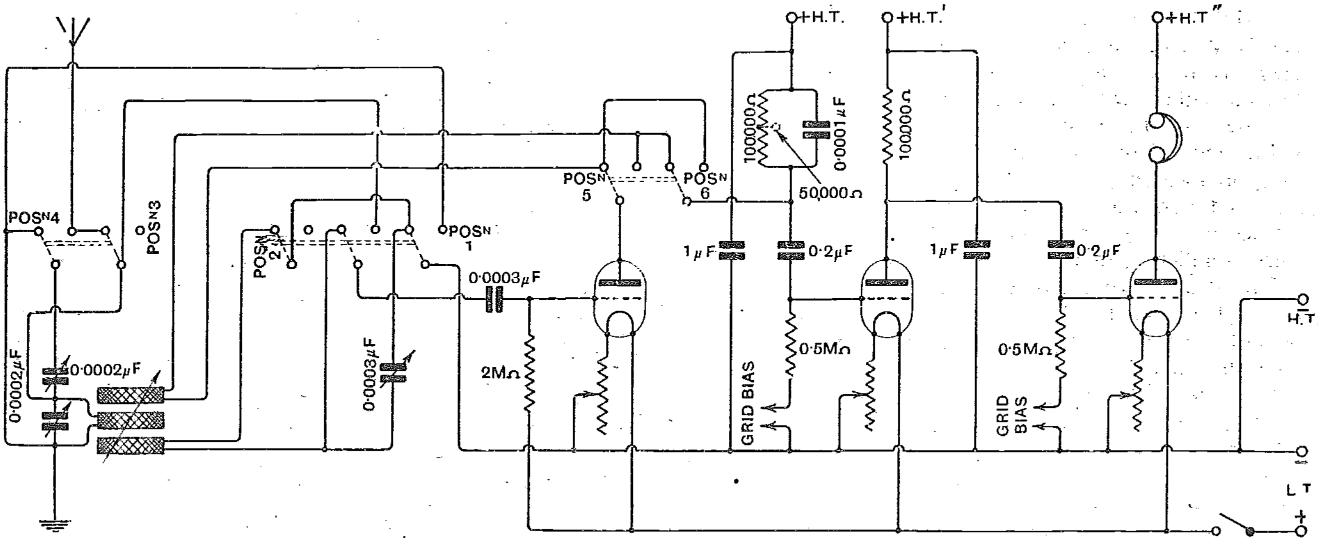
The article is full of practical advice bearing on the elimination of distortion as applied to the design of the amplifying apparatus.

Building a Resistance Coupled Tuner-Amplifier.

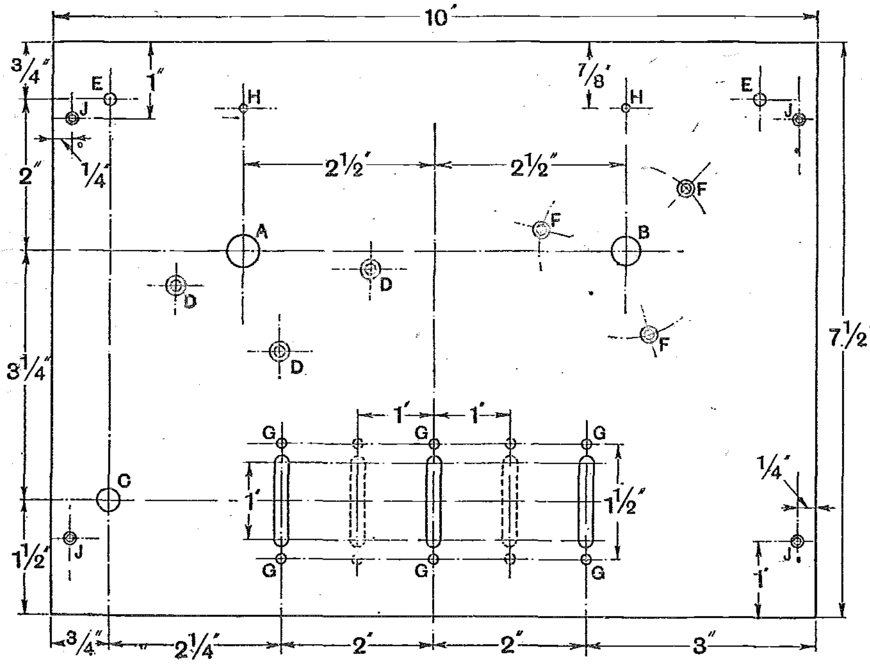
By F. H. HAYNES.

THE design of broadcast transmitting equipment not only requires a knowledge of the science of electricity but involves a careful study of some of the most intricate problems of sound. The advance of broadcasting has brought about a better understanding of some of the difficulties attendant on the pure reproduction of sound, and in the modern broadcasting station will be found many devices the design of which has been a slow process and only the outcome of prolonged research work. It can be said that a very high standard has been obtained, and the modulated waves sent out carry the original sounds truly represented as regards their relative frequencies and amplitudes.

It should, therefore, be the aim of the listener to equip himself with a receiver which does not at once disregard the efforts already made to maintain purity of sound by



Selectivity is obtained by employing a loose coupled tuning circuit. With the three-pole switch in "Position 1" the detector valve is connected directly across the aerial tuning coil and the closed circuit condenser and inductance disconnected from one another, so that the proximity of the closed circuit coil to the aerial coil will not influence the tuning. In "Position 2" the closed circuit is completed and the leads to the detector valve transferred. The filament circuit is not shown connected to the earth lead, and consequently when receiving with the closed circuit in action extraneous noises due to electric lighting mains and earth currents may be eliminated. "Position 4" of the aerial switch is for long wave reception, and "Position 3" with both series and parallel aerial tuning condensers gives stable working on the shorter waves. The switch in "Positions 5 and 6" reverses the direction of reaction coupling. Self-oscillation in the tuning circuits may when required be stimulated by reducing the value of the first anode resistance by means of a tapping at 50,000 ohms. Alternatively the resistance may be shunted with the secondary (or primary and secondary) winding of an intervalve transformer. The valves from left to right are: D.E.5 (or D.E.5b), D.E.5b, D.E.5.



Scale drawing of the front ebonite panel. If the reaction reversing switch is abandoned, the remaining switches may be transferred to the positions shown dotted. Where the closed circuit is not fitted, the reaction reversing switch and the long and short wave switch are arranged on either side of the aerial tuning condenser, the latter taking up a position where the line AB intersects the centre vertical line. If it is decided not to fit a reaction reversing switch then the aerial switch can be made to balance with the filament "on and off" switch. Drilling details: A, $\frac{7}{16}$ in. clearance for condenser spindle. B, $\frac{3}{8}$ in. clearance for condenser spindle. C, $\frac{5}{16}$ in. D, $\frac{5}{32}$ in. and countersunk. E, $\frac{5}{32}$ in. for 4 B.A. terminals. F, $\frac{1}{8}$ in. and countersunk. G, $\frac{1}{8}$ in. H, $\frac{3}{32}$ in. J, $\frac{1}{16}$ in. and countersunk.

being selective in its response to the various note frequencies.

Distortion at High Frequency.

It is not long ago that one could hear it said that amplification of the incoming signal at radio frequency was the *sine quâ non* of pure speech reproduction. This idea probably arose from the fact that the transmitting stations were of very limited power, and an efficient high-frequency amplifier brought about so much increase in signal strength that a low-frequency stage could be dispensed with. Provided that a sufficient grid potential fluctuation is fed to the detector valve there is no purpose in attempting to create oscillations of high amplitude by a multi-stage high-frequency amplifier. Another difficulty is that a straightforward tuned high-frequency amplifying stage will bring about a condition of self-oscillation in the circuits which, unless properly controlled, will be the cause of some distortion by boosting up the amplitudes in a non-uniform fashion and prolonging the modulated wave trains.

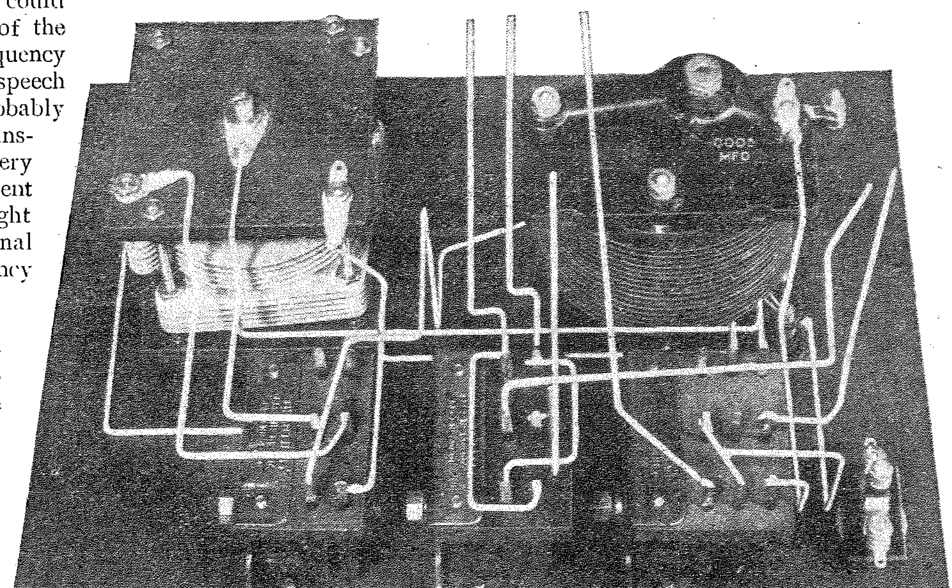
Rectification.

Crystals are frequently used as detectors by those who believe that by so doing greater purity is obtained as compared with a detecting valve, though the latter correctly used can maintain purity just as well as the crystal. Having in mind the operation of a loud-speaker, the detector must be followed by a low-frequency amplifier, and distortion is often produced by operating a power amplifier from the insufficient input which is derived from a crystal working at extreme range.

Valve detection is brought about either by the use of a leaky grid condenser or controlling the grid potential by a potentiometer, so that the lower bend in the valve characteristic curve is made use of. Either of these methods can be used, though it would appear that anode rectification making use of the lower bend in the characteristic curve would maintain the form of the modulated wave more truly than would the grid condenser and leak arrangement.

Low-frequency Amplification.

It is in the low-frequency amplifier that uneven response to the different note frequencies arises. There are three ways by which amplification is obtained: (1) Intervalve



How the front panel should appear with apparatus assembled and wired

Eliminating Distortion.—
transformer, (2) choke coupling, (3) the resistance capacity method.

The L.F. Intervalve Transformer.

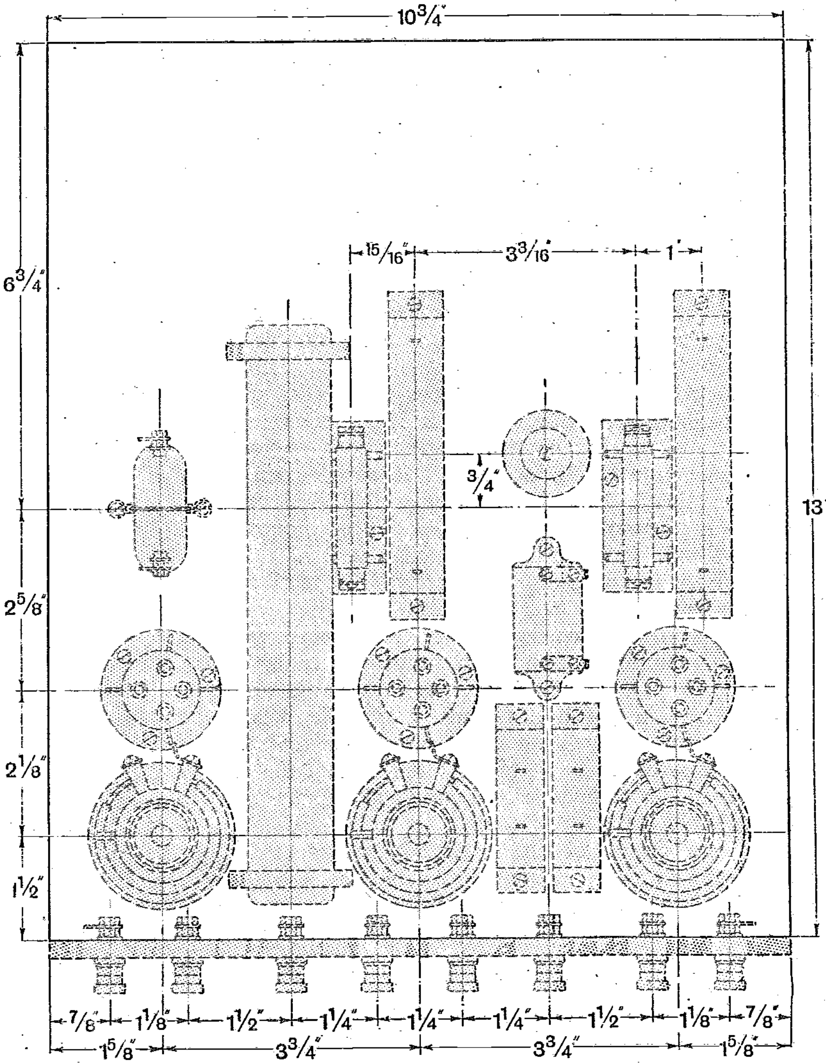
Considerable progress has been made in the design of intervalve transformers during the past two years, and a tolerable degree of purity can be obtained from a carefully constructed transformer coupled amplifier, in which special attention has been devoted to the design and operation of the transformers. It is quite evident, however, that amplification for the different note frequencies is not uniform, and particularly is a marked falling off in amplification noticeable for frequencies below 300. Certified curves plotted by the National Physical Laboratory should be available in respect of transformers offered to the amateur, and in the instances where these are exhibited by the manufacturers, the shortcomings of the suitability of the transformer for use in sound-carrying circuits is at once apparent if a very high degree of sound quality is to be preserved. These remarks in no way imply that transformers are unsuitable, but draw attention to difficulties which have yet to be overcome.

Choke Coupling.

The choke method of intervalve coupling fails to produce a uniform degree of amplification at the lower note frequencies. The potential developed across the ends of the coupling inductance, as, of course, is also the case with the intervalve transformer, depends upon the frequency of the applied current, and although, by employing a coupling coil of very high inductance (say, of the order of 100 henries), almost uniform results are obtained for frequencies from 500 to 3,000, it is the lower note frequencies which fail to produce corresponding potentials. We assume, of course, that the core is correctly designed, and the capacity of the windings does not exceed the limits which experience shows should be regarded as a maximum.

Resistance Capacity L.F. Coupling.

The third method of intervalve coupling makes use of the potential developed across a resistance by the plate current of the valve and applying it to the grid of a subsequent valve through a high capacity condenser, which passes the fluctuating potential and acts as a stopper to the H.T. battery potential. Making reference to the circuit diagram, it will be seen that the fluctuating currents in the amplifying stages are fed to the plates of the valves through resistances of the order of 100,000 ohms. These fluctuating currents develop varying potentials across the ends of the resistances, and the latter, being in series with the condenser shunted high-tension battery, means that the potential which is to be fed to a subsequent valve is available between the plate and filament circuit. To apply this potential between grid and filament, therefore, it is only necessary to include in the circuit a grid coupling condenser. This condenser is shown as having a capacity of 0.2 mfd., a value more determined by practice than calculation, and which can be regarded in its action as passing currents of all note frequencies practically equally.



The layout of the components on the base board. Grid cells can be attached to the base board as shown, or alternatively four terminals carried on an ebonite strip may be attached along the left-hand edge. The apparatus should not be assembled until the front panel and woodwork are completed, to make certain that instruments will not foul each other when fitting up.

The writer has found that it is important to make use of condensers in which mica is the dielectric, and in the first resistance-coupled amplifier which was described in this journal [1] mica condensers were employed. As suitable mica condensers are not obtainable, details of construction are given later. To prevent isolation of the grid circuit, and to maintain the grid potentials at a correct value, leak resistances are seen in the circuit

[1] *The Wireless World and Radio Review*, Vol. XIII., No. 2. October 10th, 1923.

LIST OF PARTS.

Ebonite for front panel, ¼ in. in thickness, to be 10 in. × 7½ in. when finished.
¼ in. ebonite, from which the terminal strip measuring 1¾ in. × 10⅝ in. can be made.
⅜ in. planed mahogany, for constructing wooden frame-work.
Piece of 3/16 in. ebonite, to measure 1¼ in. × 5⅞ in. when finished, for terminating flexible wires passing from the coil holder.
A Variable condenser with two sections, each 0·0002 mfd. (Burndept).[1]
1 Variable condenser, capacity 0·00025 or 0·0003 mfd. (Sterling).[2]
1 Zenite rod, 100,000 ohms.
1 Zenite rod, 100,000 ohms, but with tapping point at 50,000 ohms.
Dubilier grid condenser and leak, 0·0003 mfd., and 2 megohms.
Also small Dubilier bracket and clip for picking up contact with one end of the grid leak.
3 Valve holders (Burndept, Athol or McMichael).
3 Filament resistances (Ashley).
8 4 B.A. brass terminals.
2 Ebonite covered 4 B.A. terminals for aerial and earth leads.
2 Utility switches, 2-pole, with lever movement and nickel-plated.[3]
1 3-pole switch, with lever movement and nickel-plated.[4]
1 Fixed condenser, 0·0001 mfd. (Dubilier).
2 Condensers, 1 mfd. (T.C.C.).
On and off switch for panel mounting.
2 doz. soldering tags, with holes to clear 4 B.A. spindles.
2 Leak resistances, with clips and small ebonite base pieces, 0·5 megohms (Marconiphone).
1 Burndept 3-coil holder.[5]
Mica transmitting condenser, from which two condensers can be made up, each having a capacity of 0·2 mfd. (Thompsons, of Greenwich).

[1] and [3] may be substituted by a 0·00025 or 0·0003 mfd. condenser when short and long switch is omitted.
[2], [4] and [5]. The condenser is omitted when loose coupling is not required, together with the 3-pole switch, while a two-coil holder only is needed.

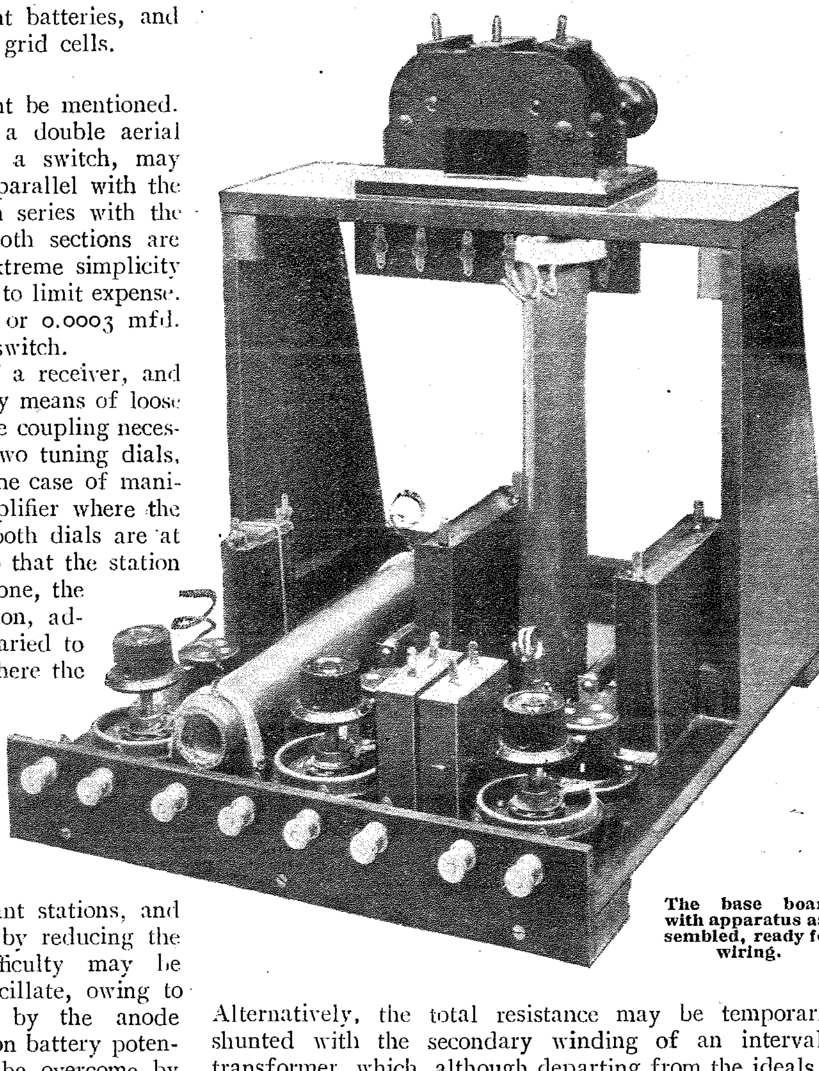
between the grid connection and filament batteries, and including in series a suitable number of grid cells.

The Circuit.

A few other points in the circuit might be mentioned. The wave range is extended by using a double aerial tuning condenser, which, by means of a switch, may be connected with one of its sections in parallel with the tuning inductance, while the other is in series with the aerial or, on the longer wavelengths, both sections are connected across the inductance.[1] If extreme simplicity of construction is desired, or it is wished to limit expense, a single condenser of capacity 0.00025 or 0.0003 mfd. may be fitted, omitting the double-pole switch.

Selectivity is an essential property of a receiver, and can only be produced to a high degree by means of loose coupled aerial and closed circuits. Loose coupling necessitates the simultaneous adjustment of two tuning dials, yet the difficulty is not so great as in the case of manipulating the kind of high-frequency amplifier where the desired signal can only be heard when both dials are at the correct setting. A switch is fitted so that the station can be tuned in with the aerial circuit alone, the closed circuit being later thrown in action, adjusted, and the aerial tuning slightly varied to give maximum signal strength. Again, here the design may be simplified by omitting the closed circuit condenser and three-pole switch and placing the aerial condenser in the centre of the panel, while fitting only a two-coil holder to the top of woodwork.

Reaction is included in the plate circuit of the detector valve to assist, when required, in the reception of distant stations, and at the same time to improve selectivity by reducing the damping in the tuned circuits. Difficulty may be experienced in causing the circuit to oscillate, owing to the very small plate current passed by the anode resistance when only moderate high-tension battery potentials are applied. This difficulty may be overcome by fitting an anode resistance, which is provided with a tapping, so that its value may be reduced to 50,000 ohms.

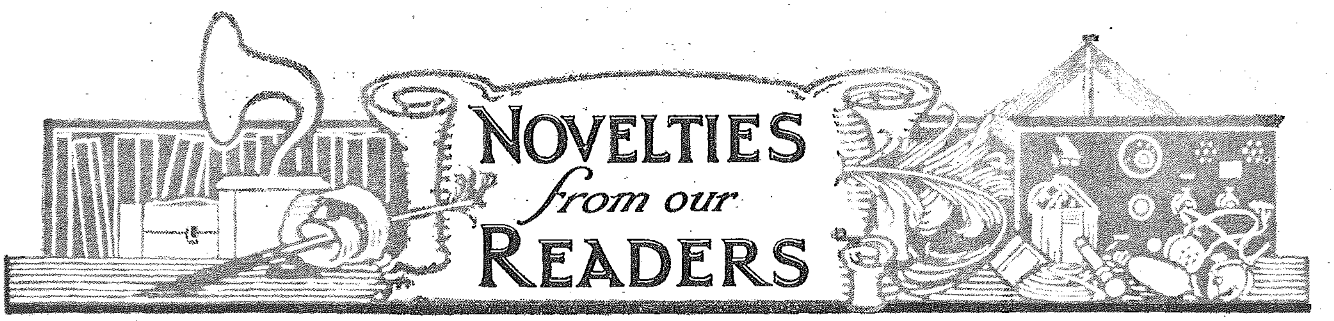


The base board with apparatus assembled, ready for wiring.

Alternatively, the total resistance may be temporarily shunted with the secondary winding of an intervalve transformer, which, although departing from the ideals of distortionless reception, may be introduced when reaction is being employed for reception at extreme range, and where some degree of self-oscillation accompanied by extraneous noise is unavoidable.

(To be concluded.)

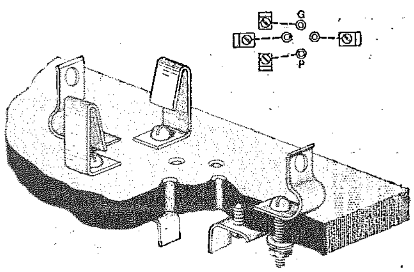
[1] The merits of this method were discussed in *The Wireless World and Radio Review*, Vol. XV., No. 13. December 24th, 1924.



A Section Devoted to New Ideas and Practical Devices.

COMBINED HOLDER FOR V24 AND R VALVES.

To be able to interchange valves of the V24 and Q types with the standard R pattern fitted with 4 pin con-



The drawing is cut away to show how contact is made with the valve legs under the panel when R type valves are used.

nectors is often very desirable. The additional apparatus and leads will not appreciably increase the capacity, for by far the bigger part of the inter-electrode capacity is created within the valve itself. A useful form of construction is shown in which all the necessary constructional details can be easily seen.—J. H. D. R.

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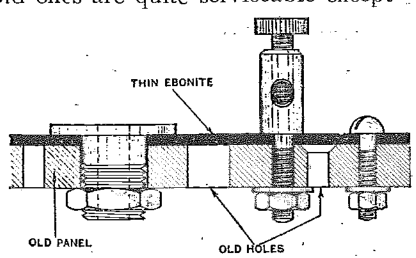
USING OLD EBONITE PANELS.

The amateur is rarely contented for very long with any particular receiving set, and in his endeavour to experiment with various circuit arrangements he finds that new panels are constantly being prepared, whilst the old ones are quite serviceable excepting that the number of holes used for other jobs detracts very much from the good appearance. To overcome this difficulty, a piece of thin ebonite possibly only $\frac{1}{16}$in. in thickness can be clamped down on the face of the old drilled panel to cover all previous holes. It is held in position by the screws and bolts, etc., used to attach the new components, whilst if a big area exists to which no components are fitted, a few small nuts and bolts will clamp down the new ebonite facing.—H. W. J.



The only precaution necessary in using up old panels in the manner illustrated is to see that new holes are not made too close to old ones, especially where the new holes are to be tapped for screws.

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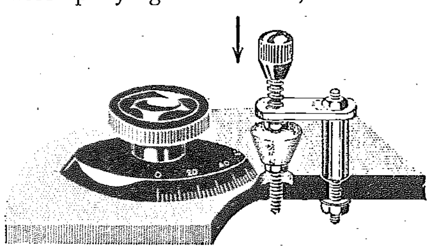
A SIMPLE VERNIER ATTACHMENT.

A simple device is shown in the accompanying illustration, which is

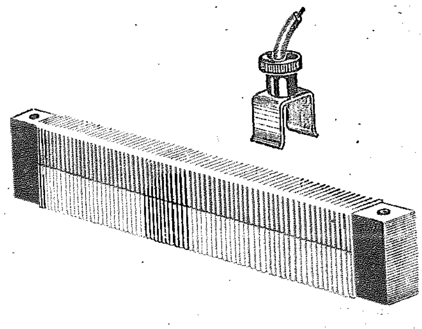


A simple method of providing a vernier control which can be fitted to any existing set.

very effective for providing critical tuning of condensers and like components. It consists of a valve stem into which a piece of 4 B.A. screw is soldered, so that a small brass plate may be supported at about a height of $\frac{3}{4}$in. above the surface of the panel. Into this is arranged a piece of threaded brass rod carrying a knob and an india-rubber or cork cone clamped between a pair of nuts. A small spring presses between the knob and the brass plate and forces the cone upwards out of contact with the bevelled edge of the dial. By pressing on to the knob, the cone may be brought down to engage on the dial, and, when rotated, provides a very critical adjustment.—O. J. R.

SIMPLE POTENTIOMETER.

The construction of a potentiometer may be very much simplified by abandoning the rod used to carry the slid-



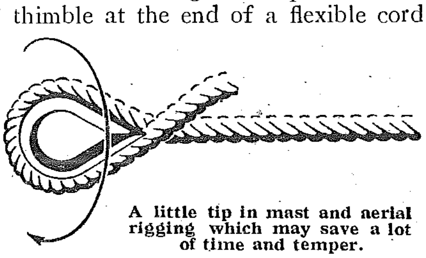
A special point of this arrangement is that very fine wire can be used because of the absence of friction which would result from the use of a sliding contact of the usual type.

ing contact. Using a clip for the purpose of picking up contact, a reliable connection is made, whilst different potentials may be obtained by the use of several clips. The former is made of wood or ebonite, and a suitable dimension would be about $6 \times 1\frac{1}{4} \times \frac{3}{8}$in., with corners slightly rounded. The winding may consist of very fine wire, as the friction met with in the sliding type is now avoided. After winding, the insulation must be removed from the portion of the wire on to which the clip engages.—A. E. W.

oooo

TWISTING LOOPS IN STRANDED WIRES.

When making a loop round a thimble at the end of a flexible cord



A little tip in mast and aerial rigging which may save a lot of time and temper.

such as a guy wire, it will be noticed that the strands may spread out and buckle, whilst at other times a neat result is obtained. It depends entirely upon the lay of the rope, for the strands can be made up with either a right-hand or a left-hand twist.

Referring to the illustration, and assuming this resembles a right-hand screw thread, then the right side of the loop should cross over the left. Contrary to what one would expect, the loop is twisted up in a direction which will apparently untwist the rope, and this is possibly the easiest way to remember the correct direction for twisting.—H. E. A.

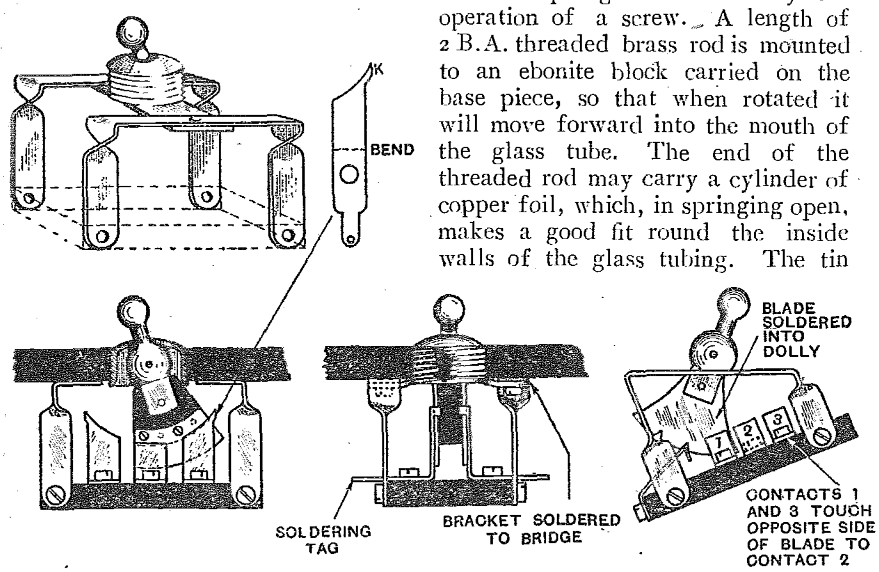
oooo

NEAT PANEL SWITCHES.

Compact panel mounting switches can be made up from damaged tumbler switches. Two types are shown, one a double-pole change-over, and the other for throwing circuits in parallel.

The lever and bridge of an old switch are required. For a double-pole change-over switch a piece of ebonite shaped in the manner shown is pinned into the stem of the lever. The sides of the ebonite are faced with thin brass by means of four No. 6 B.A. brass screws, while six contacts are assembled on an ebonite block, so that the ebonite piece attached to the lever moves between them. The ebonite block which carries the contacts is supported by means of brackets which may be either screwed to the instrument panel or supported on a cross-piece attached to the tumbler switch movement. The swing of the lever is limited by turning over the ends of the contacts. Such a switch is very useful for bringing in and out of action the L.F. amplifying stages, whilst, in view of the low capacity present between the contacts, it can be used for a number of purposes in the tuned circuits of the receiver.

Another type of switch useful for completing the filament circuits of one, two, or more valves is also shown. In this case a brass blade moves across the face of three or more contacts arranged in line. A spring attached to the edge of the ebonite engages in slots on the brass contact piece, so that the lever will remain in position.—A. P. J.

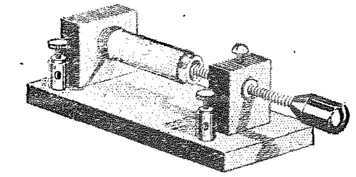


An illustration of a number of possible arrangements of useful switches where old tumbler switches provide the necessary material for construction.

oooo

CONDENSER FOR NEUTRODYNE CIRCUITS.

A condenser of very low capacity is easily made up from a piece of glass tubing which has a covering of metal foil on the outside, and into which a plunger is driven by the operation of a screw. A length of 2 B.A. threaded brass rod is mounted to an ebonite block carried on the base piece, so that when rotated it will move forward into the mouth of the glass tube. The end of the threaded rod may carry a cylinder of copper foil, which, in springing open, makes a good fit round the inside walls of the glass tubing. The tin or copper foil on the outside of the tubing is bound in position by means of a wire which serves to pick up contact with one of the terminals. The other terminal connects with the threaded rod by means of a wire soldered to the nut which provides the thread in the ebonite endpiece.—O. J. R.

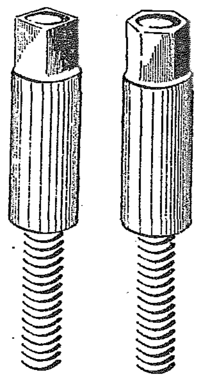


A vernier condenser, especially suitable in neutrodyne circuits. The screw action provides an easy yet stable method of adjustment.

oooo

INSULATION BETWEEN VALVE LEGS.

When nuts and washers are used to hold valve legs in position, the insulation on the back of a panel is often brought to a very low value, owing to the small distance between the washers on the grid and filament contacts. The use of back nuts may be avoided by screwing the valve legs into tapped holes. To prevent injury to the turned or perhaps lacquered surface, the end of each valve stem should be filed to a square or octagonal shape, so that a box spanner can be used to screw the thread tightly into the tapped hole. —E. L. B.



A suggested method of screwing valve leg sockets into ebonite panels. Instead of trying to grip the round action with pliers the heads are first filed to fit a spanner.

oooo

ATTACHING IVORINE LABELS.

The scales or labels should first be roughened on the underside by scraping or glass-papering. Next smear with amyl acetate until the surface becomes "tacky." Now, if pressed into firm contact with the panel the label will after a minute or two be found to be firmly attached.

P. N.

Valves for Readers.

For every practical idea submitted by a Reader and accepted for publication on this page the Editor will forward by post a receiving valve of British make.

ABOUT DETECTION.

For the guidance of the Beginner, the Purpose and Action of the Detector is explained, describing the Process by which Aerial Currents Actuate the Telephone Receivers.

By R. D. BANGAY.

THE term "detection" is used to imply that stage in the process of reception in which the high-frequency oscillations representing the received signals are converted into a form capable of affecting an indicating instrument, either directly or through an amplifying system. For the purpose of this article, we will assume that the indicating instrument used is an ordinary telephone receiver. Whether or not an amplifying system is used after the process of detection is purely a matter of requisite strength and does not in any way affect the question of detection.

Before we attempt any explanation of the methods adopted in practice for detecting high-frequency oscillations, let us be quite sure that we understand why any process of detection is necessary. Why, in fact, the high-frequency oscillations cannot be utilised to actuate directly the telephone receiver. It is very much easier to follow the methods adopted in practice for detecting wireless signals if we have a perfectly clear understanding of this question. And since the beginner frequently shows a good deal of haziness on the point, the writer proposes to devote the whole of this article to its explanation and leave a description of the several methods adopted in practice for obtaining the required results for a later article.

High-frequency Currents.

Let us take as an example the case of the currents induced in the receiving aerial by a telephone signal radiated from one of the broadcasting stations. These signals consist of a continuous succession of high-frequency oscillations occurring at a frequency of some 750,000 per second on which are impressed the sound

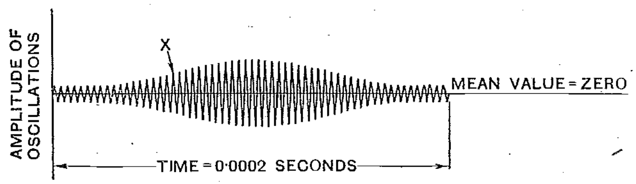


Fig. 1.—Diagram representing a high-frequency oscillation.

modulations which occur at various frequencies, between some 6,000 per second and 30 per second, according to the pitch of the sound, and representing the ordinary range of audible frequencies. It will be seen, therefore, that on this wavelength there may be anything from 125 to 2,500 individual high-frequency oscillations occurring in the period of time occupied by a single sound vibration.

Fig. 1 shows graphically the nature of the high-frequency oscillations generated by an incoming telephone signal during a single sound period when the wavelength is 1,000 metres and the frequency of the superimposed sound modulation is 5,000 per second. This comparatively long wavelength and extremely high modulation frequency have been chosen for the purpose of the illustration on account of the great difficulty of reproducing many lines close together. Had we tried to tuck a much greater number of oscillations into the space of the diagram the lines would all run together.

However, the diagram will serve our purpose by illustrating two things. First, it illustrates to some extent the enormous difference between the frequency of the oscillations and that of the sound modulations in a wireless telephone signal, and, secondly, it shows that in this stage, the character of the sound is not represented by an alternating current at all. It merely exists as a gradual periodic variation in the amplitude of the high-frequency current. It will be noticed that the amplitude of each successive high-frequency oscillation is only slightly greater or slightly less than its predecessor, and each element or cycle of sound is the *total* result of a very large number of these oscillations. Obviously, therefore, if we wish to interpret the sound modulations in the telephone receivers, we must not look for the individual effect of each oscillation, but for the total effect of all the oscillations which occur during each cycle of sound. In other words, we must so arrange matters that the movement of the telephone diaphragm responds to the change in amplitude of the high-frequency currents during each sound cycle, and not to the change in current during each high-frequency cycle.

Telephone Receivers.

Now the telephone receiver operates on an electromagnetic principle. The operating current has to pass through the coils of a small permanent magnet of which the diaphragm forms the armature; and since the pull exerted on the diaphragm is dependent upon the magnitude and direction of the current passing through the magnet coil, the movement of the diaphragm follows sympathetically any variation in the current passing through the coils. Thus, if an alternating current is applied to the coils, the diaphragm is attracted to the magnet during, say, the first half cycle, and is repelled during the second half cycle.

The diaphragm, however, has certain limitations in the extent to which it can follow rapid fluctuations in the current; these limitations are imposed by its natural inertia and momentum, which makes it to a certain extent sluggish. If, therefore, the frequency of the fluctuations is too high for it to follow exactly, it tends to take up an average or mean position corresponding to the average force applied to it during each cycle or fluctuation.

About Detection.—

The current induced in the receiver by the incoming signal is, as we have seen, an alternating current, but the frequency is much too high for the comparatively sluggish diaphragm to follow. If, therefore, these currents were passed through the coils of the telephone, the movement of the diaphragm would follow the average force exerted by each cycle of high-frequency current. At first sight this would appear to be just what is wanted because, as we showed in the earlier paragraphs, what we wish to detect is the total effect of all the oscillations, or, in other words, the change in amplitude during each sound cycle. This result would, in fact, be obtained if the mean effect of each high-frequency cycle on the movement of the diaphragm were proportional to the amplitude of that cycle. Let us see if this is the case.

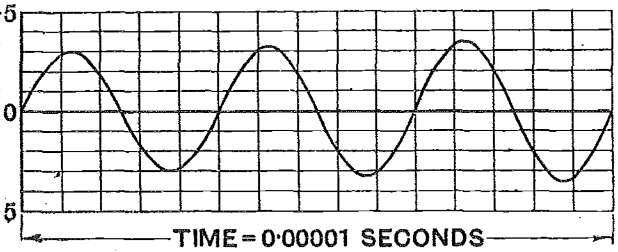


Fig. 2.—Three complete cycles of current.

Fig. 2 shows three successive high-frequency cycles of the series illustrated in Fig. 1. These cycles are exactly the same as those illustrated at the point X in Fig. 1 except that the time period is plotted on a larger scale for the sake of clearness. As previously noted, the difference in the amplitude of adjacent cycles is extremely small, even though they are taken at the point where the rate of change in the amplitude is greatest. It is also evident that the difference between consecutive *half* cycles is even less, and therefore the average amplitude of all the upper half cycles will be, for all practical purposes, exactly equal to the average amplitude of all the lower half cycles, whether we take the average over the whole group of oscillations which occur during the sound period or for each separate oscillation.

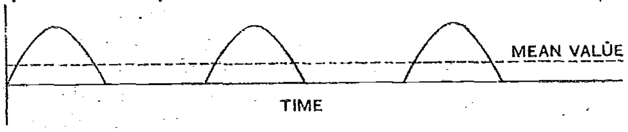


Fig. 3.—Three half cycles; the lower half cycles have been suppressed.

The upper half cycles are trying to pull the telephone diaphragm closer to the magnet, and the lower ones are trying to repel it. The diaphragm, however, is, as we have seen, too sluggish to follow the rapid oscillations, and therefore moves in proportion to the average or mean of the forces acting upon it. Since half of these forces are in one direction and the other half are always in the opposite direction, and that the two halves are always equal, it is clear that its movement is controlled by the mean of two equal and opposite forces, which must always be zero, no matter what their amplitude. Obviously, therefore, the telephone receiver by itself is incapable of detecting the received signals.

Suppose, however, by some means or other we suppress all the lower half cycles of the H.F. current, as illustrated in Fig. 3; then it will be seen that the forces acting in one direction will no longer be opposed by equal forces acting in the other, and, consequently, the diaphragm, although too sluggish to follow each little impulse, will respond to the average effect of all the impulses, as indicated by the dotted line in Fig. 3. Moreover, the greater the impulses, *i.e.*, the greater their amplitude, the greater their average effect on the diaphragm. If, therefore, the amplitude of the impulses remains constant, the diaphragm will take up a new position relative to the magnet and remain there so long as the oscillations persist, but if the amplitude of successive impulses gradually grows and fades, as shown in Fig. 4, then provided the period of these changes is slow enough for the diaphragm to follow, the latter will move in sympathy with the amplitude changes. This is exactly what we require for the purpose of detecting the sound variations impressed on the high-frequency currents.

Inductance of the Telephones.

So far we have dealt only with the mechanical side of the question as it affects the movement of the diaphragm. There is, however, an almost exactly similar effect to be considered in the electrical circuits. The effect of the inductance of a circuit on the flow of an electric current is exactly analogous to the effect of the inertia or momentum of the diaphragm on its movement. That is to say, it gives the circuit a certain sluggishness and tends

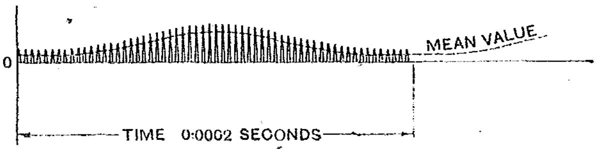


Fig. 4.—The mean value of current which passes through the telephones.

to oppose any change in the magnitude of the current flowing through it. If, therefore, an alternating electric force of very high frequency is applied across a circuit of sufficiently high inductance, the current which tries to start flowing in one direction as the result of the first half cycle of force is instantly arrested by the reversed effort of the second half cycle; and so long as these two opposite forces are always equal, the resulting current will be practically zero. This, in fact, is the case in the circuit we are considering.

Inductance is an electro-magnetic effect, and consequently the magnet coils of a telephone receiver, which are designed to produce the greatest possible magnetic effect, are very highly inductive. Their inductance, however, is not high enough seriously to impede alternating currents having frequencies corresponding to those representing sound, *i.e.*, up to about 6,000 cycles per second; but to the extremely high frequencies generated by an incoming signal, they offer an almost infinitely high impedance. Consequently, if the high-frequency alternating voltages generated by the incoming signal are applied directly across the telephone receiver, no appreciable current will pass through the magnet coils.

About Detection.—

Rectification.

Suppose, however, we suppress every alternate half oscillation in the manner suggested previously and illustrated in Fig. 3. In that case it will be seen that the current is no longer a true alternating current, but although of an impulsive character, is always acting in the same direction. The result of applying such a force across the coils of a telephone receiver will therefore be analogous to what occurs when a similar mechanical force is applied to the diaphragm. That is to say, the force will produce an average or mean effect of a more or less uniform character which will be proportional to the amplitude of the impulses, with the result that a more or less steady current will pass through the magnet coils. Moreover, this current will vary in sympathy with any comparatively slow changes in the amplitude of the high-frequency impulses, as indicated by the dotted line in Fig. 4. Thus it will be seen that in this way the sound frequencies impressed on the carrier wave of a telephone transmitter can be translated into a modulated direct current suitable for operating the telephone receivers.

The object of the process of detection is therefore to suppress, or "rectify," as far as possible, the alternate half cycles of the oscillatory currents or E.M.F.s generated by the incoming signal. It is not, of course, essential that the alternate half cycles are entirely suppressed.

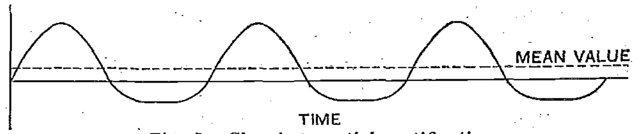


Fig. 5.—Showing partial rectification

So long as they are reduced in comparison to the amplitude of the other half cycles, the desired effect will be produced, although obviously the more complete the suppression the greater will be the resulting effect in the telephones. Partial suppression, or "rectification" as it is usually termed, results only in a certain amount of loss of efficiency, as indicated in Fig. 5.

VALVES TESTED.

The Cosmos Types S.P.18 and D.E.11.

FROM Metro-Vick Supplies, Ltd., we have received samples of two valves, the S.P.18 and the D.E.11. The former type, with which we deal first, is a most interesting valve of quite novel construction, and is illustrated in Fig. 1.

The filament is of the coated variety, the active material surrounding a core of platinum-iridium. Filaments of this type operate at a dull red heat, and in bright daylight the glow will be barely visible. Great care must be taken on the part of the user never to overrun coated filaments, because, once the emission has been lost, no subsequent treatment can restore it.

Reference to the illustrations shows the unusual design of the grid. The anode is of the flattened form now general in modern construction, but the straight filament is to one side of the plate and is surrounded by a cylindrical grid. The electrode system is more than usually rigid, for the complete system is braced at the top, as well as the bottom, by a glass bridge piece. The whole thus forms a stiff framework, and relative movement between the electrodes is prevented. This construction thus enables the distances between the electrodes to be made very small and the attendant advantages gained.

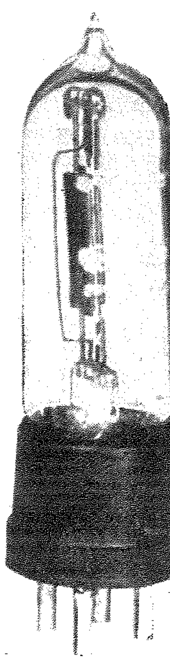


Fig. 1.—The S.P.18.

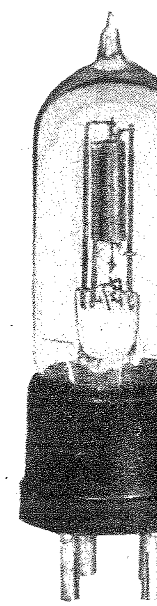


Fig. 3.—The D.E.11.

Cosmos S.P.18.

Filament volts, 1.7 to 1.8; filament current, 0.3 ampere; plate voltage, 20 to 120; the results of our tests being given in the subjoined table.

Our results show the filament current closely to approach the rated values, and the efficiency of 47.8 milliamperes per watt is of the order to be expected from this class of cathode.

When a moderately high plate potential is used, the characteristic has a long, straight portion with negative grid potential, so that good L.F. amplification may be expected. By the way, it is to be noted that the grid current does not commence to flow until the grid is well positive to the filament (1.5 volt or so), and, therefore, the available grid swing for amplification purposes is extended on the positive side by this amount.

For detector or H.F. work, a plate potential of 20 to 40 volts may be used, but, due to the fact that the grid current is late in starting, the grid leak *must* be connected to the positive filament lead when the valve is operating as a detector.

This class of valve needs much less reaction than the ordinary types, so, when substituting, see that the reaction coupling is opened up.

COSMOS S.P.18.
(Metro-Vick Supplies, Ltd., London.)

Filament volts, 1.8.
Filament amps., 0.29.

Emission (total), 25 milliamperes.
Filament Efficiency, 47.8 milliamperes per watt.

Plate Volts.	Plate Current at Zero Grid Volts.	Grid Bias.	Plate Current Milliamperes.[1]	Amplification Factor.	Plate Impedance.
40	1.85	0	1.85	6.1	7,400
60	4.64	–2	2.9	6.25	7,400
80	7.55	–4	3.9	6.25	7,300
100	10.67	–6	4.96	6.25	7,250
120	14.00	–8	6.1	6.25	7,150

[1] Plate current when grid is biased to the value shown in col. III.

For L.F. work, the S.P.18 is especially suited, and the table above will indicate suitable combinations of plate and grid potentials. Due to its constants, the valve will handle quite an appreciable amount of power

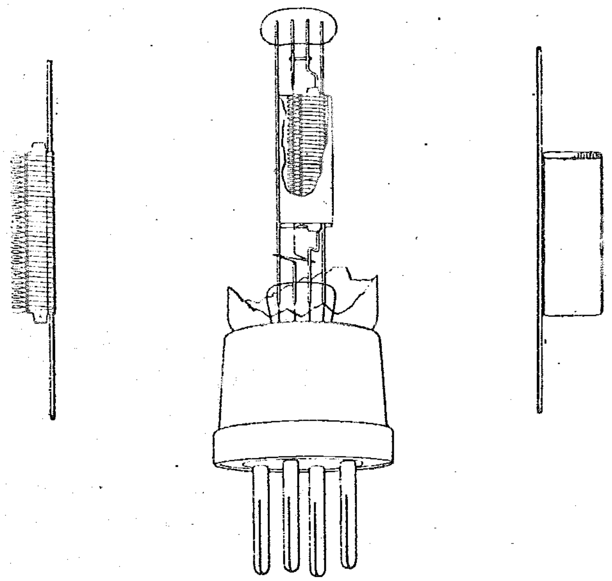


Fig. 2.—The electrodes of the Cosmos S.P.18. On the left, the grid of the valve; centre, the arrangement of the electrodes; right, the anode.

and is consequently very effective when used in the last stage.

Our practical circuit tests on this valve have been very extensive, and it can be recommended as a really excellent all-round tube.

Cosmos D.E.11.

The second Cosmos valve to be tested has its electrodes mounted in the usual cylindrical manner. The straight filament is of the coated type, and is surrounded by the usual spiral grid and cylindrical anode. The construction, therefore, calls for no special comment. The clearances are, however, quite small, and in appearance the tube somewhat resembles an elongated Wecovalve. Parenthetically, we may mention that the bulbs of both the Cosmos valves reviewed here are quite clear and free from the dense deposit which has recently become fashionable.

Our previous remarks regarding filament and temperature and over-burning apply, with equal force, to the D.E.11, which, as we have already stated, also has a coated filament. The filament is rated at 0.25 ampere, 1.0 to 1.1 volt; anode rating 30 to 120 volts.

During test we found the plate current very apt to "creep," which made our task of obtaining accurate figures rather difficult, and those given in the table may be regarded as the average of a number of readings.

When the valve is used as a H.F. amplifier or detector, 30 to 40 volts potential should be used; the value, however, is not very critical. When used as a detector with the customary grid condenser and leak, the usual practice of connecting the grid leak to the positive lead of the filament must be adhered to. This is important if the best results are to be obtained.

For low frequency work, the figures given in the table may be taken as suitable combinations for grid and plate potentials. The makers give the grid bias as approximately 1-15th of the plate voltage, and our figures above are seen to be in fairly close agreement.

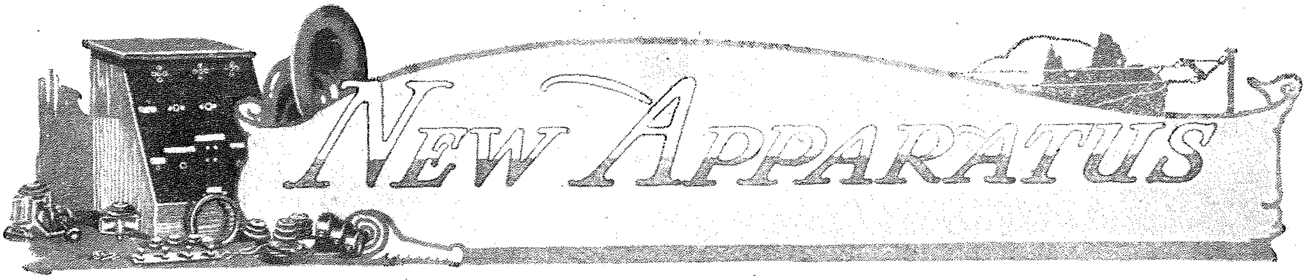
COSMOS D.E.11.
(Metro-Vick Supplies, Ltd., London.)

Filament volts, 1.0.
Filament amps., 0.23.

Emission (total), 12.4 milliamperes.
Filament Efficiency, 54 milliamperes per watt.

Plate Volts.	Plate Current at Zero Grid.	Grid Bias.	Plate Current Milliamperes.[1]	Amplification Factor.	Plate Impedance.
20	0.68	0	0.68	6.4	20,000
40	1.7	–1.5	1.18	6.6	19,500
60	2.8	–3	1.74	6.6	18,200
80	4.04	–4.5	2.31	6.6	17,800
100	5.3	–6	2.88	6.6	17,000
120	6.68	–7.5	3.56	6.6	16,800

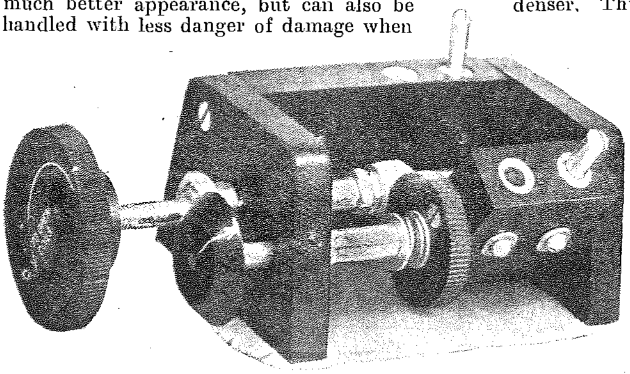
[1] Plate current when grid is biased to the value shown in col. III.



A Review of the Latest Products of the Manufacturers.

THE PETO-SCOTT TWO-COIL HOLDER.

Coil holders have been produced in a vast variety, but it is surprising that so few of the available patterns are suitable for mounting behind the instrument panel. When operating over a limited range of wavelengths there is no reason why the tuning coils should be exposed, and receiving instruments not only have a much better appearance, but can also be handled with less danger of damage when the tuning inductances are enclosed in the box work of the set. Messrs. Peto, Scott have recently introduced a two-coil holder of new design and in which the aim has been to produce an instrument which can be attached to the face of the panel and if necessary supported by the baseboard, so that the tuning coils are completely hidden away in the interior of the receiver. Critical adjustment is obtainable through a reduction gear, whilst the spindle to which the movable coil holder is secured is extended for the purpose of rotating a small indicator which appears on the front of the panel.

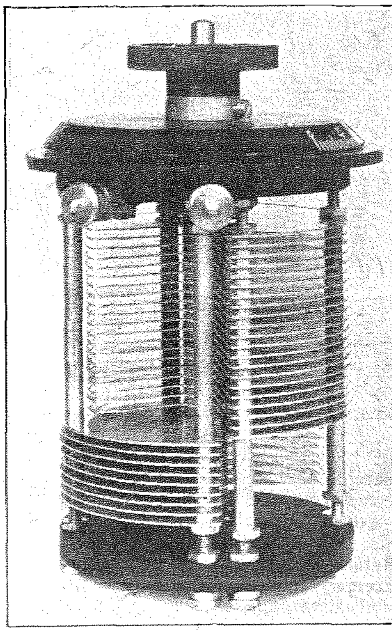

The Peto-Scott two-coil holder.

This coil holder is a robust and beautifully finished job, and it is with satisfaction that we notice that all spindles are provided with brass bushes where they pass through the ebonite endplates. One hole fixing is adopted for attaching the coil holder to the panel, whilst the indicator passes through a clearance hole.

THE DUWATCON AERIAL TUNING CONDENSER.

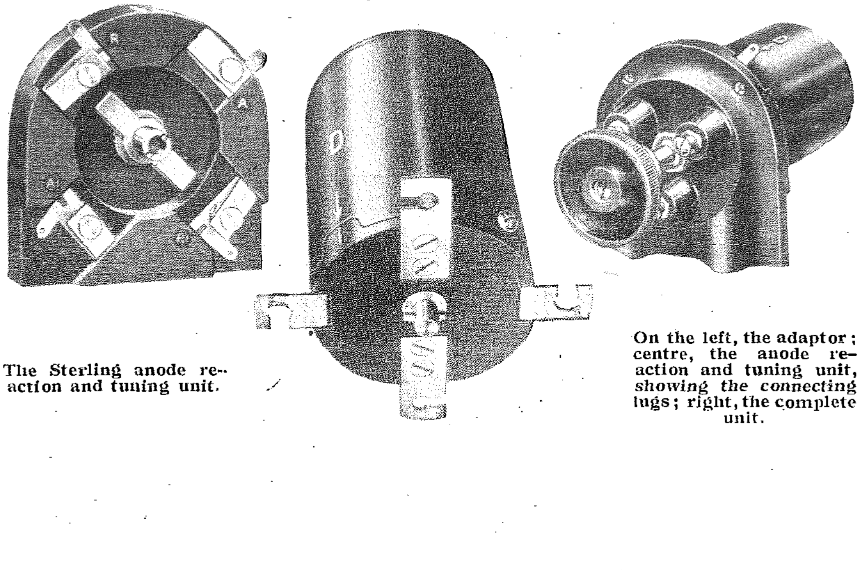
It is well known that when an ordinary tuning condenser is used in the aerial circuit, a break occurs in the wavelength range upon switching the condenser from series to parallel. The break is caused by the effect of the capacity of the aerial on the total capacity of the circuit, and varies with the tuning range of the condenser. Thus part of the benefit of employing a series-parallel switch is lost unless a compensating condenser is introduced into the circuit. The Dubilier Condenser Co., Ltd., have introduced a specially constructed variable condenser which is designed with constants such that when used with ordinary aerials there is a small overlap of wavelengths when switching from the series to the parallel position. Thus the desired range of wavelengths may be tuned over with a minimum number of coils. This condenser, which is illustrated here, has two sets of moving and fixed plates, and the moving plates are specially shaped. The condener is well made, and may be recommended for use in aerial circuits when it is proposed to employ a series-parallel switch.

The instrument is well constructed, being the product of a company who are specialists in condenser manufacture.


The Duwatcon aerial tuning condenser.

AN ANODE REACTION & TUNING UNIT

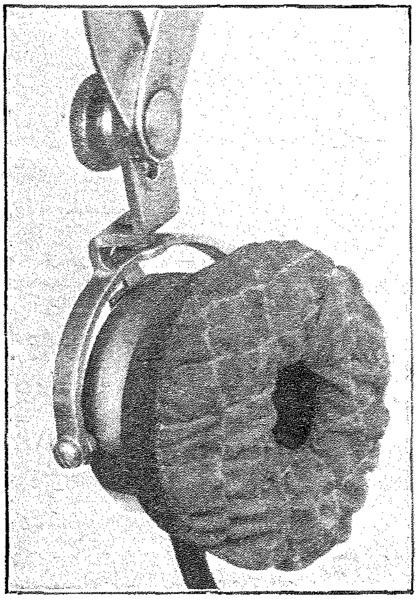
The illustrations reproduced here are of the Sterling reaction and tuning unit, which is in general use in Sterling sets, but can now be obtained separately as a component. As the illustration shows, the unit is clipped into a special adaptor, which is permanently attached to the panel, and four connecting tags are provided. Only the control knob appears in the front of the panel, the rest of the unit being housed behind. Eight units are made which will cover the range of 40-5,000 metres when used in the anode circuit and tuned with a .00025 mfd. condenser of the Sterling square-law type. The separate units providing this range of wavelength can be interchanged with the utmost ease. The units can also be used in the aerial circuit when reaction is applied to the aerial coil.


The Sterling anode reaction and tuning unit.

On the left, the adaptor; centre, the anode reaction and tuning unit, showing the connecting lugs; right, the complete unit.

WEARING TELEPHONES WITH COMFORT.

Everyone knows how uncomfortable telephones can become when they are worn for a long period, and therefore the little "Macondo" pneumatic ear pads,



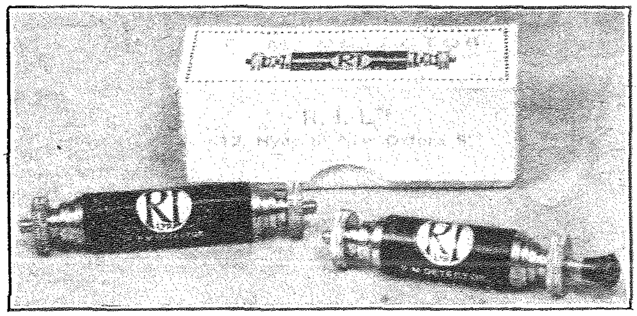
Macondo ear pads.

a sample of which is illustrated here, can be recommended as a satisfactory way of overcoming this disadvantage. The pads are of rubber composition and inflated with air, so that they are extremely comfortable and have the additional advantage of helping to keep out extraneous noises which otherwise might interfere with reception, especially when listening to weak signals.

These telephone ear pads are supplied by McLeod & McLeod, of 329, High Holborn, London, W.C.1.

A PERMANENT DETECTOR.

A good deal of trouble and uncertain operation arises when a detector depending for its sensitivity upon critical adjustment is employed. This is particularly true when the detector is used in a reflex set where a slight change in the pressure of the contact of the elements of the detector is sufficient in many instances either to make the set "dead" or cause it to howl. These troubles are due to the load which the detector puts upon the circuit varying with its adjustment, and it becomes a difficult matter to design a circuit which will result in maximum effectiveness when such a variable element is present in the circuit. One of the advantages of a fixed or semi-fixed type of detector is, therefore, that it is stable, and it may be put in a suitable designed circuit and left for a period without attention, retaining its operating characteristics unimpaired. A detector of this type is marketed by Messrs. Radio Instruments, Ltd., and is known as the P.M. Detector. This device has a fairly high resistance, is stable, and appears to be a satisfactory detector in every way. No doubt it will come into general use, because it is trouble-proof, and not likely to get out of adjustment.

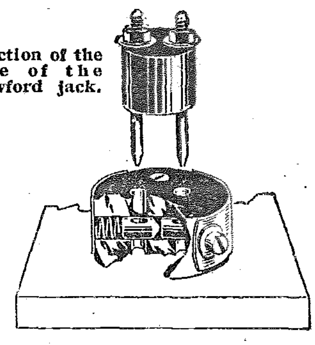


Two types of P.M. detector, the new crystal detector supplied by Messrs. Radio Instruments, Ltd.

A USEFUL JACK.

One can always find uses for such a convenient little article as the "Crawford" jack illustrated here. It is so designed that when the plug is inserted

A section of the base of the Crawford jack.



it breaks the circuit which otherwise is through between the two outside terminals. Besides being useful where it is desired to insert one or more pairs of phones in series, it is also applicable as a switch for connecting the aerial to earth. This piece of apparatus is supplied by Motor Accessories, Ltd., Oakley House, 14, 16, 18, Bloomsbury Street, W.C.

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CABINETS FOR WIRELESS SETS.

We have had the opportunity of seeing some very attractive cabinets made by Henry Joseph & Co., Ltd. The prices are very reasonable. In addition to cabinets for sets, accumulator crates and boxes of various types for instruments can be obtained from the same makers.

The amateur usually experiences much greater difficulty in constructing a suitable cabinet than building the instrument which it is to contain, and it is advisable, therefore, to purchase a ready-made cabinet, finished with a high-grade polish.

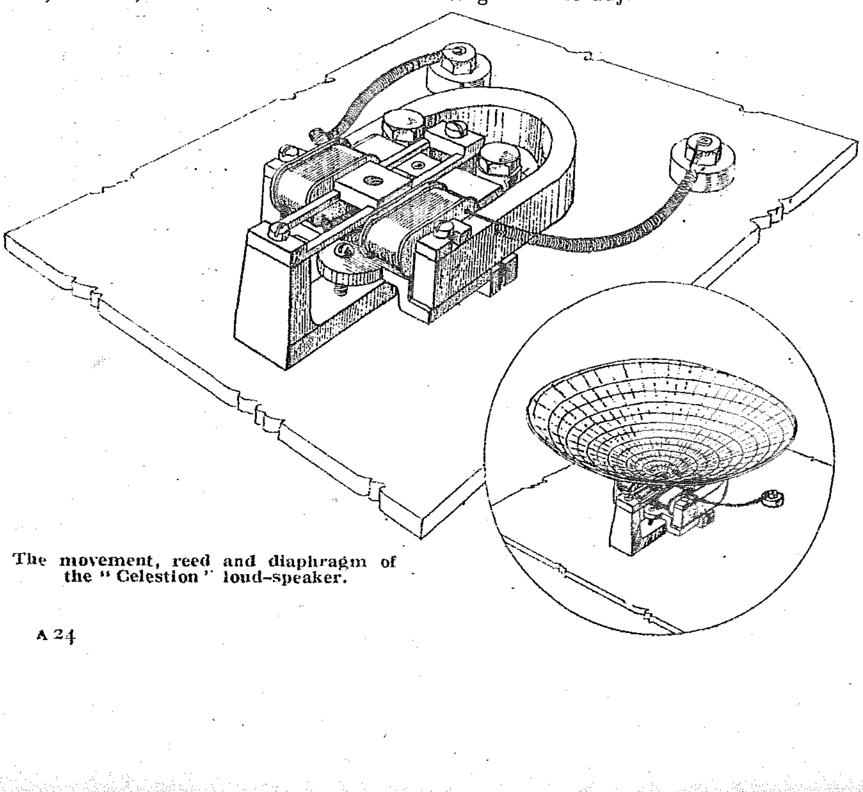
o o o o

A REALLY GOOD LOUD-SPEAKER.

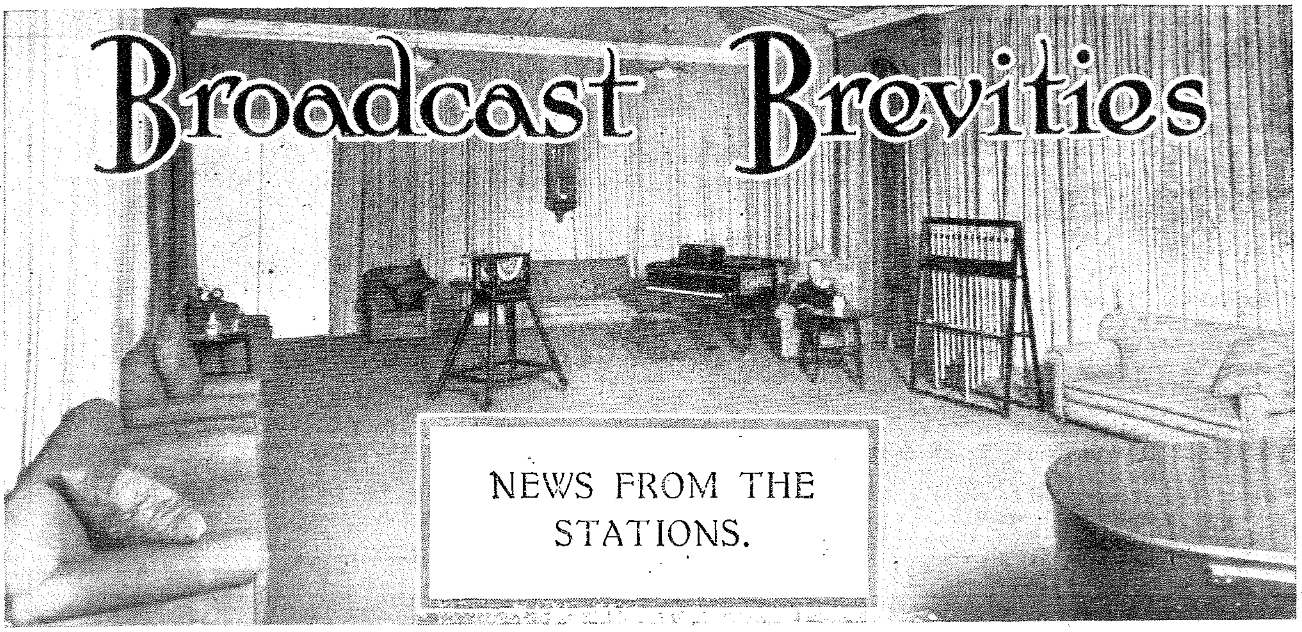
In spite of the fact that loud-speakers are now very numerous, our experience with the "Celestion" illustrated here has convinced us that it ranks high amongst the modern instruments of its kind. A good deal of attention has been paid to the design. As the sketch shows, this loud-speaker is of the hornless type and consists of a large diaphragm connected to a specially shaped reed at the centre, whilst the edge of the diaphragm is entirely free.

The general appearance of the instrument is pleasing. The quality is distinctly good, although the tone may be slightly on the loud side.

The manufacturers are the Electrical Manufacturing and Plating Co., of Hampton Wick.



The movement, reed and diaphragm of the "Celestion" loud-speaker.



NEWS FROM THE STATIONS.

Long Distance Reception.

A report has just come to hand of reception on crystal of 5XX at Vevey Latour, Switzerland. This is believed to be the first authentic crystal report from that country.

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Chelmsford to America and Back.

Some curious results were experienced in connection with the recent experiment of re-broadcasting Chelmsford from KDKA, the Pittsburg Station. A correspondent stated that he received the Savoy Bands and the Quartet, which he described as exceptionally good.

As a fact, the transmission from 5XX was eminently satisfactory; but the reception was not good enough, and some enthusiasts appeared to have become confused and picked up 2LO on 365 metres, and thought that they had got one of the American stations, which broadcast on wavelengths in the neighbourhood of that of 2LO.

oooo

Radio Drama.

Urgent need exists for plays specially written for radio transmission, and the B.B.C. will welcome with open arms writers who can "deliver the goods."

With fifty thousand hours a year of broadcasting, there is a practically inexhaustible field for this class of work; but radio drama is in a sphere by itself, and it by no means follows that the successful stage or film writer will be successful with radio plays.

Broadcasting stands where the cinema stood fifteen years ago, and the B.B.C. must be constantly on the alert to find writers who can write and people who can act in a manner suitable for radio transmission, or it will perish.

oooo

Five Shilling Licence Fee?

Considerable stir has been caused by the rumour that the licence fee may be reduced to five shillings. All that the Postmaster-General implied in the statement from which that rumour emanated was that if every listener discharged his liability then there was a possibility that the fee might be reduced even to five shillings.

Unfortunately, listeners cannot build up any hope of an early reduction. The B.B.C. licence will continue until the end of 1926, and it is improbable that any modification will be introduced in the meantime.

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A Record Week of Star Items.

This is about the biggest week in broadcasting that the world has yet known.

Yesterday, March 10th, we had Tetrazzini, who with the possible exception of Clara Butt and Melba, is probably the biggest singing attraction with which the British listener has yet been provided.

To-morrow, March 12th, there will be the American composer, Edgar Stillman-Kelley, superintending the broadcasting of his Musical Miracle Play from the Royal Opera House, Covent Garden.

It has been asked why a Birmingham orchestra was chosen for this important occasion in preference to a London Symphony orchestra. The reply is that Mr. Joseph Lewis, the Assistant Conductor of the City of Birmingham Orchestra and Musical Director of the Birmingham Broadcasting Station, did not choose his orchestra because he thought Birmingham performers would make a better show, but in order to have adequate opportunity for rehearsal. He thinks now that he has assembled the best orchestra in the world for his purpose.

Already this year Mr. Lewis has done the Messiah, Elijah, and The Creation for the B.B.C.

There are one thousand choristers for "The Pilgrim's Progress" drawn from the City of Birmingham Choir, the Wolverhampton Musical Society, and the Walsall Philharmonic.

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Paderewski Before the Microphone.

Another big night will be next Sunday, March 15th, when M. Paderewski, the distinguished pianist, will play from 9 o'clock until 10.30. Prolonged negotiations took place before M. Paderewski's consent was obtained. His programme will include a Nocturne of his own composition.

It is possible that attempts will be made to re-broadcast both Tetrazzini and Paderewski to America, and these great performers will in that case have audiences numbering more than thirty millions—sufficient surely to gratify the desires of any prima donna or virtuoso.

oooo

The Better Programme Plea.

In connection with the appeal for better programmes, it has been suggested that every Station of the B.B.C. should have its annual musical festival. Birmingham is one station at any rate which appears to look forward to this development, and is aiming to establish a festival of international standard.

There is the danger that important towns without broadcasting stations may not be altogether pleased at the idea of places with broadcasting facilities being able to steal a march on them.

oooo

Post Office and the New Bill.

In the debate on the Bill controversy will rage round the right of search and the penalties which it is proposed to inflict on listeners who listen without a licence. It may be taken for granted that these penalties are merely a repetition of those in the Act of 1904, and they indicate that the Post Office fails to recognise the advance which has taken place in the science of wireless.

FUTURE FEATURES.

Wednesday, March 11th.	
Cardiff, 7.30 p.m.	"Tannhäuser" (Wagner).
Belfast, 7.30 p.m.	Symphony Concert.
Hull, 7.30 p.m.	"The Dream of Gerontius" (Elgar).
Thursday, March 12th.	
All Stations, 8 p.m.	The Musical Miracle Play, "The Pilgrim's Progress." Relayed from the Royal Opera House, Covent Garden.
Friday, March 13th.	
Aberdeen, 8 p.m.	"An Hour with Elgar."
Glasgow, 7.35 p.m.	"Scots Night."
Saturday, March 14th.	
London, 8.30 p.m.	"A New Feature by Old Friends."
Bournemouth and 5XX, 8 p.m. ...	"Pictures": Well-known paintings brought to Life.
Aberdeen, 7.30 p.m.	The Catterall Quartet.
Sunday, March 15th.	
London, 3 p.m.	Orchestral Programme.
London, 9 p.m.	De Groot and the Piccadilly Orchestra.
Bournemouth, 3 p.m.	Band of the 1st Middlesex Regiment.
Aberdeen, 9 p.m.	"Parsifal" Choral Selection.
Monday, March 16th.	
Birmingham, 7.30 p.m.	Music and Drama.
Bournemouth, 7.30 p.m.	Twenty-first Symphony Concert.
Aberdeen, 7.30 p.m.	"Saint Patrick's Eve."
Glasgow, 7.30 p.m.	Chamber Music Programme.
5XX, 7.30 p.m.	The Catterall Quartet. Robert Ratford. Ballad Concert.
Tuesday, March 17th.	
London, 7.30 p.m.	"St. Patrick's Day."
Belfast, 10.30 p.m.	"New Prince's Frivolities Cabaret, relayed from the Ulster Hall.
Wednesday, March 18th.	
Birmingham, 7.30 p.m.	Mystery Programme.
Bournemouth, 8 p.m.	Winter Gardens Night.

Under present arrangements the sectional engineers of the Post Office are deputed to instruct telephone maintenance men to enquire into cases of alleged failure by listeners to take out licences, *i.e.*, to find out whether a listening set is installed and a licence held. There is a feeling on the part of some of these maintenance men that this is a job outside their normal sphere, and that they will get nothing out of the discovery of delinquents.

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New Continental Stations.

Very occasionally, criticism of broadcast programmes is of a constructive character. It is suggested, for instance, that the nightly transmission should include a minimum of ten minutes devoted to some Continental station.

Something on these lines may be done in course of time.

Hanover, for instance, will be giving a daily concert in future at 4 p.m. G.M.T. This station and that at Bremen were originally relay stations from Hamburg, but they have now been transformed into main stations.

Other new stations on the Continent include the following:—

A station of 1 kw. being erected at Bilbao.

In Madrid, the new station of the Asosacion Radio Espanola, which began its tests towards the end of last month.

A new Madrid station of the Compania Iberica de Telecomunicacion commencing operations shortly.

A third new Madrid station of 8 kw. which is nearing completion.

A station of the Sociedad General de Publicidad General y de Industrias Perlas which is being started at Barcelona.

The Sociedad Espanola de Radiofusion completing a new 3 kw. station at Seville, and further stations are being erected at San Sebastian, Cadiz, Oviedo and Saragossa.

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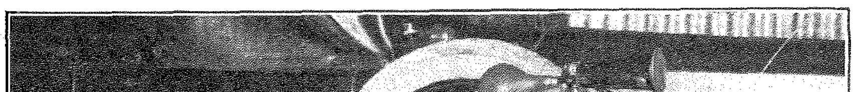
Attempt to hold up Payment to the B.B.C.

An interesting case is likely to arise out of the action of Mr. R. M. Ford, who, appearing before Mr. Justice Astbury, recently moved *ex-parte* for an injunction to restrain the Postmaster-General from handing over £350,000 to the British Broadcasting Company, Ltd. Mr. Ford expressed the view that the Postmaster-General had no right to collect the licence dues from persons having receiving apparatus, and ought, therefore, to be restrained from parting with this money to the B.B.C. until the trial of the action. The case stands over for hearing in a few days' time.

oooo

Japhet in Search of a Father.

A correspondent suggests that the B.B.C. should make a feature of broadcasting requests for information concerning lost relatives and friends. When transmission between this country and America reaches greater perfection, it is highly conceivable that a request from the "rich uncle" in America might bring forth more responses than he would welcome.



An enthusiast who listens-in while making minor adjustments to his Brough Superior. He will, no doubt, listen to the programme sent out by his own spark transmitter when he needs to test the ignition.

NEWS *from the* CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Manchester Radio Scientific Society.

Clear handling of a technical subject marked Mr. L. F. Fogarty's lecture on "Resistance, Capacity and Inductance" on February 4th.

On February 12th an evening was spent in efforts to cut out the local broadcasting station by means of wave traps. It is feared that the results, whilst illuminating, were not productive of any really effective device!

Hon. secretary, Mr. J. Morris, jun., John Morris & Son, Ltd., Cross Lane, Salford.

Ilford and District Radio Society.

"Selective Circuits," a subject of exceptional interest at the present time, was the title of an able lecture given before the Society by Mr. A. E. Gregory on February 17th. After explaining the necessary properties of a selective receiver, Mr. Gregory detailed many circuits designed for this purpose. These included double circuit tuning, various types of wave trap, and the Hinton rejector circuit.

Hon. secretary, Mr. F. W. Gedge, 157, High Road, Ilford.

Wireless Interest in Rochdale.

An able lecture on wireless and its applications was given by Mr. W. Bannister, chairman of the Rochdale Wireless Society, at an open meeting of the Rochdale Association of Engineers on February 20th. The lecturer's remarks covered a wide range from the early days of wireless to the possibilities of television in the future. He dealt in particular with the evolution of broadcasting, and, in referring to the increasing number of relay stations, observed that while this practice was beneficial to the crystal user, it made the problem of selective reception a very difficult one.

Mr. Bannister concluded with an interesting demonstration of a receiver of his own design.

Inland Revenue Radio Society.

The above is the name of a new society which has been formed for the benefit of permanent, temporary, and retired members of the Inland Revenue Department. Meetings are held at 2, South Place, London, E.C.2, on the first and third Fridays in each month during the winter, and on the first Friday in each month during official Summer Time.

On Friday, February 20th, the meeting was divided into two sections, viz., elementary and advanced. Mr. M. A. Beetlestone, M.I.E.E., provided the elementary class with an instructive lecture on "Induction," while the advanced class profited from a lecture by Mr. A. H. Sheffield (5AI) on "2LO's Control Room." Morse practice is a feature of the Society's meetings.

Hon. Secretary: Mr. J. O. Claxton, 570, Salisbury House, E.C.2.

Belfast Association of Engineers.

"Selectivity in Wireless Receivers" was the subject of a lecture delivered before the Association on February 12th by Mr. John Wylie, B.A. The lecturer made interesting experiments illustrating a non-selective circuit, a selective circuit, a resonance curve, effect of secondary circuit, an absorption circuit, a series filter, and a parallel filter.

Beckenham and District Radio Society.

A lantern lecture dealing very comprehensively with the manufacture of condensers was given by courtesy of the Dubilier Company on February 19th. Of particular interest were the slides showing the monster condensers to be installed at the new high-power station at Rugby.

Hon. Secretary: Mr. A. West, 3, Manor View, Beckenham.

Derby Wireless Club.

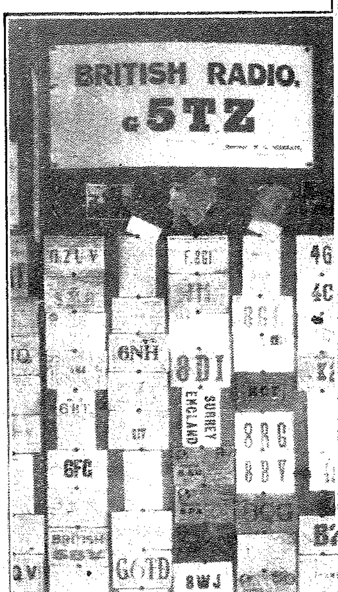
As a result of the Club's annual general meeting held early in the year, changes of policy have been decided upon which will considerably enhance the attraction of future meetings. An interesting programme has been arranged for the remainder of the session, and it is believed that the meetings will prove of added value to all members. Mr. F. W. Shurlock, B.A., B.Sc., has been elected President.

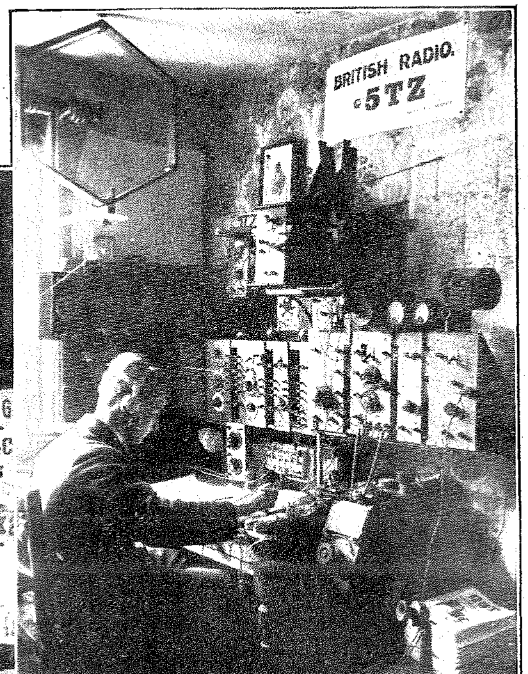
Hon. Secretary: Mr. E. Harold Tawn, 26, Curzon Street, Derby.

Tunbridge Wells Wireless Society.

The Tunbridge Wells and District Wireless Society are having a well-attended and instructive series of meetings.

On February 20th Mr. H. Featherstone, A.M.I.E.E., one of the society's transmitters (5IF), delivered an interesting lecture on "Accumulator Charging from A.C. Mains." After outlining the various methods of converting alternating into direct current, and demonstrating and ex-





Mr. Walter Sherratt, of the Isle of Wight, in his wireless den, where his trophies, in the form of acknowledgment cards, are pinned. Mr. Sherratt is one of those who have been conducting successful two-way communication with Mosul.

plaining a Tungar Rectifier, the lecturer dwelt at some length on Chemical Rectifiers, and gave some details for the construction of a transformer for use with these rectifiers.

February 25th was devoted to a visit to Marconi House, and the studies of the Broadcasting Company at 2, Savoy Hill, London, arranged by the kind permission of Messrs. The Marconi Co., Ltd., and the B.B.C.

A forthcoming attraction will be a lecture by Mr. Haywood, of the Dubilier Condenser Co., with lantern illustrations, on March 6th.

Headquarters: No. 9, Vale Road, Tunbridge Wells.

TRANSMITTING NOTES.

British Transmissions on 20 Metres.

Mr. Gerald Marcuse, secretary to the Transmitter Section of the Radio Society of Great Britain, advises us that he hopes to have some news for members of this section regarding working on 20 metres in a few days. The number of American and Canadian amateurs on this wavelength is increasing daily, and, although Mr. Marcuse states that he knows there is anxiety on the part of British amateurs to get down to this wavelength, he specially desires that they shall postpone doing so until he has some information to pass to them.

Another Remarkable Amateur Achievement.

Intelligible telephony was transmitted at 0705 G.M.T. on Sunday, March 1st, by G2OD to Z4AG, the New Zealand amateur whose station is located at Dunedin. This is the second time that this station has reported reception of telephony from Mr. Simmonds' station G2OD, the previous occasion being the morning of February 16th. After the transmission on March 1st, Z4AG was able to repeat back in Morse remarks which had been made by Mr. Simmonds in his speech transmission.

FORTHCOMING EVENTS

WEDNESDAY, MARCH 11th.

Manchester Radio Scientific Society.—Lecture: "Electricity in Connection with Railway Signalling." By Mr. J. Moore.

On March 18th, Mr. H. S. McGowan has kindly undertaken to deliver the weekly lecture.

Streatham Radio Society, Streatham Hill College, 35, Streatham High Road, S.W.—Lecture: 2LO.

THURSDAY, MARCH 12th.

Luton Wireless Society.—At 8 p.m. At Hitchin Road Boys' School. Experimental Evening.

Radio Society of Highgate.—A 8 p.m. At the Highgate 1919 Club, South Grove, Highgate, N.6. Lecture: "Wavemeters and the 4-electrode Valve." Members may bring wavemeters, coils, etc., for calibration by Mr. H. Andrews and Mr. G. A. V. Sowter.

Derby Wireless Club.—Harmonic Calibration of Receiving Sets by Mr. E. F. Clark, B.Sc., A.M.I.E.E.

Also Radio Frequency Condensers and other attractions. By Mr. Blackmore.

FRIDAY, MARCH 13th.

Sheffield and District Wireless Society.—At 7.30 p.m., Department of Applied Science St. George's Square. Elementary Lecture: "The Valve." By Dr. Walls.

MARCH 14th TO 18th.

Exhibition organised by the Schools Radio Society at the L.C.C. Beaufoy Technical Institute, London, S.E. Open from 10 a.m. to 9 p.m. Admission by purchase of programme, price 6d.

MONDAY, MARCH 16th.

Dorking and District Radio Society.—At the headquarters, 65, South Street, Dorking Members' Evening with Apparatus.

TUESDAY, MARCH 17th.

Liverpool Co-Operative Radio Association.—At 137, Oakfield Road, Liverpool. Demonstration on a 7-valve Supersonic Heterodyne Set. By Mr. F. J. Morgan.

WEDNESDAY, MARCH 13th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green. "High Frequency Currents and Electrical Wave Production." Demonstration Lecture. By Mr. Maurice Child.

PROGRAMME OF THE FIRST INTERNATIONAL AMATEUR CONFERENCE.

To be Held in Paris from April 14th to 19th, 1925.

Congress of the International Union of Amateurs of the T.S.F.

Judicial Congress of the International Committee of the T.S.F.

Tuesday, April 14th.

3 p.m.—Formal opening meeting. Reception of Congress members.

5 p.m.—Discussion of the order of the day. Nomination of sub-committee.

Wednesday, April 15th.

Morning.—Excursion and Scientific Visit.

2.30 p.m.—Working Meeting.

4 p.m.—Judicial System of the Waves. Rights of the Transmitter and Receiver. State Control.

Thursday, April 16th.

Morning.—Excursion and Scientific Visit.

3 p.m.—International Regulations of Wavelengths, especially Amateur Transmissions and Radiotelephonic Art.

Friday, April 17th.

Morning.—Excursion and Scientific Visit.

2.30 p.m.—Working Meeting.

4 p.m.—Artistic and Literary Property and Radiotelephonic Transmissions. Authors' Rights.

Saturday, April 18th.

10 a.m.—Meeting for Lecture on Sound.

2.30 p.m.—Working Meeting.

4 p.m.—Priority Rights for Exploitation of Press, Financial, and Public Information and Wireless.

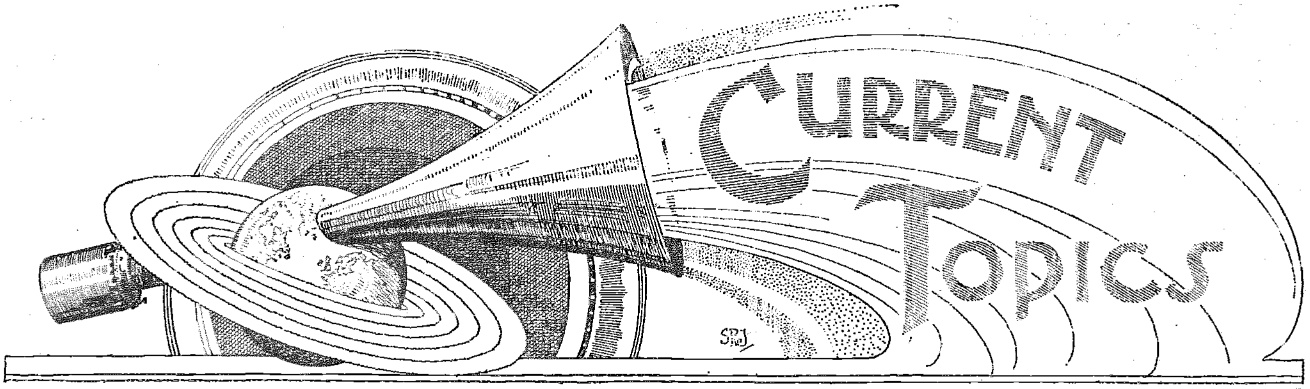
5.30 p.m.—Last Sitting, Various Questions.

Sunday, April 19th.

2 p.m.—Radio Rally.

Every morning meetings of sub-committees will be held at 10 o'clock. The sittings and re-unions will take place at the "Faculté des Sciences," where several halls can be put at the disposal of the Congress members having to sit on different committees. The definite programme will be fixed at the opening meeting on Tuesday, April 14th, 1925

The company assembled on the occasion of the annual dinner of the Radio Society of Great Britain, held at the Waldorf Hotel, London, on the 4th March, 1925.



Events of the Week in Brief Review.

A NEW STATION FOR VIENNA.

Up till now Austria has had to be content with only a one-kilowatt broadcast station in Vienna, although even this is still the largest in that country, but of late enthusiasm of listeners has grown to such an extent that the Austrian Broadcasting Company, which has the monopoly for broadcasting, has responded to the demand and announces that plans are being made for the erection of a station of considerably higher power. The studio of the old station is located on the top floor of the old Austro-Hungarian War Office, but unfortunately the accommodation is not sufficient for a large orchestra to be arranged at the proper distance from the microphone, and so listeners have had to be content with less elaborate programmes.

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WIRELESS AT VIENNA FAIR.

The International Trade Fair which has just opened in Vienna devotes considerable attention to the exhibition of wireless apparatus, and it will be by far the biggest opportunity which the Austrian public has yet had to inspect a variety of broadcast receivers. It is stated that the increase in popularity of broadcasting in Vienna has had the effect of emptying the restaurants and cafés in the evening.

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LETTER CABLES TO WEST INDIES.

The Postmaster-General announces that a service of week-end letter telegrams with the following places in the British West Indies and British Guiana has been instituted, *via* the Imperial Cables: Antigua, Barbados, Dominica, Grenada, St. Kitts, St. Lucia, St. Vincent, Trinidad, and Georgestown.

The rate charged will be 11s. 8d. for messages of 20 words or less (including the indication TWT charged for as one word) plus 7d. for each additional word.

A corresponding service at the same rate is now available *via* Imperial, to Bermuda, Turks Islands, and Jamaica. Messages may be handed in at any post office in Great Britain or Northern Ireland.

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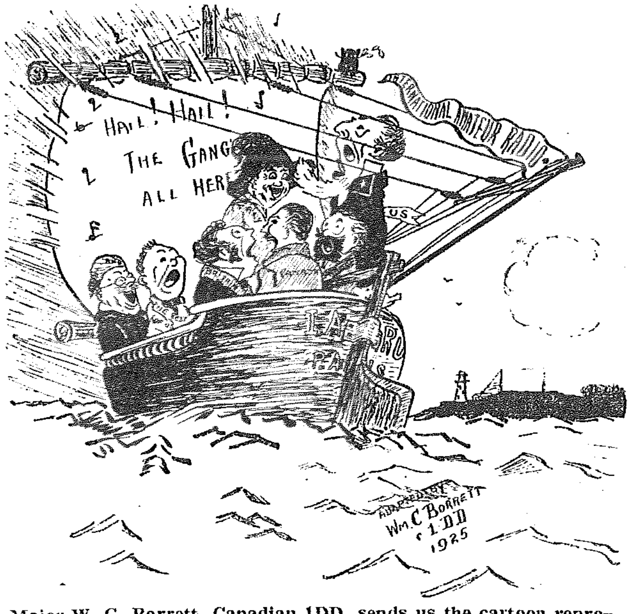
WIRELESS TELEGRAPHY ON DREDGERS.

The Basrah Port Authorities have arranged for Marconi wireless telephone installations of the YB type to be fitted on their dredgers *Liger* and *Tiger*, and also for a shore station with similar equipment. A wireless bell will be included in the installation, thus obviating the necessity for maintaining a continuous watch. The transmitter has a power of 100 watts, and the range for telephony, depending on local conditions, varies from 35 to 80 miles. The telegraphy radius is from 100 to 200 miles.



Major W. C. Barrett, Canadian 1DD, sends us the cartoon reproduced above, which represents the forgathering of amateurs of all nations for the Paris conference in April, when amateurs affairs will be discussed by the I.A.R.U. (International Amateur Radio Union).

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FURTHER BROADCASTING STATIONS FOR GERMANY.

It is announced that the German Postal Department intends to set up new broadcasting stations at Kiel, Dortmund, and Stettin, and that the cost is estimated at £50,000.

Germany has been very active in erecting broadcasting stations, and is only second to Great Britain amongst the European countries.

The Dresden relay station is about to commence trial transmissions on a wavelength of 292 metres.

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HARD TIMES FOR CZECHO-SLOVAKIAN AMATEURS.

A wireless amateur in Czecho-Slovakia was recently sent to prison for six weeks for the two offences of building a receiver and occasionally selling wireless components.

This and other indications of the severity of the wireless regulations in Czecho-Slovakia have reached us *via* the American Radio Relay League. In order to obtain a receiving licence the Czecho-Slovakian enthusiast has to submit a diagram of the set with a list of the components employed, and to state whether the instrument is home-made. Moreover, he must be a permanent resident in the country, and a subject of the Czecho-Slovak Republic.

In spite of these regulations wireless enthusiasm is rapidly growing. One obstacle, however, lies in the cost of wireless apparatus, which although approximating to English and American prices, is beyond the pockets of many of the people. There is a great demand, however, for wireless text-books and magazines.

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R.A.F. WIRELESS AWARD.

An interesting "wireless" award is announced by the Air Ministry, which states that the "Hyde-Thomson" memorial prize, amounting to about £32, has been won by Flight Cadet C. W. Cooper.

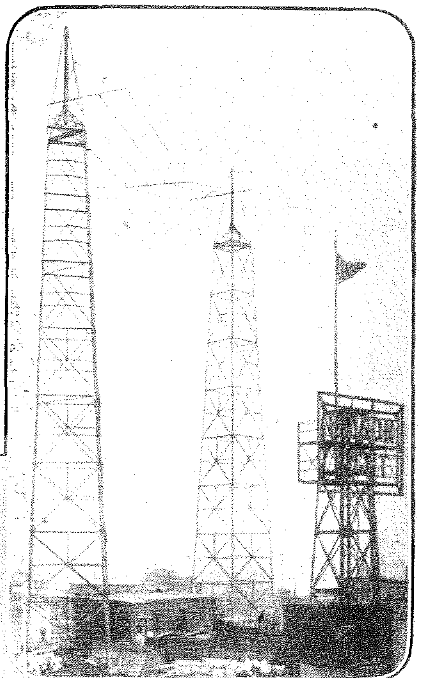
This prize was founded in 1919 by Mr. R. D. Hyde-Thomson for the promotion of proficiency in wireless telegraphy, in memory of his son, the late Lt.-Colonel Douglas Hyde-Thomson, R.A.F., who was killed whilst flying on duty.

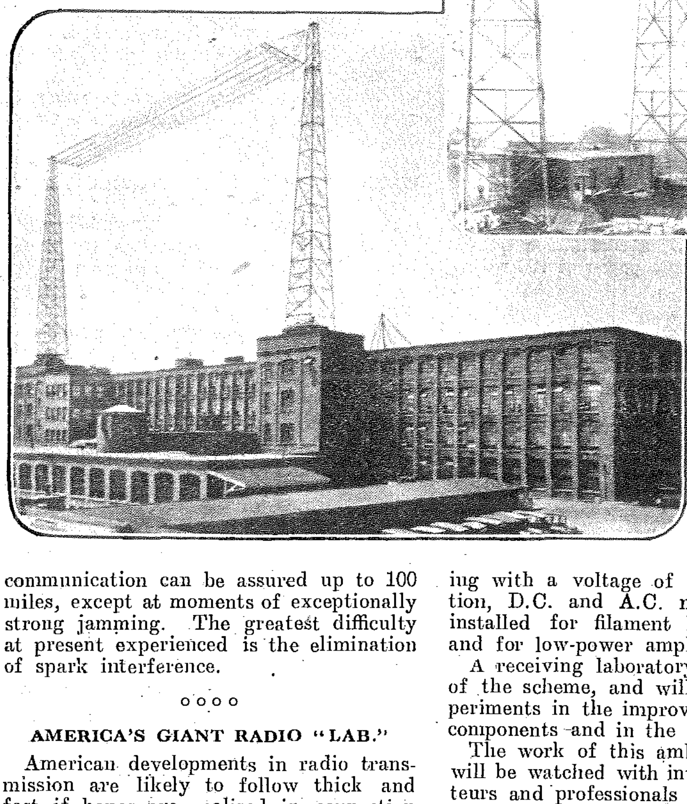
SHIP TO SHORE TELEPHONES.

A wireless telephone service between ships and the shore, which may be linked up with the G.P.O. land lines, is now undergoing experiment at Southampton. All that is required to make the service commercially practicable is a suitable wavelength to avoid interference with broadcasting and Morse stations.

The experiments are being conducted by the Marconi Company in conjunction with the General Post Office and the Southern Railway Co., whose cross-channel steamer *Princess Ena* is being used for the purpose.

Under suitable conditions perfectly good simplex telephone communication has been obtained between Southampton and this vessel up to a distance of about 200 miles; and reliable duplex communication can be assured up to 100 miles, except at moments of exceptionally strong jamming. The greatest difficulty at present experienced is the elimination of spark interference.





Two famous sources of Broadcast entertainment in America. Above is the aerial equipment of WEEI located in the heart of Boston, whilst below is the Westinghouse station WB2 at East Springfield, Mass.

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AMERICA'S GIANT RADIO "LAB."

American developments in radio transmission are likely to follow thick and fast if hopes are realised in connection with a "giant radio transmitter laboratory," which the General Electric Company is erecting in a fifty-three-acre field six miles to the south of Schenectady, New York. The endeavours of the engineers will be in the direction of improving quality in transmission, and in eliminating the twin bugbears, atmospherics and fading.

Three steel towers, 300 ft. high, are to be erected in triangle formation, and from these towers may be suspended any type of aerial for operation between 600 and 3,000 metres. Numerous wooden masts will also be employed for experiments on wavelengths between 15 and 200 metres.

The power plant will include a number of high-power rectifiers, capable of dealing with a voltage of 30,000. In addition, D.C. and A.C. machines will be installed for filament lighting, biasing, and for low-power amplifier operation.

A receiving laboratory also forms part of the scheme, and will be used for experiments in the improvement of receiver components and in the testing of valves.

The work of this ambitious laboratory will be watched with interest by all amateurs and professionals of all countries.

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BELFAST CORPORATION AND AERIALS.

Certain Belfast amateurs have received a rude shock by reason of a notice issued by the City Council notifying them that all aerials erected across streets or thoroughfares must be removed at once. The notice further states that written permission must be obtained from the Improvement Committee for the retention of aerials erected, or for the erection of aerials, across back passages. Such permission will only be given on an undertaking signed by the applicant that the aerials will be erected to the satisfaction of the city surveyor and will be removed when required by him. All applications must be accompanied by the licence issued by the Postmaster.

ARGENTINE TRANSMITTERS.

For the following list of the higher power experimental stations in the Argentine we are indebted to Mr. George C. Stretton, of Southampton, whose informant is Senor Brown, of Cuenca, Buenos Aires.

CALL WITH NAME AND ADDRESS.

A8—Ignacio Gómez, Av. Alvear 2740 Capital.

Capital Federal.

AA1—Horacio Seeber Martinez, Sante Fe 2116. AB1—S. M. Correa, Larera 894. AB2—Hector Bates, Argerich 3343. AB4—Enrique Marti Mas, Sima 667. AC8—Rolando E. Cesares, Córdoba 612. AD1—Hugo Novaro, Mansilla 2663. AE5—Segundo P. I. Acuña, Navarro 4159. AF1—Ismael V. Andrade, Montevideo 1560.

Provincia de Buenos Aires.

CB8—Carlos Braggio, Belgrano 120 Bernal. DB2—Pedro Amado Cattáneo, Lavalle 11, Bahia Blanca. EA6—José M. Bosch, Carlos Cesares.

Provincia de Santa Fé.

FA2—Eduardo Carlos Smith, San Martin 175, Arroyito (Rosario). FA8—Frederico G. Weihmüller.

Provincia de Mendoza.

MA1—R. Raven Hart, Colón 741, Mendoza. MA4—E. H. Vignoles, Mendoza.

Gobernación de Rio Negro.

VA1—Franklin B. Yolde, Viedma.

The majority of these amateurs speak English fluently. In addition to CB8, AE5, and FA2, also work frequently with Australia and New Zealand. A8 was received for the first time in England by Mr. J. Ridley, of South Norwood, on Sunday, January 25th.

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THE WIRELESS BOOM IN AMERICA.

The annual statement of the Radio Corporation of America gives some interesting figures which serve to indicate the enormous increase in the popularity of wireless during the past year or two. The gross income of the Corporation for 1924 was 54,848,131 dollars, a gain of 28,453,341 dollars, or 108 per cent. over that of 1922. It is further stated that the cost of developing and operating the broadcasting stations has been more than doubled during last year.

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ATMOSPHERICS.

Wireless is bringing the Eskimos in touch with the peoples of Europe. They seem to be enthusiastic, nevertheless.

Mr. G. K. Chesterton suggests making listeners jump. Certain broadcast programmes have already caused us to skip. Sometimes a dozen items.

The extension of the broadcasting hours gives still less time in which to draw the dole. A protest is expected.

The statement that a Wigan listener had discovered a new type of melodious atmospheric on February 27th is discounted by the fact that Dundee broadcast a Gaelic concert on that evening.

Wireless, we are told, saved the Eiffel Tower from destruction. Then, what if it does wreck homes?

Building the SUPER-HETERODYNE RECEIVER

A Powerful Set for Long-Range Work.

PART II.

In this instalment we give full instructions for constructing the seven-valve superheterodyne receiver, and describe how to adjust the circuits and operate the set.

By W. JAMES.

THE front panel is of ebonite, measuring 30in. × 8in × $\frac{5}{16}$in., and mounted on it are the two tuning condensers, the vario-coupler, four filament resistances, the potentiometer, the adjustable high resistance, four terminals (two for the frame aerial or tuner and two for the telephones), and a Clix socket and plug. These are arranged as indicated by the photographs and the drawing of the front panel of Fig. 3 (page 112, *Wireless World*, March 4th).

Choosing the Components.

In a set of this type it is essential to employ good tuning condensers, and the writer recommends the Burndept condenser as being one of the best that can be used. The essential point to remember is that the selectivity of the tuner or frame aerial circuit depends on the effective resistance of the coil and condenser. These should be as low as possible, because reaction is not employed to compensate for losses, and the selectivity depends entirely on the design of the tuning arrangements. Selectivity is, of course, improved, as explained in Part 1, by providing the grid of the first valve with a negative bias, and by using a stage of high-frequency amplification (untuned) before the first detector.

A supplement giving complete details for the wiring of this receiver was supplied with our issue of last week.

A geared dial of American manufacture, giving a ratio of 8 : 1, is employed on each variable condenser. With these geared dials it is relatively an easy matter to tune-in a signal; tuning is much more difficult when geared dials are not employed. The effect of using single plate fine tuning condensers is not the same, as the ratio of the capacity of the single plate to the main condenser varies with the adjustment of the latter. When the main condenser is set at a low value, exact tuning is far more difficult than when the main condenser is set at a larger value, owing to the change in the ratio of the capacities. Also, when separate fine tuning condensers are employed the set really has four controls instead of two. Geared condensers or dials of British manufacture are not, the writer believes, available at the present time.

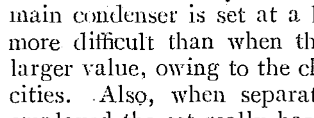


Fig. 1.—Details of the mounting of the No. 400 coil and the 0·0002 mfd. tubular condenser.

Two of the filament rheostats have a resistance of 7 ohms, and the other two of 15 ohms. Looking at the views of the front panel, the first filament rheostat (on the left) has a value of 7 ohms, the second 15 ohms; then in the centre is the potentiometer, and then the third and fourth rheostats, having values of 7 and 15 ohms respectively.

The Vario-Coupler.

The only component which must be partly remade is the vario-coupler. This consists of a Sterling "boardcast" variometer with fresh windings; 12 turns of No. 22 D.C.C. are put on the stator tube, and 20 turns

Superheterodyne Receiver.

of No. 26 D.C.C. on the rotor. The 12 turns on the stator are eventually connected in the grid circuit of the oscillator, and the movable winding of 20 turns in series with the secondary winding of the first H.F. transformer. It is an advantage to be able to vary the coupling of the oscillator and grid circuit, as the strength of the oscillations generated is not constant over the whole range of the tuning condenser, and weak signals are more easily received when the strength of the oscillations is suitably adjusted.

It is an easy matter to construct the whole vario-coupler. Obtain a tube of ebonite or cardboard about 2½in. diameter and 3in. long, and fit a ball or short length of tube on spindles as in some types of variometer. Then put on the windings and terminate them at four screws or connecting tags.

On the base of the set, which is of wood measuring 29in. × 10½in. × ½in., are mounted the valve-holders, grid batteries, bye-pass condensers, and the intervalve couplings. Looking at the illustrations, we see on the left-hand side of the set the two V24 type valve-holders; the holder for the oscillator, O; and then the holders for the three H.F. stages and second detector. The coupling condensers and grid leaks are easily recognised; the two plug-in coils fitted close together in holders are the grid and anode coils of the oscillator, and the three boxes contain the tuned anode coils of the H.F. amplifier. A coil mounted horizontally can be seen between the first detector and first H.F. valve; this is the coil of the "sharply tuned" circuit or filter, which is connected in the anode of the first detector. A tubular condenser of the wire-wound type is mounted above it, and is adjusted to tune the circuit to exactly the right wavelength.

The list of components, below, gives the values of the parts which may be purchased. One can also purchase the anode coils if desired, or they can easily be wound at home. These coils are fitted inside metal boxes, which

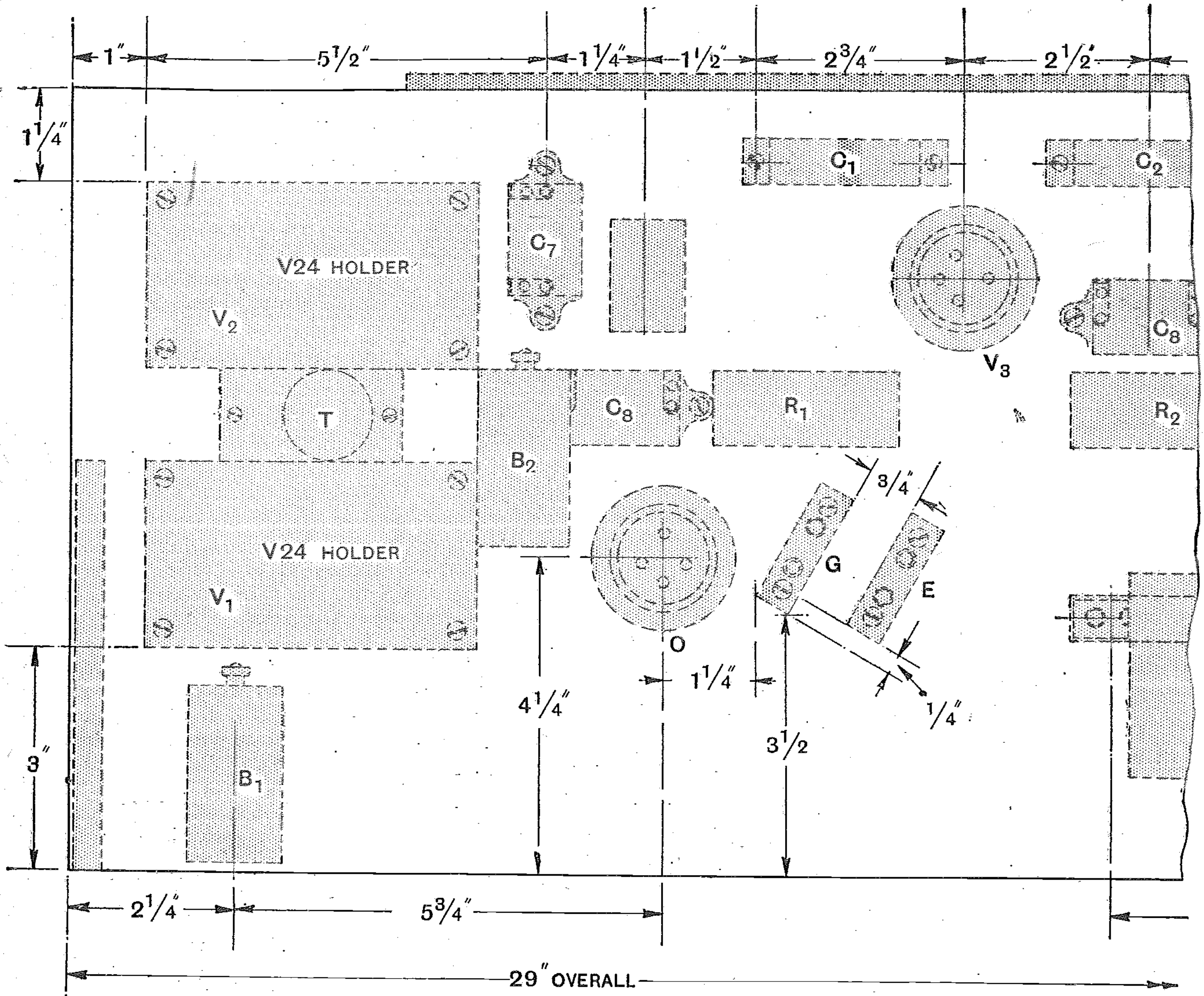


Fig. 2.—Layout of the parts on the base. V_1 = holder for first valve, D.E.V.; V_2 = holder for first detector, D.E.Q.; O = holder for phone 250–550 metre transformer; C_1, C_2, C_3, C_4, C_5, C_6 = 1 mfd. condensers; R_1, R_2, R_3, R_4 = 1 megohm Marconiphone grid mfd. fixed condenser; G, E = plugs for oscillator coils;

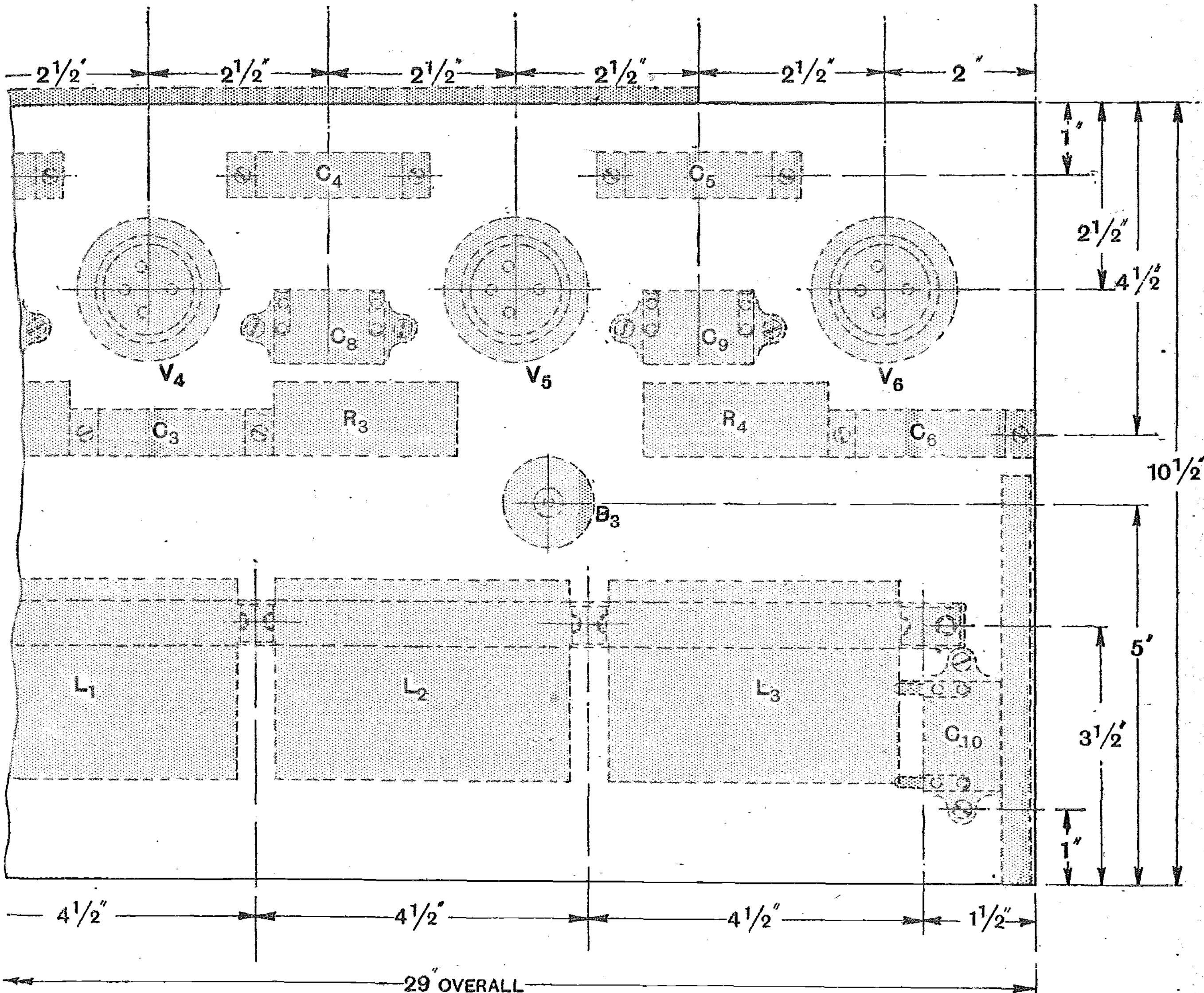
Superheterodyne Receiver.

act as shields or screens, and besides preventing coupling between the anode coils, also prevent the amplifier picking up and magnifying long-wave morse signals. When the shields are not used, troublesome interference is experienced, and it is difficult to stop the amplifier oscillating.

The screening boxes may be of brass or tinned iron, and do not have a very great effect on the constants of

tubular condensers (supplied by Marconiphone Co.), the advantage of this type of condenser being that the capacity is easily varied by altering the number of turns of wire in the condenser.

The reader can construct suitable coils of No. 36 D.S.C. by winding the wire on a former having a groove about ⅜in. wide, 1in. deep, and having an inside diameter of 2in. If the reader prefers to use manufactured



oscillator valve; V_3, V_4, V_5 = holders for H.F. valves; V_6 = holder for second detector; B_1 = B_2 = B_3 = single dry cells; T = Marconi-leaks and holders; C_7 = 0·001 mfd. fixed condenser; C_8 = 0·005 mfd. fixed condenser; C_9 = ·001 mfd. fixed condenser; C_{10} = 0·005 L_1 = L_2 = L_3 = tuned anode coils in boxes.

the anode coils, as they are much larger than the coils, which are packed tight with cotton wool. As a matter of fact, the writer used tobacco boxes (Player's four-ounce tins), which were so satisfactory that it was not thought worth while to make special boxes. These tins are 4in. diameter and 2¾in. deep, and will accommodate No. 400 Burndept coils. Actually, slab coils of 1,000 turns, having an inductance of approximately 67,000 microhenries are employed. These are all tuned to the same wavelength (about 7,000 metres) by 0.0002 wire-wound

coils, No. 750 Burndept or Igranic will be found suitable. The exact wavelength of the H.F. amplifier does not matter, provided it is in the neighbourhood of 7,000 metres, and each anode circuit is tuned alike. If the wavelength is too low, difficulty will be experienced in preventing oscillations when D.E.5B valves are used; on the other hand, the wavelength may be increased if necessary to secure stability, but the disadvantages of too long a wavelength, as explained in earlier issues of *The Wireless World*, should be borne in mind. Chief among

Superheterodyne Receiver.

these is the question of interference; from the point of view of good selectivity and when the set is mainly for telephony, it is better to employ as short a wavelength as is consistent with stability.

The size of the screening boxes to be used depends, of course, on the type of coil the reader prefers. It is only necessary to make the boxes sufficiently large to take the coils and tuning condensers comfortably. All joints should be soldered, except the lid, which must be a good fit.

As mentioned above, a "filter" circuit is connected to the anode of the first detector. This consists of a No. 400 Burndept plug-in coil with the plug removed, shunted by two fixed condensers. One of the fixed condensers has a capacity of 0.001 mfd., and the other is of the tubular type, having a capacity of 0.0002 mfd. This coil is held in position by two pieces of ebonite which are screwed to a small block of wood fastened to the base, as indicated in Fig. 1. The tubular condenser is screwed to the top piece of ebonite, and its value adjusted when setting up the amplifier.

Readers will find it an easy matter to assemble the parts on the base as indicated in Fig. 2. The components are lettered, and their values indicated below the figure.

Wiring.

The wiring diagram was printed on a separate sheet and inserted in all copies of the last number of *The Wireless World*. It is an easy matter to wire the set, as most of the wires are short and direct. Those wires which connect the coils of the oscillator, the tuning condenser and the vario-coupler should be carefully put in, as if these coils are wrongly connected the oscillator will not generate. Certain wires are run in insulating sleeving; there is the wire which runs from the +L.T. terminal to the filament resistance, and the pair of wires from the three anode coils.

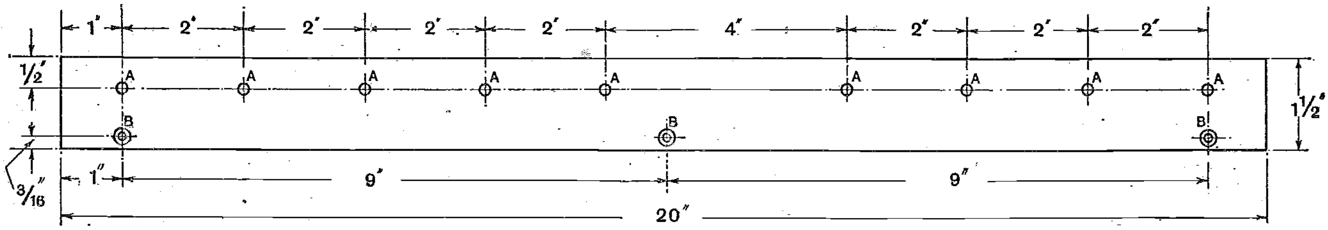


Fig. 3.—Details of terminal strip: A = drill $\frac{5}{32}$ in. dia.; B = drill $\frac{1}{8}$ in. dia.

Setting up the Amplifier.

The most difficult part of the work of making a receiver of this type is the tuning of the anode circuits. It is necessary to tune the three anode circuits and the "filter" to approximately similar wavelengths. To do this an oscillator or a buzzer-excited circuit must be employed.

If a buzzer circuit is used, set it to the wavelength of, say, 7,000 metres, and couple it to the coil of the filter by one turn of wire, leaving the buzzer circuit some distance away from the set. Then, with the valves of the set switched on, set the filter to 7,000 metres. This is most easily done by connecting a valve voltmeter across the filter circuit, and making adjustments to the tubular condenser. When a valve voltmeter is not available, a high-resistance crystal detector, such as a perikon or carborundum, may be connected in series with a pair of high-resistance telephones, and these connected across the filter. The detector-telephone circuit does, of course, alter the tuning of the filter, but not to a very great extent.

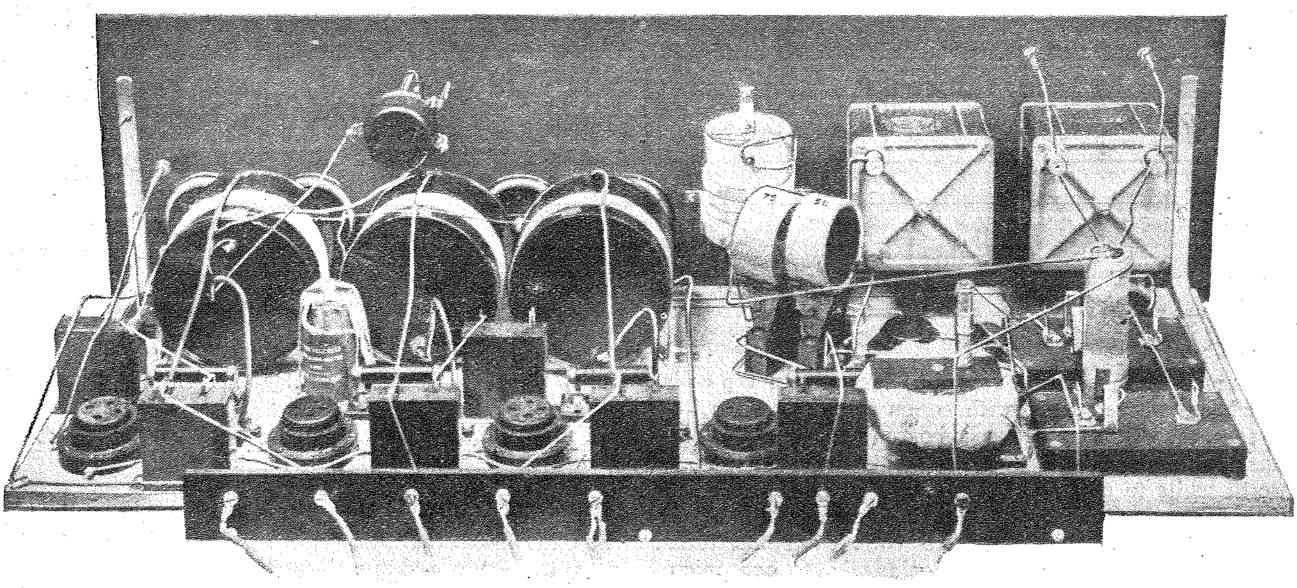


Fig. 4.—View of back of set. On the right can be seen the two tuning condensers, the H.F. transformer, the two plug-in coils of the oscillator and the "filter" circuit. The three circular boxes contain the tuned anode coils.

COMPONENTS REQUIRED.

1 Ebonite panel, 30 in. × 8 in. × $\frac{5}{16}$ in.
1 Ebonite strip, 20 in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.
1 Base of hard wood, 29 in. × $10\frac{1}{2}$ in. × $\frac{1}{2}$ in.
2 Brass brackets.
2 (CFC$_0$) variable condensers, 0·0005 mfd. (Burndept).
2 Apex mechanical dials (Unique Wireless Co.).
2 (R_5R_7) filament resistances, 7 ohms (Burndept).
2 (R_6R_8) filament resistances, 15 ohms (Burndept).
1 Potentiometer, 200-300 ohms (Burndept).
1 (R_9) High resistance potentiometer, 30,000 ohms (Igranic).
5 Anti-phonic valve holders (Burndept).
1 (T) H.F. transformer, 250-550 metres (Marconiphone Co.).
4 (C) Fixed condensers, tubular type, 0·0002 mfd. (Marconiphone Co.)
4 (C_8,C_{10}) Fixed condensers, 0·005 mfd. (Dubilier).
1 (C_9) Fixed condenser, 0·001 mfd. (Dubilier).
4 ($R_1R_2R_3R_4$) grid leaks, 1 megohm (Marconiphone Co.)
6 ($C_1C_2C_3C_4C_5C_6$) fixed condensers, 1 mfd. (Burndept).
3 Single dry cells.
1 Frame aerial (Burndept).
3 Anode coils, see text.
1 Vario-coupler, see text.
Terminals, screws, etc.
Containing Cabinet (Picketts).

When the filter has been set to, say, 7,000 metres, put the valve voltmeter or crystal-telephone combination across the anode circuit of the first H.F. stage, and adjust the tubular condenser, which is contained in the screening box with the coil, so that, with the lid of the box on, the biggest deflection or loudest note is secured.

Carefully adjust each stage in this way. It will be found necessary to reduce the coupling of the buzzer circuit with the amplifier to a very small value when adjusting the second and third stages.

Those who are able will find a valve oscillator set to the wavelength of great assistance. The circuits may then be set up by using a valve voltmeter as described above, or a crystal detector and milliammeter may be employed.

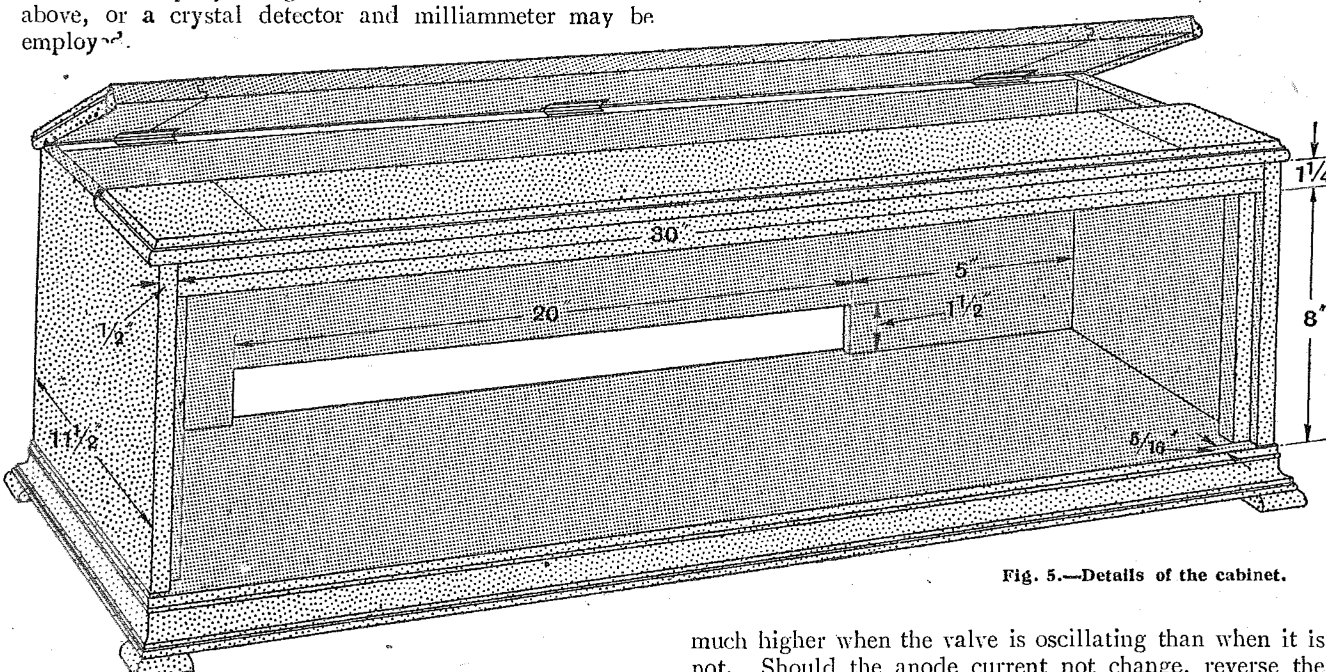


Fig. 5.—Details of the cabinet.

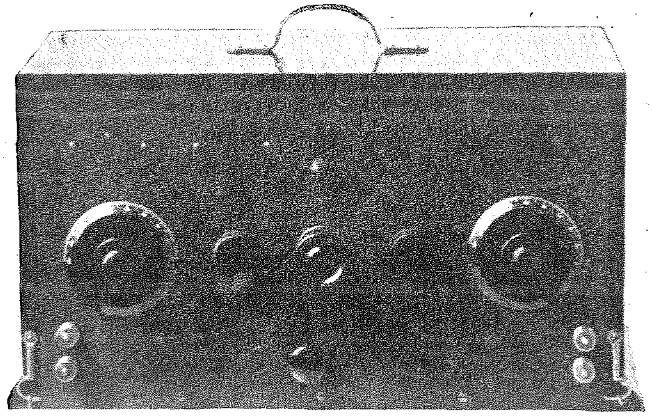
When bought coils are used in the anode circuit of the three H.F. valves it will not be necessary to make elaborate adjustments, as the coils and their tuning condensers should have values sufficiently alike to give approximately similar wavelengths. It is then only necessary to adjust the filter to the wavelength of the amplifier.

Operating the Set.

Connect the frame aerial to the terminals, and the L.T. and H.T. batteries. A common 6-volt L.T. accumulator is used, a dry cell H.T. battery is connected to the oscillator, and a separate H.T. battery to the remaining valves. With a D.E.V. in the first valve holder, a D.E.Q. for first detector, three D.E.5B. valves in the H.F. amplifier, a D.E.5 as second detector, and another D.E.5 as oscillator, the writer found the following anode voltages suitable: first valve, 36; first detector, 30; H.F. amplifier, 90; second detector, 30; and oscillator, 15.

Put a No. 75 coil in the anode circuit and a No. 50 in the grid circuit of the oscillator and test for oscillations. To do this, connect a milliammeter between positive H.T. and the positive terminal on the set and notice whether the anode current changes when the grid terminal is touched. In the receiver described the anode current is much higher when the valve is oscillating than when it is not. Should the anode current not change, reverse the connections to one of the coils. No. 75 and 50 coils are suitable for the reception of broadcast telephony.

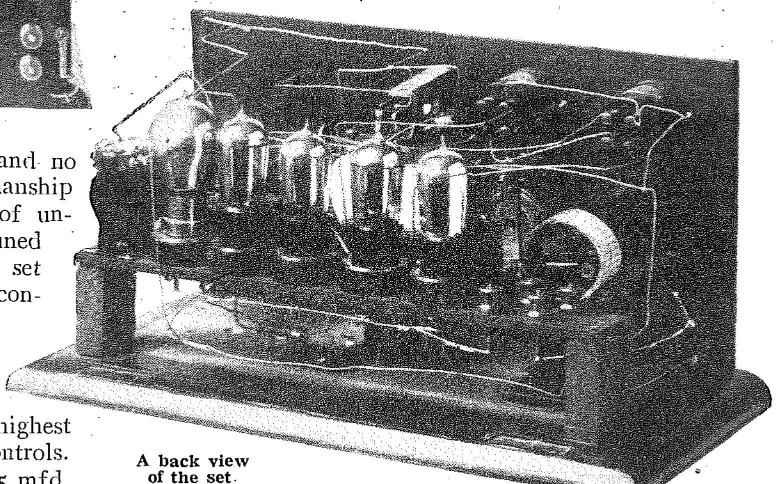
When tuning for the first time, set the frame aerial tuning condenser at any value and turn the condenser tuning the oscillator; when the circuits are correctly set a slight hiss will be heard. This hiss can always be heard when the two condensers are set at suitable values. When the adjustments are such that a station is heard, it is just as well to keep to that station and find the effect of adjusting the potentiometer, filament resistances, and anode voltages.



AN INTERESTING FIVE-VALVE RECEIVER.

A set with two untuned and one tuned stage of high-frequency amplification, valve detector, and one note magnifier, for long-distance telephone reception.

By JOHN R. WORTLEY TALBOT.



A back view of the set.

THIS receiver was built in a day or two, and no attempt was made to put precision workmanship into it. The set consists of two stages of untuned high-frequency amplification and one tuned stage, with valve detector, and, included in the set itself, switching for one note magnifier. The connections are given below.

It was built purely for the reception of American broadcast stations transmitting on wavelengths between 300 and 550 metres. Extreme selectivity was not desired, the aim being to secure the highest degree of H.F. amplification with the simplest controls.

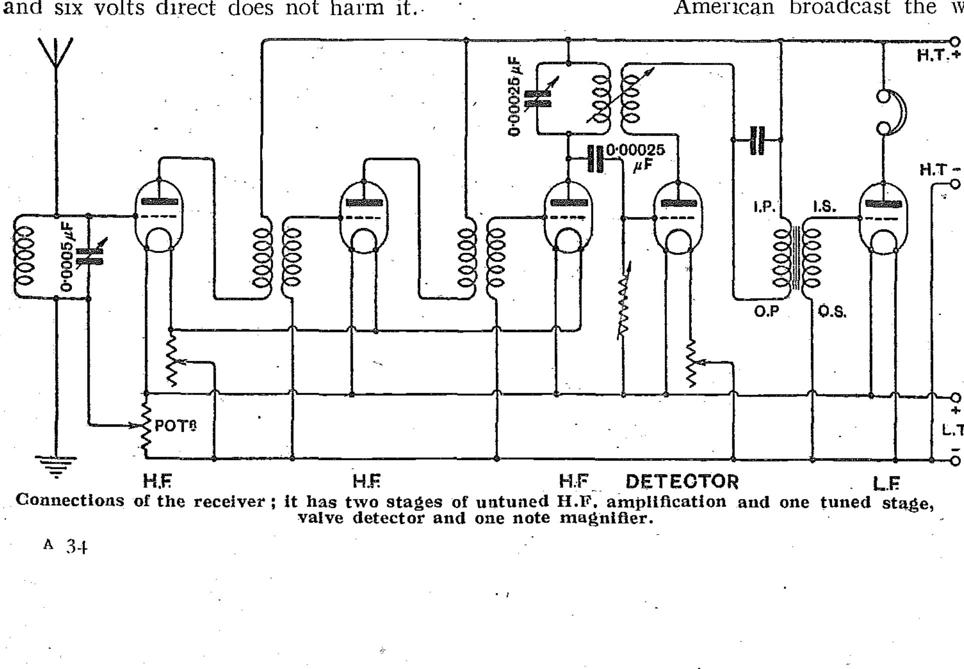
The aerial tuning inductance is tuned by a .0005 mfd. square law vernier condenser. Two radio-frequency transformers are employed. These are of American manufacture and are very efficient, but various types of British plug-in type H.F. transformers have been tried and found equally as good. These transformers are untuned to obviate the necessity for a third tuning condenser. Connected in the plate circuit of the third valve is a tuned anode coil with reaction coupling from the plate of the detector valve.

One filament rheostat is used for the first three valves, and has a resistance of 1·4 ohms. The detector has a separate 5-ohm rheostat, and no resistance is used with the note magnifier valve, as a B.T.H. B4 valve was used, and six volts direct does not harm it.

The single-valve note magnifier can be switched on or off, as occasionally one can hear a very distant American broadcast station, and this is just the occasion when the note magnifier is so useful to bring it up to comfortable telephone strength.

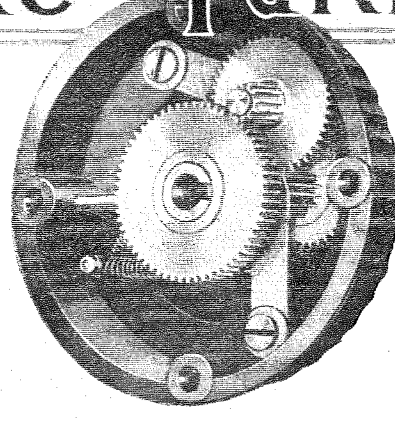
A No. 50 Igranic coil is used in the anode circuit, and in the reaction a No. 75. These are mounted in a Goswell vernier two-coil holder. A potentiometer is included in the set, but is not absolutely essential, as the set is easily controllable by the first filament rheostat and by adjusting the reaction coil.

The first night and morning the set was tried on American broadcast the writer heard WGY, WBZ, and KDKA (326 metres), WTAN and three other stations which could not be recognised. The strength of WGY, WBZ, and KDKA was exceptional, the two first-named coming through sufficiently loudly and clearly to hear every word spoken in the studios. The receiver is not used for the home stations, as it is not sufficiently selective, or intended to be so, although all the usual stations in Germany and France and Radio Iberica and Rome can be heard at good strength.



Connections of the receiver; it has two stages of untuned H.F. amplification and one tuned stage, valve detector and one note magnifier.

Fine Tuning



Obtaining Critical Adjustments by Electrical and Mechanical Fine Tuning Devices.

One of the most important factors in the design of a set is the provision of devices for fine tuning. These devices take many forms, ranging from elaborate mechanical arrangements to such simple things as a single plate tuning condenser, or a "Vernier" filament rheostat. Below a number of ingenious methods for obtaining critical control are described.

By N. P VINCER-MINTER.

WHEN considering the subject of obtaining fine adjustment of tuning, probably the first thing that comes into one's mind is the variable condenser and the ubiquitous single plate "vernier." It was for a long time standard practice among amateurs and home constructors to employ a variable condenser of fairly large capacity for tuning the various circuits of a receiver with a small two or three plate condenser connected in parallel with it. This, however, seems to have given place latterly to the instrument which has a separate single plate condenser built into it, the two portions of the condenser being operated by means of concentric shafts. Extremely fine adjustment of tuning is obtainable by both these methods, but, at the same time, they leave much to be desired. In order to realise this, let us consider the case of a two-valve set employing one stage of high frequency amplification, and a detector valve with reaction (Fig. 10). Assuming that tuning is accomplished by the usual method of plug-in coils and variable condensers, stations should always come in at definite settings of the two condenser dials, providing that the position of the reaction coil is not greatly varied; but it will require a very steady hand to set the two dials accurately, since tuning may be so sharp on distant stations that a variation of a fraction of a degree on the condenser scale will be sufficient to "lose" the station; some form of vernier will therefore be necessary.

If the usual method of employing a single plate vernier in parallel with the main condenser is adopted, it will be seen at once that it will be no longer possible to prepare a calibration chart indicating the various settings of the dials at which other stations can be heard, since the dial readings will vary as much as two or three degrees according to the setting of the vernier. It would of course, be possible to overcome this difficulty by employing separate verniers having scale readings of their own, but this would unnecessarily complicate matters and would be extremely bewildering to a novice. A far better method would be to abandon this method of adjustment in favour of a mechanical method.

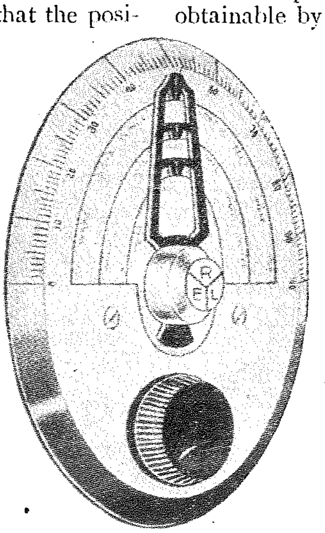


Fig. 1.—The Ultra-Vernier tuning control, a dial having an arrangement of gears which gives fine tuning. Stations may be marked on the dial.

If we arrange to have a high ratio of movement between the tuning knob and the condenser shaft by employing a train of gear wheels or some similar device, results will be much more satisfactory. It is important, however, to remember that the dial or the pointer of the indicator scale must be affixed to the shaft of the condenser and not to the knob, in order that definite readings in geometrical degrees may be found for tuning in various stations. Using this method, it will be found that the receiver may be definitely calibrated, and a chart prepared which may with confidence be placed in the hands of a novice, and the various stations can always be picked up at the same settings on the indicating scales.

Mechanical Verniers.

In addition to the advantage we have stressed, it should be pointed out that infinitely finer tuning will be obtainable by this method of mechanical control than by the single plate vernier method, since most of these devices have a very high ratio between the movement of the main shaft and the tuning knob. For instance, one particular vernier knob, illustrated above, has a ratio of no less than 80 to 1, which enables an infinitesimal movement to be imparted to the moving vanes of a variable condenser or to the rotor of a variometer.

This fine adjustment will be specially advantagous on a set employing the usual form of magnetic reaction, where a fine adjustment of the tuning elements is a necessity, and which the ordinary form of single plate vernier does not give.

It is singularly unfortunate that the construction of tuning instruments embodying this method of obtaining infinitely fine adjustment by mechanical means has been neglected by manufacturers and amateurs alike, but it is gratifying to note that at last the advantages of this method seem to have

Fine Tuning.—
been realised and is coming more and more into popular favour.

As yet there is not a great variety of these to be obtained, but it is to be hoped that this matter will be remedied during the current year, and we shall come more into line with other countries where these excellent devices are more commonly known. It will be found that the presence of the gear wheels in no way detracts from the electrical efficiency of the condenser. In fact, it may be said that in most cases where this arrangement is fitted to condensers the all-round efficiency is considerably increased, since it is customary to use a metal sheath over the gear wheels, this being in electrical connection with the shaft carrying the moving vanes. The circuit is then arranged so that the sheath, the gear wheels, and the moving vanes are all at earth potential, which has the effect of considerably reducing hand capacity effects.

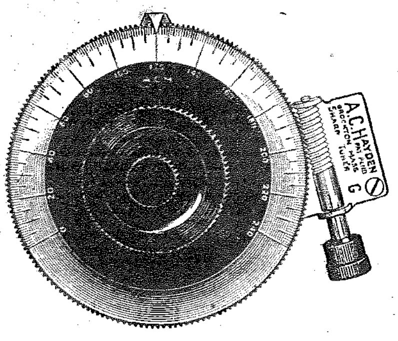


Fig. 2.—A dial having a worm gear giving a ratio of 215 to 1.

Any amateur possessing a reasonable degree of skill with engineering tools need not, of course, depend on the manufacturer to supply his needs in this respect. There are many ways of mounting gear wheels to give a vernier movement to the condenser plates, one of the more simple methods being to obtain a metal gear wheel about one-eight of an inch greater in diameter than the usual ebonite condenser dial, and to attach this to the underside of the ebonite dial by the simple process of putting two screws through the ebonite dial to the disc underneath. The dial can then be screwed on to the shaft in the usual manner. A small pinion wheel can then be attached to an ebonite knob and mounted very accurately and precisely on the ebonite panel, so that the pinion engages with the gear wheel on the underside of the main ebonite dial. The arrangement is sketched in Fig. 3. Care should be taken to electrically connect the gear wheel to the condenser shaft and to arrange that the moving vanes of the condenser are at earth potential. In this manner exceedingly fine adjustment can be made with the small knob, coarse adjustment being made with the main condenser knob.

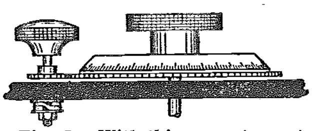


Fig. 3.—With this arrangement rough tuning is effected by turning the main knob, and a fine adjustment may be obtained by using the small knob

Frictional Devices.

Although this method will be found to be very satisfactory, it is possible to obtain far superior results by making use of a worm drive on to the main gear wheel instead of using the pinion. A long ebonite rod terminating in a knob can then be used to rotate the worm drive, as suggested in Fig. 7. This not only gives us the advantage of being able to impart a small movement to the condenser vanes by rotating the worm drive, but also enables the last trace of hand capacity effect to be eliminated owing to the fact of the long ebonite rod enabling the hand to be kept at a considerable distance from the instrument which is being operated.

There are, of course, other and simpler methods which may be, and in some cases are, employed to give a fine mechanical control over the moving portions of tuning instruments. These devices take various forms. One method is to employ a small rubber-tyred wheel mounted in such a manner that it is in frictional contact with the edge of the ebonite tuning dial. Whilst, of course, it does not give such a positive control as when using gearing, it is capable of giving very fine adjustment.

Another interesting device which is often used is what is known as the "friction pencil." This consists of a long ebonite rod terminating at one end in a metal spindle with a rubber collar fitted just above it. A small hole is drilled in the panel at the edge of the condenser dial, and the metal spindle is inserted into this. The pencil is then rotated about its axis, the rubber collar moving the dial by frictional contact with its edge. Two advantages possessed by this method are that it enables the hand to be kept well away from the panel when effecting a final adjustment, and it reduces the complication of vernier knobs on the set, as the pencil is, of course, removed altogether when tuning is completed.

Variometers.

Turning to the question of obtaining fine tuning adjustment when using variometers, it is, of course, possible to utilise all the methods of mechanical control which we have been discussing in connection with variable condensers, but in the case of these instruments the necessity for some form of mechanical control is even more apparent, since the instruments do not lend themselves so readily to the obtaining of fine tuning by electrical methods as is the case of a variable condenser employing a single plate vernier in parallel with it. True, it is possible to obtain variometers having a second rotor which consists of a rotor containing only a few turns of wire mounted inside the main rotor and driven by a shaft mounted concentrically with the shaft of the main rotor, but it cannot be said that these instruments are altogether satisfactory, and in any case they are not easy to obtain. It seems, however, to be very little realised that fine tuning can be obtained in a variometer-tuned set by using a small variometer containing but a few turns connected in series with the main one. The use of these, unfortunately, renders the set cumberous and unduly increases the number of knobs. It suffers from the same disadvantage that is apparent when using a vernier condenser in parallel with the main condenser, namely, that it makes tuning a very complicated operation for the novice, and does not lend itself readily to the compiling of a simple

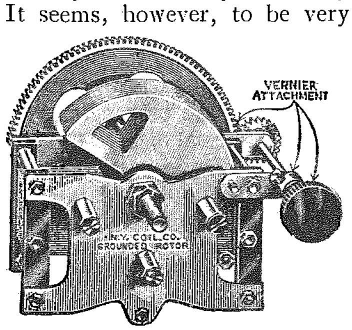


Fig. 4.—A tuning condenser with gears built in. By turning the vernier knob a minute adjustment can be made.

Fine Tuning.—
tuning chart; it will be far better to make use of some mechanical method whereby a small positive movement can be given to the rotor of the main variometer. These remarks apply equally to the vario-coupler.

Turning to the question of coil holders, it is possible that these components are one of the weakest links in the set from the point of view of fine adjustment. It is a most astonishing thing that while manufacturers and amateurs alike realise the necessity of some form of dial or indicating scale on variable condensers and such-like components, the impression seems to have gained ground that with coil holders this is a point not worthy of serious consideration. Any amateur confronted by a set where no provision had been made for indicating the setting of a variable condenser or variometer would at once proceed to remedy this omission, and yet if we reflect for a moment it will be abundantly clear that some form of scale indicating the relative positions of the tuning coils is equally necessary. If we consider the case of an ordinary two-valve set for a moment this point will be self-evident. Assuming the case of a conventional two-valve set employing one stage of tuned anode high-frequency amplification with magnetic reaction to the aerial, Fig. 10, it is quite clear that if a certain station comes

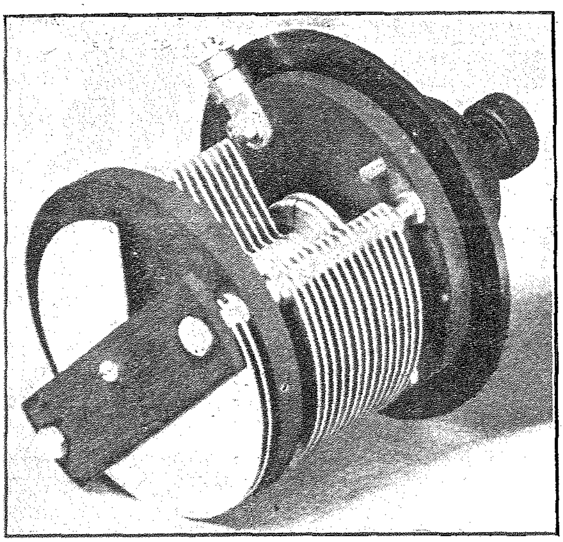


Fig. 5.—A Dubilier tuning condenser with a single plate Vernier.

in at its best when the aerial and anode condensers are at certain settings with the aerial and reaction coils wide apart, it will not come in on the same dial settings when the aerial and reaction coils are in close proximity; and yet, in nine cases out of ten, there is no method of determining accurately and noting the position of the reaction coil with respect to the aerial coil. A similar state of affairs exists in sets making use of the two-coil holder for obtaining loose coupling. However, although the provision of the scale is, as we have pointed out, an urgent necessity, it will not in itself enable us to obtain fine tuning, and it is necessary to provide some means of obtaining a delicate adjustment of the relative positions of the coils mounted in the holder.

There are one or two excellently made coil holders to

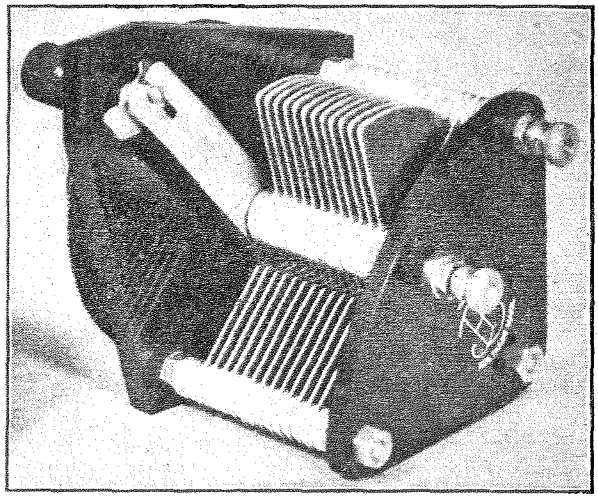


Fig. 6.—The J.B. variable condenser with mechanical Vernier.

be obtained, making use of various devices, such as gearing, frictional devices, etc. They are excellent as far as they go, but unfortunately they do not go far enough, and in any case they are greatly outnumbered by the "hit and miss" type of coil holder. It will be usually found that none of the "vernier" coil holders have any means of determining definitely the relationship existing between coils, and in the case of most of them the ratio existing between the movement of the adjusting knob and the movement of the coil is far too small. Here again some form of worm drive operated by a long extension rod is called for. With most of the coil holders even of the geared type it is necessary to place the hand close to the coils to operate them.

Another point requiring attention is the method of mounting the coils in the socket. In most cases the fitting is extremely "wobbly," which form of backlash, of course, renders any attempt at calibration or fine tuning

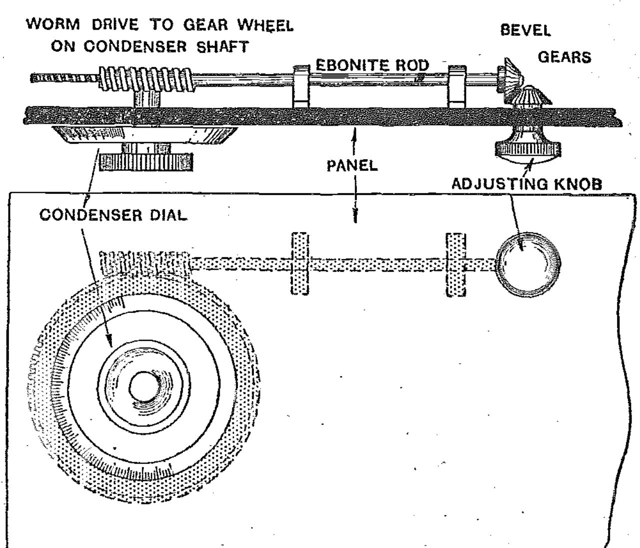


Fig. 7.—A very fine adjustment can be obtained with an arrangement of this sort. The shaft of the condenser or variometer is operated through reduction gearing.

Fine Tuning.—

abortive. In many cases, of course, this is the fault of the coil, which is not attached firmly to its mounting.

Obtaining Critical Reaction.

Whilst on the subject of coil holders, it will not be out of place to say a few words concerning methods of obtaining fine adjustment of reaction. It will not be untrue to say that in the majority of cases reaction is brought about by magnetic coupling between the aerial tuning coil and a coil connected in the anode circuit of the detector valve, which, again, in the majority of cases is effected by the use of a two-coil holder.

A rule should be made to use the smallest reaction coil with which it is possible to bring the set to the point of oscillation. If this rule is observed, it will be found

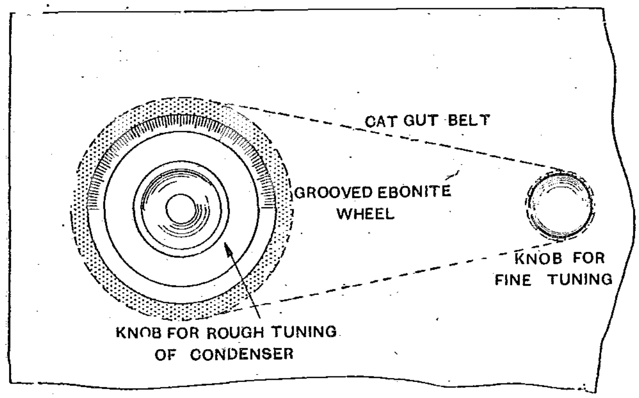


Fig. 8.—A simple device for fine tuning.

that a far smoother control of reaction is obtainable than is usually the case, the set gliding almost imperceptibly into oscillation and coming out of oscillation at the same position of the reaction coil at which oscillations commenced. In cases where an unnecessarily large reaction coil is used, it will be found that a considerable amount of electrical backlash is evident, which indicates its presence by the set going into oscillation with a "plop," and continuing to oscillate when the reaction coil is moved back far beyond the point at which oscillations commenced.

There are, of course, various electrical means which can

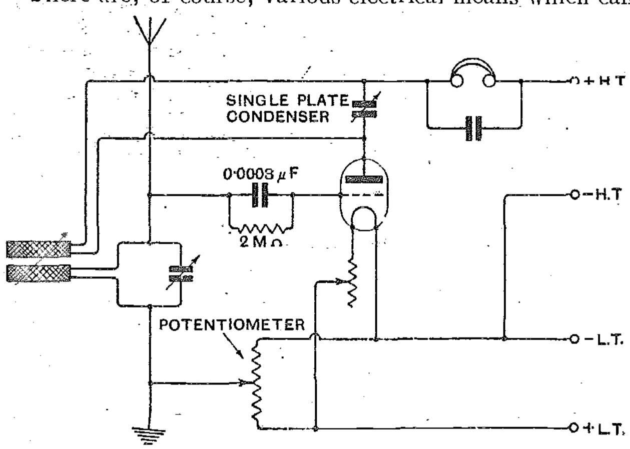


Fig. 9.—In this single valve receiver a close adjustment may be made by the potentiometer and single plate condenser.

be adopted to secure fine reaction control, apart from adjustment of filament temperature, grid leak value, etc., and it will be advisable to consider methods of doing this. A method which is in very little use among amateurs, but which is productive of very fine adjustment, is to connect a small three plate variable condenser across the reaction coil (Fig. 9). It is, however, necessary to sound a note of warning here. This condenser must not be of such a size that there is any possibility of bringing the oscillatory circuit formed by this condenser and the reaction coil into resonance with the tuned circuits of the receiver, since this is not the purpose of the condenser. The purpose of this condenser is to shunt some of the H.F. energy surging through the reaction coil and so enable a fine adjustment to be had over the energy transference between the reaction coil and the aerial coil. It will be found in practice to be very useful indeed in providing that final critical adjustment which makes all the difference between success and failure in bringing in an elusive distant station.

Three Coil Tuning.

Another method of obtaining a fine adjustment of reaction on those sets employing the conventional three plug-in coils for aerial, anode, and reaction is to mount all three coils on a three-coil holder instead of mounting the anode coil separately as is usually done. The aerial coil should be placed in the centre (Fig. 10), and the ordinary reaction coil be connected to provide reaction in the usual manner.

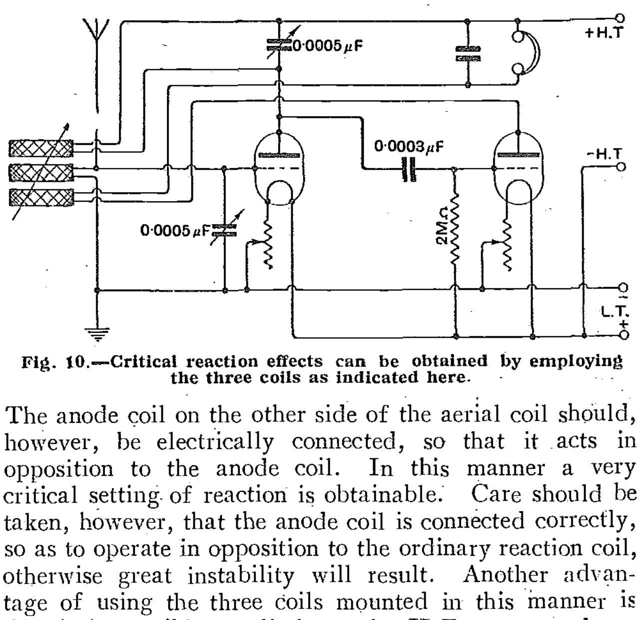
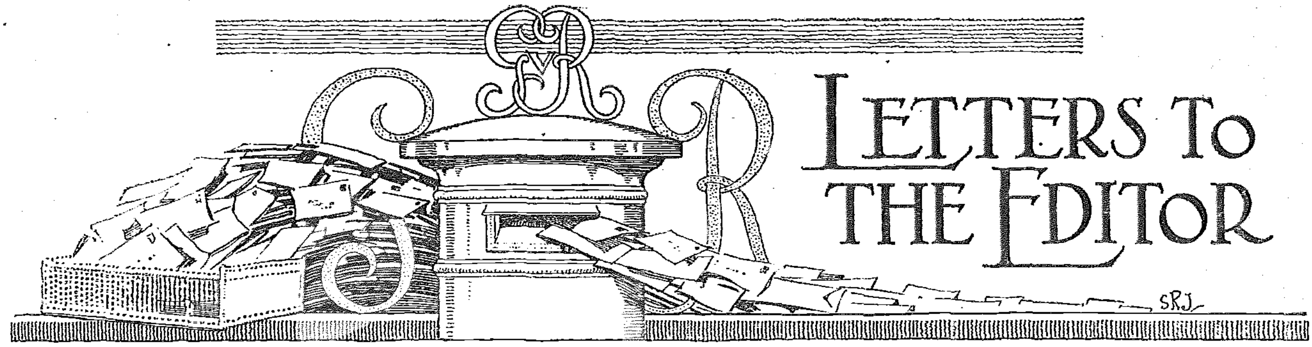


Fig. 10.—Critical reaction effects can be obtained by employing the three coils as indicated here.

The anode coil on the other side of the aerial coil should, however, be electrically connected, so that it acts in opposition to the anode coil. In this manner a very critical setting of reaction is obtainable. Care should be taken, however, that the anode coil is connected correctly, so as to operate in opposition to the ordinary reaction coil, otherwise great instability will result. Another advantage of using the three coils mounted in this manner is that it is possible to eliminate the H.F. stage and use the detector with reaction only by merely turning out the filament of the H.F. valve. If this is done, it will be found that on turning out the H.F. valve the anode coil automatically becomes the secondary coil of a loose-coupling arrangement. This is obvious, since, in a set employing the conventional tuned anode method of coupling between H.F. and detector valves, it is evident that the anode coil of the H.F. valve is also the grid coil of the detector valve. This method of obtaining a fine control over reaction is not as well known as it should be.



LETTERS TO THE EDITOR

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

"WIRELESS WORLD" SHORT WAVE RECEIVER.

Sir,—You may be interested to hear that I have made up a short wave tuner on the lines indicated in the article by Mr. James in *The Wireless World* of February 11th, and find that on an indoor aerial which consists of four wires about twelve feet long connected in parallel two feet apart and eighteen inches below the ceiling of a first floor room, KDKA comes in remarkably well. There seems to be little (if any) advantage in using an earth connection.

The valves used are D.E.Q. and D.E.V., with 30 and 50 volts high tension. They are mounted on the panel for convenience of access to enable them to be readily transferred to other receivers, and the battery terminals have also been mounted on the panel as being more satisfactory in the position in which the receiver is used. I am using a Watmel variable leak and have found it advantageous to fit extension handles to both the dial and vernier of the Sterling condenser.

The transformer is a Lissen T.1, and the anode circuit of the low frequency valve has been modified by introducing a filter circuit to prevent direct current passing through the 'phones. The choke is a discarded 'phone transformer with the windings connected in series.

The knobs controlling the coil holder are 2½ in. in diameter in order to facilitate fine adjustment. The potentiometer fitted is unsatisfactory, and will be replaced by a more reliable component.

As many of your readers will doubtless be making this receiver it might be convenient if you could publish at an early date some sort of time table of transmissions coming within the range of the instrument.

I have succeeded in getting KDKA (very faintly) with no aerial other than a piece of 16 d.c.c. wire 18 in. long, standing vertically from the aerial terminal and without any earth connection.

The above results are with long leads to a large accumulator. Doubtless better results would be obtained with a small accumulator close to the set and with both batteries insulated. Possibly also an improvement would be effected by using rather more H.T. on the second valve.

The transmissions from KDKA to which I refer are those on about 68 metres. LEWIS H. T. CHAVE.

East Putney, S.W.15.
February 22nd, 1925.

RECEPTION OF BANDOENG.

Sir,—Last evening, February 27th, from 10.35 p.m. to 11 p.m., I picked up a CQ call from ANE on wavelength about 75 metres. He gave situation of station as follows :—

Laboratory, Government Radioservice at Bandoeng, Java, Dutch East India, and asked for information about reception, signal strength, etc., and stated his plate power was 250 to 290 watts, antenna current 2 amps. He afterwards called the following stations :—PKH, PKX, PCG, and LBT. This reception was on 2 valves (0-v-1) and indoor aerial, which consisted of 5 yards of flex, which I had just temporarily slung across the room a few moments previous to picking up ANE, as QRM and QRN was very bad on the outside aerial.

Falmouth, J. RODGERS (6JO).
February 28th, 1925.

TWO-WAY WORKING WITH JAPAN.

Sir,—With reference to your paragraph in *The Wireless World* of February 18th, regarding G5MO having been heard in Japan by JKWZ on January 20th, 1925, I beg to inform you that at 22.35 G.M.T. on the same date I worked JKWZ for about fifteen minutes.

My input at the time was 18 watts (600 volts 30 m/a on the plate), and the circuit used was a loose-coupled reversed feed-back.

As the distance covered is about 8,000 miles I should imagine this constitutes something of a record for low-power DX work.

L. A. K. HALCOMB, Capt. (G5DN).

Sheffield,
February 18th, 1925.

RECEPTION OF A BERMUDA STATION.

Sir,—In writing to inform you of my reception of a Bermuda amateur transmitter, BER, I shall be very surprised if I am the first to do so, owing to the remarkable strength at which I received this station. I should think that BER must have been heard extensively, but that his location was unknown over here. I have seen no reference to him in the lists of calls heard or in the notes. On December 15th, 1924, at 06.30 G.M.T., BER was heard calling CQ on about 80 metres. His call was answered by U1CK, U410, and V8ADA, but I did not hear him working any of them.

On December 27th, 1924, at 06.10 G.M.T. I received the call "CQ ENG de BER" on about 80 metres and at strength R5—6 on a 0-v-1 receiver. Later I heard U1ALL calling BER, and sent him a card asking for the situation of BER. I have just received a card from U1ALL confirming my reception of his signals, and he states that BER is at Hamilton, Bermuda. The strength of these signals was remarkable, being equal to that of the strongest U.S.A. amateurs. Hoping this will be of interest. MARCUS F. J. SAMUEL (5HS).

London, N.W.8,
February 25th, 1925.

LOW POWER AMERICAN TESTS.

Sir,—I have received a communication from U.S.A. in reference to some low power (10 watt) tests to be carried out by 9BNK, 9CRT and 9BC of Minneapolis. These stations will call CQ GB at 12 midnight Central Standard Time, on March 15th and April 15th, on or around 80 metres, and reports of reception by English amateurs would be greatly appreciated. Such reports may be sent either direct to Mr. O. C. Besser, 3019, Pillsbury Avenue, Minneapolis, or to myself. 9BC has already been received here when using only 10 watts. H. STOPHER.

Cricklewood, N.W.2. (5GF).
February 23rd, 1925.

TESTS ON SHORT WAVELENGTHS.

Sir,—I should be very glad if you could ask that some station would work with me from 20 to 60 metres. I am able to make two turns of wire on a three inch former oscillate and imagine that I am in the region of 6-10 metres. I use a small thick vertical aerial. My call sign is now 2GN, and I have worked French 8DA on 45 metres. My wave metre goes down to 50 metres, but I calculate where I am by harmonics.

I frequently hear stations testing on 20-40 metres, but unfortunately, they do not listen-in, or make any call signs. They simply transmit "test," "test," and "V's," and sometimes speak a few words If I am testing on very short waves I simply make my call letters, so that anyone hearing me may know who I am. Perhaps your good journal can help in this matter.

Sheffield. LAURENCE MANNING.

"LICENCE" OR "FEE."

Sir,—I observed with regret the note in your issue of January 28th to the effect that in Bournemouth licences have been taken out at a rate of 120 per thousand of the population, whereas in Sheffield they have been taken out at the rate of only 22 per thousand.

I am a native of Sheffield, and I cannot think that this is due to any lack of taste for music in Sheffield, nor that it is due to the fact that Sheffield is a relay station. Moreover, it is well known in Sheffield that a great many people who own receiving sets have not taken out licences. Apart from the fact that this is dishonest, it means a loss of revenue to the B.B.C.

I think that a great deal of trouble is due to the fact that the "licence" is called a licence at all. Everyone objects to paying a licence for anything, and it seems that this feeling is extended to the wireless licence. Here, however, the case is different. Here one does not pay for a privilege, as one does in the case of a dog or motor cycle licence, but one actually pays for music and entertainment received, just as one would for any other form of entertainment.

Perhaps if it were called the "B.B.C.'s fee," those people who so meanly take advantage of the fact that their non-payment cannot be readily detected might pay their due. Be the fee a licence or not, I cannot understand how anyone can be so miserly as to try and get out of paying 10s. only for those who provide them with entertainment nightly for a year—a sum which would provide only two nights' enjoyment of many other forms of entertainment.

DOUGLAS C. BIRKINSHAW.

Corpus Christi College, Cambridge.

WJZ ON SHORT WAVES.

Sir,—I should be interested to know if any readers have reported reception of WJZ on its low wavelength, which I think has only just been started. I have picked it up, so far as I can judge, on 35-40 metres. At least they are about 20° lower on my tuning condenser (.00025 mfd. sterling square law) than KDKA's *short wave* transmission.

I might add that KDKA on 63 metres is received here regularly on two valves (0-v-1), generally R4, and most nights all over the room on loud-speaker, using three valves (0-v-2).

The circuit used is one described in your paper some months back. I have never found a circuit giving such delightful control of reaction, and it makes reception a real joy.

J. C. LOWE (2APY).

Hendon, N.W.

STATION WKAQ.

Sir,—The Department of Commerce has assigned us a wavelength of 340.7 metres, corresponding to 880 kilo-cycles.

We hope that you will give the necessary publicity to this change in our wavelength for the benefit of your readers and our listeners in your locality.

WKAQ has been heard in Czecho-Slovakia and all the Western part of Europe, while we were using the 360 metres wavelength.

We are broadcasting regular concerts every Tuesday from 9 to 10.30 p.m., from our studio; Wednesday from 8 to 10 p.m., from the Plaza Baldorioty de Castro; and Thursday from 8.30 to 10 p.m., from the restaurant, "La Cafetera." The time specified is Porto Rico time, one hour earlier than E.S.T.

Our slogan is "Porto Rico, the Island of Enchantment, where the world's best coffee grows." All the announcing is made in both languages, English and Spanish. J. AGUSTY,

Manager, Radio Corporation of Porto Rico and Announcer of WKAQ.

San Juan, P.R.
February 6th, 1925.

KENYA COLONY RECORD RECEPTION?

Sir,—I am afraid your correspondent, Mr. Abdul Rashid, in your issue of February 18th, makes claims which cannot be substantiated, when he says he "was the first person to succeed in this Colony (Kenya Colony), in the reception of long-distance messages."

What he has just succeeded in doing now was done at least six years ago, to my certain knowledge. ABERDEEN.

Essex.
February 26th, 1925.

AMERICAN AMATEURS AND WATTS.

Sir,—There are two points in connection with Mr. J. Gordon Ritchie's letter in the issue of *The Wireless World* for February 18th which should be brought to the notice of your readers. When an American amateur states that he is using 5 watts he means that he is using a "5 watt tube." The actual power input to the anode is generally about 50 watts. Similarly, the actual input to a "50 watt tube" may be as much as 500 watts. This is the American method of rating valve transmitters.

With regard to 4CH's "radiation" of 0.2 amps, let it be said once more that radiation can be measured only in watts—not amps. The important point, however, is that the value of the aerial current as shown by the ammeter is of no interest. The current is not the same at all points in the aerial; it is at a maximum at the "nodal point" or, more correctly, at the current antinode. Now, when an aerial is operating on a low wavelength the ammeter is considerably removed from the point of maximum current, resulting in a low and deceptive reading, although the actual radiation may be very high.

I would add that I have received a card from U4CH with the same statement. One of the strongest Americans I have heard has an aerial current of 0.08 amps according to the meter. S. K. LEWER (6LJ).

W. Hampstead, London.

DON'TS FOR TRANSMITTERS.

Sir,—I read with interest your correspondent's letter on "Don't" for transmitters in the February 18th issue of *The Wireless World*.

Although I heartily agree with everything in his letter, I feel that it is rather inclined to mislead a lot of genuine transmitters.

There are still a lot of listeners who longingly look forward to Sunday mornings and evenings, when they can listen to amateur telephony, and, in fact, prefer it to broadcasting, as quite a number of the transmissions are decidedly of better quality than some of the B.B.C., who, I am afraid, have yet a lot to learn about the efficient transmission of speech and music.

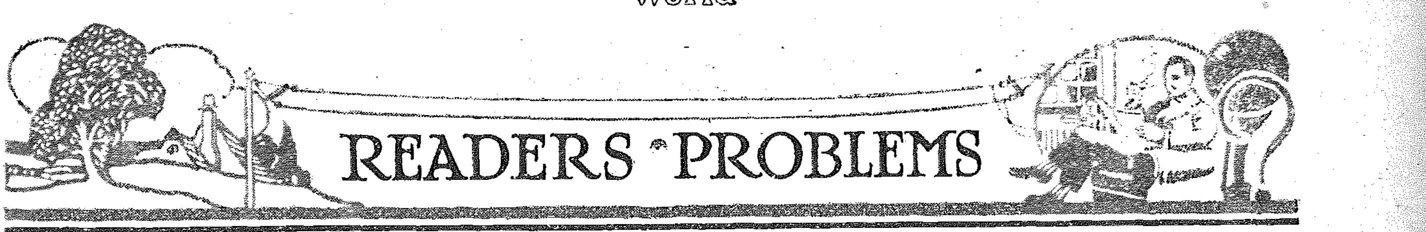
Amateurs, don't be downhearted; carry on with earnest your telephony experiments, with some real good stuff, and plenty of it, as we used to do before the B.B.C. came into existence.

There are hundreds of us waiting to hear those old familiar call signs again.

Hoping this will meet the eyes of all those who have gone off the ether, and encourage them to once again keep the ball rolling and uplift the amateur position in general.

A RADIO ENGINEER SINCE 1912.

Weybridge, Surrey.



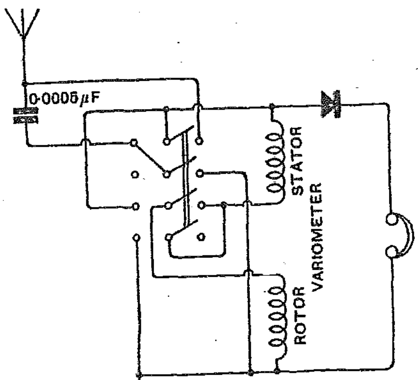
READERS' PROBLEMS

Readers Desiring to Consult the "Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Reception of Long Wave Stations without the use of Loading Coils.

A CORRESPONDENT wishes to know if it is possible to design a crystal receiver which is capable of tuning to the London and Chelmsford wavelengths, and also to the wavelength on which the spark time signals are emitted from the Eiffel Tower, by using a variometer with no additional loading coil.

It is possible to effect all these combinations by using a four-pole double-throw switch in conjunction with a suitable variometer and a .0005 μF fixed condenser, provided that the variometer is of suitable size. It is therefore important that this instrument be carefully chosen. The circuit which we give will be found to easily cover the wavelengths of all these stations without any additional loading coils, and as only one switch is used, it is possible to construct a very neat and attractive-looking receiver. It will be seen that by placing the switch to the left, the stator and rotor windings are placed in parallel with each other with the .0005 μF condenser in series.



By means of a four-pole switch, a variometer can be made to provide a wide tuning range. The two windings are alternatively series or parallel connected and combined with a tuning condenser of fixed capacity.

This arrangement will cover the wavelengths of the B.B.C. stations. Upon placing the switch to the right, the variometer windings are placed in series with each other and the fixed condenser in parallel across the whole. This will enable the wavelengths of Chelmsford, Radio-Paris, and the Eiffel Tower to be comfortably covered on an average aerial.

Methods of Increasing Valve Sensitivity.

A READER has been informed that it is possible to obtain increased signal strength from a valve detector when it is placed in a strong magnetic field, and asks us for further information on this subject.

The influencing of the sensitivity of a valve detector by means of a magnetic field produced by some external source of power is a peculiarity of the "soft" or gas-filled valve. It was at one time greatly in vogue among American experimenters, the usual arrangement being to construct a solenoid by winding turns on a cardboard former, and attaching the windings to some source of supply. This cylinder was then placed over the valve and adjustments made by varying the position, and also by varying the direction and intensity of the current through the solenoid. This practice has, however, fallen into disuse with the coming of the highly exhausted modern valve, with which it is inoperative.

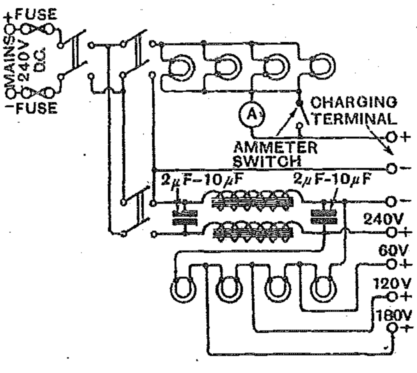
o o o o

Connections of a Charging and H.T. Supply Switchboard.

A READER wishes to construct a switchboard from which he will be able to charge his accumulators from his 240-volt house lighting mains, and at the same time supply various values of H.T. to the valves in his set.

The circuit shows a suitable system of wiring the switchboard for this purpose. With regard to the accumulator charging portion of it, the charging current can be regulated by placing carbon lamps of varying candle power in the four sockets provided. For instance, if we insert four 240-volt 16 c.p. carbon lamps, we shall obtain a charging current of approximately 1 amp., whilst inserting one lamp only will give us a charging rate of 0.25 amp., which is suitable for the very small "dull-emitter" accumulators now on the market. Two similar lamps of 60 c.p. and two of 16 c.p. will give a rate of between 2 and 3 amps., and so on. The ammeter should always be short-circuited except when a reading is being taken.

With regard to the H.T. supply portion of the circuit, it will be noticed that four lamps are employed as potential dividers in order to give various H.T. values. If all these lamps are of the same candle power, the H.T. values which we indicate will be obtained, and other intermediate values can be effected by employing lamps of varying candle power. These lamps are preferably of the metallic filament type in order to reduce current consumption to the minimum. It will be found



Method of utilising direct current supply for accumulator charging and producing a range of plate potentials.

that the cost of the H.T. supply will work out at considerably less over a given period than if H.T. batteries of the ordinary type are employed.

o o o o

Erection of Aerials.

TWO READERS whose respective houses are situated at a distance of approximately 150 feet from each other wish to know if it would be possible for them to erect two single-wire aerials, stretched parallel to each other and six feet apart, from their two houses.

Although this would be possible, it is a practice that cannot be recommended, since each aerial will most certainly have a very marked effect on the other, and it will be found that when the two sets are critically adjusted a slight movement of the tuning controls of one set will upset the adjustment of the other. A far better plan in this and similar cases is to arrange for a single wire to stretch from house to house, an insulator being fixed at about 60 feet from each house, and the centre portion of 15 feet being made up of a supporting wire. With the two aerials erected in this manner, far less mutual interference will take place, the only disadvantage being, of course, that if at any time it is necessary to temporarily lower one aerial for any reason, the other aerial will come down also.

An Efficient Crystal Circuit.

A READER is desirous of knowing what is the most efficient crystal circuit from the point of view of sensitivity and simplicity.

Since, in a crystal set, we have no local source of energy which we can use to counteract losses, it is obvious that the utmost attention must be devoted to the elimination of losses in the tuning arrangements. The aerial resistance must be made as low as possible as, of course, we cannot use reaction to counteract this as is the case with a valve set. With regard to losses in the actual tuner, although resistance is a great contributory cause, it is probable that in the average crystal set the major portion of these are brought about by excessive capacity in the circuit, both intentional and unintentional. Possibly one of the best crystal sets that can be made, from the point of view of low losses, is one consisting of a solenoid wound with thick, bare wire, and whose turns are air-spaced. The number of turns should be slightly in excess of the number required to tune to the wavelength of the station which it is desired to receive. Final adjustment can then be made by a clip attached to the aerial lead-in. An important point which is often overlooked is that the crystal and telephones need not necessarily be connected across the whole of the inductance, and for this purpose the best tapping position for the detector circuit should be found by experiment by means of a clip. It should be remembered that the less the number of turns across which the crystal and telephones circuit is tapped, the less is the damping caused by the crystal, and consequently greater selectivity will be obtainable.

oooo

The Tuning of a Four-valve Set.

A READER who has constructed a four-valve set employing the usual type of standard circuit receives several of the B.B.C. stations at good strength, but is puzzled by the fact that stations rarely come in for the same dial settings on two consecutive evenings.

The reason for this is in all probability due to the fact that although the dials of the condenser are carefully set to the same value, it is seldom that the reaction coil is in the same relative position to the aerial or anode coil. It is obvious, of course, that the mutual inductance existing between this coil and the aerial or anode coil has a direct effect on the tuning of the coil to which it is coupled. Although geared coil holders are to be had, by far the greatest number are not geared, and, in any case, they have no dial nor scale to indicate exactly the angle between the two coils. It is therefore probably only a coincidence if the two coils happen to be set in the same relative positions on two consecutive nights, and it naturally follows that if these coils are not set in the same position, it will be necessary to have a different setting on the condenser tuning the coil to which the reaction coil is coupled, in order to produce the same value of *LC*. However, even supposing that the coil holder is carefully calibrated, it is probable that the dial settings for any given station will change after a time. This is due to many factors. One is that in course of time, owing to usage and consequent wear of moving parts, the whole bank of moving vanes tend to change their spacing with respect to the fixed vanes. This considerably alters the capacity given by the instrument at a given setting. Also, it will be found that coils do not always fit tightly into their sockets, and they are prone to become rather loose after a time. In the case of basket coils, or those commercial coils not completely encased, their inductance value is apt to be changed by an accidental knock. Another important point often overlooked is filament temperature and H.T. voltage, which have some effect on tuning, especially on H.F. valves. It is obvious that inserting the wander plug in the same socket of the H.T. battery will not always give us the same voltage value.

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A Selective Loud-Speaker Receiver.

A CORRESPONDENT wishes to build a receiver in which it is possible to make a rapid change from valve to crystal detector, according to whether local or distant reception is desired. The receiver is also required to give the utmost selectivity consistent with stability and ease of control. Since the receiver is required to operate a large loud-speaker, two stages of power amplification are also included.

In the circuit which we give below it will be seen that selectivity is attained by means of loose coupling, which can be eliminated as desired by means of a simple throw-over switch. We do not include an H.F. valve, since this in conjunction with loose coupling is apt to prove an unstable combination. It is possible with loose coupling to obtain a high degree of selectivity, once a certain amount of manipulative skill has been attained. A rapid change can be made from valve to crystal by means of a switch. It is recommended that a low impedance valve of the type usually recommended for loud-speaker work be used as a rectifier. In this event both transformers can be of the usual 4 to 1 ratio, since this ratio will give equal satisfaction when preceded by either a crystal or a low impedance valve. It is most essential that the correct value of grid bias and anode voltage be applied to the L.F. valves.

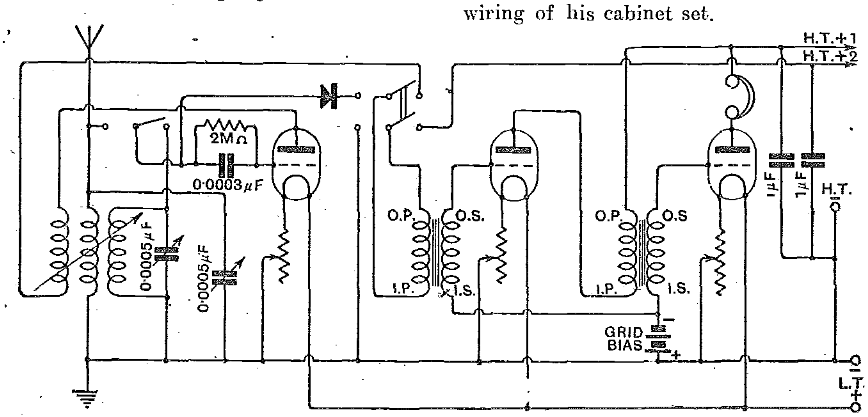

Fig. 3.—A receiver in which a crystal or valve rectifier can be used merely by operating the switch. Two note magnifiers are employed.

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Method of Comparing Received Signal Strengths.

A CORRESPONDENT asks if we can suggest a simple method of comparing the signal strength received from distant stations or from the same station with different tuning arrangements.

The easiest method of doing this where the test is made by aural observation is to shunt the telephones with a variable high resistance which has some form of calibrated scale. It is obvious that the less the value of this resistance, the less will be the strength of signal heard in the telephones, since of course the current will divide itself between the resistance and the telephones in accordance with the ratio of impedance between the two. Thus there will be a point on the scale of the resistance at which a signal of given intensity is no longer heard in the telephones. This point of disappearance can then be noted for different stations, and an approximate comparison effected.

oooo

Incorrect Connections of Loading Coil.

A READER asks if it is possible to receive the long-wave B.B.C. station by connecting a loading coil in parallel across the aerial and earth terminals of his existing crystal set, as he does not wish to disturb the internal wiring of his cabinet set.

If a loading coil is attached in parallel with the existing aerial coil, as our correspondent suggests, the wavelength to which the set will respond will be immediately decreased. The loading coil must be connected in series in the usual manner, and must not be added externally between the aerial lead-in and the aerial terminal of the set, since, although this will tune the aerial to the requisite wavelength, the full potential developed across the tuning system will not be applied to the crystal, but only the voltage set up across the low wavelength coil across which the crystal and telephones are connected.

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"BOTTLED" PROGRAMMES.

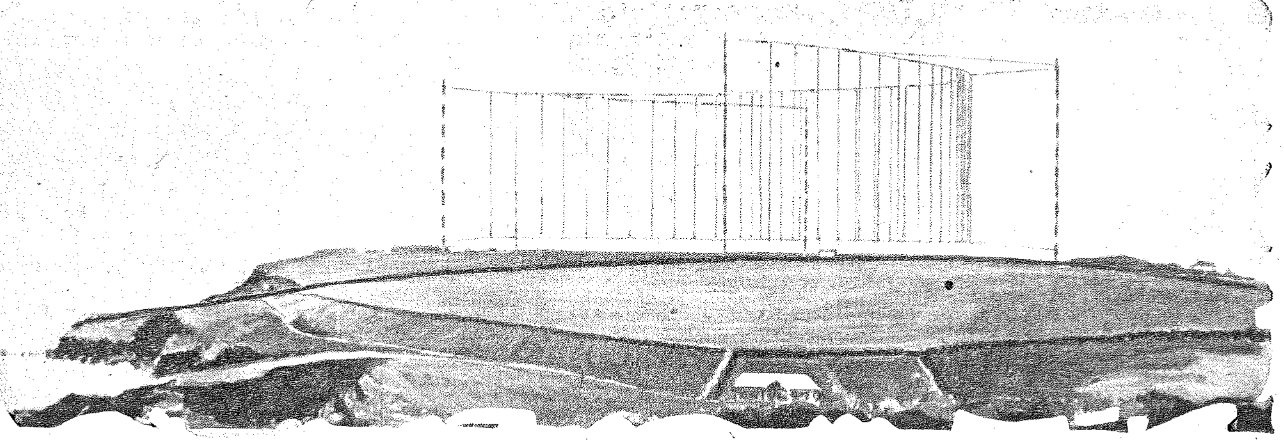
APART from the continual criticism of the B.B.C. programmes, which it is only human nature to suppose will continue so long as there are any programmes to criticise, there is another point where the opportunity certainly does exist for adding to the value of broadcasting and meeting a wide-felt want.

Broadcasting is conducted here only during very limited periods of the day, whereas in the United States of America, for instance, it is possible to listen-in to programmes at almost any hour from early morning to last thing at night. Although the vast majority of listeners want the programmes in the evening, there are very many other people who have leisure time in the day, when they would like to avail themselves of the benefits which broadcasting offers. The Broadcasting Company has already a sufficiently big task set itself in providing programmes for the evenings, so that one would not suggest that they should attempt to run to a varied programme throughout the hours of the day, but it seems to us that the possibility exists for a compromise. If the evening programmes provide a sufficient variety of subjects, the public who wish to listen-in during the day-time would not expect new programmes, but would be very well satisfied if they could have a repetition of, say, the evening programmes of the previous week.

It would not be necessary, in these days when science can be called to the aid of broadcasting in so many directions, for the artistes to appear again for the performance during the mornings and afternoons, because a record could be taken whilst the original performance is being given, and this record would provide the means of rebroadcasting at a later date.

We understand that the Broadcasting Company is already considering making a permanent record of broadcast items of special interest or importance, and there are alternative methods of doing this. For example, the system now in use in connection with the "Speaking Film," which is a photographic method, will produce an extraordinarily faithful record of speech and musical items, which would fall little short of the original performance in quality. There is also another system where a moving wire is influenced by magnetic means to a varying extent, so that the final record consists of the wire magnetised along its length to an extent dependent upon the sounds which it is desired to record. Although it is not suggested that the quality of reproduction would come up to the original standard, such records could be used for broadcasting day-time programmes as we suggest, and, whilst offering entertainment for those who desire to listen-in during the day and an opportunity to hear programmes missed during the original performance, it would have the additional advantage that demonstrations of sets could be given during the ordinary shopping hours, and thus do much to assist in the choice of sets by prospective purchasers.

CONTENTS.



THE WIRELESS BEAM.

An Explanation of the Theory of the System.

By R. H. WHITE, M.I.E.E.

In much the same manner that a beam of light is thrown by a searchlight, so wireless electromagnetic waves are now being sent out in the desired direction.

In the case of light the concentration is sometimes accomplished by means of a lens, but more generally by the use of a reflector.

The wireless beam station also employs a reflector, although the wireless reflector is not a solid sheet of polished metal, but a screen of wires arranged behind the receiving or transmitting aerial, sometimes in the form of a curve, and sometimes simply as a flat wall.

Although reflectors were used by Mr. Marconi in his earliest experiments, they fell into disuse until the subject was taken up again in 1916. From 1916 to the present date continuous research has been carried out with the reflector on short waves, and the system has been developed, until with its aid a wireless beam has been thrown from England to America, carrying strong signals from continent to continent, whilst the short waves employed have been used for direct telephony to Australia.

It is obvious that if all the energy radiated from an aerial is concentrated into the form of a beam, a greater effect will be produced in a distant receiving aerial, situated in that beam, than would be produced by a transmitting aerial radiating the same energy equally in all directions.

Power Economy.

For instance, with a simple vertical aerial the power is radiated equally in all directions, so that at any fixed distance in any direction around the aerial there will be the same field strength. This is represented in Fig. 1, where the circle *c* represents points of equal field strength around the vertical aerial A; that is to say, the power is radiated equally throughout the 360 degrees of this circle. If, however, the power can be directed and radiated only in one direction, say towards B (Fig. 1), there will be an economy in the power required to generate the same potential in an aerial at this point B, compared with the power which was required in the former case. The more the radiation is prevented from spreading in other directions, the greater will be the efficiency of the system. Thus, if all the energy is confined to a sector of 36 degrees, *i.e.*, $\frac{1}{10}$th of 360°, then the power required to produce unit field strength at the distance AB will be $\frac{1}{10}$th of that required if the energy is radiated uniformly throughout the 360 degrees. However, a wireless beam which has an angle of divergence of 36 degrees is a very poor affair—it is quite easy to concentrate all the energy into a beam of 18 degrees, in which case the power required becomes 1-20th, whilst if a beam having a divergence of only 9 degrees is employed, the power required is again halved, and would be 1-40th of that required by a simple aerial to produce the same effect at unit distance. The economy, however, does not end at the transmitter, for reflectors may be employed with equal efficiency behind the receiving aerial, and, if the reflectors at both transmitter and receiver are of the same size, the over-all efficiency is the square of the efficiency obtained with one reflector. Thus in the case under consideration, where the power has already been cut down to 1-40th by the employment of a reflector behind the transmitting aerial, the addition of a similar one behind the receiving aerial will theoretically reduce the power required to 1-1,600th of that required

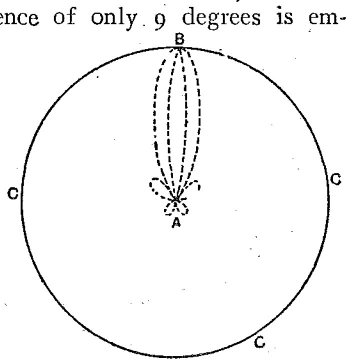


Fig. 1.—If the beam transmitter is located at A, the diagram shows how radiation may be concentrated in the direction of B.

The Wireless Beam.—
to work over the same distance and obtain the same signal strength when both aerials have no reflectors.

It is at present difficult to forecast what will be the final limit of this concentration of the wireless waves on to one point, but the above figures show how very desirable is the economy which can be effected by directing the signals on to the distant receiving aerial.

The reflectors which are constructed for this work do not resemble the curved mirrors which are used for the reflection of light. Although it is true that in the earlier work cylindrical parabolas of metal were used as reflectors, these were superseded later on by vertical wires arranged in the form of a cylindrical parabola, and finally by the flat reflector, which is now in use at the South

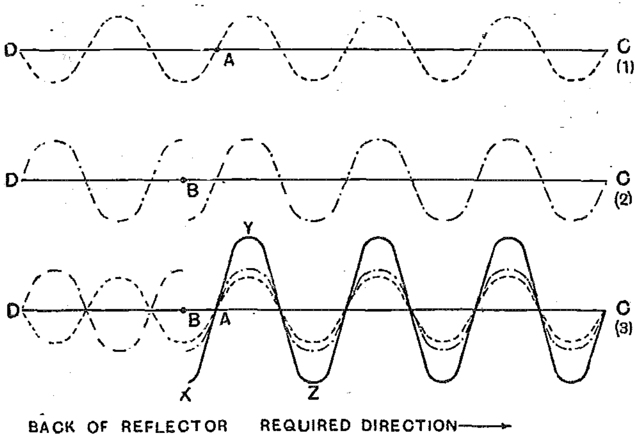


Fig. 2.—A diagram to illustrate the "adding effect" of the arrangement of the vertical aerial wires

Foreland, and other wireless beam stations. In this connection it may be mentioned that Senatore Marconi, in a paper read before the Royal Society of Arts on July 2nd, 1924, made the statement that the concentration of energy due to the directional effect has been carefully calculated by C. S. Franklin, and that these figures have been confirmed by tests which have been carried out at Poldhu.

Fig. 1 makes it apparent how real and important is the gain from using a reflector.

In this figure the circle *c* represents the polar curve from a plain vertical aerial, whilst the curve shown by the dotted lines is the polar curve of a reflector having a two-wavelength aperture. The curve shown by dashes is for a reflector having an eight-wavelength aperture.

All these arrangements give an equal field strength at the point B, whilst the energy expended to produce this equal field strength is proportional to the areas of the curves.

When similar aerials are used at both the receiving and transmitting ends, the energy required to produce equal signal strength at point B is :—

10,000 units for plain aerials;
25 units for aerials with two-wavelength aperture reflectors;

and only

1.56 units for aerials using eight-wavelength aperture reflectors.

In this article it is not proposed to go into any details of the construction or arrangements made at the stations to provide these effects, but rather to show how the beam is produced.

The Reflector.

The working of the parabolic reflector is easier to follow than that of the flat reflector, although the manner in which the waves sent out from the aerial are cancelled out in one direction, and augmented in the other, is common to both types.

When a single vertical aerial wire (A, Fig. 2) is erected and connected to an oscillator, electro-magnetic waves will be radiated equally in all directions. If, however, another simple vertical aerial wire is also erected exactly a quarter wavelength away from the first (B, Fig. 2), and the aerials A and B are in tune with one another, when A oscillates B will also have a current induced in it, and will also oscillate, and re-radiate electro-magnetic waves, although it has no transmitter connected to it.

Now the waves going out from A and from B will interfere with one another, and they will interfere in a definite and constant manner.

In Fig. 2 (1) the wave transmitted by the aerial A is depicted, whilst immediately below it (Fig. 2 (2)) the re radiated wave from B is also shown. It is quite clear from these two figures that the waves going towards 1 and 2 are in phase, and assist, whilst those going in the opposite direction are out of phase, and will cancel one another.

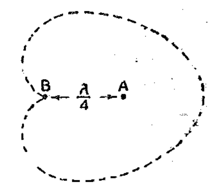
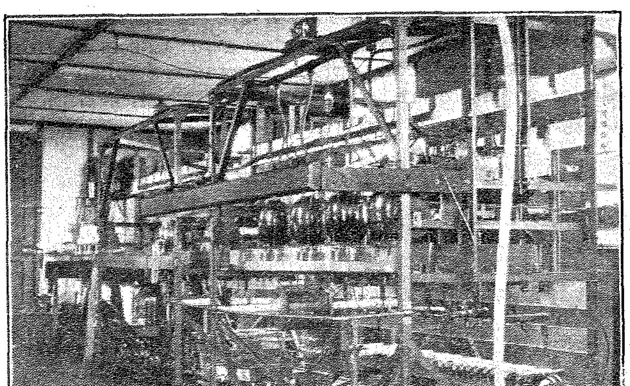


Fig. 3.—Heart-shaped diagram representing the polar curve of a system employing a single aerial wire and a single reflector wire.

The third figure (Fig. 2 (3)) shows the result where in the direction (3) the waves have double their initial amplitude and in the opposite direction they have practically cancelled out. They would, in fact, have cancelled out entirely had they been of equal amplitude to start with, but because the currents induced in B are slightly less (due to resistance) than those in A, the waves from B are slightly less in amplitude than those from A.



Interior of the Poldhu experimental station, where much of the early research work was carried out by the Marconi Company.

The Wireless Beam.—

These figures give a picture of what actually takes place, but it is rather hard to follow the phase relationship between the original wave in A and the reflected wave from B. It can best be explained by saying that as the distance from A to B is a quarter of a wavelength, and a quarter of a wave is 90 degrees, then the wave from A travelling towards B will have changed 90 degrees during its passage from A to B. There will be another change of 90 degrees in phase in generating the current in B, and a third change of 90 degrees on re-radiation from B, so that the wave leaving B is 90 + 90 + 90, *i.e.*, 270 degrees out of phase with the wave leaving A, but by the time it comes up to A it will have lost still another 90 degrees, so that it is now 360 degrees out of phase. That is, it is in phase.

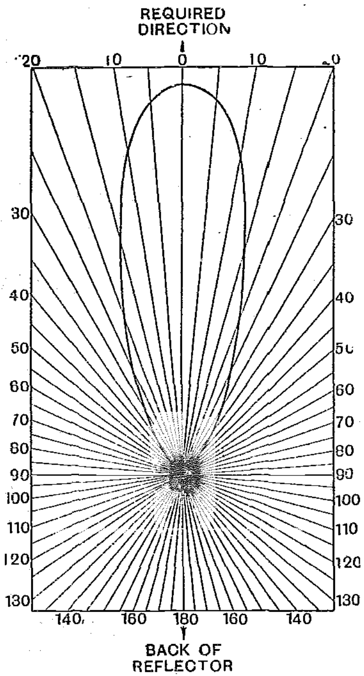


Fig. 4.—The polar curve of a beam station where many reflector wires are in use, showing how radiation is concentrated in the direction of the receiving station.

In the other direction it leaves B 270 degrees out of phase with A, but the wave from A in travelling towards B has lost 90 degrees, so that the waves are 270 − 90 = 180 degrees out of phase, or they are in opposition. The effect of all this is that the strength of radiation in one direction has been considerably increased, and has been almost cancelled in the other.

The well-known heart-shaped diagram (Fig. 3) represents the polar curve of such a system having only a single aerial and a single reflector wire; this is the first step towards the beam, which is obtained when many reflector wires are used, an example of which is depicted in Fig. 4.

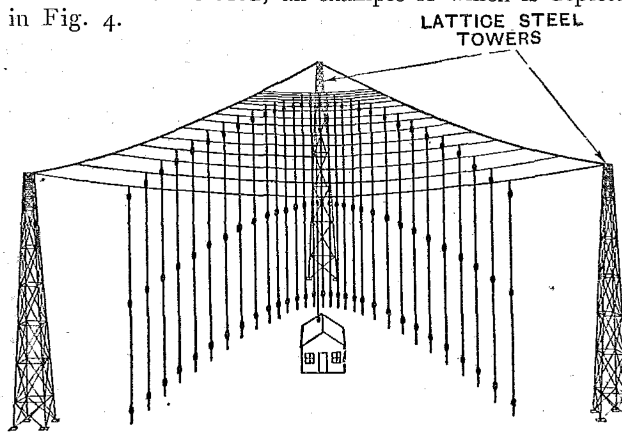
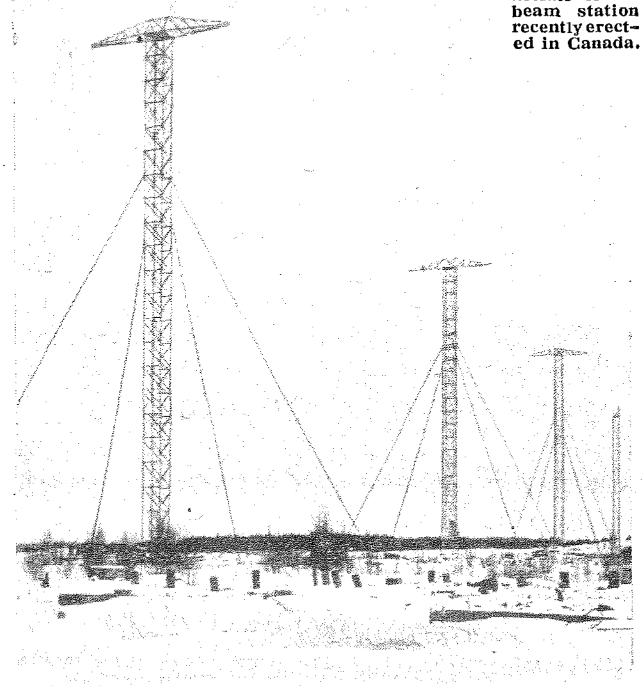


Fig. 5.—The arrangement of the parabolic reflector.



The towers to support the aerials of the beam station recently erected in Canada.

The two types of reflector which are already in use are the Parabolic and the Flat reflectors. The Parabolic reflector, which is employed experimentally at Hendon and Birmingham, and which is in operation as a wireless direction transmitter, or "wireless lighthouse," at Inchkeith, Firth of Forth, consists of a vertical aerial connected to the transmitter, and partially surrounded by a screen of vertical reflecting wires, arranged in the form of a parabola.

This type of reflector is illustrated in Fig. 5, where

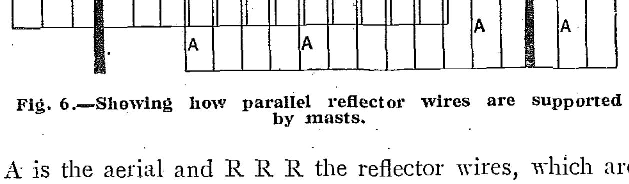
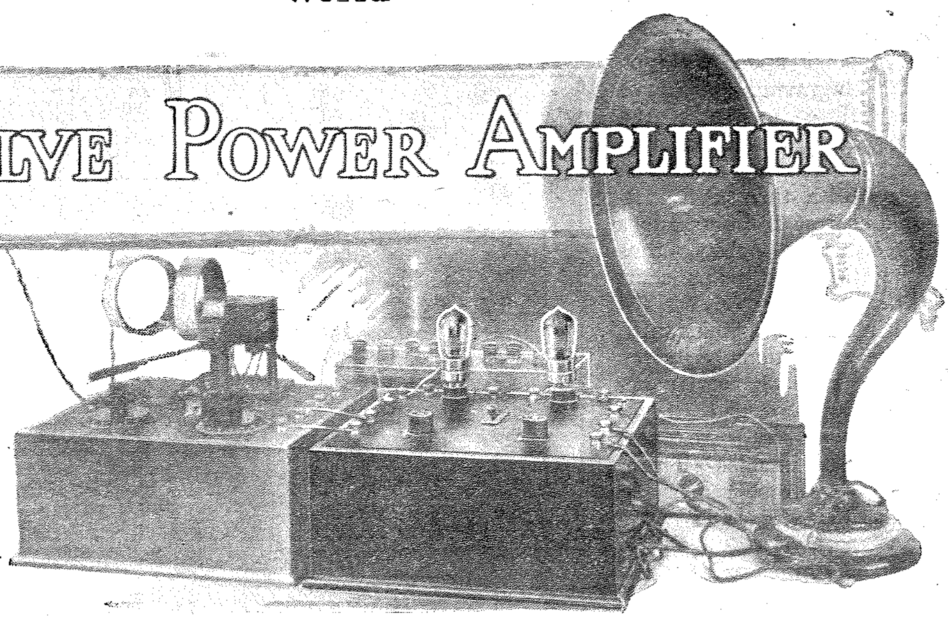


Fig. 6.—Showing how parallel reflector wires are supported by masts.

A is the aerial and R R R the reflector wires, which are suspended by insulators from the cross supports.

The flat reflector is a more convenient structure to erect than the parabolic, for all the aerials and reflector wires may be suspended from overhead and supported by masts. This type of aerial has also been described by Senatore Marconi, and is depicted in Fig. 6, where A A A are the aerials and B B B the reflector wires.

TWO VALVE POWER AMPLIFIER



An Instrument to give Loud Speaker Reproduction with Signals Audible on a Crystal or Valve Set.

By G. M. JONES.

ALTHOUGH primarily designed to operate in conjunction with a crystal set, this instrument is one of general utility and will well repay the trouble spent in constructing it. It is capable of giving enormous power and really good quality reproduction from the loud-speaker.

The circuit, Fig. 1, is conventional with the exception, perhaps, that the method of supplying H.T. potential to the anodes of the valves by means of a switch which also cuts in or out one of the valves is unique and uncommon. Provision is made for a common H.T. voltage for both valves, whilst it is possible to provide an additional potential to the second valve when considered necessary. The switch when used to cut out the last valve automatically throws out of circuit the "extra H.T. voltage," thus avoiding excessive voltage on the first valve.

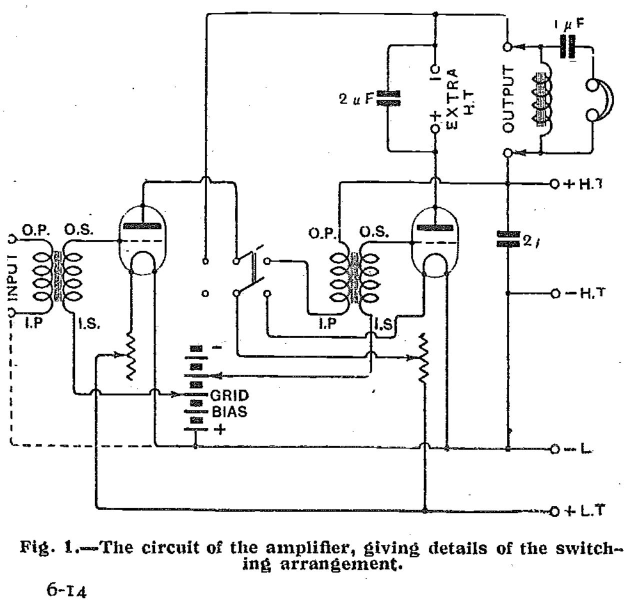


Fig. 1.—The circuit of the amplifier, giving details of the switching arrangement.

When two different types of power valves are in use, and the amplifier is called upon to handle very great volume, it is particularly convenient to be able to apply the necessary additional anode voltage and thereby avoid overloading the valves. As an illustration, if the amplifier is in use with a valve detector or H.F. amplifier and very strong signals are being received, the second power valve, if of the D.E.5 class, will be overloaded when worked at its normal anode potential of 120 volts. It would be necessary, therefore, to increase the anode voltage of this valve.

Transformer Ratios.

As low impedance valves are generally used in power amplifiers the transformers must match such valves. The first (input) transformer, being connected in the crystal circuit or the plate circuit of a detector valve, should have a high impedance and also a low ratio. The second transformer is connected in the anode circuit of the first power valve, which has a low impedance; the transformer should, therefore, have a high step-up ratio.

The ratio of the input transformer is 2.7—1 and may be of the Marconiphone Ideal or other good type of this ratio. The second has a ratio of 4—1, matching the moderately low impedance of the D.E.5 or B.T.-H. B.4 valves.

The materials required are as follow :—

1 Ebonite panel, 12 × 10 × ¼.
2 Ashley 6-ohm rheostats.
1 Utility 2-pole lever switch.
2 Good transformers. Ratios 2.7—1 and 4—1.
2 2-mfd. Mansbridge condensers.
2 Valve holders.
12 Terminals.

The panel, after being squared up to the required size, should be rubbed down to produce a matt surface, and drilled to the dimensions given in the drawing of Fig. 2, but the drilling holes for fixing the transformers

Two Valve Power Amplifier.—must depend upon the type used. Engraving should be done before mounting the components. Care should be taken to mount the transformers with their O.S. terminals nearest to the grid legs of the valve sockets, thus keeping all grid leads short and direct.

Wiring is straightforward, and the connections are given in Fig. 3. It is carried out with No. 20 tinned copper wire sleeved into systoflex. This method enables all connecting wires to be kept short, avoiding angles and long wires.

A fixed condenser of about 0.001 mfd. should be connected across the primary winding of the first transformer, but this in most cases will be found across the telephone terminals of the set used as a detector, and is therefore not shown connected in the amplifier.

It is not advisable to shunt the loud-speaker with a fixed condenser when low impedance valves are used, but if the loud-speaker requires one to correct acoustic faults it is best applied externally to the amplifier. "General purpose" valves are useless with this instrument unless they are employed to amplify one frequency only, such as supplying power to a Morse recording instrument. It may be found necessary to earth the filament battery when the amplifier is connected up to a crystal receiver; this is particularly necessary when extended leads for loud-speakers are in use.

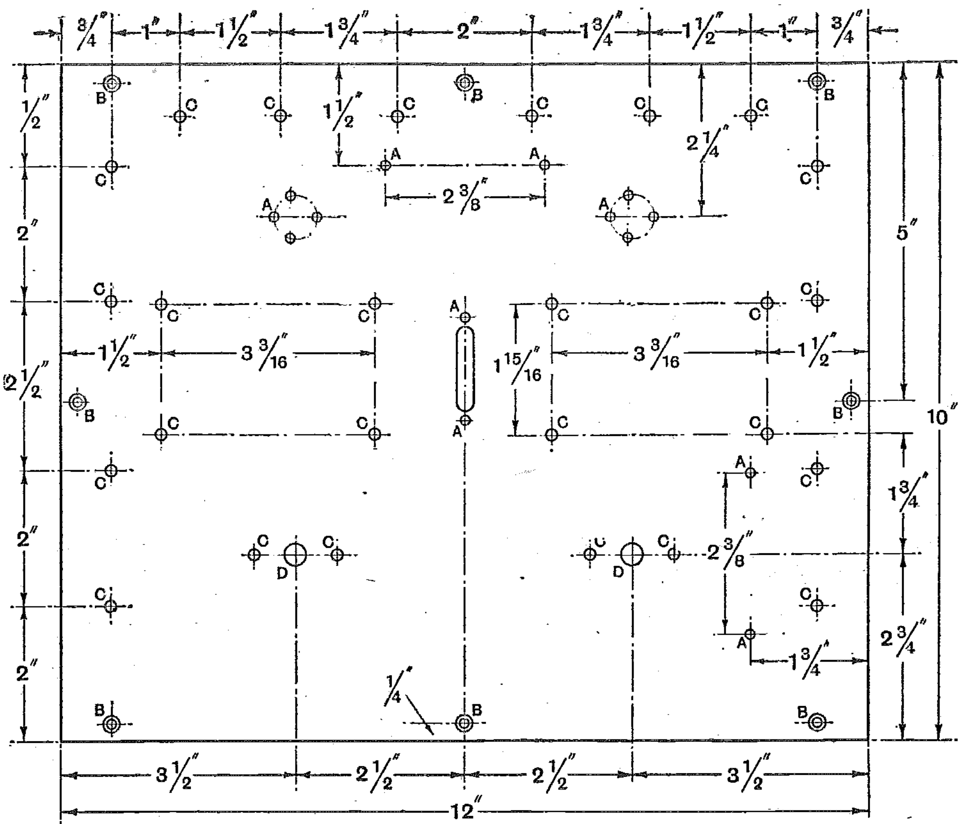


Fig. 2.—Drilling dimensions for the panel. The dimensions for fixing the transformers will depend upon the type used. The holes should be drilled as follows: A = 1/8 in. dia.; B = 1/8 in. dia. (countersink for No. 4 wood screws); C = 5/32 in. dia.; D = 5/16 in. dia.

Suitable Types of Valves.

The following types of valves may be used to advantage and are recommended:—

Mullard D.F.A.1.
Marconi D.E.5 and L.S.5.
B.T.-H B4.

When very strong signals are to be amplified, it will be necessary to use, in the last stage, a valve which will handle very great power, viz., an L.S.5, and even with this valve it may be necessary to work at an anode voltage of 200 with about 20 volts grid bias.

Used within fifteen or twenty miles of a main B.B.C. station, and coupled up to a good valve detector and loud-speaker, it will be possible to create sufficient power to be heard five hundred yards from the loud-speaker, maintaining the quality of crystal reception.

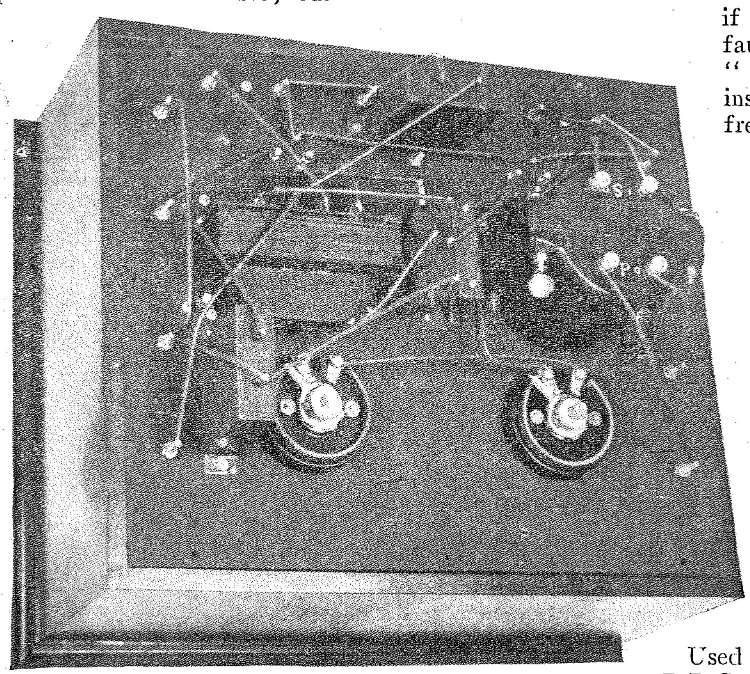


Fig. 3.—The wiring of the underside of the panel is neat and easy to follow. In this instrument the types of transformer used are Western Electric and Marconiphone, but other types of suitable ratios may be substituted if desired.

Two Valve Power Amplifier.—
Such power is rarely required by the average individual, but it is there if wanted. In the summer evenings, on the lawn or the tennis court, such a reserve of power is very useful. Under ordinary circumstances where the receiver is located reasonably near to a broadcasting station it will seldom be necessary to use more than one valve.

when ordinary H.T. batteries have been in use for a few weeks, even when large by-pass condensers are used.

A word of warning. Ordinary telephone receivers must not be connected to this amplifier when power valves are in use. The current flowing in the anode circuit is much too heavy for the windings. A 1 to 1 in the case of high resistance phones, and 10 to 1 telephone transformer with 120 ohm phones, should be used, or, alternatively, a choke filter circuit consisting of an iron core choke wound to about 25 henries and a 1 mfd. Mansbridge condenser.

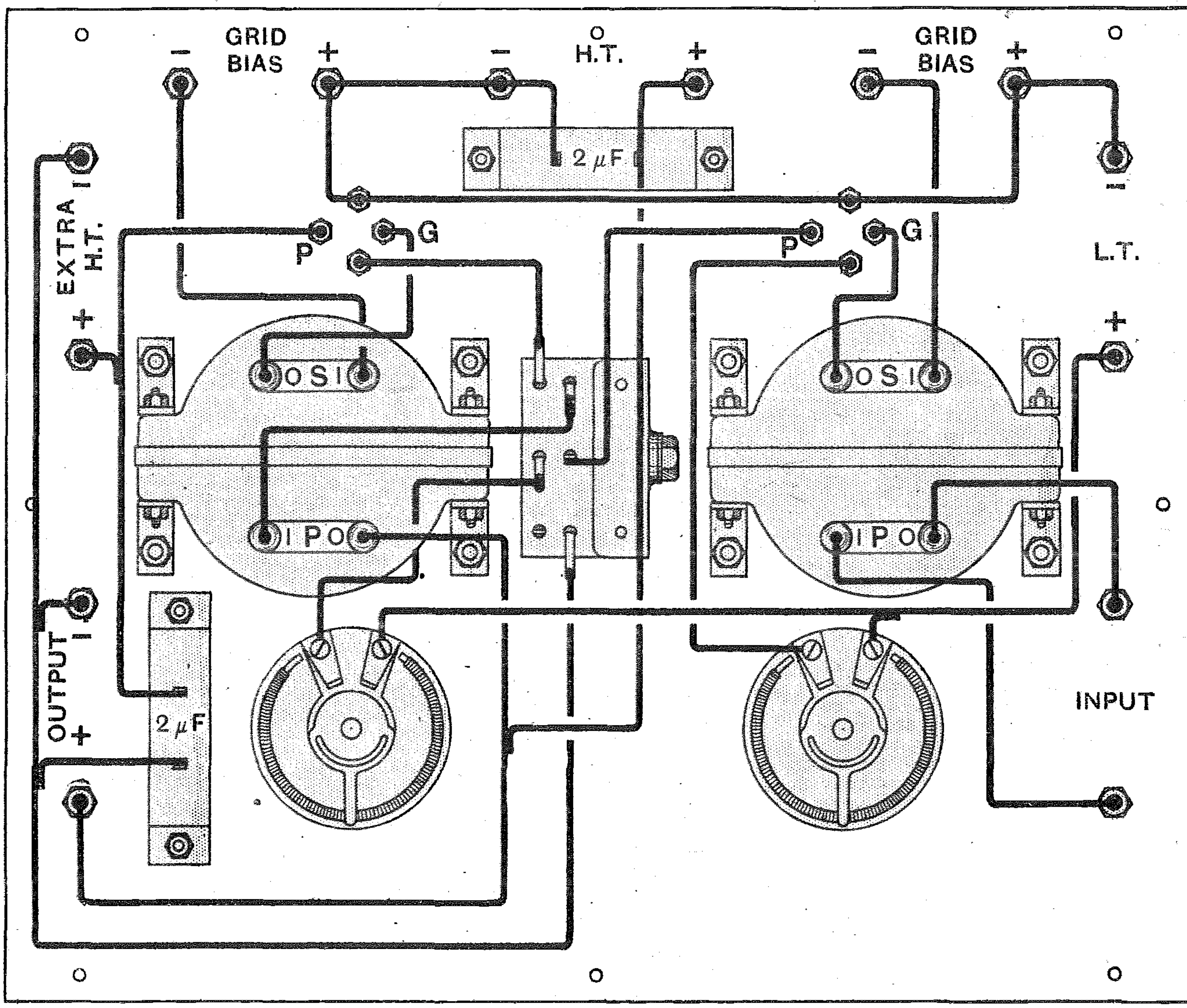
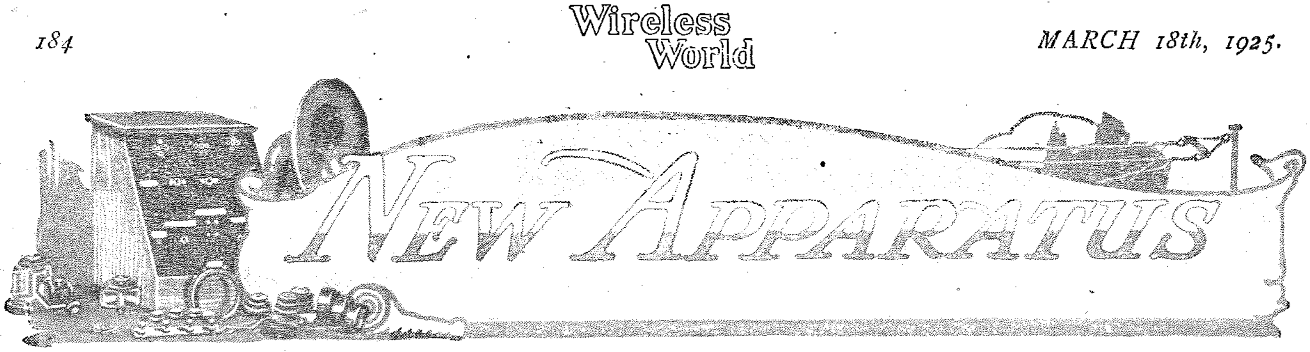


Fig. 4.—A diagram which will facilitate the wiring of the panel. The provision of a switch so that one or two valves may be used at will is a point which adds greatly to the value of the amplifier without elaborating the wiring to any appreciable extent.

In conclusion, it might be mentioned that as the plate current of the valves is in the neighbourhood of 10 to 12 milliamperes, the high tension battery must be of generous capacity. The ordinary type is quite useless for the purpose, and would give rise to "cracklings" in a very short time. Several manufacturers turn out batteries which are suitable and, although high in cost initially, they are really very economical. Incidentally, these batteries are recommended for any multivalve set, as a "dead" background of silence cannot be obtained

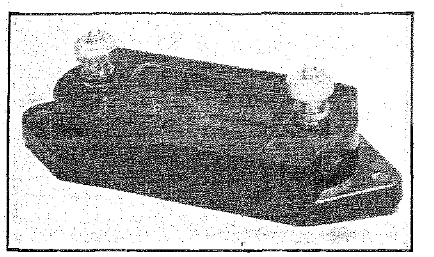
When an L.S.5 or L.S.5.A. valve is used in the last stage it may be found advisable to use the D.C. mains for H.T. The mains are sometimes earthed, and in any case it is not advisable to connect them to earth; hence the negative terminal of the amplifier should be connected to the earth terminal of the valve or crystal detector through a 2 mfd. Mansbridge condenser.



A Review of the Latest Products of the Manufacturers.

THE DUBILIER "DUBRESCON."

To eliminate the danger of damage to the high-tension battery by short circuit and to avoid the risk of destroying valve filaments by accidental contact with the H.T. supply, the "Dubrescon," a recent product of the Dubilier Condenser Company, is connected in the positive lead of the H.T. battery. As the name implies, the component consists of a resistance and a condenser connected in parallel. The resistance, which is well built on a mica former, is of sufficient value to limit the



The Dubilier H.T. battery protecting device.

current, so that should the filament of any type of receiving valve be accidentally connected across the H.T. supply no damage will occur. The radio and audio-frequency currents circulating through the high tension battery circuit are by-passed by a large capacity condenser which is connected across the resistance. The "Dubrescon" is larger than the usual types of Dubilier receiving condensers, and measures $4\frac{1}{2} \times 1\frac{5}{8}$in.

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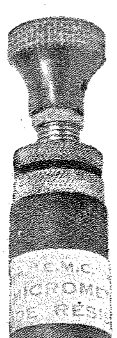
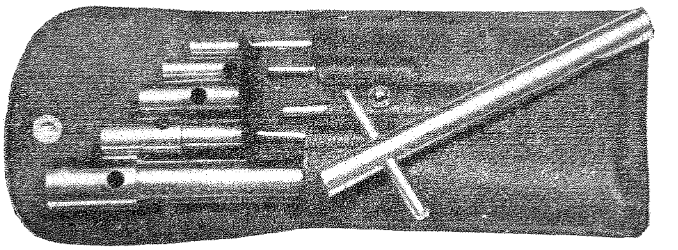
A USEFUL SET OF BOX SPANNERS.



The use of box spanners for instrument work is frequently recommended in the constructional articles appearing in the pages of this journal. Messrs. F. M. Carson, of 27, Upper Thames Street, London, E.C., have recently introduced a range of spanners known as "Star-angled Spanners," ad-



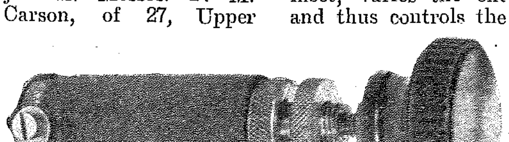
Set of box spanners for B.A. nuts.

mirably suited for amateur use. They provide a range from 0 to 10 B.A.

oooo

"E.M.C." VARIABLE RESISTANCES.

A new principle has been introduced into the construction of the "E.M.C." variable resistances, manufactured by Enterprise Manufacturing Co. and procurable in a range of values from 0 to 5 ohms, suitable for insertion in filament leads, to the very high resistances which are required in grid leak circuits. The general construction of the various models is very much the same, and the dimensions of the resistance units have been standardised to permit of the interchanging of the inset resistances. The resistance material is sealed into a small piece of rubber fitted with brass end caps and engraved with the resistance value of the inset. The outer case consists of an ebonite holder with bush for single hole fixing to the instrument panel and a spindle which, by advancing on to the inset, varies the extent of compression and thus controls the resistance value.



E.M.C. resistances.

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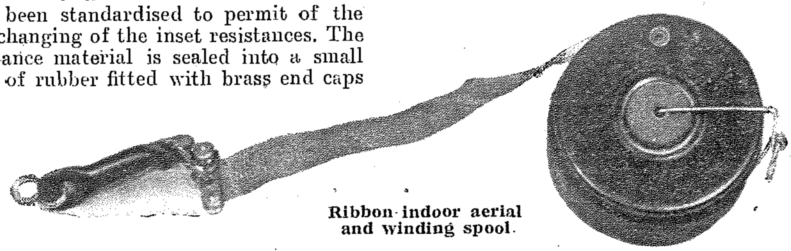
A USEFUL FORM OF INDOOR AERIAL.

A useful form of indoor aerial has recently made its appearance, and is a product of Messrs. B. E. N. Patents, Ltd., of Victoria Street, London, S.W.1. It is provided with a suitable winding spool, so that for indoor use it can quickly be erected or dismantled, and for this purpose a supporting insulator is attached to the spool, while the instrument end is provided with a tag connector for inserting under the aerial terminal of the receiving set. It is a network aerial and is formed of a number of strands of enamelled wires of a gauge of approximately 44 S.W.G. The total length is 52 ft. This aerial certainly works very well, though it is difficult to form any definite gauge of its merits as it is not possible readily to apply a comparative test with aerials of other types.



Ribbon indoor aerial and winding spool.

THE LISTRON CRYSTAL.

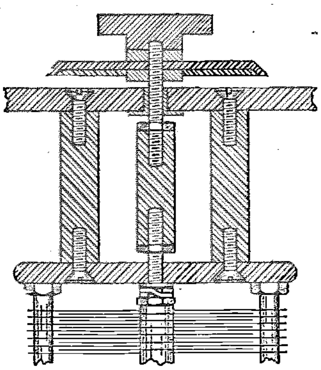
It is extremely difficult to apply a quantitative test to the specimens of crystal which are submitted. A process of examination is therefore applied by way of comparison with a detector the merits of which are known. The specimen of Listron tested was not only found to possess a very high degree of sensitiveness, but its special merit would appear to be that fine adjustment is scarcely required, and that good signal strength can be obtained by lightly driving the wire point supplied with the crystal on to the face at almost any point.

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

LOW CAPACITY CONDENSER CONTROL.

An endeavour should always be made, when wiring up a receiver, to arrange for the spindle to be joined



Eliminating hand capacity by spacing the tuning condenser away from the front of the panel.

to the earthed side of the circuit, so that when the knob is operated the tuning will not be affected by the earth capacity produced by the hand. On short wavelengths, however, difficulty may be experienced, owing to the proximity of the fixed plates to the back of the panel, and hand capacity effects may result. Should it be found that the tuning changes when the dial is operated, it is advisable to mount the condenser upon ebonite extension pieces. Pieces of ½in. ebonite rod should be attached to the front plate of the condenser and secured with screws passing into tapped holes. The spindle is fitted with an ebonite extension also and is clamped in position by means of threaded holes and locknuts.—W. R. C.

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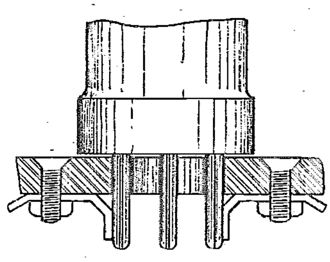
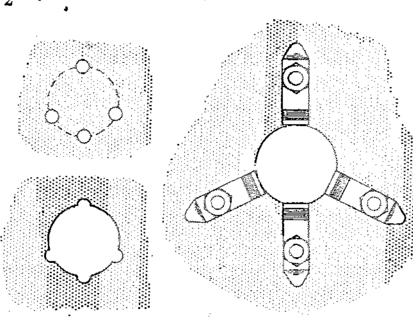
REDUCING VALVE HOLDER CAPACITY.

Although the capacity presented between the electrodes of a valve is produced essentially at the point where the leads from the interior pass out to the valve socket, some small saving as regards stray capacity may be obtained by the use of a valve holder of the type shown. Four holes are made through the panel, spaced apart in the same manner as the valve pins. A hole



Sectional view of a low capacity valve mounting.

17 mm. in diameter is then made concentrically with the circle on which the four holes fall, or alternatively the ebonite may be cut away from hole to hole with a fretsaw. Contact with the valve pins is obtained by means of four small brass or bronze strips attached to the underside of the panel with No. 6 B.A. screws and nuts.—F. J. M.



Steps in the construction of a low capacity valve holder.

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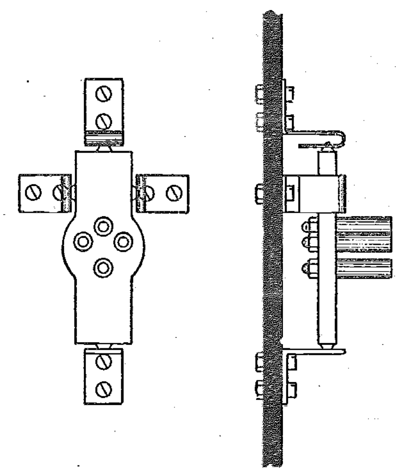
V 24 OR R TYPE VALVE HOLDER.

If valves with the V 24 form of mounting are to be interchanged with the usual capped type, clips should be fitted for mounting the tubular valves and a platform arranged to carry the R type when required.

Valve clips for the V 24 type valves are mounted on the panel in the usual way, and a platform is made up which will engage on the



Adapter for interchanging tubular and pin type valves.

clips. The platform carries screws around the edges which make contact with the clips and leads which run to the four valve sockets of the R type holder.—G. S.

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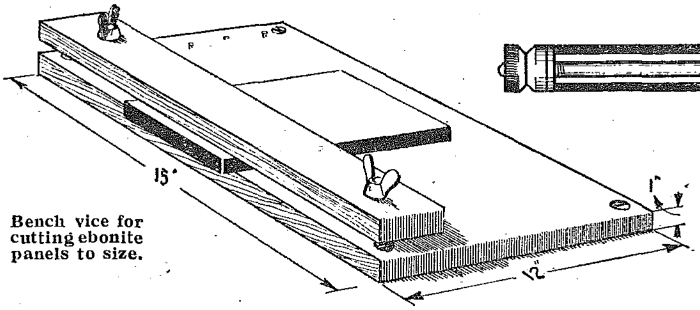
MAKING INSTRUMENT PANELS.

The amateur usually finds difficulty in accurately truing up ebonite panels, mainly owing to the lack of suitable clamps to securely hold the panel down to the bench. The drawing shows an easily constructed bench vice which will save a great deal of trouble, for it enables one to cut the ebonite to a smooth, straight edge, so that the final finishing can be carried out with sand paper or carborundum cloth. The piece of ebonite to be cut is placed under the narrow strip of wood with the side to be reduced projecting. When quite true in position, the two butterfly nuts are screwed down to give a firm hold on the panel. The projecting piece is sawn off preferably with a small tenon saw, though an ordinary hack-saw may be used equally well. The edge of the saw is thus steadied by the top strip of wood, and as a result a clean cut edge is obtained. A straight rub with sand paper gives a finish, and the other edges can then be treated in a like manner. It will be found that the barest minimum of edge may be sawn off by this method much more speedily and neatly than by working laboriously with file and sand paper, while the risk of breaking the panel is entirely avoided. Three small screws arranged in line along one edge serve to hold the panel firmly when rubbing down the surface. In order that the clamp may be suitable for use with small panels, a third bolt and wingnut may be inserted mid-way between the other two.—J. D.



Bench vice for cutting ebonite panels to size.

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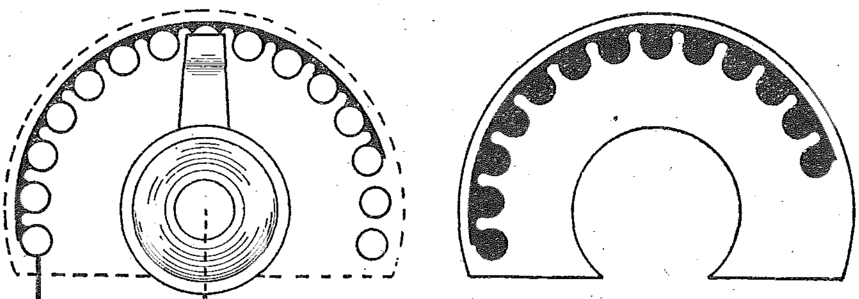
CONSTRUCTING A VARIABLE GRID LEAK.

The diagram shows a very simple form of construction for making up a variable grid leak which can be relied upon to retain its resistance value on the various settings. It consists of an ordinary rotary studded switch to which is fitted a piece of cartridge paper. The surface of the paper is treated with a mixture of indian ink and the scrapings from a soft lead pencil. This mixture is rubbed into the paper to the outline shown, so that reliable contact is made when clamped under the studs of the switch.—J. H. L.



Variable grid leak resistance made by inserting paper treated with indian ink on the contacts of a studded switch.

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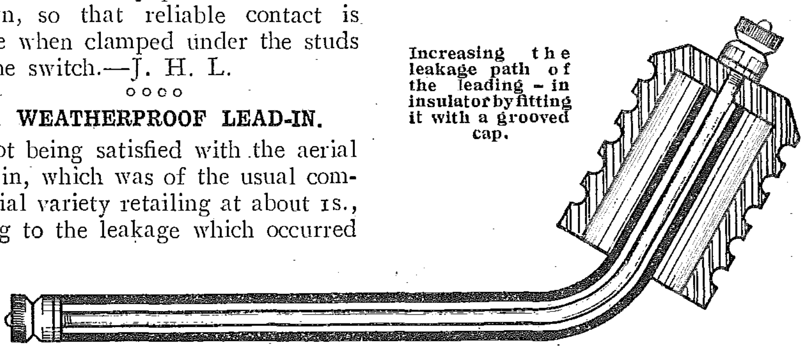
A WEATHERPROOF LEAD-IN.

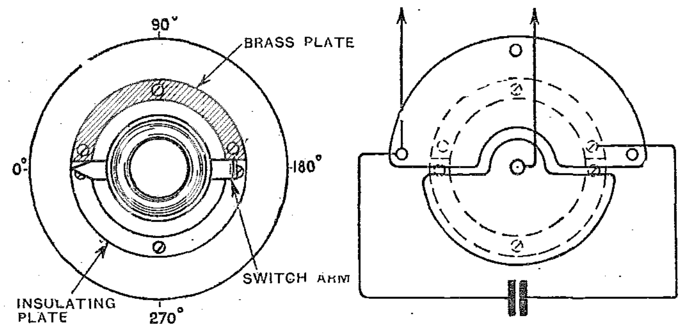
Not being satisfied with the aerial lead-in, which was of the usual commercial variety retailing at about 1s., owing to the leakage which occurred during wet weather, the insulator of the type shown here was made up to improve matters. Taking the ordinary lead-in tube, a bend was made about 3in. from one end, and to do this it is necessary to soften the ebonite in the steam passing from the spout of a kettle. The brass rod will easily bend at the same time. A small turned ebonite cap is fitted over the end of the insulator to prevent the leakage which normally occurs by moisture and measures about 2in. in depth and $1\frac{1}{2}$in. in diameter.—E. A. C.

Increasing the leakage path of the leading-in insulator by fitting it with a grooved cap.



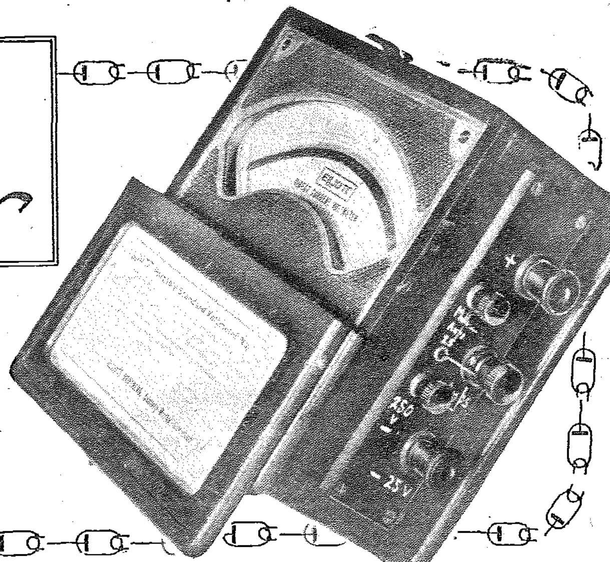
INCREASING CONDENSER CAPACITY.

The accompanying diagram shows the top of a variable condenser to which has been fitted a brass arm on the operating knob, together with a brass semicircular plate and also a dummy plate. At 0° of the condenser setting the movable plates of the condenser are in the position of minimum capacity, and the arm is resting on the dummy guide. At 90°, when the condenser is half in, the arm still rests on the insulating material. At 180° the variable condenser reaches the position of maximum capacity, and at this moment the arm, in making contact with the brass segment, connects across the variable condenser a fixed condenser having a capacity equal to the maximum value of the variable. Thus if the total capacity of the variable is 0.0005 mfds., it will produce a capacity at 90° of 0.00025 mfds. As the knob is rotated, capacities greater than 0.0005 mfds. can be obtained, and it will be seen that at 270° the value is 0.00075 mfds. Care must be taken to ensure that the capacity of the fixed condenser is not greater than that of the variable.—J. D.



The maximum capacity of a variable condenser can be doubled by fitting an arm to the spindle so that it brings into circuit an additional fixed capacity condenser.

Multi Range Volt-Ammeter



A Method of Converting a Standard Voltmeter into a Volt-Ammeter for Measuring Volts, Milliamperes and Amperes.

By A. J. DIXON (6PD).

DOUBTLESS many readers of this journal at some time or other feel the need of an instrument whereby they can accurately determine the voltage or amperage of a particular electrical circuit. In the following article the writer describes the methods by which he provided himself with such an instrument, combining the ability of being able to read the following scales :—

Volts : 0 to 25 by $\frac{1}{5}$ of a volt ; 0 to 250 by 1 volt.
Milliamperes : 0 to 8 by $\frac{1}{15}$ of a milliampere ; 0 to 25 by $\frac{1}{5}$ of a milliampere.
Amperes : 0 to 25.

The original instrument was an Elliot standard voltmeter, and was incorporated in the Patterson-Walsh height finder used by the R.A.F. for accurately judging the height in feet of aircraft. It was purchased for about £2. The scale reads from 0 to 25 volts with a mirror parallax scale, the movement being a high-class moving coil one and having, in the writer's instrument, a total resistance of 3,457 ohms. The scale is divided so that on this reading each division equals one-fifth of a volt and is therefore particularly useful for testing the potential of the L.T. and tappings of H.T. batteries, as well as grid volts, etc.

Increasing the Range.

The first addition taken in hand was to increase this reading by ten times to 250 volts, which is useful for testing H.T. batteries and low power transmission plate voltages when this is taken from the public supply mains. The means adopted were first to put another terminal on the original terminal board, and, secondly, to wind such a resistance as to cause any voltage applied with it in series to read one-tenth of its true value on the scale. By this means one is able to dispense with the necessity of using any other instrument for calibration. The resistance for the 25-volt scale being 3,457 ohms, an approximation is 31,113 ohms for the 250-volt reading—that is, nine times the original resistance of the instrument.

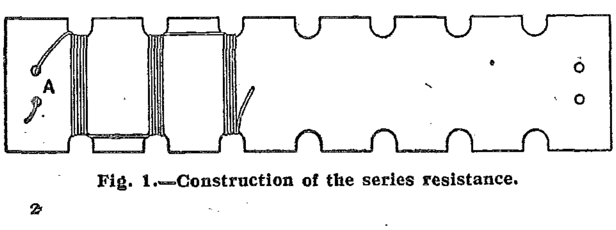


Fig. 1.—Construction of the series resistance.

The method of making this extra resistance is as follows : Obtain a sheet of some insulating material, such as ebonite, paxolin, mica, or even well-shellaced cardboard, and cut it out as indicated in Fig. 1, and, after drilling holes A to secure the ends of wire, proceed to wind with silk-covered Eureka wire of about No. 44 or 45 S.W.G., winding the slots alternately in different directions to minimise inductive effects. The length and weight of wire can easily be worked out by consulting the tables given in any handbook. Thus, No. 44 Eureka wire has a resistance of 83,664 ohms per 1,000 yards, which weighs 0.093 lb. After winding each slot full, test for continuity by placing it in series with the meter and a battery of known voltage, as by this means one is able to obtain a guide as to the amount required in further slots by the decrease in voltage registered by the meter.

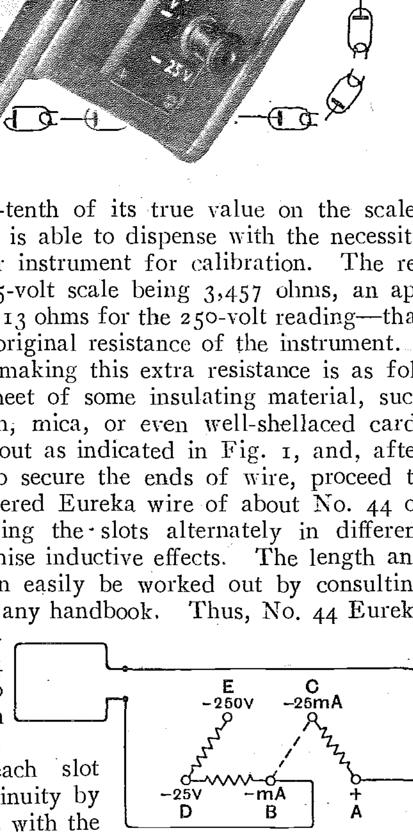


Fig. 2.—Method of connecting additional terminals and resistances.

Measuring Current.

When completed, and the resistance finally adjusted so that 20 volts applied with it in series shows only 2 volts on the scale, the resistance should be well shellacked and the ends secured to short pieces of insulated wire of a stout gauge, which can be threaded through the holes A. Then the resistance can be slid into the two slots at the left of the instrument interior shown in Fig. 3, which is a photograph of the meter converted by the writer.

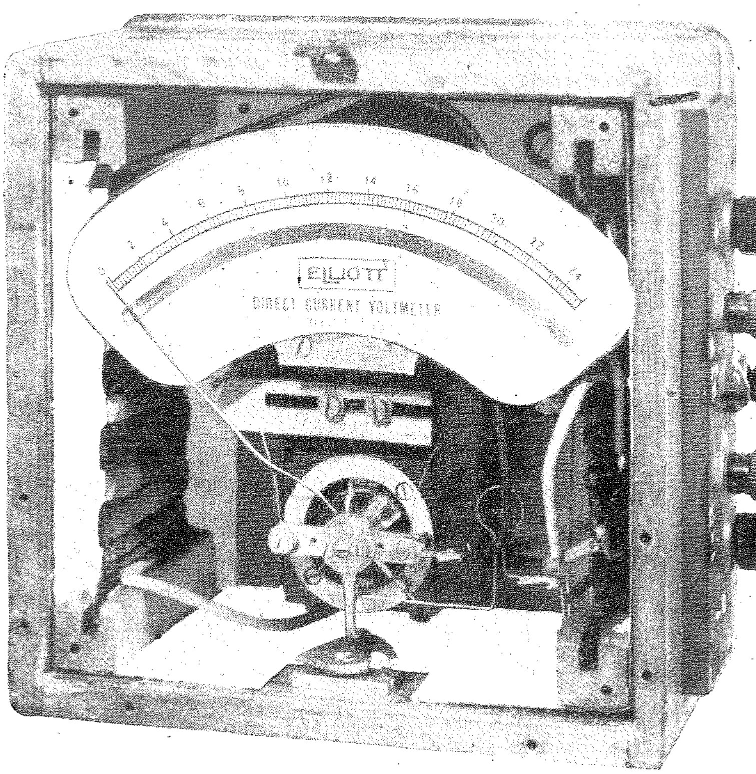


Fig. 3.—View of the interior of the instrument showing, on the left, the series resistance employed when measuring up to 250 volts; top right-hand corner, the shunt connected between terminals AC, fig. 2.

The next step can be to construct and insert the shunt for obtaining direct reading of milliamperes. This consists of a small bobbin of ebonite wound with No. 30

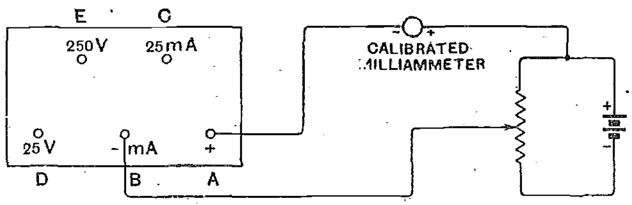


Fig. 4.—Connections for calibrating the instrument in milliamperes (0–8).

D.S.C. Eureka wire, and so adjusted as to make the figures on the scale represent true milliamperes. One end of this winding is connected to the + terminal, and the other to a small terminal C, fig. 2, added to the instrument terminal board. The bobbin itself is fixed to the top right-hand corner of the case. If finer readings than this are needed, the moving coil can be connected

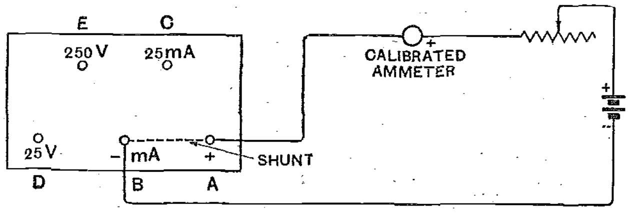


Fig. 5.—Calibrating the instrument in amperes.

to a separate terminal, B, fig. 2, when the instrument will give a full-scale deflection with about 8 milliamperes.

To calibrate the milliampere current reading scale, it is necessary to connect a calibrated milliammeter in series with the instrument and supply both from a small battery-potentiometer arrangement as indicated in Fig. 4. In the case of the 25 *m*A scale, the shunt should be suitably adjusted until both instruments give similar readings. For the 8 *m*A scale, note where the needle rests at the different readings, and either mark the dial or take a note of its position on the scale for each point of reading required. Heavier currents may be measured by employing external shunts made of strips of resistance material and connected across the terminals marked A, B (Fig. 2). The correct size for the shunts can best be found experimentally by connecting the instrument and its shunt in series with a calibrated ammeter and battery, as in Fig. 5.

When the work is completed, the terminals should be marked. The instrument will then read as follows:—

0-8 *m*A by connecting to terminals A and B;

0-25 *m*A by connecting to terminals A and C and joining a copper wire between terminals B, C;

Amperes, by connecting to terminals A and B and bridging them with a shunt;

0-25 volts by connecting to A and D; and

0-250 volts by connecting to A and E. When measuring volts, the connection between terminals B and C, and the shunt, should be removed.

Resistance Measurement.

Apart from the utility of the converted instrument for the purpose of voltage and current determinations, it can of course be used for rapidly measuring resistance values. For instance, to find the resistance of one of the windings of an intervalve transformer which may be of the order of, say, 2,000 ohms, it is only necessary to measure the exact potential of a battery giving about 10 volts, and then on the lower milliampere scale find the current passed when the unknown resistance is connected in series with the battery. Thus if the battery potential is 10.5 volts and current shown on the milliampere scale is 5.5, then the resistance value will be $\frac{10.5}{.0055}$, or roughly 1,900 ohms. The sum of other resistances in the circuit, such as the resistance of the instrument coil and the internal resistance of the battery, should be deducted, and can be estimated in this instance as being roughly 50 ohms. Low resistance values are best determined by shunting the terminals of the volt scale with the resistance to be measured and observing the decrease in the scale reading. It will, of course, be necessary in this instance to know precisely the resistance present in all parts of the circuit.

CURRENT TOPICS.

Events of the Week in Brief Review.

H.R.H. THE PRINCE OF WALES.

The following is the reply of H.R.H. the Prince of Wales to the telegram sent by the President to His Royal Highness on the occasion of the annual dinner on Wednesday evening, 4th March. A delay in the delivery of the telegram prevented this reply arriving in time to be communicated to those present at the dinner before they dispersed :—

To : President, Radio Society of Great Britain, Waldorf Hotel, London.

Am most grateful to you and the members of the Radio Society for your kind telegram of good wishes for my forthcoming tour. I wish all success to the Radio Society of Great Britain.

EDWARD P.

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GERMANY AND JAVA WIRELESS SERVICE.

Direct wireless service has been established between Nauen and the Dutch East Indies on 1,800 metres wavelength.

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AMERICA HEARD IN SYRIA.

Mr. G. H. Koran, of Saadnail Observatory, in Mount Lebanon, has picked up signals from a station in the United States on 70 metres wavelength, and has heard music played in America.

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THE IDEAL ANNOUNCER

A Radio Voice Technique Committee of New York considers that the ideal announcer should speak at an average rate of 175 words per minute, that he should have a voice of low middle range, speak in a formal but friendly manner, and introduce marked variations in pace, pitch and stress.

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THE WORLD'S MOST SOUTHERN STATION.

The new station now being installed in the Antarctic contained on one of the South Orkney Islands, is believed to be the Southernmost station in the world.

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BROADCASTING IN RUSSIA.

The first wireless concert in Russia was transmitted from the Trade Union Hall in Moscow in December. The orchestra, which brooks no conductor, gave a performance which included Grieg's "Peer Gynt" suite, and the triumphal march from "Aïda."

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AMERICAN AMATEURS HEARD IN SWEDEN.

The signals of about sixty amateur radio stations in the United States and Canada have recently been heard in Sweden.

A BABEL OF CACOPHONY.

It is understood that all the 350 rooms of the new hotel building at Miami, Florida, will be fitted with loud-speakers.

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ELIMINATION OF INTERFERENCE.

In the weekly bulletin of the Radio Society of Great Britain broadcast from 2LO on March 12th, Mr. Maurice Child gave some valuable advice on the subject of selectivity and emphasised the importance of keeping the losses in the aerial circuit as low as is possible. A counterpoise of two or more conductors supported from five to eight feet above the ground under the aerial was recommended. This can be used either with or without the usual earth connection, as experience indicates. Useful advice was also given on the best methods of winding and using aerial tuning inductances and in "balancing out" disturbing signals.

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WIRELESS IN PARLIAMENTARY BUILDINGS.

A loud-speaker has been installed in one of the recreation rooms of the Storthing Building at Oslo, for the entertainment of Norwegian legislators. It is also understood that Lieut.-Col. Moore-Brabazon, the Paliamentary Secretary to the Ministry of Transport has had a receiving set installed in his private room in the Houses of Parliament.

CHANGE OF WAVELENGTH IN U.S.A.

It is understood that the wavelengths of all "B" stations in the United States will shortly be revised. We look forward to a time when the ever-changing wavelengths of that restless nation will have settled down to some degree of finality.

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PURITY OF REPRODUCTION.

Those who recall the raucous-voiced utterances of the earlier loud-speakers, should not fail to attend the demonstrations of power and quality in the amplification and reproduction of speech and music given at the Ideal Home Exhibition by the Marconiphone public speech amplifying equipment. The equipment is used primarily to amplify the music of the Royal Air Force Band in the main hall at Olympia and to relay it into the small hall and the vestibule of the Hammersmith Road entrance.

Provision is also made at Olympia for broadcasting such B.B.C. programmes as may be available when the band is not playing. In this way the chimes of Big Ben often resound throughout the exhibition. These famous chimes have quite a fresh significance in the Ideal Home Exhibition. They add to the charming atmosphere of the Hamlet of Heart's Desire, so that visitors might well imagine the village clock striking the passage of a peaceful and perfect day.

A corner of the Ideal Home Exhibition showing the way in which the loud-speakers are arranged for the distribution of band music and broadcasting.

INTERNATIONAL RADIO TELEGRAPHIC CONFERENCE.

The Council of the Radio Society of Great Britain desires to see the Society strongly represented at the International Radio Telegraphic Convention to be held during Easter week in Paris. It will be one of great interest and importance. Special arrangements for members of the transmitter and relay section have been made to secure adequate travelling and hotel accommodation at a moderate and inclusive charge.

Any member wishing to join the party should lose no time now in writing to the Hon. Secretary, the Transmitter and Relay Section of the Radio Society of Great Britain, 53, Victoria Street, London, S.W.1.

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NEWSPAPER'S DEBT TO AMATEUR TRANSMITTERS.

Two amateur transmitters saved the situation at Decatur, Illinois, recently, when the *Decatur Herald* was completely deprived of telegraphic communication with the outside world owing to heavy snowstorms. In a moment of inspiration the wireless editor of the newspaper got in touch with a local amateur, Mr. Mark Spies, of the A.R.R.L., who in turn communicated with Mr. W. C. Fowler, of St. Louis. In this way relay working was established, and for two nights both the operators worked "nine-hour watches," supplying five "front page stories." These appeared in the *Decatur Herald* under the heading, "By Amateur Radio."

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LOCATING INTERFERENCE FROM POWER SUPPLY.

Amateurs in Stamford, Conn., were for a long time troubled with interference believed to be due to high power lines of the local lighting company and the railway system. Eventually members of the Plate and Grid Club installed an eight-valve super-heterodyne receiver on a motor car and set out to locate the source of trouble, visiting first those sections of the city where interference was known to be serious. Most of the trouble was found near poles supporting transformers. It was found that the signal strength was *not* as pronounced while the car was running parallel to the power lines, as when passing through side streets at right angles. About half-a-dozen bad leaks were discovered and reported to the respective companies, with the result that the interference no longer exists.

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BROADCASTING IN MALAYA.

The Singapore Radio Society invites applications for membership, not only by those having expert technical knowledge, but also those interested in broadcasting. The society will endeavour to afford practical help to all interested in wireless, to promote broadcasting, and to provide lectures and demonstrations.

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SHORT WAVES IN BROAD DAYLIGHT.

Mr. J. L. Reinartz, of South Manchester, Conn., has succeeded in transmitting signals across the Atlantic in broad daylight on a wavelength of twenty-one metres. at 10 a.m., Eastern Standard time. The signals were picked up with great reliability by Mr. F. A. Mayer in Wickford, Essex.

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MISTAKEN IDENTITY.

Under correspondence in our issue of last week a letter appeared from a correspondent in Weybridge who signed "A Radio Engineer since 1912." Mr. W. J. Crampton, M.I.E.E., a well-known resident of Weybridge, and also a radio engineer of long standing, has received a number of communications from persons who attribute the authorship of the letter to him. Mr. Crampton disclaims all knowledge of the letter and is not in sympathy with all the views expressed therein.

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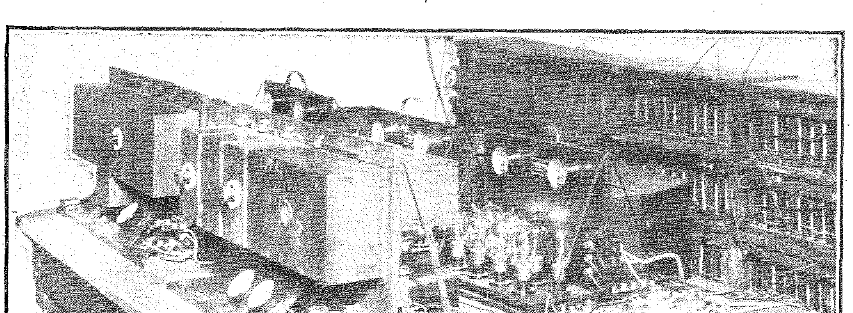
NO LICENCED SWISS TRANSMITTERS.

Mr. John Gysin, of Switzerland, informs us that, up to date, no amateur licences for transmission have been granted in Switzerland, and, therefore, it is incorrect to state that the "9" series belongs to that country. It is hoped that the first transmitting licences in Switzerland will be granted within the year.



[Courtesy Marconiphone, Ltd.

The amplifying equipment used in conjunction with loud-speakers installed at the Ideal Home Exhibition.

FLOOD WARNINGS.

Arrangements are being made in Germany to broadcast warnings to towns in danger of sudden floods. Powerful loud-speakers will be placed in official buildings for this purpose.

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BROADCASTING PARLIAMENTARY DEBATES.

The vexed question of the advisability of broadcasting Parliamentary debates is not confined to England. The Massachusetts House of Representatives recently rejected a motion to install a transmitting device in the State House, in spite of the protest that voters have a right to know what goes on in the General Court.

In Sweden, also, three separate motions were made at the recent opening of the Riksdag to broadcast the debates. Similar proposals may be expected in other Parliaments.

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HARD-WORKED OPERATORS.

The use of wireless between ship and shore continues to grow. Passengers now avail themselves of its services not only for business correspondence, but even for the ordering of flowers to meet the steamer on its arrival.

The White Star liner "Majestic" during 1924 received and sent over 35,000 messages, totalling 750,000 words, an average of 3¼ words per minute throughout each voyage, a considerable increase on her record for the previous year.

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8NA.

Mr. B. W. Warren, 2APG, referring to the mention in *The Wireless World* of February 18th, of the transmissions of the station 8NA on 370 metres, states that he heard this station, strength R4, with a single valve receiver a 10.45 on the morning of January 18th.

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VOLUME XV.

Binding cases and indexes are now available for volume XV, which was completed with the issue of February 4th, 1925, and can be obtained from the Publishers, Iliffe & Sons Ltd., Dorset House, Tudor Street, London, E.C.4, at a cost of 2s. 10d., post free.

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FINE TUNING DIALS.

We are informed that Messrs. Gaston E. Marbaix, of 27-28, Anning Street, London, E.C.2, are British agents for the Accuratune Dial referred to in the recent article describing methods of obtaining fine tuning.

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NEW R.I. REPRESENTATIVES.

Our Midland readers may be interested to know that Messrs. Radio Instruments, Ltd., have appointed the following representatives:—For Manchester and District: Manchester Radio Co., Ltd., 155, Oxford Road. For Liverpool District and North Wales: B.N.B. Wireless, Ltd., 65, Renshaw Street, Liverpool. For Bradford District and the Northern District of Yorkshire: Frank Riddiough & Sons, Westgate, Bradford. For Sheffield District, South Yorkshire and North Lincolnshire: C. E. Needham, Bros. & Sons, Change Alley, Sheffield.

AN INTERVALVE TRANSFORMER.

A Design for Experimental Work.

The writer shows how an efficient transformer may be constructed with the minimum of trouble and with an expenditure of very little labour. By the method described below the actual time taken in winding 16,000 turns was only 40 minutes. Only ordinary tools are required, the winding being done with a hand brace.
The construction of the transformer is ideal for experimental purposes, owing to the ease with which various ratios and inductance values may be tried.

By A. R. TURPIN.

THE main points to be remembered in transformer design are as follow:

(1) Primary impedance to be large compared with that of the valve after which it is used.

(2) Gauge of wire to be comparatively heavy in order to prevent burnt-out primaries.

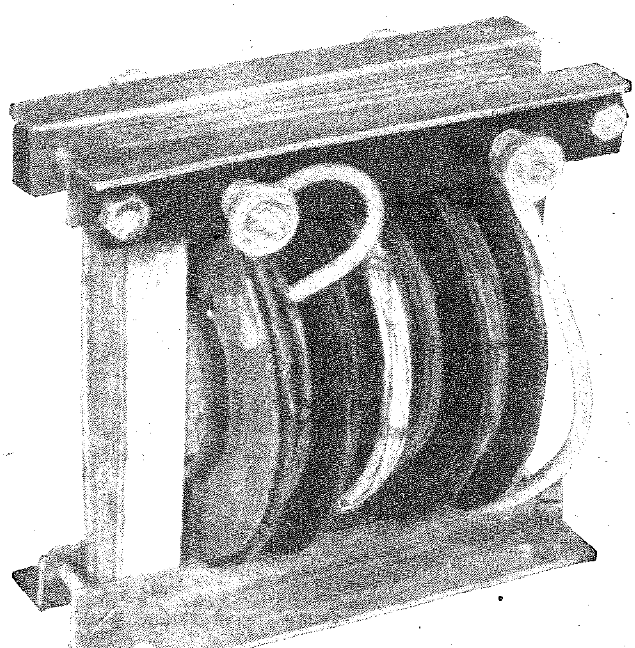
(3) Core to have a large cross-section.

(4) Low capacity between windings.

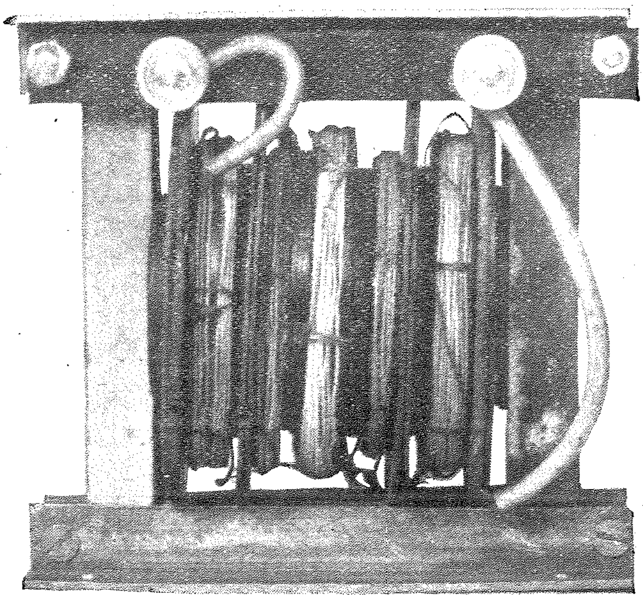
(5) Low capacity between turns.

For those who wish to build a good transformer without experiments, a design is described later, but for the amateur who wishes to try the effect of different ratios and turns, the procedure is as follows:

First, it is necessary to wind a number of slab coils. To do this, a former will be needed, which is constructed as in Fig. 1. The two large discs are of $\frac{1}{4}$in. ebonite



Another view of the transformer, showing the arrangement of the core and ebonite terminal strips.



Front view of an experimental intervalve transformer.

or fibre, and measure 3in. in diameter. They should be of this thickness, otherwise, as the slot fills with wire, they will bend outwards, which is fatal. A third disc is cut from the same material $1\frac{1}{4}$in. in diameter by $\frac{3}{16}$in. thick for large coils, and $\frac{1}{8}$in. thick for smaller ones. These three discs are bolted together with a 2 B.A. rod, as shown. Six equally spaced slots are now cut with a hack saw to within $\frac{1}{2}$in. of the centre, and the whole fixed in the chuck of a hand brace.

Winding the Coils.

The first operation is to fix the brace firmly, in such a manner that it will not work loose; the writer suggests that the horizontal handle be removed and two flats filed on the boss into which it screws, these flats being gripped between the jaws of the vice, as indicated in Fig. 2. With a large vice the frame may be gripped bodily by the jaws.

The next point to consider is the spool containing the wire, which is No. 44 enamelled copper.

One of the chief difficulties in winding fine wire coils is the continual breaking, but if the amateur follows the following instructions there is no reason why a coil should not be wound without a break. The spool must be allowed to rotate easily, but not too freely, and this may be arranged by the following method:

A 2 B.A. hole is drilled in the work-bench in line with the slab coil former and at a distance of about 18in.

If it is preferred not to drill a hole in the bench itself, a piece of hardwood clamped down firmly in any manner that may suggest itself will serve equally well for drilling. Into this hole screw a length of 2 B.A. rod, and on the rod slide a 2 B.A. brass bush, flange upwards. The spool holding the wire is placed over the spindle, and everything is now ready to start winding.

A short length of No. 30 silk-covered wire should be soldered to the fine wire, and the joint covered with

An Intervalve Transformer.—

thin waxed paper. Sufficient thick wire should be allowed to wind one layer. Having proceeded so far, the fine wire should be allowed to run between the first finger and thumb of the left hand, keeping a very slight pressure upon it, and it should be guided backwards and forwards slowly across the former, so that the wire will not bank up on one side or the other.

The best position to hold the wire is about 4in. from the centre of the former and slightly below it, as suggested by Fig. 2. An important point to note is that when it is necessary either to start or stop winding, the increase or decrease in speed with which the handle of

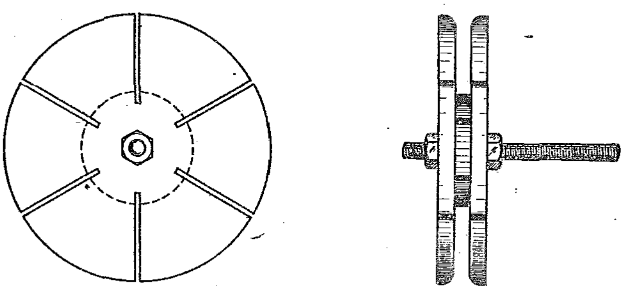


Fig. 1.—Construction of the former for the slab coils.

the brace is turned should be very gradual. The experimenter should not try to work too fast to begin with, for a large number of turns may be quickly put on. With the usual ratio of gears used, 1 to 4, sixty turns of the handle per minute will give 240 turns of wire a minute, or 3,000 in thirteen minutes.

When the coil has been wound to the required diameter, a further length of stout wire should be soldered on, and a whole layer of this wound and fixed by winding the end between two of the slots.

Remove the former from the brace and with a needle and thread bind the coil firmly by passing the needle through the space in the bottom of the slots and then over the top; repeat this two or three times in every slot.

Now put the coil and former in a bath of paraffin wax and allow to remain for about fifteen minutes. When the wax has set, but is not quite hard, remove the coil from the former. Then stick a strip of thick paper on the inner face of the coil.

It is suggested for experimental purposes that four coils having an inside diameter of $1\frac{1}{4}$in., an outside diameter of $2\frac{5}{8}$in., and a thickness of $\frac{3}{16}$in., and three coils with an inside diameter of $1\frac{1}{4}$in., an outside diameter of $2\frac{1}{2}$in., and a thickness of $\frac{1}{8}$in., be constructed. A finished coil is illustrated in Fig. 3.

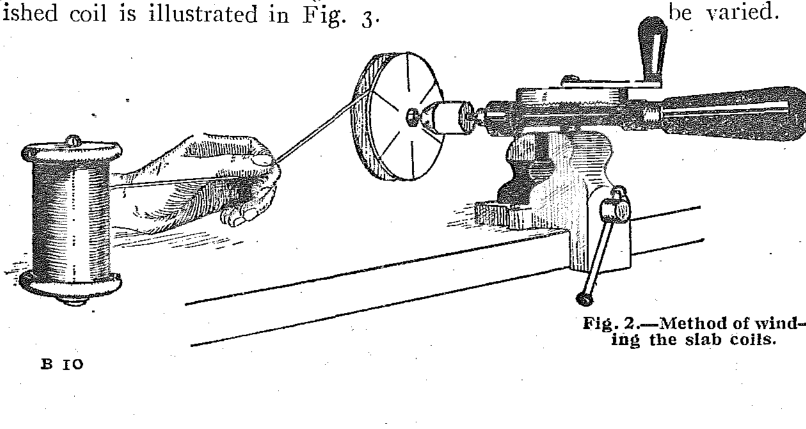


Fig. 2.—Method of winding the slab coils.

If these sizes are adhered to, a standard size of transformer core stamping may be utilised when the best turns, ratio, etc., have been experimentally decided.

Having constructed these coils, an experimental core must be constructed. This is made as shown in Fig. 4.

Cut off a length of ebonite tube $3\frac{1}{2}$in. long having an inside diameter of about $\frac{3}{4}$in., and fill with soft iron wires. Drill a hole in a piece of hardwood 4in. square, and into this fit the end of the core. Then cut up some small squares of wood or ebonite to act as spacers.

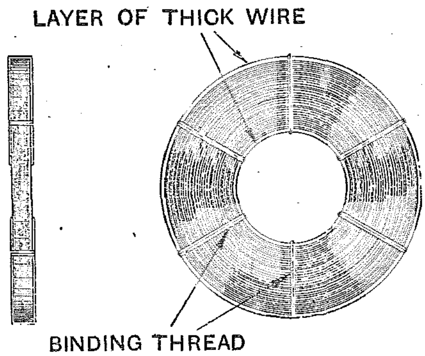


Fig. 3.—A complete slab coil.

Now, suppose we wish to try out a transformer having a primary of 3,000 turns and secondary of 12,000. Place over the core a large slab coil, then a spacer, followed by a small coil, spacer, large coil, spacer, small coil, spacer, large coil. Join all the large coils together, being sure that the windings all run in the same direction, and treat the small coils in a like fashion.

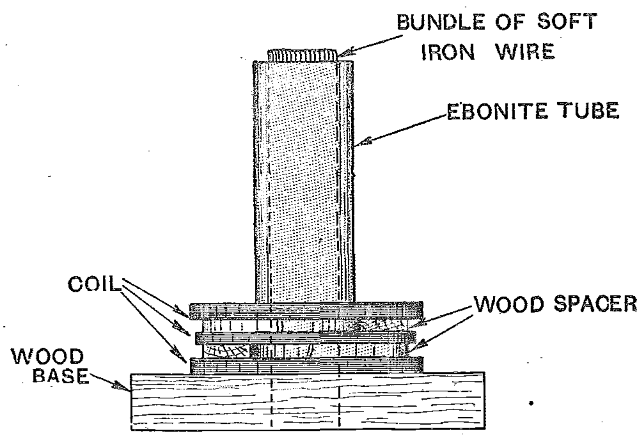


Fig. 4.—A trial transformer, having an open core of soft iron wires.

A number of experiments may be tried. For instance, the spacing and hence the capacity between coils may be varied. Likewise the position between primary and secondary coils, the number of turns, etc.

It may be seen also that choke coils of various inductances may be tried out in a few moments.

Having decided on the best type of transformer, the windings should now be mounted on a closed core, and for those who wish to built a transformer for use without experiment, that shown in Fig. 5 (if following a D.E.3 type of valve with an impedance of about 20-15,000 ohms) will be found excellent.

An Intervalve Transformer.—

The particulars are as follow:

For the secondary, three coils, 1½in. inside diameter, 2¾in. outside diameter, $\frac{3}{16}$in. thick, each containing about 4,000 turns No. 44 enamelled wire.

For the primary, two coils, 1½in. inside diameter, 2½in. outside diameter, ⅛in. thick, each containing 2,000 turns No. 44 enamelled wire.

Assembling the Transformer.

The core consists of about thirty-six pairs of No. 4 Stalloy stampings, which may be obtained from Joseph Sankey and Sons, Ltd., 168, Regent Street. These are placed into an ebonite tube 1¼in. inside diameter and 2⅜in. long until they are tightly packed, taking care that the white insulated sides all face in the same direction.

It is, of course, necessary to mount the coils on the tube before assembling the core, and this should be done in the following manner: First, put on a large ebonite washer 1½in. inside diameter by 2¾in. outside diameter and $\frac{1}{16}$in. thick; then a large coil; next a spacer $\frac{5}{16}$in. long cut from a piece of ebonite tube of sufficient inside diameter to slip over the tube covering the core; now a small coil, a ¼in. spacer, a large coil, a ¼in. spacer, a small coil, a $\frac{5}{16}$in. spacer, a large coil, and a large washer. The large coils should be joined together for the secondary winding, and the small ones for the primary, the ends being brought out to terminals mounted on a strip of ebonite as shown in Fig. 5. The core is now clamped with iron or brass brackets, and the windings may be encased in celluloid for appearance.

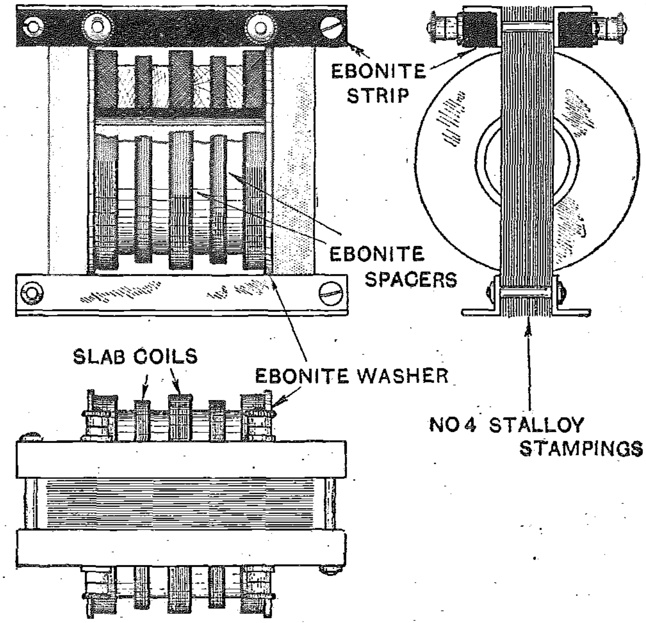


Fig. 5.—Details of the intervalve transformer illustrated.

Book Reviews.

WIRELESS VALVE RECEIVERS IN PRINCIPLE AND PRACTICE.* By *R. D. Bangay* and *N. Ashbridge, B.Sc.*

The name of R. D. Bangay is so well known as a sound writer on wireless subjects that his latest contribution, a book entitled "Wireless Valve Receivers and Circuits," written in conjunction with N. Ashbridge, will very naturally attract special attention.

The aim of the book has been to put the wireless amateur in possession of the necessary theoretical knowledge to enable him to follow intelligently what happens in the various circuits with which he may experiment.

To cover the subject in a book of twelve chapters, the authors have set themselves a task of no mean order, but so much care has been taken to eliminate all unnecessary padding that the little volume as it stands contains a vast amount of well-expressed information on every page, and its value will be appreciated by amateurs whose acquaintance with the theory of wireless reception and the operation of different types of circuits may require revision or strengthening. It must not be thought, however, that the book is merely theoretical. On the contrary, the authors have dealt with their subject in an essentially practical manner, and have evidently borne in mind that almost every wireless enthusiast of to-day takes a very practical interest in his hobby.

The book contains over seventy diagrams, all of an essentially practical character, and has a well-compiled index which facilitates reference. Price 2s. 6d. net.

TUNING COILS AND METHODS OF TUNING.* By *W. James.*

Much has been written on the subject of winding tuning coils, but most of the text books which have come to our notice merely give constructional methods and formulæ and assume too much technical knowledge on the part of the reader.

In this book the author not only describes the practical method of winding all kinds of tuning coils, but explains clearly and concisely the problems to be considered in each type and their comparative advantages and disadvantages. The elementary principles relating to resistance, capacity and inductance are explained, and numerous formulæ and useful tables are given in the opening chapters. The well-known charts for finding at once the values of capacity and inductance to tune to a given wavelength or vice versa are reproduced.

Full details with explanatory diagrams and photographs are given of the construction and method of winding single-layer, bank-wound, honeycomb, duolateral and basket coils, with practical advice upon their respective merits and various methods of mounting. The different systems of tuning are also fully discussed and profusely illustrated with diagrams and curves. The book is priced at 2s. 6d. net.

THE HOME CONSTRUCTOR'S EASY TO BUILD WIRELESS SETS.* By *F. H. Haynes.*

In this eminently practical book the author writes from his personal experience for the benefit of the amateur who wishes to construct an inexpensive and efficient receiving set, but may not possess the high skill and mechanical facilities of the professional instrument maker. The home constructor who follows the very lucid directions given may feel assured that he will not come up against a job requiring any special apparatus or any extraordinary skill in the construction.

The six designs given comprise a simple crystal set, a single-valve set, note magnifier, three-valve set, H.F. amplifier, and detector valve set, and a power amplifier, which have all been specifically prepared for this book, and have not hitherto been described in journals. The function of each component is plainly stated, so that the amateur may fully understand its use and appreciate its correct relation to the other parts.

A complete list of all the material required is given for each receiver, so that the constructor may easily estimate the cost, and the valuable advice on details of construction by one who has made these sets with his own hands will enable him to avoid or overcome any practical difficulties he may encounter. The book is offered at the reasonable price of 1s. 6d. net.

(*Published from the offices of "The Wireless World" by Messrs. Iliffe and Sons Ltd.*)

Broadcast Brevities

NEWS FROM THE STATIONS.

A Wrong Idea.

Considerable misconception still exists over the licence fee, and some listeners who have indoor aerials think that their is no need for any licence. A correspondent whose landlord prohibited the erection of an outdoor aerial voices his complaint in a letter to the B.B.C. There is no doubt as to the correspondent's bona fides, but, like many others, he was mistaken in thinking that the licence fee was for the aerial and not for the receiving set.

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A New Idea.

It has been suggested that a subscription list should be opened to enable listeners who wish to hear only the best artists to contribute something towards the enormous cost. Apart from the fact that the B.B.C. cannot under its contract with the Postmaster-General obtain additional funds in this way, the question arises whether listeners might not become surfeited with star casts night after night. The novelty would quickly wear off.

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The New Wireless Bill.

M.P.'s are being bombarded with protests concerning the right of search proviso in the new Wireless Bill. By a curious coincidence it is estimated that more than sixty per cent. of the protests, so far as they can be tabulated, come from districts in which it is known that evasion of the payment of licence fee is already practised.

De Groot.

On Sunday afternoon, March 22nd, De Groot will broadcast from the Studio at 2LO for the first time. He has always hitherto been transmitted from the Piccadilly Hotel.

On the same day Wagner will be broadcast by the British National Opera Company from Manchester Station.

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Foreign Listeners.

Steps will presently be taken to clarify the position as regards foreign listeners. The situation is becoming critical, particularly in respect of the Irish Free State, where listeners are paying the Post Office a licence fee of £1 and the Free State Post Office simply puts the money in the till and does nothing for it.

It is believed that the majority of listeners in Belgium and France also spend a great part of their time listening to 2LO programmes, and there seems to be need for an International Conference to straighten things out in the interests of both the Post Office and the B.B.C. exchequers.

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Two Sets—One Licence.

The Postmaster General informed a correspondent last week that he does not at present see any objection to two or more wireless receiving sets being used "by the same family and at the same address under one licence."

The official tendency a year ago was to make each receiving set a separate item for which a licence fee was necessary, the argument being that while father listened by means of the dining-room set daughter Angelina and her betrothed would be whiling away the time in the drawing-room with another set, either as the reason or the excuse for their isolation. But there is some sentimentalism in the official heart after all, and in some circumstances a family might be entitled to ten or a dozen sets. I have heard of an enthusiast in the Thames Valley district who has a receiving set—either crystal or valve—in each of the eleven rooms of his house. He is getting a cheap ten shillings' worth.

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Beware!

The B.B.C. wishes to warn the public that persons representing themselves as B.B.C. inspectors are calling on owners of receiving sets, and attempting to get possession of them on the pretext of overhauling, standardising, and so forth.

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Tetrazzini.

Prior to her appearance before the microphone, Mme. Tetrazzini, with her manager and accompanist, paid a visit of inspection to the studio at 2LO to "sense" the atmosphere. In voluble French she expressed her admiration of the artistic arrangement of the studio and the preparations which were then being made for her broadcast performance. "C'est épatant," she cried. "It will fill me with happiness to sing to all those dear people."

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Radio Drama.

Apropos last week's Brevities on the need for a new technique for Radio Drama, a few points might be of use to aspirants for dramatic honours.

The best length for plays at present is that which occupies about half-an-hour in transmission. "Triangle" or "Sex" plays are not required. Good adventure, melodrama, mystery or dramatic comedy plays are acceptable. Dream situations are capable of broadcasting well if carefully handled.

Several points should be borne in mind. Elaborate stage directions as to

Madame Tetrazzini, with a Burndept receiver, listening to broadcasting.

setting, placing of doors, tables, windows, etc., are useless. Players have to be arranged in the studio to conform to certain technical limitations and requirements, so that their positions when speaking may bear no relation whatever to the story. A slight indication of the type of room or building is helpful, *e.g.*, a bachelor flat, a restaurant, etc. Similarly, scenic description can be slight: "A seashore in Devon," "A railway station," etc., is sufficient.

Gestures and looks cannot be transmitted, so the character must say something about everything that is required to carry on the story. As an obvious illustration, the villain, instead of glancing furtively at the telephone, must mutter as an aside, "Ha! the Telephone!" In general, the dialogue must give a "pointer" to every occurrence or situation—to the gathering storm, the approaching footstep, the entry of a character and the discovery of documents revealing the conspiracy.

Sound effects can largely replace scenery. Sea coasts, ships' decks, railway trains, restaurants, etc., can be indicated by "effects," as also can some actions, *e.g.*, the launching of a boat, arrival of a coach or motor, or even the dispensing of a whisky and soda.

Generally, would-be writers of Radio Drama will have to scrap present ideas very largely if they wish to impress listeners. But to those who succeed there is a wide field for effort, and, as Radio Drama develops, it will be found that their reward is not incommensurate with their efforts.

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FUTURE FEATURES.

Thursday, March 19th.	
London, 7.35 p.m.	Chamber Music.
Manchester, 8.30 p.m.	The Halle Orchestra: Conductor, Hamilton Harty. S.B. to 5XX.
Aberdeen, 7.35 p.m.	Popular Evening.
Friday, March 20th.	
London, 7.30 p.m.	Popular Concert.
Cardiff, 7.30 p.m.	Women's Night.
Manchester, 7.30 p.m.	An Evening of Variety.
Glasgow, 7.30 p.m.	Clan Campbell Night.
Saturday, March 21st.	
Cardiff, 7.30 p.m.	Pre-War Reminiscences—II. Relayed to 5XX.
Newcastle, 7.30 p.m.	Popular Concert.
Sunday, March 22nd.	
London, 3 p.m.	De Groot and the Piccadilly Orchestra. S.B. to other Stations.
London, 9 p.m.	Ballad Programme.
Birmingham, 3 p.m.	Classical Programme.
Cardiff, 9 p.m.	"The Song of Miriam" (Schubert).
Manchester, and 5XX, 9 p.m. ...	Wagner Programme by the British National Opera Company. S.B. to other Stations.
Glasgow, 9 p.m.	"Art in Italy."
Monday, March 23rd.	
Bournemouth, 8 p.m.	Winter Gardens Programme
Glasgow, 7.30 p.m.	"In Days of Old."
Tuesday, March 24th.	
5XX, 7.30 p.m.	Casano's Octet.
All Stations except 5XX, 7.30 p.m.	A Ballad Opera: "The Red Pen."
Wednesday, March 25th.	
London and 5XX, 7.30 p.m. ...	Popular Classics.
Birmingham, 7.30 p.m.	Operatic Programme.
Cardiff, 7.30 p.m.	Early Italian Opera.
Cardiff, 8.30 p.m.	A Few Welsh Favourites.
Manchester, 7.30 p.m.	*Band of the Prince of Wales' Volunteers.*
Glasgow, 7.30 p.m.	"Where the West Begins."
Belfast, 7.30 p.m.	Symphony Concert.

Parliamentary Proceedings.

Negotiations are proceeding for broadcast talks explaining in popular language Parliamentary proceedings from week to week. These talks will, it is expected, be delivered by a well-known Member of the last Parliament, and if his verbal descriptions are as entertaining as his pen has proved in the past, listeners should find in his talks much entertainment and amusement.

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An Incorrect Statement.

The wireless correspondent of a Sunday newspaper introduced his week's Notes with the following flourish:—

"Crystalites are the backbone of wireless, and at present exempt from P.O. licence. This may not be for long, but ought to be for ever. Ten shillings is a real tax on a poor man who enjoys a little music after supper, but is nothing to the proud possessor of valves, H.T., and accumulators."

"Crystalites" on reading the above paragraph no doubt lifted up their voices and cried a fervent "Hear, hear," but unfortunately for them the *obiter dicta* was too good to be true.

Whether wireless has a backbone, and whether "Crystalites" possess that anatomical distinction or not, they should not be under any misapprehension as to their alleged exemption from payment of the Post Office licence.

As for the rest of the paragraph, we are reminded of John Henry's little story of a man who was complaining about having to spend ten shillings for his year's entertainment. "How much time," said a friend, "do you spend on your newspaper each day?" "Oh, about an hour," was the reply. "Well, you pay 25s. a year for that, don't you? What are you jibbing for over ten shillings for many hours of entertainment every day of the year?"

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"Evening Standard" Broadcast Concert.

The excellent musical programme given under the auspices of the *Evening Standard* must have afforded great delight to a widespread multitude of appreciative listeners.

Madame Tetrazzini's marvellous voice naturally requires the reverberation of a concert hall or opera house to get the full charm of its wonderful tones, which were somewhat damped by the heavily curtained studio. Her perfect intonation and easy execution of the most florid passages were indeed a joy to hear, but it must be admitted that the tender notes of Madame Butterfly's aria were lost in the receiver, and, on the whole, the reproduction of the flute-like passages in her rendering of "O luce di quest' anima" was more satisfactory from a purely acoustic point of view.

Madame Tetrazzini's last group of songs in English was especially charming, and her singing, as was to be expected, was characterised by evenness of tone throughout its great range and absence of tremolo.

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A Reminder.

Many people are reporting to the B.B.C. that their aerials are charged with static electricity, particularly during snow and hail storms. Listeners are reminded that they should earth their sets when switching over.

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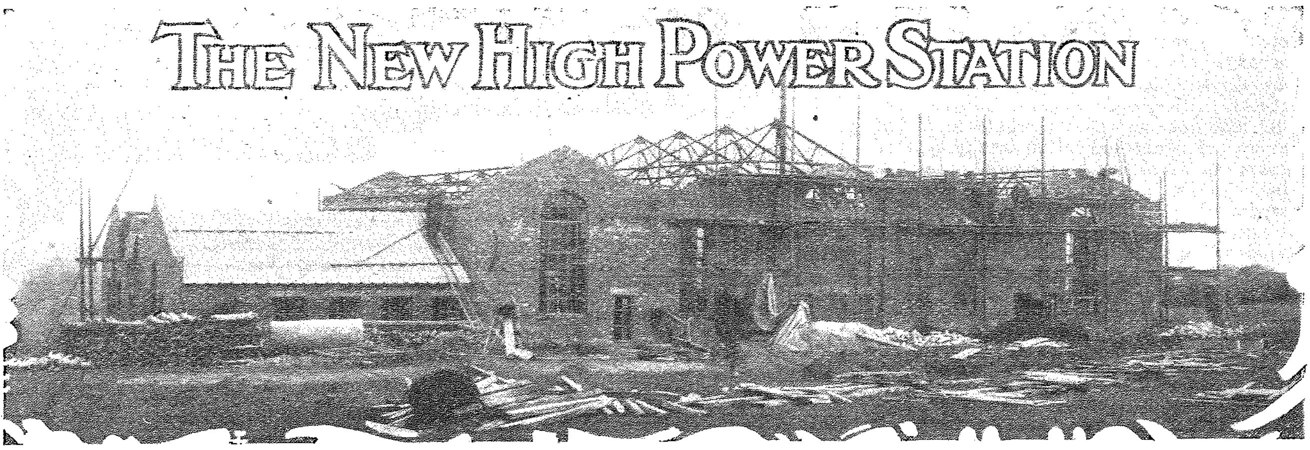
Daventry.

Although the new high-power station at Daventry is not expected to be ready for two or three months to come, Mr. Rex Palmer, who is adding to his multifarious duties as Station Director of 2LO the directorship of the new station, is already getting busy on the arrangement of Daventry's work.

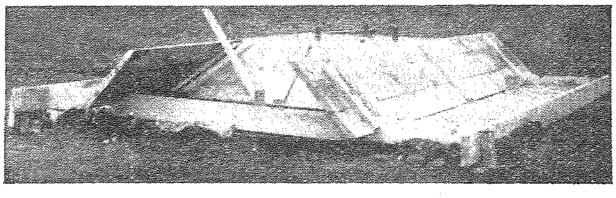
Artists in London areas will be dealt with by the new Station Director, and it is fitting, therefore, that Mr. Palmer should combine the duties of director of both stations, thereby securing co-ordination.

THE NEW HIGH POWER STATION



At Work on the Daventry Broadcasting Station.

THE development of broadcasting in this country is rapidly moving ahead, and the high power station of which mention has already been made is beginning to take a definite form. Our representative, on the occasion of a recent visit to Daventry, found that the central buildings were already nearing completion, as is evident from the illustrations on this page, whilst the foundations for the masts will soon be ready to receive the steel mast sections, and several of the anchorages for the guys are either marked out or already in place.



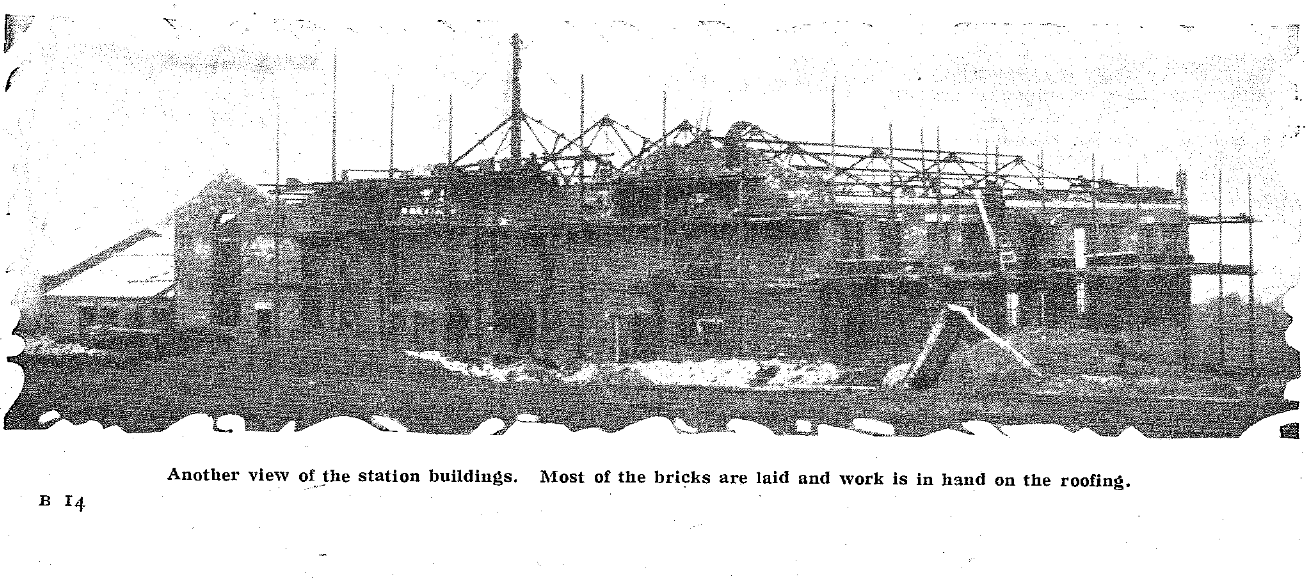
One of the mast foundations. The bolts to which the base plate is to be attached are seen projecting. The boards are used, of course, to hold up the cement faces during setting.

On approaching the site from the main London to Birmingham road, the station is seen to be located nearly a mile from the roadway, on the high ground which is known as Borough Hill, and history tells us that it is here that once stood the tree which appears in the Common Seal of Daventry, and from which the town derived its ancient name of "Daintree." A light railway with petrol locomotives has been laid from the main road to the top of the hill for the purpose of transporting building materials.

The station building, of which most of the brickwork is completed, is to consist of a main central hall for the accommodation of the wireless equipment proper, with the power house on one side and on the other the workshop. The battery and instrument rooms, studio and offices are in the form of extensions from the main building and can be seen in the illustrations as that part of the building in which the roof is already completed.

The aerial will be carried by two steel lattice masts 500ft. in height. As the station buildings are situated midway between the two masts, a "T" aerial will be employed and the aerial wires will be of cage formation. The distance between the masts is 800ft., and a matter of interest is the fitting of lamps reflecting vertically into the sky at the top of each mast as a guide to aircraft.

The earth screen will consist of a number of elevated wires running out in all directions to a distance of 100ft. from the central building.



Another view of the station buildings. Most of the bricks are laid and work is in hand on the roofing.

NEWS from the CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Croydon Wireless and Physical Society.

At the last meeting of this society Mr. Camplin delivered an interesting lecture on "The Design of Experimental Wireless Receivers." The lecturer dealt with the essentials to be aimed at in designing wireless receivers, and exhibited circuits of one, two, and three valve sets which he found gave most satisfactory reception. A useful discussion followed, after which a hearty vote of thanks was accorded the lecturer. The secretary announced that the next lecture would be by Mr. P. G. A. H. Voigt on "Dual Amplification."

Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

Norwich and District Radio Society.

The second of the series of fortnightly meetings arranged by this society was held on Tuesday evening in the Colman Room, Y.M.C.A., St. Giles Street, Norwich. The proceedings on this occasion took the form of a lantern lecture which, by the courtesy of the Igranic Electric Company, was delivered by their representative, Mr. Goss.

Basing his remarks upon the fact that the quality of a receiver is neither better nor worse than the quality of its components, the lecturer proceeded, with the aid of some descriptive slides, to deal exclusively with the merits and otherwise of various coils and their peculiar uses in connection with alternative circuits. Not the least interesting perhaps were his concluding remarks and pictures showing photographs of some of the machines, with close-up views, in the actual process of coil winding.

Radio Society of Highgate.

At a meeting of the Radio Society of Highgate, held at the Highgate 1919 Club on February 26th, Mr. E. B. C. Kerry gave an interesting lecture on "Loud-speaker reception of broadcast, with three different types of Amplification." Mr. Kerry briefly described his apparatus, which was built on the unit system, enabling easy changes of circuit. The lecturer deplored the use of reaction on the aerial for reception of local broadcast, and said that in most cases the chief cause of distortion emanated from its misuse. He emphasised the need for pure rectification, and that was only obtained by working the detector valve on the proper part of its characteristic curve, the best point being obtained by the use of a separate high-tension battery. He then demonstrated a 2-valve transformer-coupled amplifier, pointing out the need for grid bias. In a further demonstration of choke-transformer and transformer-choke amplifiers, the members were able to judge for themselves the difference in quality of the reproduction. Mr. Kerry gave some interesting details of the types of valves best suited for the methods of amplification, and recommended one of the latest types of power valves now on the market. His remarks on the acoustic properties of various loud-speaker horns were of great interest, and his statements were amply justified by the excellent reproduction of the orchestral pieces played by the B.B.C.'s London station on a loud-speaker embodying his own improvements.

A 2-valve resistance-coupled amplifier loaned by Mr. G. A. V. Sowter gave a further comparison. Mr. Sowter explained that he considered that resistance amplification was best used with a crystal rectifier.

Application for membership to this society should be made to the Hon. Secretary: Mr. F. J. W. Squire, 31, Harvey Road, Hornsey, N.8.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 18th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green. "High Frequency Currents and Electrical Wave Production." Lecture and Demonstration. By Mr. Maurice Child.

THURSDAY, MARCH 19th.

The Radio Society of Highgate.—At 8 p.m. At Highgate 1919 Club, South Grove, Highgate, N.6. Surprise Evening.

Derby Wireless Club.—Reinartz Circuit with Demonstration. By Mr. Allwood.

Luton Wireless Society.—At 8 p.m. At the Hitchin Road Boys' School. "Esperanto—the International Language for Radio." Lecture by a Member of the British Esperanto Association.

FRIDAY, MARCH 20th.

T. and R. Section, Radio Society of Great Britain.—At the Institution of Electrical Engineers, Victoria Embankment. "Mystery Debate."

Sheffield and District Wireless Society.—At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture. By Mr. J. Hollingworth.

TUESDAY, MARCH 24th.

Liverpool Co-operative Association.—At 137, Oakfield Road, Liverpool. "Short Wave Reception." By Mr. H. Hardy.

WEDNESDAY, MARCH 25th.

Manchester Radio Scientific Society.—Open Evening.

Radio Society of Great Britain.—At the Institution of Electrical Engineers, Victoria Embankment. At 6 p.m. "Testing and Measurement of Wireless Components." By Mr. P. K. Turner.

Streatham Radio Society.—At Streatham Hill College, 35, Streatham Hill Road, S.W. "Direction Finding." By Mr. A. G. King.

Nestanglo Radio Society.

On February 19th the Nestanglo Radio Society received a visit from Captain Plugge, B.Sc., who gave an interesting address on "Continental Broadcasting Stations."

At the meeting on February 26th the society held an experimental night, when Mr. G. Harrison, one of the members, demonstrated a two-valve set of his own construction, whilst other members brought sets for testing and criticism.

On Thursday, March 5th, a most enjoyable talk was given by Mr. J. E. Nickless, A.I.E.E., on "Early Detectors and Short Wave Reception."

Hon. Secretary: Mr. J. H. D. Clark, 6-8, Eastcheap, E.C.3.

TRANSMITTING NOTES.

20 to 40 Metres.

Mr. G. Marcuse, hon. secretary of the T. & R. Section of the Radio Society of Great Britain, wishes to call attention to the fact that very few amateurs in this country are as yet licensed to carry out experiments on a wavelength below 80 metres, and he therefore hopes that Mr. Laurence Manning, whose letter appeared under "Correspondence" in the issue of the 11th March, will have a little patience, after which it is hoped that the necessary licences will have been obtained and definite arrangements for short wavelength tests will become possible.

Across the Atlantic on Two Watts.

Mr. C. L. Naylor, G5SI, sends a report of successful two-way working across the Atlantic on 2 watts.

G2NM on Indoor Aerial in Australia.

A report from New South Wales states that G2NM was heard there on January 19th with two valves on an indoor aerial.

Forthcoming Transmitter Meeting.

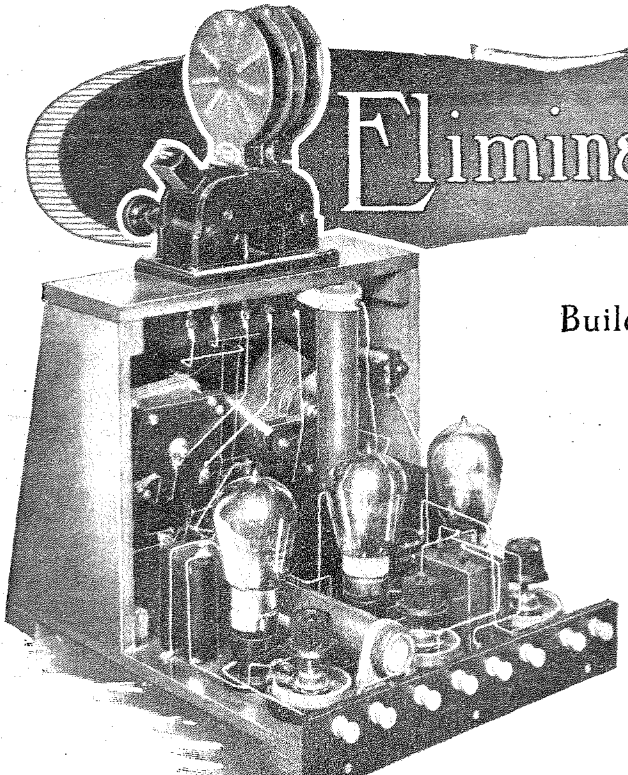
What is termed a "Mystery Debate" will be held by the T. & R. Section of the R.S.G.B., on March 20th, at the Institution of Electrical Engineers. It is hoped that all members will make arrangements to attend for this meeting of special interest.

Long-Distance Work with America.

The American fifth district stations have been coming in well here, even after full daylight, and work has been done with 5UK later than 8 a.m.

Mr. Schnell, 1AW, who is now working almost every night at 0030 G.M.T. on 75 and 40 metres, is heard well on both of these wavelengths. Mr. Schnell is shortly leaving America for Australia, when he will take his set with him.

Eliminating Distortion



Building a Resistance Coupled Tuner-Amplifier.

The considerations governing distortionless reception were discussed in the previous issue and this instalment gives the constructional details for building a receiver designed to operate a loud-speaker, maintaining a maximum of purity of reproduction.

By F. H. HAYNES.

(Continued from page 148 of the previous issue.)

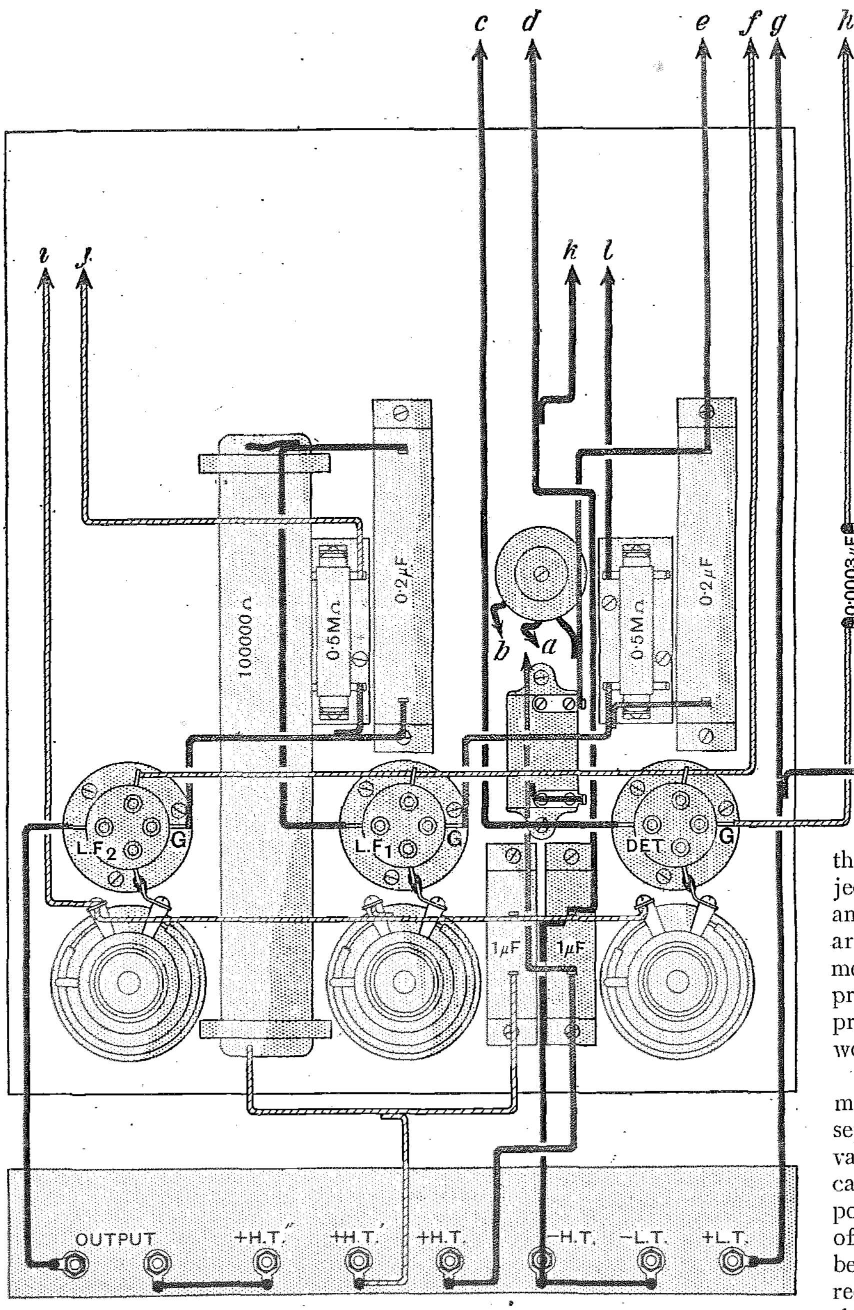
THE Front Panel.—In the process of construction, the instrument is built up as two units, each of which is completely wired after assembly. Thus, the front ebonite panel carrying the switches and tuning condensers must be built up and wired as if it were a complete instrument in itself. The panel must be accurately squared up, as it forms a basis around which the woodwork is subsequently to be built, and any small discrepancy as regards squareness will cause trouble in the making of the wooden container. The ebonite used can be purchased finished with a special matt surface, which not only obviates the necessity of rubbing down, but produces an appearance superior to that which can be obtained by other finishing processes. The positions for the centres are given, though the setting out of the holes for securing the condensers must be done with the templates supplied with these components. If only one tuning condenser is used owing to the closed circuit being dispensed with, its centre should be $2\frac{3}{4}$in. down from the top edge and equidistant from the two sides. Referring to the switches, when the reaction reversing switch is abandoned alternative positions are shown for the aerial tuning switch and the switch for the closed circuit. When the closed circuit is omitted, and only one condenser dial and a single change-over switch are carried by the front panel, a good appearance can be obtained by balancing this switch with the press-button, which is fitted to break the filament circuit. In the front view of the instrument, the closed circuit tuning condenser is on the left, as this dial receives less attention than that used for tuning the aerial circuit, which is placed on the right for easy manipulation with the right hand. The aerial terminal is on the left, as is usual. The aerial tuning switch is on the right beneath the aerial tuning condenser, with the closed circuit switch on the left and reaction reversing in the centre.

The wiring of the front panel is shown separately, so that it can be completed but for the leads which link to the remainder of the apparatus on the baseboard, these being left sufficiently long for the purpose. A connector strip is made use of for joining the flexible wires from the coil holder to the stiff internal wiring of the set, and is merely a piece of ebonite screwed to the woodwork and carrying six 4 B.A. screws, which may be driven into tapped holes or held in position with back nuts. A pair of tags under each screw for connecting the wires will be found particularly convenient, should it be necessary to reverse the leads to the coil holder, or, on the other hand, the entire coil holder can be removed without disturbing the arrangement of the internal leads.

The Baseboard Apparatus.—The components carried on the baseboard must be arranged to be clear of the equipment of the back of the panel, and using the parts listed in the previous instalment, the dimensioned baseboard layout can be adopted. An endeavour has been made to arrange the apparatus so that the wiring will be as short and direct as possible, and it will be seen that the components forming each of the amplifying stages are similarly arranged excepting that the anode resistances are set up at right angles to each other to avoid interaction between the magnetic fields which surround them. Anode resistances of the type shown are not entirely non-inductive, and, if assembled side by side, may cause the low-frequency circuits to break into self-oscillation. It might be mentioned, also, that great care must be taken with regard to the wiring to maintain perfect insulation and moderately low capacity and inductive effects between the leads, for, as compared with transformer coupling,

Eliminating Distortion.—

these matters become of utmost importance. The necessity of using grid coupling condensers having mica as a dielectric has already been mentioned, and these will have to be specially made up for the purpose, as suitable mica condensers cannot be purchased. A supply of small transmitting condensers should be procured from a dealer in ex-Government material, which, on melting out the wax, will be found to consist of a number of sections connected in series. One type which was used in the trench transmitting set contains ten sections giving a total capacity of about 0.002 mfd. Each section will, therefore, have a value of ten times 0.002 mfd., and the entire ten sections connected in parallel will have a capacity of one hundred times 0.002 mfd., and be suitable for our purpose. Another type of transmitting condenser which is available and a product of the Dubilier Company, has a capacity of 0.01 mfd., and is designed to withstand 20,000 volts when used in commercial type spark transmitters. When the wax has been melted out, twenty sections will be found, each having a capacity of 0.2 mfd. The condenser to be used should be mounted up in a box made from thin tin plate fitted up with connecting tags and sealed in with wax or pitch. Other simpler methods of mounting will readily present themselves.



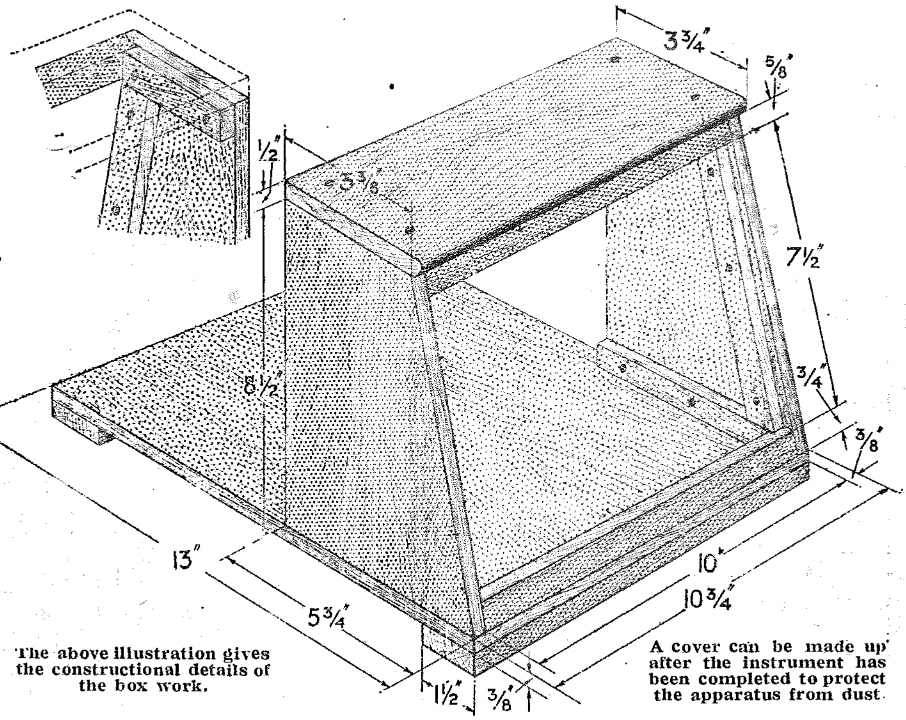
Practical wiring diagram of the base board. *a*, end of Zenite resistance to include 100,000 ohms in circuit; *b*, tapping point resistance at 50,000 ohms; *c*, reaction coil circuit; *d*, earth potential side of tuning circuits; *e*, reaction coil return lead; *f* and *g*, break-switch leads in filament circuit; *h*, grid lead from tuning circuits; *i*, and *j*, grid cells for second amplifier; *k* and *l*, grid cells of first amplifier. The grid condenser may be short circuited and the leak disconnected from the positive side of the filament battery so as to give a negative bias on the grid of first valve, a condition which may be found to produce greater signal strength in a resistance coupled circuit.

The Box Work.—The baseboard is best constructed from planed $\frac{3}{8}$in. mahogany, with grain parallel to the longer dimension. Cross battens about 1in. wide are needed on the underside to prevent warping, and should be screwed and glued into position. The side pieces which support the platform to which the coil holder is attached are, of course, higher than the depth of the panel, so that the components will not foul the baseboard, and a good appearance is obtained by inserting wooden strips above and below the panel. The coil holder platform projects over the front of the instrument and its edges are rounded. Vertical filets are used for attaching the panels by means of four screws, and these should provide for leaving the face of the panel projecting about $\frac{1}{16}$in. above the woodwork.

Operation.—When connecting up it may not be found necessary to apply separate H.T. battery potentials to each valve circuit, for final regulation can be carried out by adjusting the grid biassing potentials. The detector valve may be of the D.E.5 type if the receiver is to be used in an oscillating condition. For receiving from a local station, however, the use of reaction should be avoided, and the necessary selectivity obtained, if required, by use of the closed circuit. In this case the first valve should be a D.E.5.B, and a test should be made with the grid leak connected straight across the

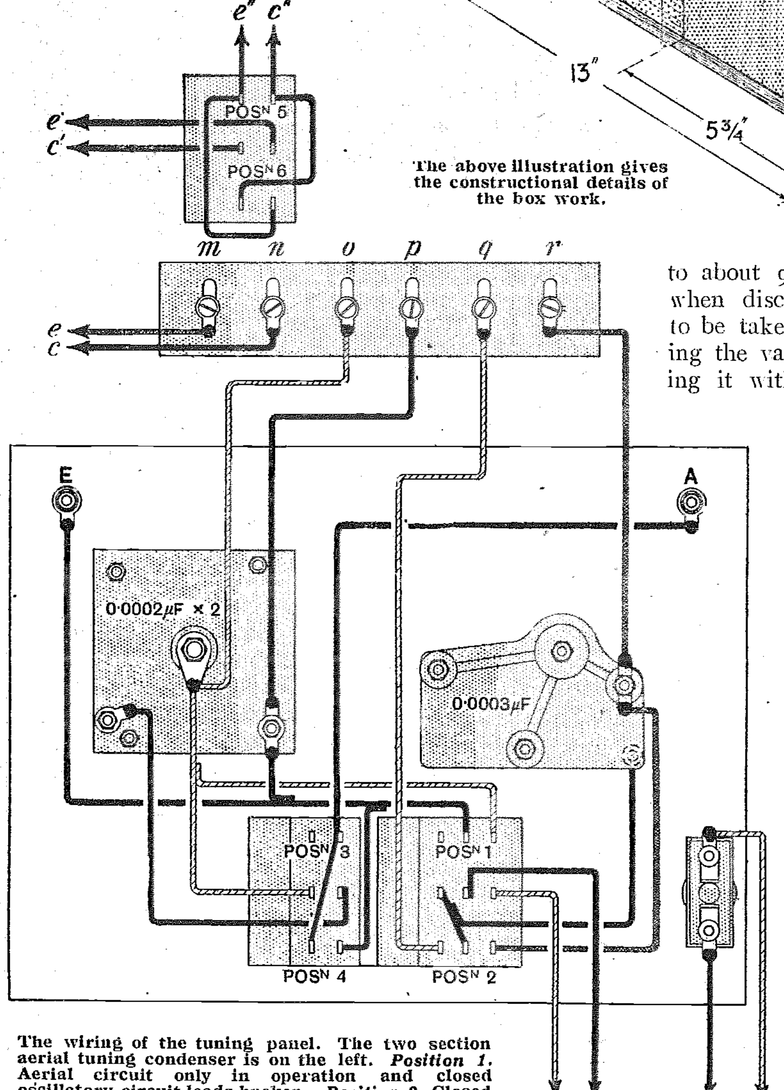
Eliminating Distortion.—

grid condenser. The second valve is a D.E.5.B and the third a D.E.5. The set will work quite well and give good amplification with a voltage of 100 and grid biassing batteries of only one or two cells, though it will probably be found better to operate the set with a couple of hundred volts to every valve (assuming the first to be a D.E.5.B with grid leak across the condenser and picking up contact with the *minus* side of the battery), and introducing grid bias up



The above illustration gives the constructional details of the box work.

A cover can be made up after the instrument has been completed to protect the apparatus from dust.

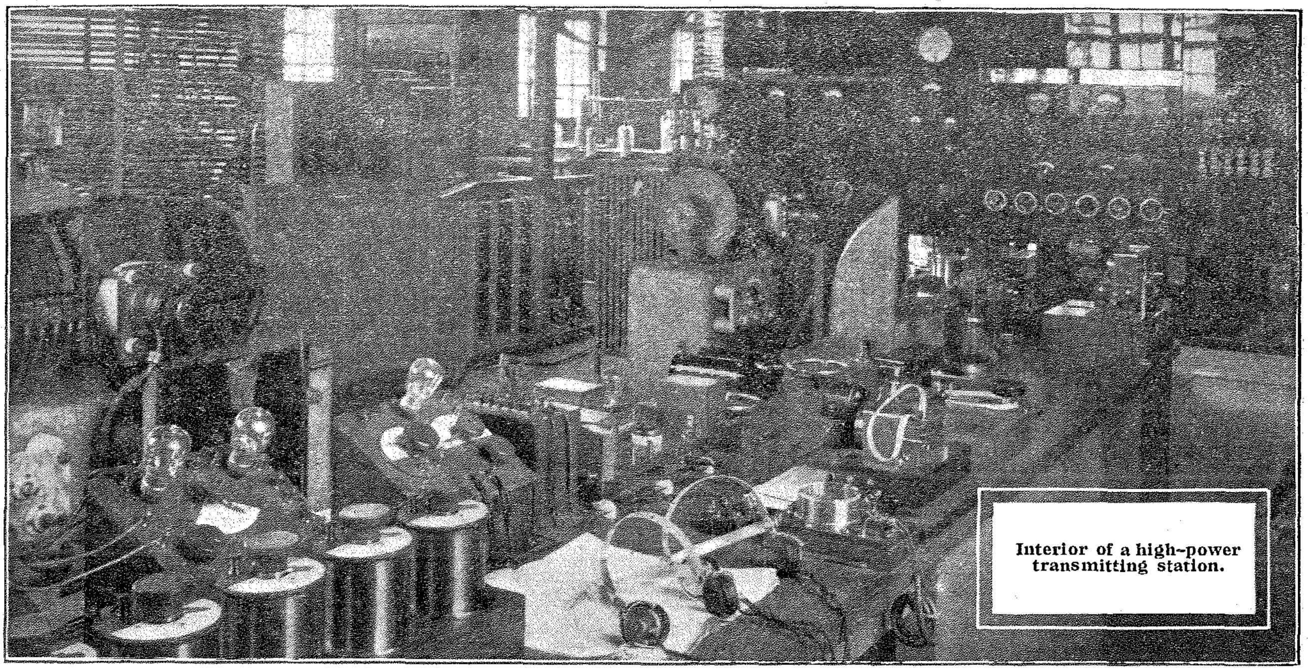


The wiring of the tuning panel. The two section aerial tuning condenser is on the left. *Position 1.* Aerial circuit only in operation and closed oscillatory circuit leads broken. *Position 2.* Closed circuit in action for selective reception. *Position 3.* Sections of the aerial tuning condenser in series and parallel with the tuning inductance. *Position 4.* Both sections in parallel across the inductance. *Positions 5 and 6.* Reaction reversing switch, connected between lead *c* and *e* of terminal strip and base board. *m* and *n*, reaction coil. *o* and *p*, aerial coil. *q* and *r*, closed circuit coil.

to about 9 volts. Reference has already been made, when discussing the circuit principle, as to the steps to be taken to bring about oscillation, either by reducing the value of the first anode resistance or by shunting it with the secondary of an intervalve transformer.

Results on Test.

Tested at a distance of 12 miles from 2LO good loud-speaker reproduction was obtained using a single wire "L" aerial 50ft. in length and about 32ft. in mean height. The reaction coil socket was short-circuited with a double-ended plug, and reception on the closed circuit was, if anything, slightly stronger than with the direct-coupled circuit. When direct-coupled, a Gambrell "C" coil (equivalent to a "75") was used for aerial tuning, whilst on switching over to the closed circuit, results were improved by connecting the aerial condensers in parallel with a "B" coil (or "50"), and inserting the "C" coil in the closed circuit coil-holder. Birmingham (5IT) was also tuned in at moderate strength, and Cardiff (5WA) weakly without the use of reaction. With the reaction coil in operation most of the European stations have been heard at sufficient strength for loud-speaker work, while on the short wavelengths with coils "a2," "a," and "A," American amateur Morse transmissions can also be read. With telephone receivers several of the American broadcasting stations have been heard at sufficient strength to be intelligible, while KDKA, Pittsburg, Pennsylvania, comes in well on the short wavelength of 68 metres.



Interior of a high-power transmitting station.

INTERFERENCE.

PART II.

Discussion of a Type of Interference Set Up by Local High-power Stations.

By N. W. McLACHLAN, D.Sc.(Eng.), M.I.E.E., F.Inst.P.

WHEN a continuous wave telegraph station is transmitting signals in the Morse code, a series of clicks can be heard in near-by receivers, these corresponding to the make and break of the current in the transmitting aerial.

The click is caused by the sudden rise and fall of the current through the phones corresponding to make and break at the transmitter. A simple mode of simulating key clicks is to put a pair of telephones (high resistance type or low resistance with transformer) in series with a battery and an interrupter. Let the interrupter be set to give clean breaks at ten per second. A series of clicks will be heard at make and break, these corresponding to the sudden current changes in the telephone receiver.

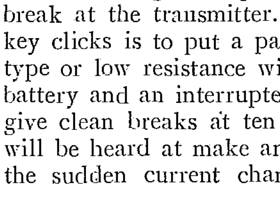


Fig. 1.—Simple circuit for studying key clicks.

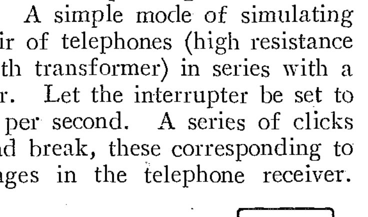


Fig. 2.—Valve circuit for studying key clicks. The battery may be replaced by an A.C. source and the valve set to rectify.

Now insert a resistance of, say, 30,000 ohms (a valve will serve the purpose) in series with the phones, and increase the battery voltage to give the same steady current as before. The initial clicks will become more severe, since the current rises more rapidly, owing to the augmented value of R/L. If a high inductance of *small resistance* is inserted to replace the high resistance, the clicks will be less severe, since R/L is less than before and the current grows more gradually. With the customary class of telephone there is not only the effect of the rising and falling current, but in addition the impulsing of the reed or diaphragm. This occurs at the beginning and end of a dot, *i.e.*, at make and break. The natural frequency of the diaphragm is generally masked by the sound of the click.

Magnitude of the Clicks.

The magnitude or abruptness of a click depends on the rate of rise and fall of the current, *i.e.*, upon the wave-form of the modulation. In a circuit similar to the one considered here, the wave-form will be akin to that shown in Fig. 3.

A more rectangular profile can be obtained by using a shunted condenser circuit similar to that illustrated in Fig. 1. A perfectly rectangular *current* wave-form is only possible when the telephones have zero inductance or capacity. The *voltage* wave-form is obviously rectangular under the preceding conditions.

A closer approximation to receiver conditions can be secured by putting the phones in the anode circuit of a rectifying valve and using either A.C. or D.C. to operate on the grid of the valve, as illustrated in Fig. 2. Finally, to study the circuital effects in key clicks, an

Interference.—

actual transmitter must be used, although a model is serviceable. There are, of course, no difficulties in studying the key clicks from any near-by station on one's own receiver. By using a circuit with variable selectivity, the intensity of the click can be controlled. The higher the selectivity, the less the click.

The Wave Band.

In an analysis of certain classes of interference, it is extremely useful to consider the "wave band" or spectrum of the interfering signals. By aid of this artifice it is fairly easy to obtain a mental picture of the action of the interference upon the receiver. Since the problem of "wave band" is of great importance in both radio telegraphy and telephony, a detailed treatment will be given without recourse to mathematics.

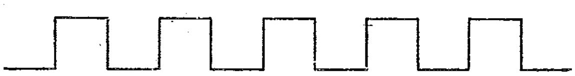


Fig. 3.—Rectangular modulation of telegraph transmitter devoid of time lag.

It is common knowledge that between wave lengths of, say, 500 to 1,000 metres, only a limited number of stations can work. It might be argued that, by increasing the selectivity of the receivers, preserving a constant wavelength, and cutting out harmonics at the transmitter, the number of stations would be increased appreciably. Unfortunately, this argument is based on an erroneous hypothesis. When the current in a transmitting aerial varies, the result is equivalent to modulation of the carrier or main wave of the station. The alteration in current also yields shock excitation of the aerial, which varies in degree according to the rate at which the current alters. The result is to create both the fundamental and partial oscillations of the aerial. The presence of a loading inductance, shortening condenser or both, is to make the relationship of these oscillations depart from the usual sequence 1, 3, 5, 7, *i.e.*, the partials are not integral multiples of the fundamental. These oscillations, caused by shock excitation, die away in accordance with the decrements of the aerial for the fundamental and partial frequencies under consideration.

In broadcasting, for example, the modulation is really a succession of transients, so that both transmitting and receiving aerial are continually being mildly shock excited.

Over and above these "excited" oscillations there are others due to what may, for the sake of convenience, be referred to as modulation.[1] Everyone knows that the audio modulation of a broadcasting station is concomitant with "side frequencies," *i.e.*, if the carrier wave has a frequency of 10^6 and the highest audio frequency is 8,000, the wave band of the station is $10^6 \pm 8{,}000$ cycles, *i.e.*, 16,000 cycles. We have now to deal with this wave band in telegraphy. Take the simple case of a station sending regular dots at fifty per second (about 130 words per minute). When the wave-form of the modulation is plotted, it consists of a series of rectangles as shown in Fig. 3. The vertical strokes represent the make and break of the voltage on the oscillator. The aerial current is assumed to attain its maximum and zero values at the respective moments when the transmitting key is closed and opened respectively.

In practice this is, of course, impossible, owing to electromagnetic inertia, for the current cannot attain its maximum value immediately the voltage is applied. This is depicted in Fig. 4. When the modulation of the transmitter is regular and recurrent, *i.e.*, it is periodic, it can be analysed by Fourier's theorem. The analysis shows that the carrier wave can be considered to be modulated by oscillations of the following frequencies: 50, 150, 250, 350, etc., *ad infinitum*. The wave-form of the modulation is determined by the phases and relative amplitudes of the harmonic constituents. Moreover, the wave band of any telegraphic transmitter having regular modulation is infinite in extent.

The Effect of the Receiver.

Coming now to the receiver, the aerial is excited by a carrier wave modulated by the audio frequencies 50, 150, etc. If the receiver were such that the frequencies had the *same amplitudes and phases* as those at the transmitter, the voltage variations on the grid of the rectifier (assuming a simple aerial and detector valve) would be

Fig. 4.—Current wave-form of modulation in transmitting aerial—slightly exaggerated to show the effect of electromagnetic inertia.

similar to those of Fig. 4. Such a receiver would obviously be distortionless. Owing to selectivity and tuning at the receiver, the amplitudes of the side frequencies—especially those more remote from the carrier—are reduced in intensity and *altered in phase*, thereby altering the wave-form of modulation. Furthermore, additional frequencies are added in general, due to the curvature of the rectifier [2] characteristic, although with a strong heterodyne the amplification is almost linear. It is these modulation frequencies which cause key clicks. The more faithful the reproduction of the incoming signals at the receiver, the greater the key click. A receiver of low decrement will attenuate a large number of the side frequencies and alter their phases so that the signal profile is rounded. The effect of the rounded signals is to cause the current in the phones to rise and fall much more gradually, as depicted in Fig. 5. It can also be shown that with the irregular modulation encountered in telegraphic communication the wave band is infinite in extent. In practice, however, the width of the *received* band can

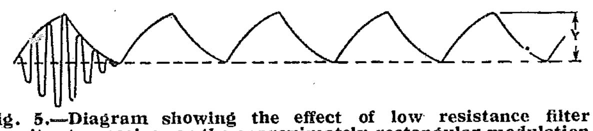


Fig. 5.—Diagram showing the effect of low resistance filter circuits at a receiver on the approximately rectangular modulation at the transmitter. When all but the fundamental side frequency are extinguished the curve is sinusoidal. This applies to a sequence of regular dots. Under the latter condition the amplitude Y would increase from the beginning of the transmission until an approximately constant value was attained. It is to be understood that the above curve is merely the upper "envelope" of the radio frequency oscillations, *i.e.*, the lower portions of the oscillations have been omitted.

1 See *Experimental Wireless*, April, 1924.

2 The various band frequencies beat with each other.

Interference.—
be relatively narrow, since little energy is conveyed by harmonics of more than triple frequency [on dots at the speed of transmission].

Consider a station sending dots at fifty per second. If there is no local oscillator and the receiver is so selective that all the frequencies 150, 250, etc., are suppressed, a note of fifty per second will be heard, this being continuous. As the selectivity of the receiver is decreased, other frequencies, *e.g.*, 150, 250, are brought in, and the note becomes mixed until it sounds like a series of clicks when many frequencies are present and the phases are appropriate. This argument applies whether a local oscillator is used or not. In practice the local oscillator and rectifier make the matter complicated, as a numerical example will easily show. Let the carrier wave be 40,000 cycles, the local oscillator 42,000, and consider the effect of two side frequencies, viz., $40{,}000 \pm 50$ and $40{,}000 \pm 150$. There are in all six frequencies, namely, 42,000, 40,150, 40,050, 40,000, 39,950, 39,850. The result is that these six heterodyne each other and give the following beat notes: 1,850, 1,950, 2,000, 2,050, 2,150, // 100, 150, 200, 300, // 50, 100, 200, // 50, 150, // 100. After rectification there are ten different notes due to the interaction of the six high frequency waves. First we have the original 50 and 150, their doubles and difference. When a note filter is used, these are suppressed. There are also the notes $2{,}000 \pm 50$, $2{,}000 \pm 150$, and 2,000, these being equivalent to modulation of the beat tone by 50 and 150 cycles.

We have tacitly assumed the transmitter to have no harmonics, but this is seldom if ever true in practice. Moreover, the modulatory frequencies create subsidiary bands round each harmonic. In general, these are not serious, but are of more importance in telephony than in telegraphy, since the modulation characteristic in the former case extends over a very wide range (16,000 cycles).

GRID BIAS.

The Importance of Operating Amplifying Valves with a Suitable Grid Potential.

By G. H. WATSON.

THE necessity of a grid bias on audio-frequency amplifiers is realised by nearly every one at the present time, but very few really recognise the full importance of it.

Most experimenters have connected a condenser or resistance across the secondary of an audio-frequency intervalve transformer, and noted how it has toned down the loud notes, also how different values of resistance have produced varying results. The flow of grid current through a valve can be stated in terms of resistance across the secondary of a transformer.

The grid current-grid volts curve of an R valve using 80 volts H.T. was taken, and is as shown in Fig. 1 and Table I.

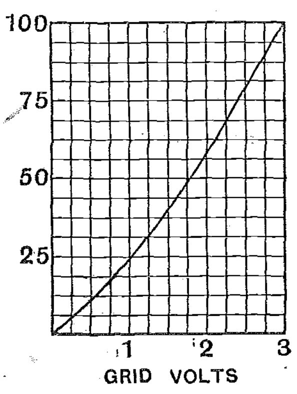


Fig. 1.—Grid volts-grid current curve for R valve.

Turning these readings into equivalent resistances across the secondary of the transformer, we get from $R = \frac{E}{I}$ the results of Table II. This table shows that the effective resistance is relatively low, and varies with the voltage of the grid.

It is very rare that a resistance of 45,000 ohms is ever intentionally placed across the secondary of a transformer.

With the grids of the audio-frequency valves at zero and a grid voltage swing of 6, the transformer secondary has no load across it for the negative swing, and a varying increasing load for the positive swing; distortion and weaker speech must occur. The effect of a resistance across the secondary of a transformer is equivalent to one T^2 times smaller across the primary. With a transformer having a turns ratio of 4–1, the equivalent resistance across the primary in the case considered would, therefore, vary from 3,000 to 2,000 ohms.

Thus the effect of allowing grid current to flow by employing an insufficient negative grid bias is to weaken the signals and to distort them. The grid bias should be

Table I.

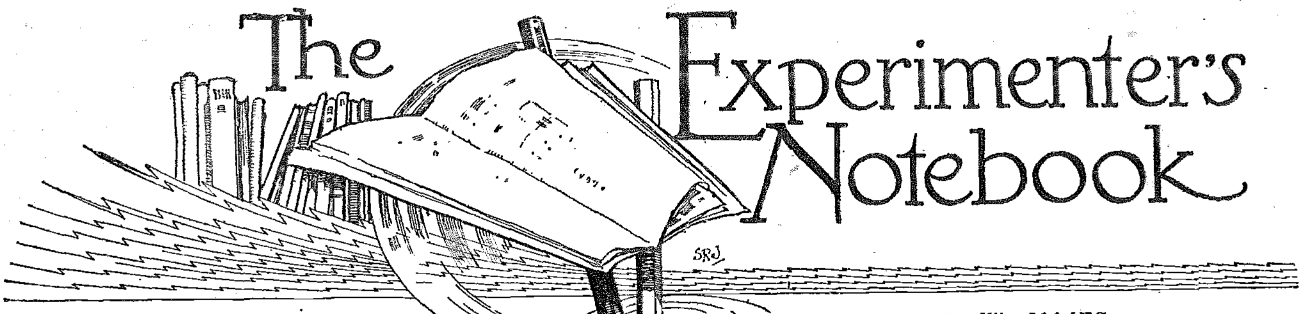
Grid volts.	Grid Current. Micro amps.
0	2
.5	11
1.0	24
1.5	40
2.0	60
2.5	88
3.0	100

Table II.

Volts.	Ohms.
0.5 =	45,000
1.0 =	41,000
1.5 =	37,000
2.0 =	33,000
2.5 =	28,000
3.0 =	30,000

of such a value that the grid cannot become positive. For loud speaker work it may be assumed that the voltage applied to the last valve of the amplifier has a peak value approaching 7 or 8 volts; the grid should therefore have a negative bias of 9 volts for safety.

It should be remembered that the voltage applied to the anode circuit must be increased to compensate for the grid bias; for instance, if the normal anode voltage is 60 for zero grid volts, and the amplification factor of the valve is 8, when a grid bias of negative 9 volts is employed the anode voltage should be increased by at least 9×8, or 72 volts.



The Experimenter's Notebook

By W. JAMES.

High-frequency Transformers.

IT would appear that of the various forms of coupling for high-frequency amplification, the method which consists of a tuned coil connected in the anode circuit of the valve coupled to the grid of the next valve by a grid condenser and leak (Fig. 1) is the most widely used. The popularity of this method no doubt is due to the fact that a coil of any of the plug-in types may be put in the anode circuit, and provided the coil is reasonably efficient, the good results of this method of coupling may be obtained. There is, of course, a lot to be said for a method of coupling which is effective and at the same time easily set up and operated, but yet this is no real reason why another method, with which it is possible to obtain better results, though perhaps at the expense of a little more trouble, should not be employed by those who like to feel that the best use is being made of the valves. The better method referred to is known as transformer coupling.

The construction of inter-valve high-frequency coupling transformers is fairly well known. The coupling has two windings, one being connected in the anode circuit of the valve, and the second winding in the grid circuit of the second valve. Sometimes it is necessary to tune one of the windings, occasionally to tune both, and when the tuning adjustments are not desirable, the transformer need not be tuned by a variable condenser at all.

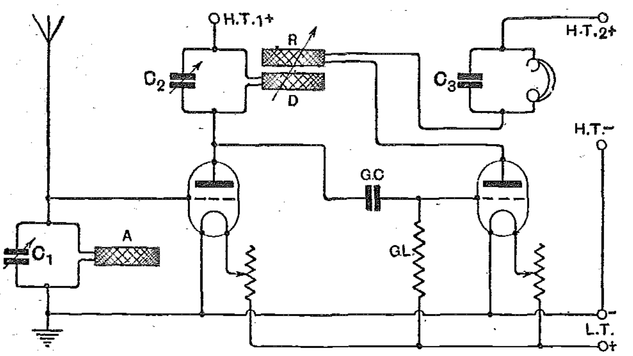


Fig. 1.—A receiver having one stage of H.F. (tuned anode) and valve detector. Usual values are: C_1, 0·0005 mfd.; A, No. 50 coil for B.B.C. wavelengths; C_2, 0·0002 mfd.; D, No. 75 coil; R, No. 50 coil; GC, 0·00025 mfd.; GL, 2 megohms; C_3, 0·001 mfd.

Two usual forms of high-frequency transformer are illustrated here. In the unit of Fig. 2, two windings are put on a basket-coil former. The method of constructing such a transformer is therefore extremely simple, as one of the ordinary basket coil type of windings may be employed. Both windings may be wound in the same direction, and be of the same gauge of wire. In the transformer illustrated, two gauges of wire are used; this was done to show clearly the separate windings.

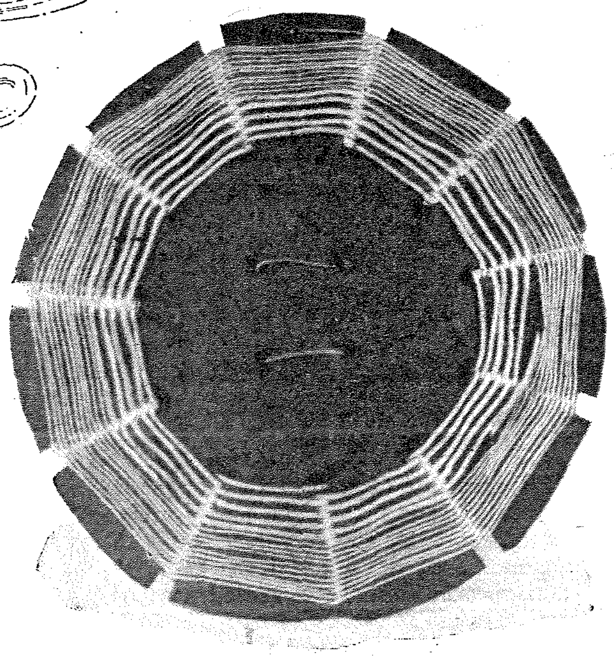


Fig. 2.—View of a high-frequency transformer having its windings on a basket coil former.

With transformers of this type, wound with, say, No. 26-30 D.C.C. copper wire, it is only necessary to connect a tuning condenser across one of the windings. This condenser then tunes the primary and secondary circuits quite as effectively as though separate tuning condensers were employed.

Another type of high-frequency transformer is illustrated in Fig. 3. This has two basket coils mounted a short distance ($\frac{1}{4}$in.) apart on a spindle of wood or ebonite. The coils may be wound with a mixed pitch if desired, to secure a tight coupling between them, or any of the ordinary styles of basket winding may be used; they may be wound on prepared cardboard or fibre formers, or on a metal former of the spoke type.

Transformers are connected in circuit as indicated in Fig. 4. In Fig. 4 we show two transformers,

The Experimenter's Notebook.—

T_1 and T_2. These are connected between the aerial and first valve, and the anode of the first valve and the grid of the second. Thus one stage of high-frequency amplification followed by rectification is obtained. The circuit of Fig. 4 shows two methods of adding reaction; the reaction coil may be coupled to the aerial transformer (T_1) as at R_1, or it may be coupled to the intervalve transformer (T_2) as at R_2. There is very little to choose between these two methods of employing reaction, although perhaps it is preferable to couple it to the aerial transformer.

This circuit is a very interesting and useful one, and merits further attention. We may have two similar transformers for T_1 and T_2, having their primary

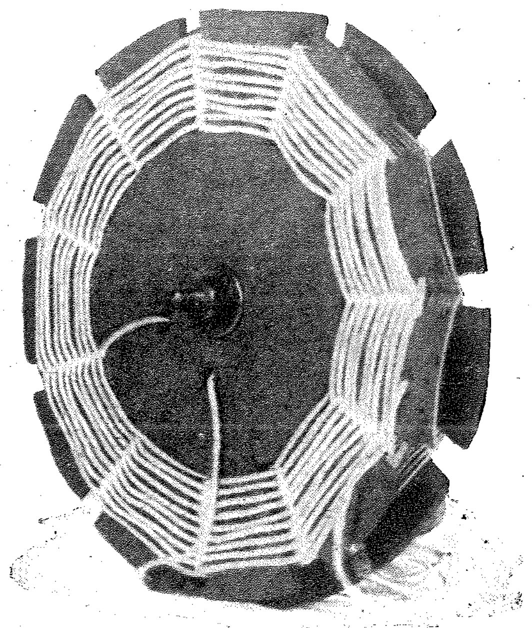


Fig. 3.—A high-frequency transformer consisting of two basket coils mounted on a spindle.

and secondary windings P, S, and similar tuning condensers, C_1 and C_2; then the condensers of these circuits will tune nearly alike. As the aerial is connected to T_1, the effective normal capacity across T_1 is greater than that across T_2, but the difference is not very marked when a large turn ratio is used. The second valve, being the detector, has a grid condenser and leak GC, GL, and the grid return wire is connected to the positive side of the filament battery. A cell, B, is employed to give the grid of the first (HF) valve a negative bias. Suitable values are indicated below the figure.

When the two windings are plug-in coils fitted in the sockets of an adjustable two-coil holder, it is advantageous to employ two tuning condensers as indicated in Fig. 5. Here the coils A and D are the primary and secondary coils of the transformer, which are tuned by two condensers.

The selectivity of a receiver with one stage of transformer coupled H.F. amplification depends a good deal on the design of the coupling transformer. If the windings are of fine wire of an equal number of turns and close together, the selectivity of the H.F. stage, taken by itself, is not very great.

To improve the selectivity of such a transformer we may employ a step-up ratio of turns (the secondary

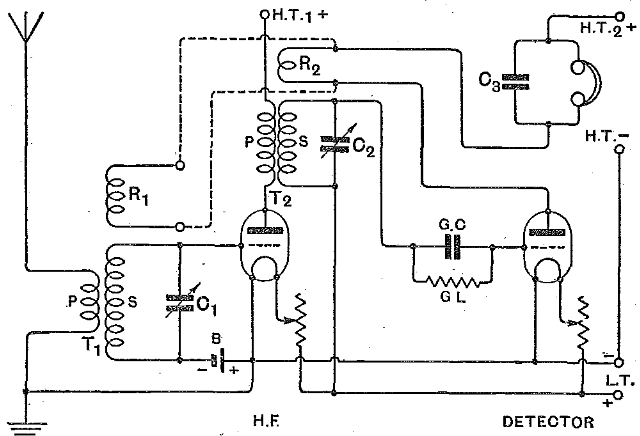


Fig. 4.—A receiver having one stage of H.F. (tuned transformer) and valve detector. Usual values are: T_1, T_2, P, 15–20 turns, and S, 40 turns, mean diameter 2·5 in.; C_1,C_2, ·0003 mfd.; GC, ·00025 mfd.; GL, 2 megohms; C_3, ·001 mfd.

having more than the primary), wind the coils with fairly thick wire, and space the windings. A usual turn ratio is two or three to one; that is, the winding connected in the grid circuit has two or three times as many turns as the primary. The best spacing of the windings should be found experimentally. Transformers of the type of Fig. 2 may have a distance of as much as ¼in. between the outside of the primary and the inside of the secondary. Those transformers with two distinct basket coils, such as that of Fig. 3, are easily adjusted while listening to signals; here, again, a spacing of ¼in. is about right for the B.B.C. wavelengths. With the arrangement of Fig 5 the selectivity may be increased to

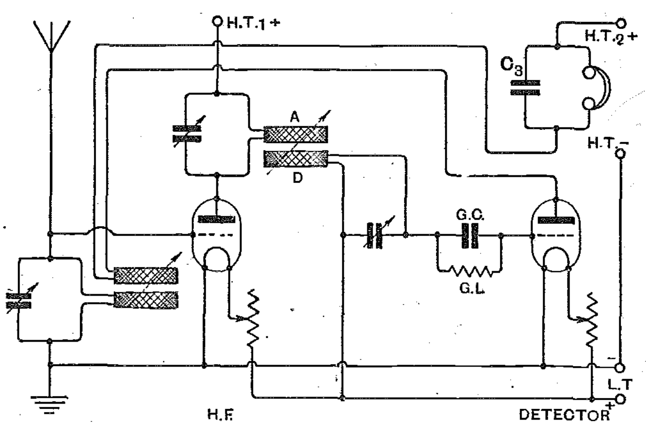
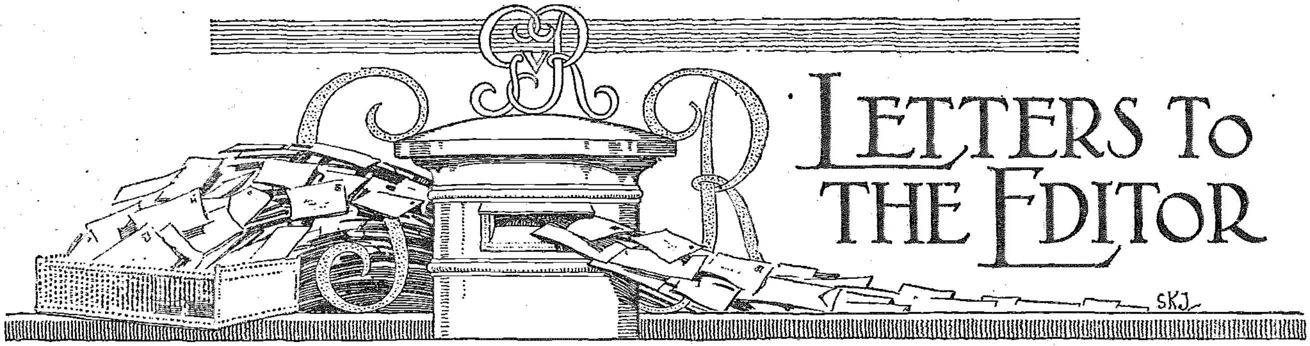


Fig. 5.—Connections when a loose-coupled H.F. transformer, A, D is employed, with reaction to the aerial.

the desired value by weakening the coupling of the coils.

Provided care is taken in the construction of the H.F. transformer, and the points mentioned above observed, it will be found that the selectivity and signal strength with one stage of transformer coupling is better than that when the tuned anode method of coupling is employed.



The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

SAFEGUARDING OF BRITISH INDUSTRIES.

Sir,—I think your correspondent is unduly alarmed at the prospect of foreign competition. I was offered German headphones nearly a year ago at 5s. a pair, but they were of poor quality and could have been duplicated in this country for less than 5s. if anyone cared to put down the plant to turn out such a rubbishy article. It is not, however, to be supposed that telephones can continue to be sold at 20s. a pair, or anything like it, because in view of the production methods now adopted this price cannot be justified. If the market were entirely closed to foreign firms, home competition alone would bring down the price very considerably.

Telephones are in a different category altogether to valves, because there is no firm holding vitally important patents. It appears to me that it should be quite possible now for British firms to market a presentable headphone to compete with a foreign article coming over here at 5s. a set. Unhappily, during the boom many people in the wireless industry have come to regard as normal and reasonable profits of many hundreds per cent. per article sold. This has led to great inefficiency, particularly on the selling side, as is evidenced by the wholesale price-cutting by retailers of proprietary articles. Any manufacturer who regards the Eldorado of the last two years as normal is doomed to a very bitter disillusionment, protection or no protection. A little less loose talk on exchange rates and a good deal more organisation would, I am sure, enable us to compete easily with any foreign competition that is likely to arise.

Personally, I consider an industry which can only subsist by robbing the public is of very little value to the nation, but an industry reared in the fierce blast of foreign competition is of inestimable value. JOHN KENNEDY.

Westminster, S.W.1.

ILLICIT USE OF CALL SIGN.

Sir,—Perhaps you could find space in your magazine to the effect that E. A. Wilson (6GM) will be pleased to forward a very favourable QSL card to the person who was using his call-sign on the evening of March 1st if that person will communicate with him. He would be pleased, however, if this illicit use of his call-sign was discontinued.

6GM has not been in operation since December 24th.

Roxburgh. E. A. WILSON (6GM).

THE EFFICIENCY OF AIR-SPACED COILS.

Sir,—You will no doubt be interested to hear of the results I have obtained using the very efficient short-wave coils described in your Vol. XVI., No. 1.

I completed the construction of these coils recently, connected them to an ordinary detector unit, and at 11.15 p.m. tuned in without any difficulty and at very good phone strength, KDKA on 68 metres. I was surprised at the clarity of the speech and orchestral items, although the latter occasionally became rather distorted.

On disconnecting the aerial the signals were still received, only at a slightly weaker strength. E. H. CARTER.

Harrow, Middlesex

THE OSCILLATION NUISANCE.

Sir,—I read with interest the correspondence in your issue of February 18th on the subject of oscillation. Mr. Procter-Gregg's suggestion seemed to me the most interesting. I have no doubt that it would be very effective, but I do not know why its author suggests that it would reduce the nuisance of oscillation. Its effect would surely be to *increase* the abuse of reaction, for the chief offender is not the listener who is content with the B.B.C. transmissions, but the searcher after "distance" and America; and if his pursuit is rendered more difficult by the increase of comparatively near stations he will need reaction more than ever to produce the necessary selectivity.

Perhaps in the future wireless will make such strides in the matter of economical efficiency that the use of reaction will become not only unnecessary, but a disadvantage, as tending to bring in every station in the world (and possibly a few others) at once!

At present the majority of listeners are absolutely dependent on reaction. A.V.S.

Chelsea.

THE WAVELENGTHS OF FRENCH AMATEURS.

Sir,—On page 52 of the issue of the *Wireless World* for February 18th you have published a paragraph under the title "French Transmitters on Wrong Wavelength" which gives the impression that I said that the French transmitters were the only ones transmitting on the American waves, or at least that they were those most concerned by my remark.

I would like to point to the fact that I spoke intentionally of "European amateurs," and that if I have heard some French transmitters on the waves between 70 and 90 metres, the majority of stations heard there were foreign. I am glad to say that I do not remember ever hearing any British amateur on those waves. Please also note that the waves between 70 and 90 metres can nearly all be used lawfully by French amateurs of the fourth category. LÉON DELOY (f8AB).

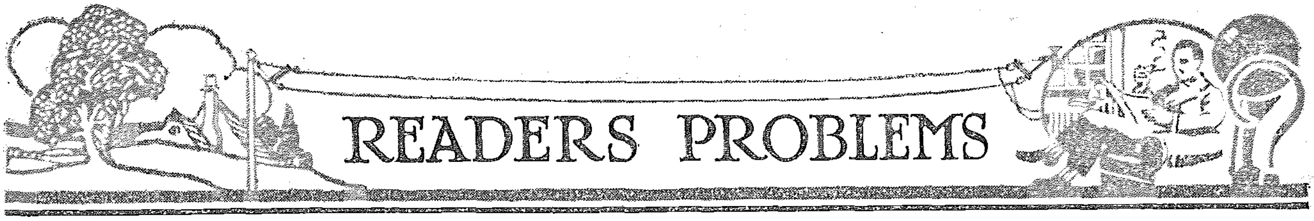
Nice.

LONG-RANGE CRYSTAL RECEPTION.

Sir,—I notice in this week's issue, among "Readers' Problems," a query on the part of a correspondent as to long-distance crystal reception.

In 1920, when on the North Atlantic trade, I heard a ½-KW commercial experimental phone station on the New Jersey coast at a distance of 1,500 miles, using a plain carborundum detector. Speech was loud enough to be understood, and, as BVY and BVZ were being received at the same time, the wave must have been 450 metres. Experiments were being conducted in conjunction with the United Fruit boats, plying the length of the western coast. On arrival in New York I reported this reception to the company concerned, and the details checked O.K. The station was heard every night until arrival in New York. A. C. THOMAS.

Gospel Oak, N.W.3.



Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

Filament Resistances for Dull Emitters.

A CORRESPONDENT is desirous of using a number of different types of dull-emitter valves with a six-volt accumulator, each valve to have a fixed resistance in series with it which will, at six volts, pass the safe maximum current required by any individual valve, and he wishes to know how to calculate the resistance required by each valve.

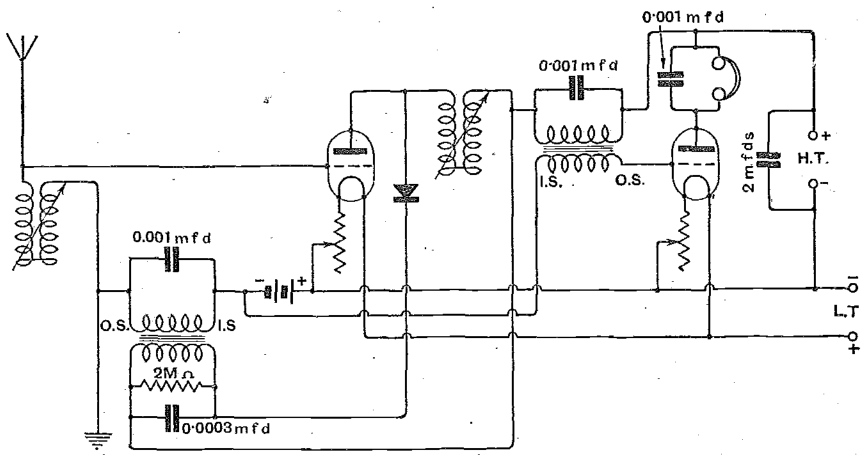
To calculate this, it is first necessary to calculate what value of resistance must be connected across an E.M.F. of six volts in order to produce a flow of current equal to the working current which the makers specify for the valve in question. For instance, in the case of a valve of the .06 ampere type, the total value of resistance which must be connected across a six-volt source of supply in order to permit a current of this value to flow will be 100 ohms. Now the internal resistance of the accumulator is negligible, but it is necessary, of course, to take into account the resistance of the valve filament. This can easily be calculated from voltage and current data specified by the manufacturers. For instance, the .06 amp. type of dull emitter is usually rated at a maximum voltage of 3 volts. Therefore the resistance of the valve will be approximately equal to $\frac{3}{.06}$ ohms, or in other words, 50 ohms. However, in order to provide an adequate factor of safety, the resistance of the valve filament should not be taken at a greater value than 90 per cent. of the calculated value, which in this case will be 45 ohms. Therefore the value of the fixed resistance which must be placed in series with the valve filament and the six-volt accumulator is $100-45=55$ ohms. In cases where one fixed resistance is used to control the filament supplied to two or more valves of the same type, it must *not* be forgotten that the value of the resistance required will decrease inversely as the number of valves. Thus, if in the instance we have mentioned four .06 ampere valves are required to be controlled by the same filament resistance, the value required will be 14 ohms approximately.

o o o o

A Stable Two-valve Reflex Circuit.

A CORRESPONDENT wishes to make a two-valve reflex receiver, using a crystal for rectification, the set to be used primarily for operating a loud-speaker on a normal aerial and earth at a distance of 35 miles from one of the main broadcast stations. He particularly emphasises the necessity of the set being stable and easy to tune.

In view of the latter requirement, we have refrained from introducing deliberate magnetic reaction into this circuit. Variometers are used to tune both the aerial and anode circuits, and it is important to note that unless a variometer of a special size, known as an anode variometer, is used in the plate circuit of the first valve, it will be necessary to shunt this component with a fixed condenser of .0002 or .0003 mfd. capacity. Alternatively, of course, the usual methods of plug-in coil and variable condenser can be used for tuning both aerial and anode circuits. In order to obtain best results, both from the point of view of stability and good quality reproduction, we recommend that low ratio transformers be used in both stages. It will be found also that shunting the primary of the first transformer with an ordinary grid condenser and leak will greatly improve the receiver. It will be necessary to experiment with the primary connections of both transformers, as it will often be found that they will function far better when connected in one particular manner, which can only be found by experiment. It will be found also that better results can be obtained with this receiver when using a higher voltage of H.T. than is customary. The presence or otherwise of the grid battery will be found to have a great effect on the efficient functioning of this receiver. This is a form of reflex circuit which can be recommended.



A two-valve reflex receiver, the first operating as a H.F. and L.F. amplifier, and the second as a straightforward note magnifier. A crystal rectifier is used.

o o o o

Adjusting the Tone of a Loud-speaker.

A READER who has been experimenting with his loud-speaker by placing fixed condensers of varying values in parallel with it in order to attempt to improve quality, has noted that as the value of this shunting capacity is increased from a very small value up to about .0015 μF, a great improvement of quality takes place until this value is passed, when the quality again declines until with a value of .003 μF, or greater, considerable distortion occurs, speech becoming very guttural and heavy. He wishes to know the technical reason for this.

It is well known that the impedance offered by any inductance increases in accordance with the frequency. It is clear, therefore, that the voltages set up across the loud-speaker will be greater in the case of the upper musical frequencies than in the case of the lower ones; consequently lower frequencies are to some extent suppressed, which, of course, is one of the causes of distortion. Now the impedance of a condenser varies *inversely* as the frequency, or, in other words, the greater the frequency, the less the impedance. As a result the upper musical frequencies will be to a certain extent diverted through the condenser, and a more even amplification takes place. If, however, we increase the capacity of this condenser too much, the upper frequencies will all tend to pass through the condenser instead of the loud-speaker, and we shall again obtain distortion, which will render itself evident by reproducing speech in a heavy, muffled manner, due to the fact that the upper frequencies do not, to any great extent, pass through the loud-speaker.

The actual capacity to be used obviously depends on the inductance value of the loud-speaker windings. A useful value is .001 μF, which offers an impedance of 160,000 ohms to speech frequencies of 1,000 cycles. The value, however, varies with different loud-speakers, and in any case the final value must be arrived at experimentally in accordance with the "tone" desired by the user.

o o o o

Operation of a One-valve "Super."

A CORRESPONDENT who has been experiencing considerable difficulty in securing satisfactory operation from his one-valve super-regenerative set, has written asking us to suggest the possible cause of the trouble. He state that he has carefully checked his wiring, and that all the components used have been found to give satisfactory results in another set. He further states that on certain occasions he has secured remarkable results from this set, receiving distant stations with remarkable strength on a small frame aerial, whilst on other occasions he has produced nothing but a medley of "howls," interspersed with distorted speech and music.

We quite frequently receive queries of this type from readers who have hitherto been used to the consistently good results which are to be obtained from receivers of the more conventional type. When using an ordinary receiver, provided that all the components are in order and wiring is carried out correctly, no difficulty will be experienced even by the novice in securing fairly good results. He may, through his lack of experience, fail to get anything like the utmost out of the set, but at the same time he is usually able to pick up one or two stations at good strength night after night. Although, of course, an experienced man will be able to secure a great increase in efficiency by delicate adjusting of filament temperature and anode voltage, these values are not critical in order to obtain moderately good results with an ordinary set. When dealing with a super-regenerative set, however, things are quite different, and very delicate handling of the controls is necessary in order to attain success. Great care is necessary also in constructing these receivers. In the ordinary type of set, if the tuning coils are placed too close to the sides of the cabinet, a certain loss of efficiency will result, but the set will still be fairly easy to operate. With a super-regenerative set of the Armstrong type, however, it may be found that if the "quenching" coils are not carefully mounted it is not possible to stabilise the set. It is often found that these receivers will operate satisfactorily in one room, and not in another. To attain any measure of success with these receivers, skill in tuning and infinite patience are essential.

o o o o

Adding an Amplifier to a Flewelling Receiver.

MANY readers seem to be in doubt as to the correct method of adding a low-frequency amplifier to a single-valve Flewelling receiver, the general opinion which appears to prevail among them being that the ordinary conventional transformer coupling cannot be used.

This idea is quite erroneous, and we give below the correct method of adding this amplifier. The addition of this will not render the circuit more unstable, but it must be remembered, of course, that the Flewelling circuit requires delicate handling in order that the best results may be obtained from it, and it is not recommended to attempt to add an amplifier to it until the intricacies of the Flewelling circuit itself have been *mastered*. Many readers require to add H.F. amplification to this circuit, but this is a course which is not to be recommended, except from the experimental point of view, as it is apt to add considerably to the difficulties of stabilisation.

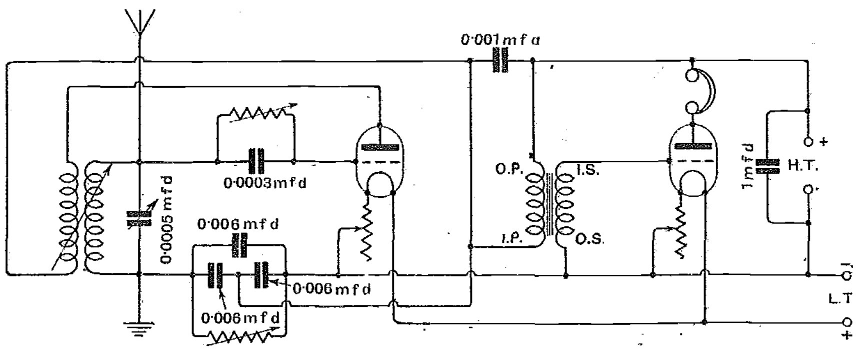
an uncommon sight to see aerials heavily weighted with insulators at each end, but passing for the greater part of their length close to some structure, which has the effect of screening the aerial. In many cases readers will experience a remarkable increase in range if they pay more attention to this all-important question of isolation. It is often the case, of course, that readers, owing to circumstances beyond their control, have to be content with the best aerial that they can erect, but even then, by the exercise of a little ingenuity, it is usually possible to erect a better aerial than is usually done under these circumstances.

o o o o

Connections of an H.F. Amplifier.

MANY readers have written to us pointing out that no connection for H.T. – is shown on the theoretical diagram of the H.F. amplified panel illustrated on page 31 of the February 11th issue of this journal.

Obviously, of course, since in all valve sets the H.T. terminal is merely a repetition of either the L.T.– or L.T.+ terminals, it would be superfluous to place a terminal here and connect it across to the H.T. – on the main set, since this connection is already effected through the L.T. – lead. Similarly the L.T. – terminal of the H.F. amplifier obtains its earth connection through the L.T. – terminal of the main set. Of course an extra H.T. – terminal may be added if desired. When using this amplifier with a crystal set, it will be necessary to earth the L.T. – terminal of the accumulator.



A Flewelling receiver with a one-valve note magnifier.

Increasing Aerial Efficiency.

A CORRESPONDENT who has been obtaining very poor results from his receiving set has sent us a sketch of his aerial. He lays stress on the fact that his aerial is well insulated, as he is using no fewer than six large insulators of the shell type in series at each end of the aerial.

It is quite obvious from our correspondent's sketch that while he has been at great pains to pay adequate attention to the important question of aerial insulation, he has totally neglected the equally important question of aerial isolation. The aerial in question runs for the whole of its length parallel to the wall of an outhouse, it being supported at each end by brackets attached to this wall. The result is that the aerial is less than 1 foot from the wall. This must be productive of very serious losses indeed. Unfortunately this type of aerial is all too frequently to be met with, it being not at all

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Power Requirements of Dull Emitters.

A READER asks which type of dull-emitter is the most economical to use from the point of view of *power* requirements.

Ignoring the special types of dull-emitters designed for power amplification, it will be found that dull-emitters fall roughly into three classes. The type requiring .25 amps. at .8 to 1.1 volts, the two-volt .3 amp. type, and the sixty milliampere type, which require a voltage of 2.5 to 3. Taking the maximum limit of voltage in each case, it will be seen that power requirements of the above three types in the order named are .27, .6, and .18 watts respectively.

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TOO MANY TYPES OF VALVES.

IN a recent editorial note we criticised the method adopted by valve manufacturers in this country for the classification of different types of valves, and we advocated that the manufacturers should take steps to agree amongst themselves to a definite classification of the various types, so that the characteristics of the different classes of valves could be recognised by their identification letters or numbers.

For our own information, and as a matter of interest, we have endeavoured to arrange the various makes and types now available under such headings, but in so doing the point has been brought home very forcibly that there appears to be a large amount of overlapping in the various types, due apparently to the fact that manufacturers are marketing not only the valves which have been designed for specific purposes, but also a large number of the experimental types which are produced in the course of research work.

A good deal of misunderstanding on the part of the public and retailers might be avoided if the valve manufacturers were to decide to limit the variety of types of valves on sale to the public generally, and to give a definite classification to the types which they decide they will continue to supply.

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WIRELESS EXPERIMENTS.

IN these days when the amateur has so many different channels for wireless experimenting open to him, it is perhaps rather natural that many subjects which may be closely associated with wireless are apt to be neglected. Making new sets and receiving signals should not be the sole aim and interest of the amateur. Many instructive and extremely interesting experiments can be carried out which, though not directly productive of wireless signals, will yet be found to provide quite as interesting a study.

In the present issue there appears a description of how to construct a simple oscillograph which can be utilised in carrying out a vast number of fascinating investigations into what happens in your receiver under varying conditions. The oscillograms which are reproduced in the article are merely examples of the many possibilities which such an instrument presents in spite of its extreme simplicity and easy construction from apparatus in the wireless den of every amateur.

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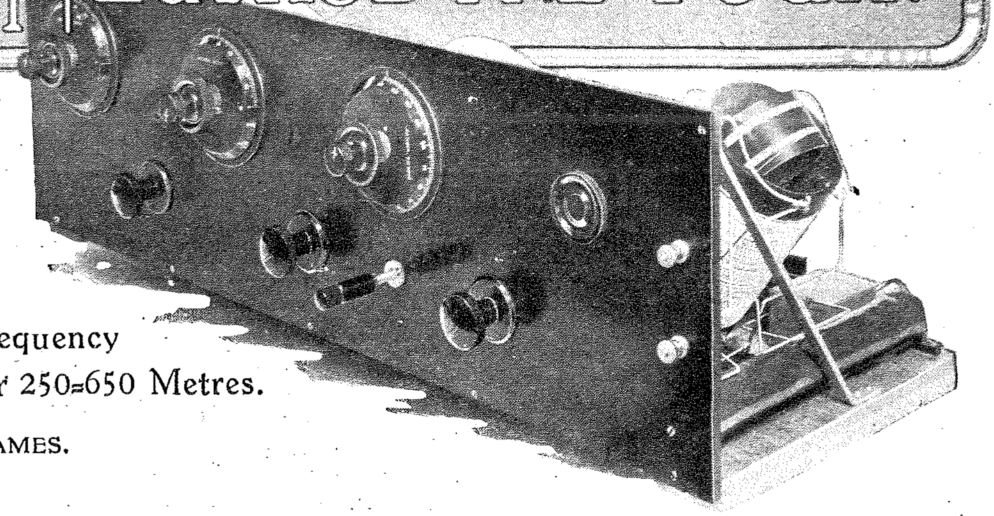
WIRELESS IN SCHOOLS.

THERE is little doubt that the interest displayed by the younger generation in the construction of wireless apparatus is greatly simplifying the task of instructors in handicraft. No longer do the senior scholars devote their energies to building objects of doubtful domestic utility, for their keenness now spurs them on to undertake difficult instrument making work, which they pursue with vigour and enthusiasm. In the science classes, too, we wonder how often a master has been surprised by the knowledge displayed by students, whilst in electrical work instructors must feel that the ground has been well tilled.

The recent exhibition held by the Schools Section of the Radio Society of Great Britain is evidence of the place taken by wireless in school work.

CONTENTS.

The "Neutrodyne Four."



A Four-valve Non-radiating Receiver with Two Stages of Tuned Radio-frequency Amplification for 250-650 Metres.

By W. JAMES.

A GOOD deal has been written in these pages recently on a method of high frequency amplification in which a wave-changing device is employed, and a practical super-heterodyne receiver was described. With this set a radio frequency amplification of three or four thousand is obtained. We referred, when describing this receiver, to the reason for

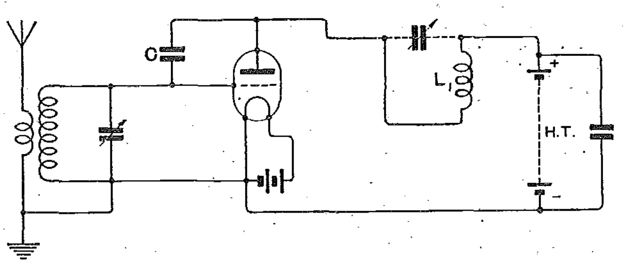


Fig. 1.—One stage of tuned H.F. amplification. Condenser C represents the unwanted capacity between the plate and grid of the valve, and L_1 is the anode coil.

employing a wave changer; namely, the difficulty of amplifying at all effectively signals of the broadcast and shorter wavelengths. Short wavelength H.F. amplifiers of the ordinary type suffer from the defect that to secure reasonable amplification the operation is decidedly tricky because of the number of controls and accidental reactions. In the super-heterodyne receiver we avoid these difficulties by converting the wavelength of the incoming signal to one which can easily be dealt with. In this—the neutrodyne—receiver, we employ amplifying circuits tuned to the wavelength of the incoming signal, and balance the circuits in such a manner that self oscillation cannot take place. Two stages of radio-frequency amplification are employed, and these are arranged in such a manner that they act as true one-way amplifiers; for instance, if the detector valve is made to oscillate, no locally generated oscillations will be set up in the aerial. The two H.F. stages and the detector give a radio-frequency amplification of approximately 500.

The reason for the special arrangement of the circuit will be better understood by referring to Fig. 1. Here we have a valve connected to an aerial, with a condenser C representing the capacity between its grid and plate. When the plate is joined to a tuned circuit, the amplifier tends to oscillate every time this circuit behaves as an inductance. This happens when the tuning condenser is set at a value below that required for resonance with the incoming signal. The magnitude of the regenerative effect depends, of course, on several factors, among them being the capacity in the grid circuit, the constants of the valve, and the value of the inductance in the plate circuit. Hence the degree of regeneration varies with tuning adjustments, and the amplifier is liable to oscillate.

Now suppose that we connect a coil L_2, Fig. 2, in series with the plate coil, and join its free end through a condenser C_N to the grid of the valve. Then the regenerative effect caused by the current passing from

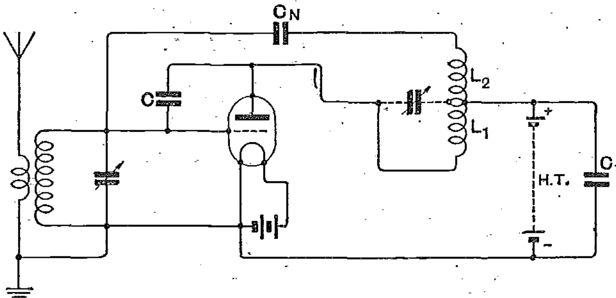


Fig. 2.—A method of neutralising the effect of the unwanted capacity by coil L_2 and condenser C_N. L_1 and L_2 are the anode coils, and C_1 the by-pass condenser.

The Neutrodyne "Four."—
the plate to the grid through the capacity represented by C can be balanced exactly by adjusting the condenser C_N and the number of turns in L_2. If the coils L_1 and L_2 are identical and tightly coupled, and the capacities of C and C_N are the same, the feed-back through C is just cancelled by that through C_N; in other words, the device is now a true one-way repeating device.

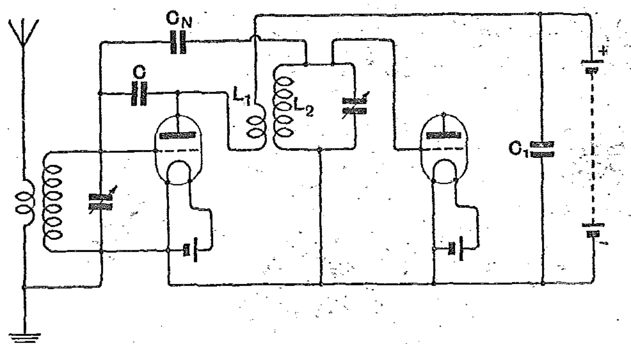
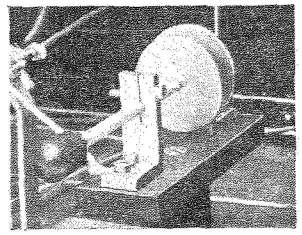


Fig. 3.—A development of the arrangement of fig. 2. The coil L_2 now acts as the secondary winding of a H.F. transformer.

In practice it is not necessary to employ a coil solely for the purpose of providing the neutralising current—the coil can be made to act as the secondary winding of a H.F. transformer as in Fig. 3. Here coil L_1 is the plate coil and L_2 the grid coil. When these are tightly coupled, and L_1 equals L_2, the capacity of C_N should equal that of C for neutralisation.

It is desirable, from the point of view of selectivity and amplification, however, to employ a secondary winding which is bigger than the primary, the exact ratio to be employed depending on the wavelength range of the amplifier and the constants of the amplifying valves. Then the value of C_N is reduced accordingly. As the number of turns in the primary are reduced the set becomes more selective, and by adjusting the ratio a balance with the degree of amplification can be obtained.

In the receiver described here the primaries have 15 turns and the secondaries 55 turns, which gives a high degree of amplification and good selectivity. The set has two stages of tuned radio-frequency amplification (more stages are difficult to operate), a regenerative valve detector and one stage of resistance coupled note magnification, Fig. 4. With four valves connected in this way it is possible to receive many broadcast stations on the loud-speaker with good volume and excellent quality. The radio-frequency stages do not introduce distortion, and that usually associated with a valve detector having a grid condenser and leak is minimised by the method of connecting this part of the circuit. As shown by the theoretical connections, Fig. 5, three high-frequency transformers, T_1, T_2 and T_3, tuned by three variable condensers, C_1, C_2 and C_3, are employed. The grids of the two H.F. amplifying valves are given a suitable grid potential by the single dry cell GB_1. A grid condenser and leak are employed for rectification,



View of the neutralising condenser marked NC_1 in fig. 5.

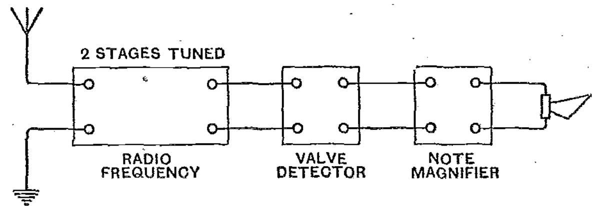


Fig. 4.—Schematic arrangement of the Neutrodyne "Four."

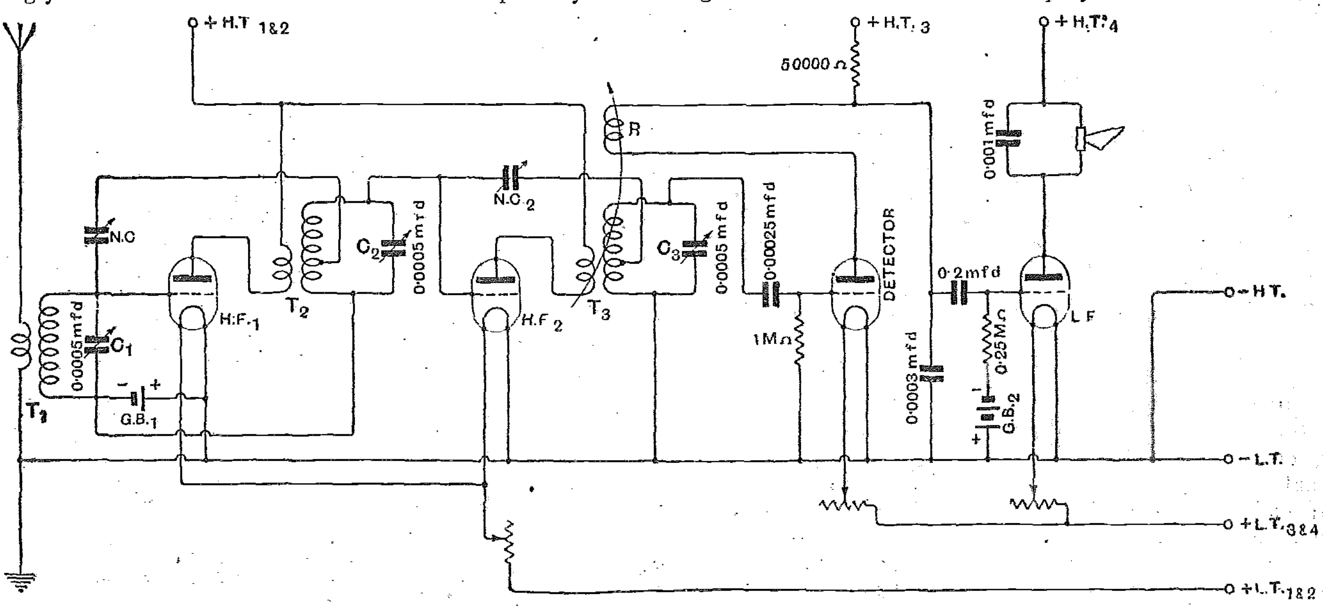


Fig. 5.—The theoretical connections of the set. NC_1 and NC_2 are neutralizing condensers. Two +LT terminals are provided in order that any type of valve may be tried in the HF, or detector and LF stages.

The Neutrodyne "Four."—
and the plate circuit of the detector contains a reaction coil, R, and a resistance of 50,000 ohms. A Mansbridge condenser of 0.2 mfd. and grid leak of 0.25 megohm are used to couple the anode circuit of the detector to the note magnifier.

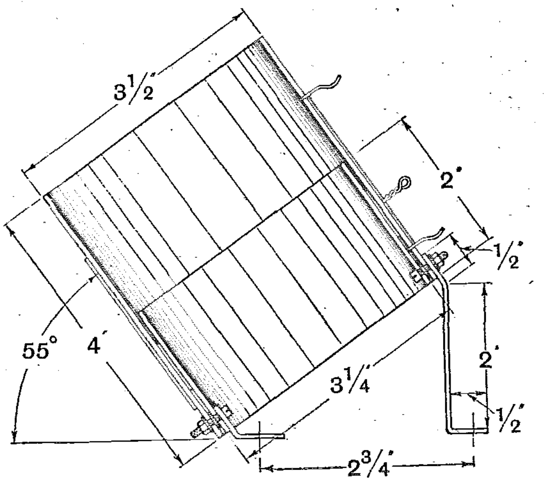


Fig. 6.—Construction of the first and second H.F. transformers.

Points of interest are the grid leak being connected to the negative side of the filament of the detector, the fixed 0.0003 mfd. condenser shunting the anode resistance, and the grid bias of the note magnifier. It was found that when a Mullard DFA1 valve (impedance 5,500 ohms, amplification factor 5) was used as the detector, best results were obtained when the grid return was made to negative instead of positive, as is usual. It was particularly noticed that the reaction adjustment was much smoother when the connection was made to the negative, all values of H.T. voltage, filament heating, number of turns in the reaction coil and value of anode resistance being tried. A signal is tuned in as follows: the variable condensers C_2 and C_3 are set at the same scale reading, and the aerial tuning condenser C_1 varied. Then the condensers are carefully adjusted one at a time, starting with C_3, then C_2, and finally C_1. If it is desirable to further strengthen the signal a little, the reaction coupling may be varied, at the same time readjusting C_3. Tuning is a simple matter, as the condensers are set at practically the same scale reading, the aerial condenser being set a little lower than the others, because of the effect of the aerial

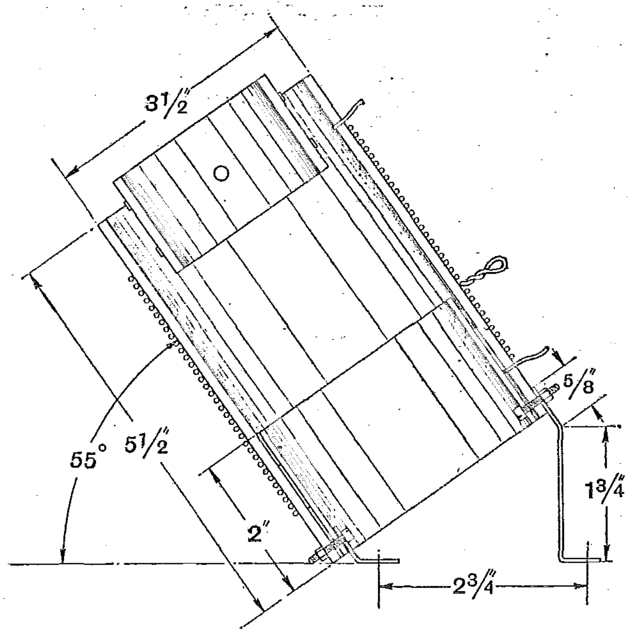
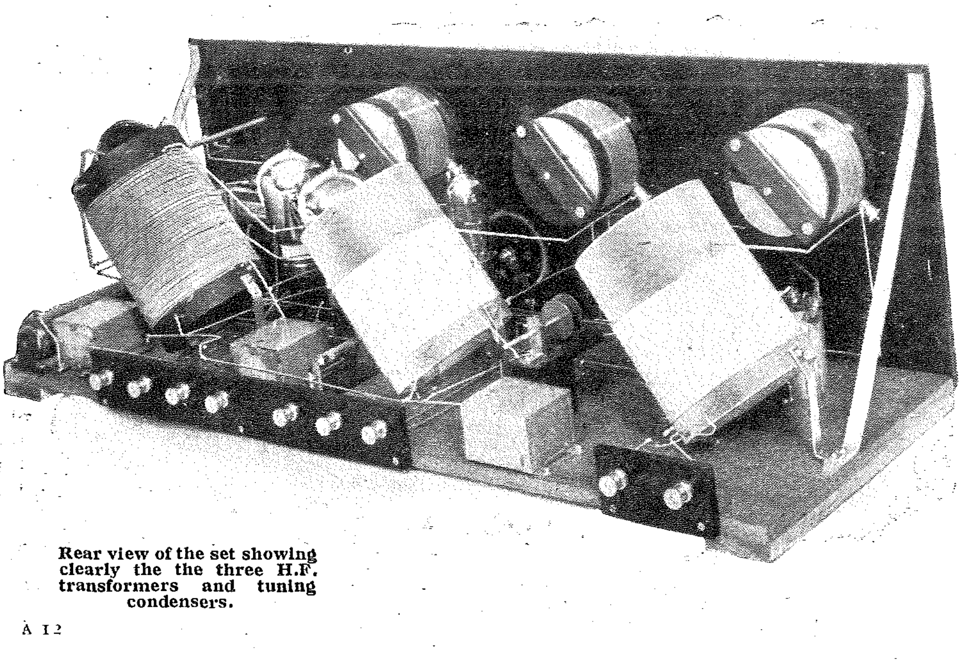


Fig. 7.—Arrangement of the third H.F. transformer and reaction coil.

capacity. Tuning is sharp, a movement of the dials of about two degrees being sufficient to completely cut out 2LO when the set is used with a large aerial five miles from the station.

Construction.

From the photograph of the set it can be seen that the three H.F. transformers are fixed to the base of the set and are inclined at an angle; the angle is about 55°. The transformers are arranged in this way to prevent magnetic coupling between them. They are similar in construction, but the third transformer has an ebonite former because it has to support the rotatable reaction coil. To construct these coils we require two cardboard tubes 3½in. diameter and 4in. long, one ebonite tube 3½in. diameter and 5½in. long, and three cardboard tubes 2in. long and of such a diameter that when they



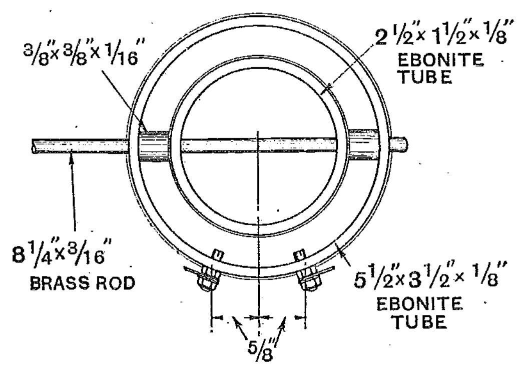
Rear view of the set showing clearly the the three H.F. transformers and tuning condensers.

MATERIALS REQUIRED FOR THIS SET.

1 Ebonite panel, 26 in. × 8 in. × $\frac{5}{16}$ in.
1 Ebonite strip, 11½ in. × 1½ in. × ¼ in.
1 Ebonite strip, 3 in. × 1½ in. × ¼ in.
1 Board of hardwood, 26 in. × 9 in. × ⅜ in.
1 Filament resistance, 15 ohms (Burndept).
2 Filament resistances, 7 ohms (Burndept).
4 Valve holders.
3 0·0005 mfd. variable condensers, with vernier (Dubilier).
3 2 mfd. transbridge condensers.
1 0·2 mfd. fixed condenser (T.C.C.)
1 0·0005 mfd. fixed condenser (Dubilier).
1 neutrodyning condenser (Lissen).
1 0 00025 mfd. fixed condenser (Dubilier).
1 0·001 mfd. fixed condenser (Dubilier).
1 1 megohm grid leak (Dubilier).
1 0·25 megohm grid leak (Dubilier).
1 50,000 ohm wire round resistance, Zenite rod (Zenith Manufacturing Co.)
1 lb. of No. 20 D.S.C. copper wire.
11 No. 4 B.A. terminals.
3 Cardboard tubes, 3½ in. diameter, about 6 in. long.
1 Ebonite tube, 3½ in. diameter, 5½ in. long.
1 Ebonite tube, 2½ in. diameter, 1½ in. long.
1 single dry cell and one 4½ volt unit.

are wound they will fit inside the large tubes. If 3½in. tubes are employed a small piece should be cut out of them so that when the wire is on they are a comfortable fit. The large tubes should be as thin as possible and carefully dried.

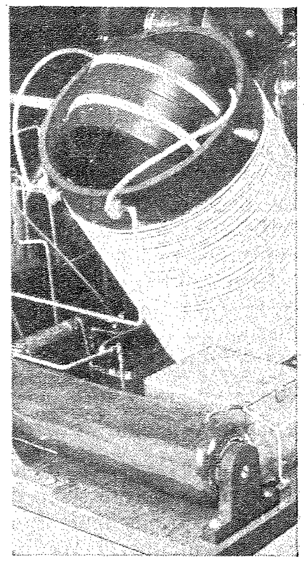
Transformers T_1 and T_2 are arranged as indicated in Fig. 6. Two long and two short supports of brass



Plan of the third H.F. transformer showing the reaction coil, spindle and distance pieces.

strip ⅜in. × $\frac{1}{16}$in. should be made as shown here, and the smaller tubes fitted inside the larger ones by 6 BA screws and nuts. The primary windings are wound on the inside formers and the secondaries on the outer ones. Both windings are put on in the same direction, and the primaries have 15 turns of No. 20 D.S.C., and the secondaries 55 turns of No. 20 D.S.C. A loop is twisted at the 15th turn from the bottom of the transformer marked T_2 (Fig. 5).

The third transformer, to which is fitted the reaction coil, is sketched in Figs. 7 and 8, and has an outer ebonite tube (⅛in. thick) and a closely fitting cardboard tube, 5½in. and 2in. long respectively, as mentioned above. A piece of ebonite tube of 2½in. diameter and 1½in. long is employed as the reaction coil, and this is mounted on a spindle of $\frac{3}{16}$in. brass rod, 8¼in. long. The spindle is a tight fit in two holes drilled ⅜in. from the top of the tube. Two pieces of ebonite tube, each ⅜in. long, are fitted over the spindle to keep the reaction coil central. This transformer is wound with the same number of turns as the first and second, but the turns are spaced, as indicated. The reaction coil has only 10 turns of No. 30 D.S.C. wire, and the ends are of flexible wire terminating at tags held by screws in the wall of the outer tube.



A close-up view of the third H.F. transformer showing the reaction coil.

Wireless Journal Defends a Libel Suit.

AN interesting item of news reaches us from America, where a contemporary journal, *Radio Broadcast*, has been the defendant in what is probably the first libel case of its character to be brought against a wireless magazine.

In March, 1924, *Radio Broadcast* published an article entitled "The Truth about Trick Circuits," and described a number of much-advertised arrangements, and disclosed their character. One particular circuit received rough handling at the hands of the author of the article, and, as a result, the originator took action for libel against the journal, but the Federal Court upheld the action of *Radio Broadcast* and dismissed the case.

In commenting on the result of the action, the Editor of *Radio Broadcast* states "it would have been very unfortunate for the radio public if truth-telling had been penalised. The public and the art of radio have already suffered enough on account of various radio exploitations which trade principally on the newness of radio, but which only succeed in adding confusion to the lay understanding of a scientific art."

In America perhaps more than any other country, the public has had difficulty in obtaining an unbiased opinion on various "stunt" circuits and sets which have been put before them, and the result of this action may help considerably in curtailing the number of attempts to make profit out of the ignorance of the public.

HOW THE CRYSTAL DETECTS.

A Discussion of the Way in which the Properties of Certain Crystals can be Applied to the Detection of Wireless Signals.

By R. D. BANGAY.

IN an earlier article[1] we discussed at some length the conditions it is necessary to bring about in order that the high-frequency oscillations generated in the receiver circuits by an incoming signal, or rather the variations in their amplitude, can be detected by a telephone receiver. We showed how equally balanced alternating forces occurring at high frequency could produce no effect either on the telephone coils or on the movement of the diaphragm owing to the electrical inertia of the former due to its inductance and the mechanical inertia of the latter due to its mass.

We also showed how this equal balance between the positive and negative efforts of the alternating cycles could be destroyed by rectification, this term implying the complete or partial suppression of the alternate half cycles of the high-frequency signal E.M.F. In this way, the current passing through the coil windings of the telephone receiver became uni-directional, having a magnitude proportional to the *mean* amplitude of each oscillation, thereby enabling the diaphragm to respond to the comparatively low-frequency modulations in the signal E.M.F., and thus detecting the sound impressed on the carrier wave.

The Components of a Rectified Signal.

Certain crystals, particularly galena and carborundum, possess the property of conducting electricity more freely in one direction than another. We may assume, however, for the purpose of this article, that the crystal conducts only in one direction.

When an alternating E.M.F. such, for example, as that generated by the incoming signal in the aerial tuning inductance is applied to a circuit, the current in that circuit tends to reverse its direction at each successive half cycle. It follows, therefore, that if a galena or carborundum crystal is connected in series with a telephone receiver across the tuning inductance of a receiver, as shown in Fig. 1, the crystal will only allow the current to pass through the telephone coils in one direction, *i.e.*, during the alternate half cycles when the E.M.F. is in the right direction. We can illustrate these conditions graphically as shown in Fig, 2, where the diagram A represents the H.F. alternating E.M.F.'s generated by an incoming signal across the detector circuit, and the diagram B represents the uni-directional H.F. pulses which are passed by the crystal, and which, owing to the inductance of the telephone windings, will resolve themselves into a steady average current, as indicated by the dotted line in diagram B. In the case of a telephone or modulated H.F. signal, the amplitude of the H.F. cycles, and therefore also of the H.F. unidirectional impulse, rises and falls with the sound modulations, and therefore the average current which flows through the telephone windings also varies in magnitude in sympathy with the modulations.

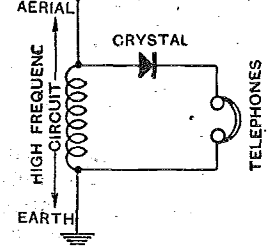


Fig. 1.—Connections of a simple crystal receiver.

[1] "About Detection," *Wireless World*, March 11th.

The sound produced in the telephone depends entirely upon the sound or L.F. variations referred to above, and this analysis shows that actually there are three components to a rectified telephone signal, namely :—

(1) The high-frequency component due to the H.F. impulses.

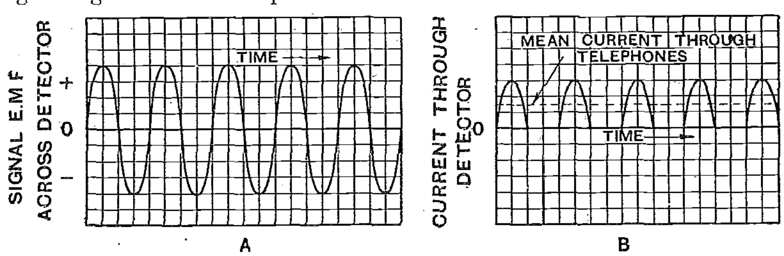


Fig. 2.—A, a high-frequency voltage, and B, the rectified current.

(2) The D.C. component due to the "averaging" effect of the inductive telephone coils.

(3) The L.F. component due to sound variations in this otherwise steady current.

Although in this article we are more particularly concerned with the D.C. and L.F. components, it is most important that the reader should thoroughly understand the significance of these terms, because of their importance when considering other questions relating to the process of reception. A clearer impression of the relation between these three factors may perhaps be obtained by taking a parallel mechanical example, and, for this purpose, we may take the case of a petrol engine which illustrates analogous effects of all three factors in a mechanical form.

The steady rotatory movement of the heavy flywheel and shaft of the engine is derived from a series of unidirectional impulses generated by the explosions in the cylinders, and this is analogous to the steady current flowing through the inductive windings of the telephones, which are derived from the H.F. uni-directional impulses passed by the detector; the speed of rotation, therefore, represents the magnitude of the steady current. By slowly opening and closing the throttle of the engine, the

How the Crystal Detects.—

speed can be varied above and below its normal value, and this is analogous to the sound variations in the telephone current due to the modulations in the incoming signal. Thus it will be seen that the H.F. component in the electrical case of the rectified signal is equivalent to the up and down movement of the pistons; the D.C. component is equivalent to the normal rotation of the flywheel, and the L.F. component is equivalent to the variations impressed on this normal speed.

The Characteristic Curve of Crystals.

Unlike an ordinary conductor, a crystal, even in the direction in which it is conductive, changes its resistance when different E.M.F.s are applied to it. The result, as we shall see, is that its efficiency as a detector changes according to the amplitude of the high-frequency signal.

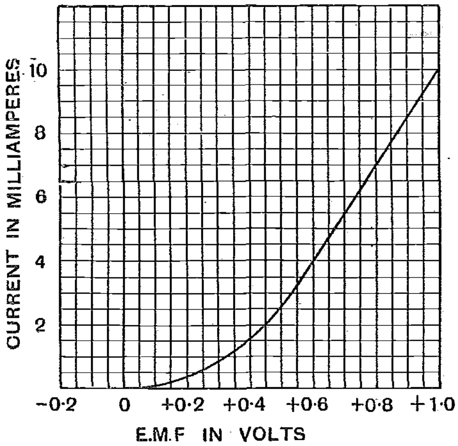


Fig. 3.—Characteristic curve of a galena crystal detector.

This feature is best illustrated by what is known as the "characteristic curve" of the crystal, a typical example of which is shown in Fig. 3. The curve is plotted by applying different D.C. voltages across the crystal and measuring the corresponding current which flows through it. If the resistance remained constant, the curve would take the form of a straight line sloping upwards. By referring to Fig. 3, however, it will be seen that the characteristic curve has a sharp bend near its base, and only follows approximately a straight line above a certain voltage (in the case illustrated above 0.5 volts). Below that point the slope of the curve becomes less and less as the voltage is reduced, indicating that the resistance of the crystal is increasing. This bending of the curve has an important influence on the question of detection. Before we look into the question, however, some explanation is necessary regarding the use of the curve.

As already mentioned, the curve is plotted by taking *steady* readings of voltage and current. The E.M.F. generated by a signal, however, is an alternating one of high frequency, and as the current has to flow through the inductive telephone windings, it is subject to an "averaging" effect. In examining the efficiency of the detector, however, we are not so much concerned with the exact values of the currents produced as with their relative values for different strengths of signals. If, therefore, we neglect for the moment the averaging effect produced by the telephone windings and compare the maximum or peak values in each case, on the assumption that there is no external impedance, we shall arrive at a sufficiently close approximation of the actual results and at the same time greatly simplify the explanation.

Efficiency of Detection.

Working on this basis, and referring to Fig. 3, it will be seen that if the amplitude of the signal is 0.6 volt, the current during each half is 4 mA.; but if the amplitude of the signal is 0.3 volt, the current is only 1 mA.; and if the amplitude of the signal is 0.1 volt or less, the resulting current is practically zero. These three conditions are conveniently illustrated in Fig. 4, where the signal E.M.F.s are plotted along an axis of time at right angles to the E.M.F. axis of the characteristic curve, and the resulting currents are plotted along an axis of time at right angles to the current axis of the characteristic curve.

If we take the ratio of the resulting current to the signal E.M.F. as indicating the efficiency of detection, we find that for a 0.6-volt signal the efficiency $=4/.6=7$ approximately; for a 0.3-volt signal, the efficiency $=1/.3=3$ approximately, and for a 0.1-volt signal the efficiency $=0/.1=0$. This shows that the stronger the signal, the greater the efficiency of the crystal detector, and that for very weak signals the crystal does not rectify at all.

Effect of Voltage Bias.

The next point to note in connection with crystal detectors is that by superimposing a small steady E.M.F. known as a voltage bias—on to the crystal, we can increase the efficiency of the detector, especially for very weak signals. Suppose, in the example under consideration, that we supply a steady voltage of +0.2 volt on the crystal. If, then, the amplitude of the signal is 0.1 volt, it is clear that the total E.M.F. on the crystal will vary by 0.1 volt above and below this steady value during each H.F. cycle, *i.e.*, from +0.1 during the negative half cycle to +0.3 during the positive half cycle, as illustrated in Fig. 5. In this case the maximum change of current due to the positive half cycle of the signal is 0.6, as against a value of zero obtained without the help

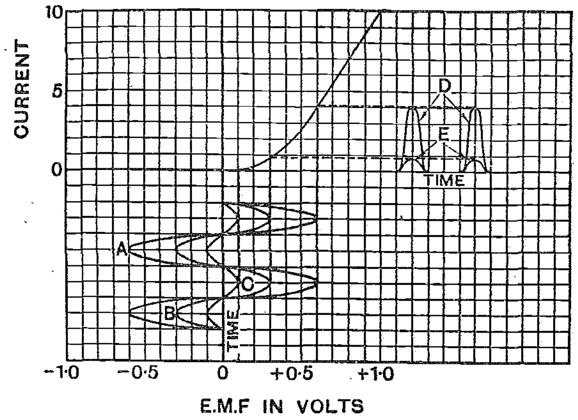


Fig. 4.—Showing the effect of applying signals of different voltages to the detector: curve A, 0·6 volt, gives the current curve D; curve B, 0·3 volt, gives the current curve E; curve C, 0·1 volt, gives no current.

How the Crystal Detects.—

of the steady voltage superimposed on the crystal. This, however, does not represent the net gain in the matter of detection because, in this case, there is a steady current of 0.2 mA. flowing through the detector before the signal arrives, and the effect of the negative half cycle of the signal E.M.F. on the current is to cause a reduction of this steady current. Obviously, any reduction in the normal current will have the same relative effect on the circuit as if the direction of the current were reversed when the normal current is zero.

The *effective* change in the current is therefore the difference between the positive and negative efforts relative to the normal condition of the circuit. In the case under consideration, it will be seen by reference to the curves in Fig. 5 that a reduction in the current of nearly 0.2 mA. tends to take place during the negative half cycle of signal E.M.F., and this value must therefore be subtracted from the 0.6 mA., which represents the increase during the positive half cycle, in order to get the effective value of the rectified current. Nevertheless, there is a distinct gain as a result of the voltage bias. By taking other examples and comparing these with the results obtained with normal zero voltage, it will be found that the gain due to the superimposed D.C. volts becomes less marked as the amplitude of the signal is increased.

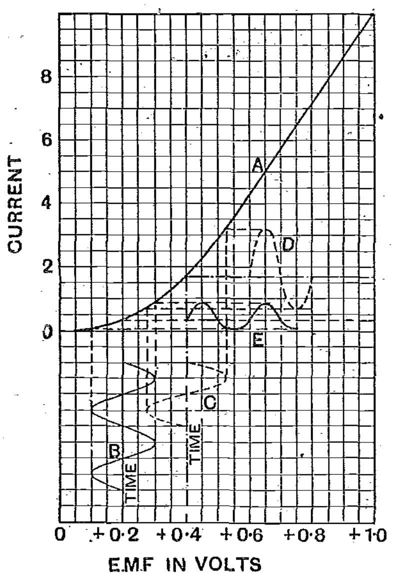


Fig. 5.—The effect of using a voltage bias. A, is the characteristic curve of the crystal; B, the applied voltage with a bias of 0·2 volt giving the current shown by curve E: C, the applied voltage with a bias of 0·4 volt giving the current shown by curve D.

Value of Bias.

Since the effective value of the resulting current depends, as we have explained, on the difference between the currents flowing during the positive and negative half cycles, it is easy to see that the voltage bias *should only be sufficient to reach the middle of the bend in the characteristic curve.* If it is higher than this value, the reduction in current due to the negative half cycle of signal E.M.F. will more than neutralise any gain obtained in the increase of current during the positive half cycle. For example, suppose the superimposed D.C. volts are taken at 0.4 in the particular case under consideration, as shown by the dotted line curves in Fig. 5, then for a signal of 0.1 volt amplitude the reduction of current during the negative half cycle is practically equal to the increase of current during the positive half cycle, and, consequently, there is no rectification.

For the same reason, it will be found that even when the superimposed volts are adjusted to the bend in the curve, as at 0.2 volt in Fig. 5, practically no rectification is accomplished for extremely weak signals. This point is better illustrated by plotting that part of the characteristic curve between about 0.15 volt and 0.25 volt on a much larger scale. This has been done in Fig. 6, from which it will be seen that practically no rectification takes place with a weak signal of 0.02 volt amplitude.

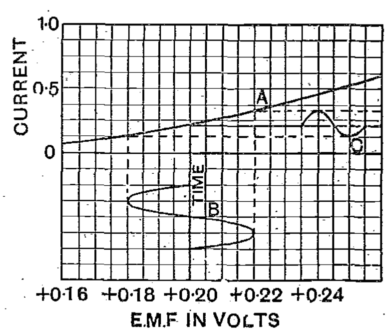


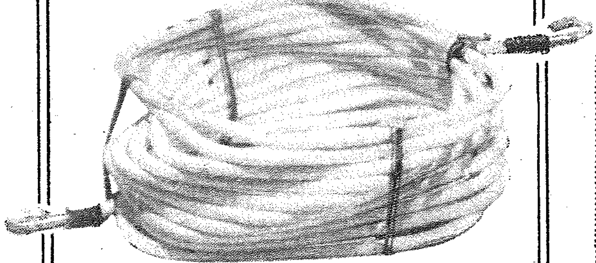
Fig. 6.—The lower part of the characteristic curve drawn to a larger scale. A, is the characteristic curve; B, the applied voltage with a bias of 0·2 volt giving the current C.

This comparative inefficiency of rectification of weak signals is common in a greater or less degree with nearly all methods of detection, and has an important bearing on the use of valves for purposes of magnification. Obviously, if the signals are so weak that no rectification takes place, it is quite useless to endeavour to use a low-frequency magnifier after the detector, because there is no low-frequency component to magnify. On the other hand, by using a high-frequency magnifier before the rectification process, the amplitude of the very weakest signals can be brought up to a sufficiently high value to give efficient rectification. In other words, in order to increase the sensitiveness of a receiver to very weak signals, high-frequency amplification before the process of detection is necessary.

It will be noticed in the particular example of crystal whose characteristic curve is illustrated in Figs. 2, 3, 4, and 5 that the grid bias required for optimum rectification is extremely small—only 0.2 volt. This curve is typical of a galena crystal, and it is doubtful whether much advantage would be gained in such a case by using a voltage bias for receiving telephone signals. The reason why a voltage bias is not required with crystals of this type is as follows:—

A telephone signal is transmitted by modulating the carrier wave, and it is only the L.F. component which is effective in the telephone receiver. In order to prevent blasting during transmission, the degree of modulation of the carrier wave is always arranged so that with the maximum intensity of sound there is still what may be termed a "residual" amplitude of the carrier wave. The "residual" oscillations do not, of course, affect the low-frequency components in the telephone, and consequently do not produce any sound. But by occupying the bottom portion of the characteristic curve they enable the L.F. variations to occur on the steep portion of the curve, where the maximum change in current is produced. As a result, if the minimum amplitude of the carrier wave is sufficient to reach past the bend of the characteristic curve, no advantage can be gained by using a voltage bias. In the case of the carborundum detector, however, the bend in the curve occurs at a very much higher E.M.F. of approximately 0.5 volt, and therefore it is practically always desirable to use a voltage bias, which should be carefully adjusted, when using carborundum crystals for detection.

LOW CAPACITY COIL



Self-supporting Coil of Simple Construction.

Many of the special tuning coils for short-wave work are wound with bare wire on an ebonite or wooden former of skeleton construction. The type of coil described here has no former, but is wound with insulated wire.

By P. J. PARMITER.

THE coil described is designed for short wave transmission or reception where comparatively few turns of wire are required. It will be found extremely easy to construct, as the customary type of former necessitating the use of pegs is dispensed with.

The "former" is of rectangular section and is built up of four pieces of dry, well-seasoned wood about ⅜in. thick and of the required length to form a rigid box. End pieces are provided having holes bored centrally through them in order that the completed former may be threaded on a winding spindle to serve as a convenient means of rotating.

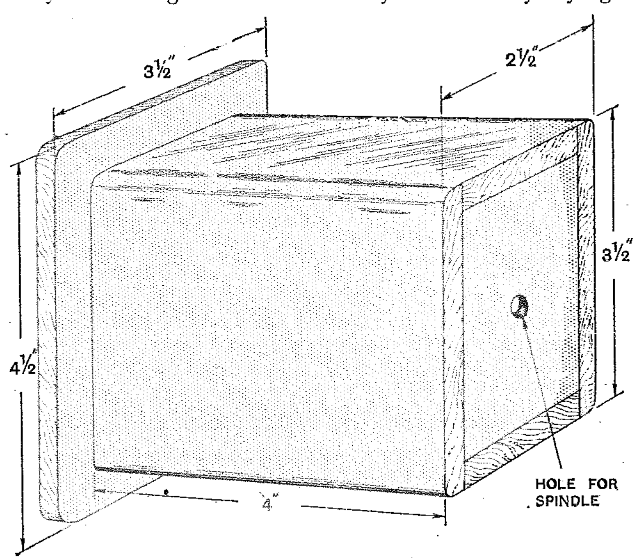
Coils of Thick Wire.

Suitable dimensions for winding a small diameter coil adaptable to the usual plug and socket type of coil holder are given in the accompanying sketch. The former is held together by glue and small screws or flat brads, the sharp corners being rounded off to prevent damage to the insulation of the wire during the process of winding.

A suitable gauge wire is No. 16 D.C.C. or D.S.C., but much stouter wire can easily be used for coils intended for transmitting.

The winding is commenced by threading the wire through a hole in one of the end pieces, which is made to form a flange which also serves as a guide in getting the turns true at the start. The coil is wound with the required number of turns in the usual manner, care being taken to bend the turns carefully over the rounded corners and to prevent the wire from "rising" on the flat faces. For this purpose a block of hard wood or a small mallet may be used to hammer the wire gently into place.

When the winding is completed the wire from the bobbin is cut off, leaving a free end of suitable length for connecting up. It is unnecessary to secure the finishing end of the winding at this stage, as the coil cannot whirl round on the former in the usual distressing way owing to its rectangular section. It will, however, spring slightly and is then carefully removed from the former, care being taken not to strain the turns apart, the easing off being accomplished by *pushing* from the starting end and not by drawing it off.



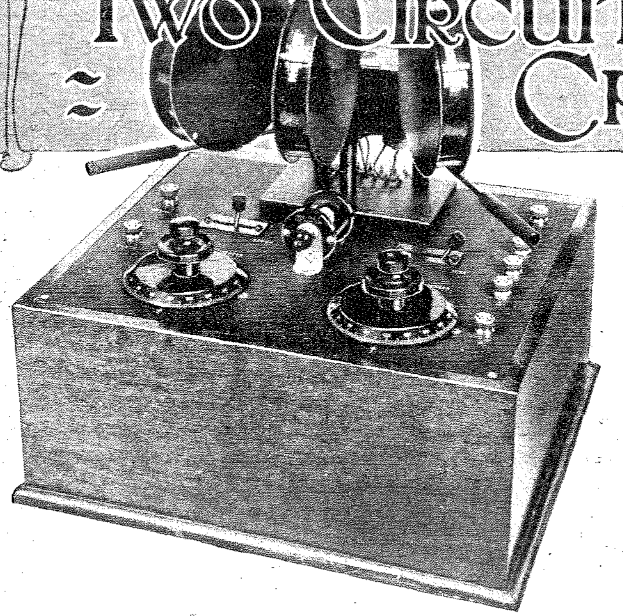
Construction of the former.

Coils of Finer Wire.

When removed from the former the coil will twist in a definite direction, and this twisting is encouraged by holding the end faces in either hand and turning in opposite directions until the projecting "corners" of the turns form a clearly defined helical arrangement similar to that produced when winding a banked coil. The coil is now firmly bound by means of thread or tape so that it may retain this shape, and will then be found quite rigid and self-supporting, no wax or shellac being required. If it is required to wind a coil by this method but using a smaller gauge wire, such, for example, as No. 20 S.W.G., there may be some difficulty in removing it from the former. This difficulty may, however, be easily overcome by laying on the turns slightly obliquely; then, when the winding is completed, if the coil is pushed off the former in such a way as to urge the turns in a direction at right angles to the axis of the former it will slide off without any trouble. Any tendency to jamb can be prevented by well sandpapering the former and rubbing the winding surface with paraffin wax.

As may be seen from the photograph of a finished coil (above) the turns are fairly well spaced. The spacing of the turns, and the absence of a solid former for supporting them renders the coil quite suitable for short-wave work.

TWO CIRCUIT TUNER and CRYSTAL SET



How to Make a Tuner for Crystal or Valve Work.

This unit is of universal application because it may be used as a crystal receiver or as a tuner for connecting to a valve detector. A particularly neat and effective receiver results when this unit is employed with the two-valve power amplifier, described in the last number of "The Wireless World."

By G. M. JONES.

THIS unit is of the type employing aerial and closed circuits inductively coupled, and each tuned with a variable condenser. The aerial tuning condenser may be switched either in series or parallel with the tuning coil, and the secondary circuit may be switched in or out of circuit as desired. A secondary circuit permits of sharp tuning and the elimination of many types of interference, but for local work it is not always required. When a switch is connected as indicated here, it is an easy matter to try by comparison whether the closed circuit improves the particular signals being received. Both tuning condensers are of the square law pattern; each fitted with a vernier for fine tuning. A simplified diagram is given in Fig. 1.

All Tuning Controls Accessible.

Difficulty has been met with in designing an efficient tuner, adaptable to any wavelength, in which all the operating controls are easily accessible. This design overcomes all these difficulties, and, as will be seen from the photograph, all controls face the operator. The hand does not come near the coils when adjusting the condensers, and the coils may be moved by means of the extended handles, either laterally for coarse adjustment, or by twisting the handles to operate a worm gear fine adjustment device.

Five terminals are arranged on the right of the panel, and from front to rear represent lower end of secondary coil or earth, top end of secondary or primary coil, according to the position of the standby tune switch, crystal detector, and two for reaction. The two terminals on the left are for the aerial and earth.

When used as a crystal set, the output terminal marked FP and the centre terminal from the crystal detector P are connected to telephones of the high resistance type, or to the "input" terminals of an amplifier. The crystal detector is then in circuit for either plain or inductively coupled reception.

If the tuner is used with a valve detector the terminals FP and G are connected to the filament and grid of the valve detector, leaving the centre terminal free. Reaction is coupled in the usual manner, and the coil may be reversed, if necessary, by crossing the leads from the reaction terminals. It will be noticed that the central coil is connected in the aerial circuit; when a valve detector is used, the reaction coil is coupled to the aerial coil and reaction effects obtained whether the secondary circuit is employed or not.

Components of Different Make Can be Used.

All the components for the tuner may be substituted, with the exception of the triple coil holder, which is of Sterling manufacture. The panel is of ¼-inch matt ebonite, 12in. × 10in., and should be of the best quality.

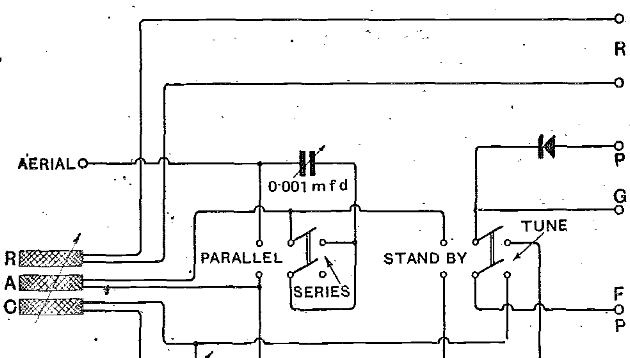


Fig. 1.—The theoretical connections from which the circuit can easily be traced out.

Two Circuit Tuner and Crystal Set.—

After squaring up, the panel should be marked with a scriber, according to the layout of Fig. 2, and centre punched before drilling. The coil holder is mounted just as it is purchased, the holes in the ebonite base acting as a template for drilling purposes. All holes should be clearance holes, and the components bolted to the panel by BA screws and nuts. After the panel is drilled and cleaned with paraffin, it may be sent to the engravers or, alternatively, may be effectively and cheaply labelled by applying transfers, which may be obtained from any dealer.

When all the components are mounted, wiring may be carried out with 16 S.W.G. tinned copper wire, which has been stretched into straight lengths of about two feet. The method of effectively doing this has many times been described in this journal. Wires coming

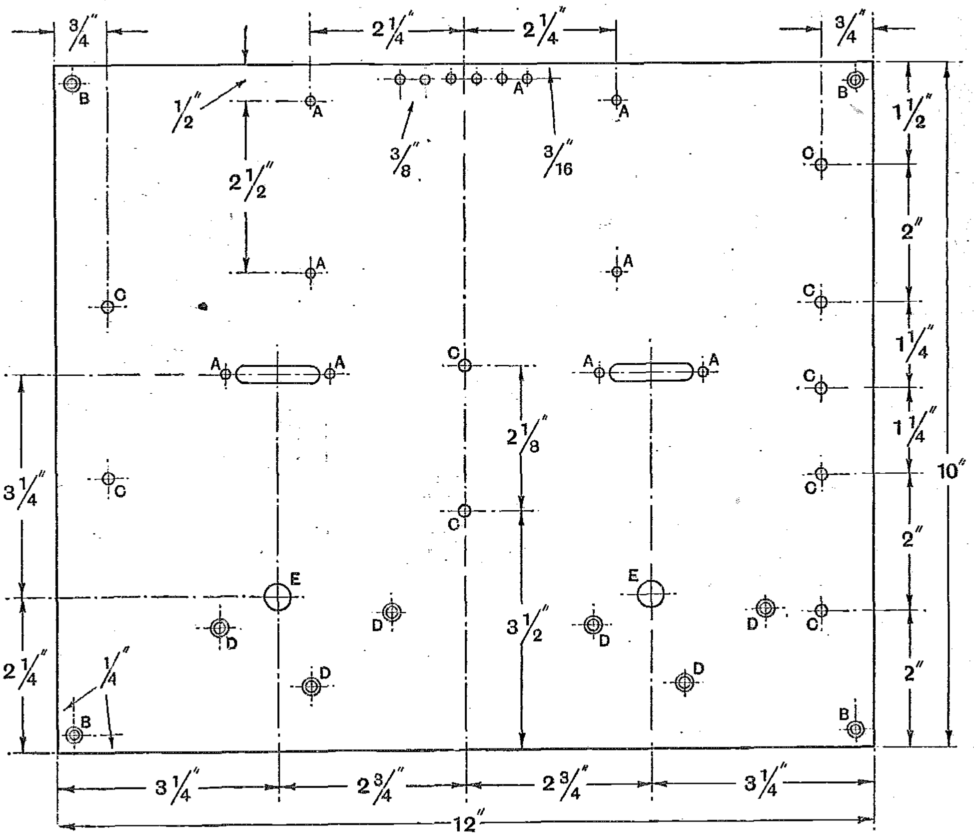
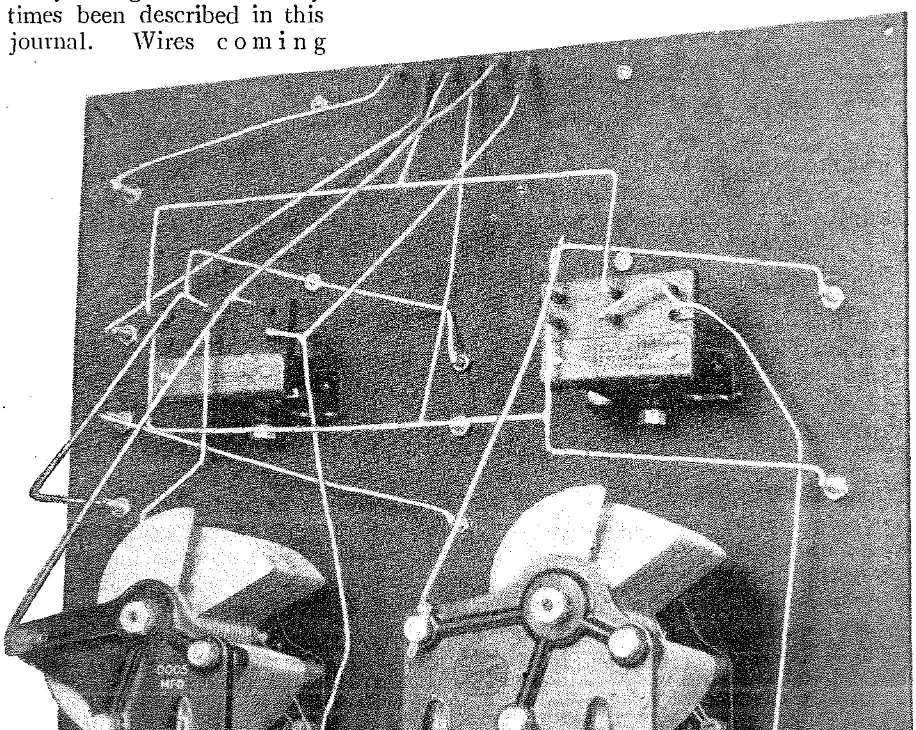


Fig. 2.—Details of the ebonite panel. The holes should be drilled as follows: A, $\frac{1}{8}$in. dia.; B, $\frac{1}{8}$in. dia. and countersunk for No. 4 wood-screws; C, $\frac{5}{32}$in. dia.; D, $\frac{5}{32}$in. dia. and countersunk for No. 4 BA screws; E, $\frac{3}{8}$in. dia.

through the panel to the soldering tags on the base of the coil holder should be bent to different angles to minimise capacity effects between parallel leads. All other wiring is simple and can be copied from the photograph, and the wiring diagram of Fig. 3.

The tuner can be used for any wavelength, and any standard plug-in coils may be used. Tuning will be a pleasure with this instrument, and after a little practice both aerial and secondary coils may be manipulated, giving that degree of selectivity so essential for undisturbed reception, especially to coastal dwellers. With the low minimum capacity of the variable condensers, the tuner is capable of tuning down below 200 metres, but as special



View of the underside of instrument showing the simple wiring. The six wires at the top are those connecting to the reaction, aerial and secondary coils.

Two Circuit Tuner and Crystal Set.—apparatus is generally used for wavelengths of this order, it will suffice to consider 200 metres the minimum.

A perikon crystal has been used with success with this tuner, but it is especially recommended that a detector having a glass cover be used. That shown in the set is of the wire contact type.

The following parts were used in building the unit:—
1 variable condenser, 0·001 mfd., with vernier (Sterling).
1 variable condenser, 0·0005 mfd., with vernier (Sterling).
2 double-pole two-position anti-capacity switches (Utility).
7 terminals.
1 triple coil holder (Sterling).
1 crystal detector (Mic-Met).

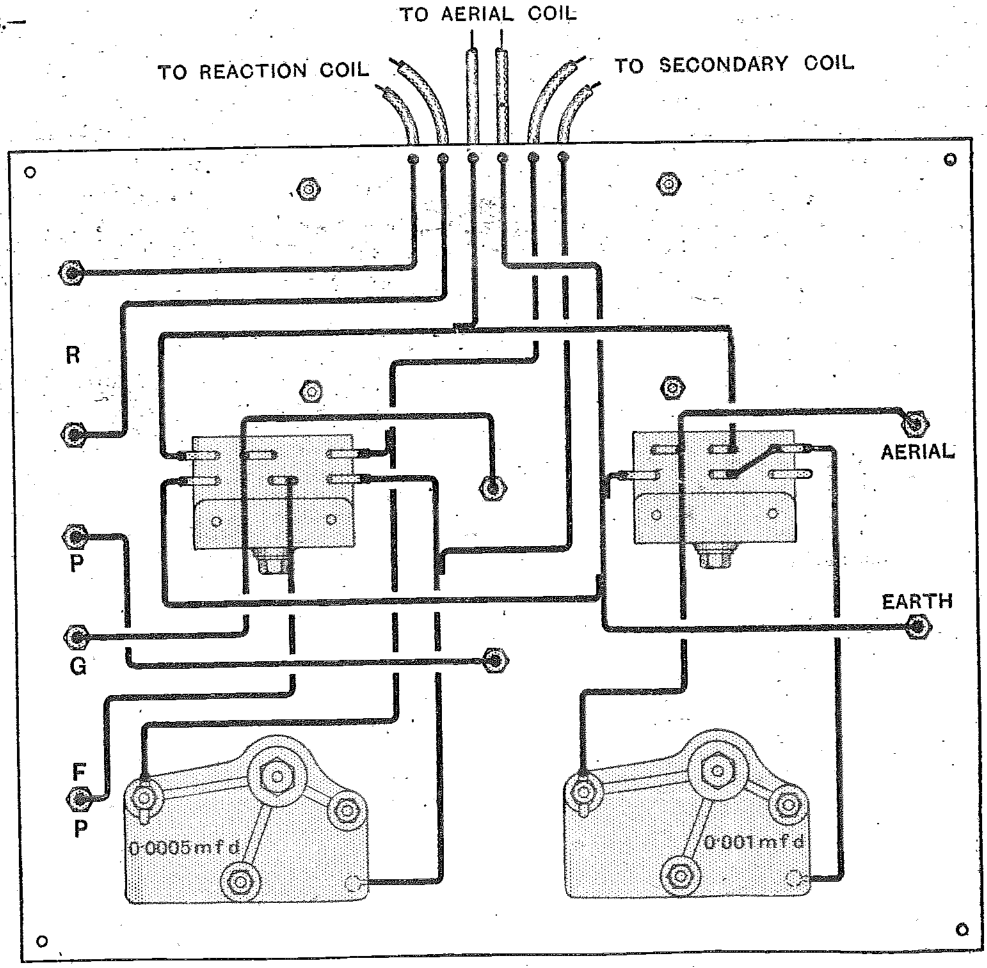


Fig. 3.—Wiring diagram. All wires are of bare tinned copper except the six wires connecting the coil holder, which are flexible.

When coupled up to the amplifying unit described in the last number of *The Wireless World*, and used on a good aerial, it will be possible to hear several other stations of the B.B.C. at moderate head-phone strength when both amplifying valves are used. The two units will give really good volume when used as directed in this article and under average conditions.

It should be remembered that the addition of a single valve with magnifier will not in any way decrease the purity of crystal reception provided a reasonably good coupling transformer is used and the valve correctly adjusted. The transformer may have a ratio of up to about 8 to 1, and any type of low-impedance valve can be used. A grid bias of one or two cells should be employed, with liberal H.T. If suitable values of grid bias and H.T. are not used signals will be distorted.

When a second note magnifier is connected care has to be taken in the matching of the intervalve coupling and the amplifying valve if distortion is to be prevented. With modern valves and transformers it is possible to obtain faultless reproduction.

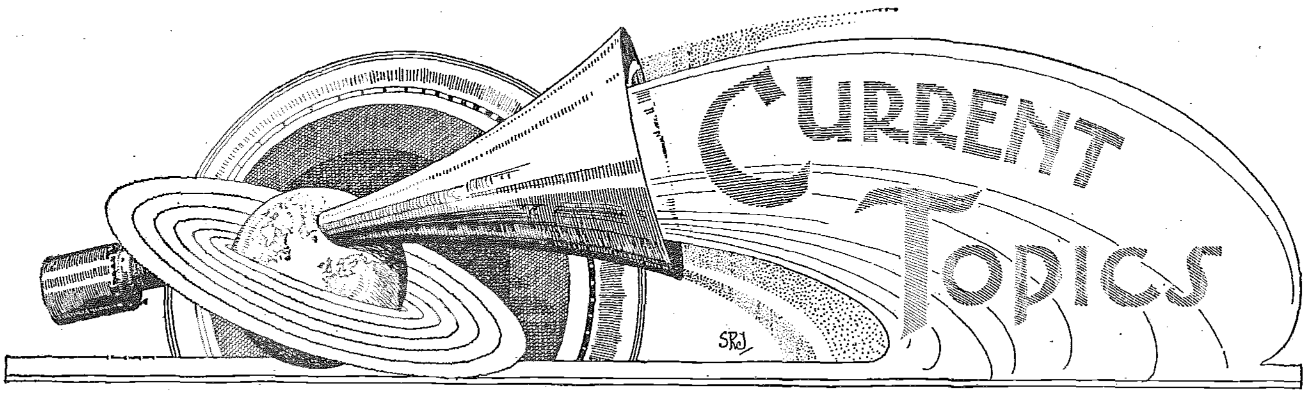
WIRELESS TELEPHONY IN SWITZERLAND.

THE Department of Overseas Trade is informed that, according to the *Gazette de Lausanne*, the municipal authority at Lausanne are contemplating a transformation of the existing wireless station at the Champs de l'Air, which is to be supplied with a new transmitter specially adapted for broadcasting and equipped with a microphone of the latest design.

A new station is also being constructed at Basle. The necessary buildings have now been erected and the installation of apparatus and the aerial is being proceeded with. It is probable that this station will be used for civil aviation purposes.

The number of receiving sets licensed by the Swiss authorities up to the end of 1924 was 16,964, and the considerable increase in the number of receiving stations which took place during 1924 is chiefly attributed to the opening of the Zurich-Hoengg broadcast station last August.

An association of Swiss wireless dealers has been formed and held its first meeting in Zurich on February 21st. The association expressed its view as to the desirability of establishing the wireless trade on a sound and healthy basis by eliminating the "occasional" dealer.



Events of the Week in Brief Review.

WIRELESS GUIDE FOR AIRCRAFT.

Sir Philip Sassoon, the Under-Secretary for Air, states that it is intended to install leader cables at all British aerodromes to ensure a safe landing for pilots during the night or in foggy weather. As soon as a machine comes within the range of transmission from the cable the pilot can drop until he sees the lights of the aerodrome, which are calculated to penetrate 800 feet of fog, and can thus be assured of his exact position for landing.

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FINNISH AMATEURS' INTERNATIONAL PREFIX.

The Radio-Amateur League of Finland has decided to adopt, from April 1st, the letters "SZ" as their nationality prefix when communicating with amateur stations in other countries.

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EXPERIMENTERS PLEASE NOTE.

The B.B.C. has forwarded to the Institute of Patentees, 44, Great Russell Street, W.C.2, a list of matters connected with wireless apparatus in which improvements are urgently required. Free particulars can be obtained from the Institute, and the assistance of experimenters with scientific knowledge and facilities for research work will be gladly welcomed.

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TELEPHONY ON RAILWAY TRAINS.

The Zugtelephonic Aktiengesellschaft Berlin has been incorporated, with a capital of 900,000 marks, for the purpose of fitting telephone apparatus to trains on all railways in Germany, thus enabling passengers on any train to speak with a subscriber in any part of the country. It is hoped that this service will be opened during the coming summer. When once telephony has been duly installed, it is probable that a radio service will also be set up in the carriages of passenger trains.

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DIRECTION-FINDING STATIONS FOR SOUTHERN IRELAND.

A scheme is now under consideration for establishing much-needed direction-finding stations on the South Coast of Ireland.

ROUND THE WORLD IN A LIFEBOAT.

Three Cornishmen—Capt. Hitchins, Mr. Philip Nichols, and Mr. George Jenkins—with a wireless operator, intend to make a tour round the world in the old Mount's Bay lifeboat, "Elizabeth and Blanche," which has been fitted with an auxiliary motor, although the adventurous crew intend to accomplish most of the voyage under sail.

Their object is to decide the best foods for sustaining life in an open boat, to perfect an appliance which is hoped to obviate the privations caused by lack of water, to test a special compass, and to prove the advantages of wireless to lifeboats and similar craft. A cinematograph camera will form part of the cargo.

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THE SCHOOLS RADIO SOCIETY EXHIBITION.

The Schools Radio Society Exhibition, which was formally opened on Saturday, March 14th, at the Beaufoy Institute, Princes Street, S.E., proved a very great success. The Society was fortunate in obtaining the services of Mr. J. C. Stobart, Educational Director of the B.B.C., to open the exhibition, and in a short speech Mr. Stobart referred to his confidence in the educational value of wireless and said that he looked forward to a time when wireless lessons and lectures from broadcasting stations would be listened to by students throughout the country as part of their regular classes. He did not, of course, mean that at any time the broadcasting of lessons would take the place of direct tuition, but that it would supplement the ordinary routine of education and provide facilities which were unobtainable through any other means.

Dr. W. H. Eccles, President of the Schools Radio Society, spoke on the value of wireless as a study and a hobby and the means of widening the student's knowledge, and particularly of introducing to his notice the all-important subject of electricity.

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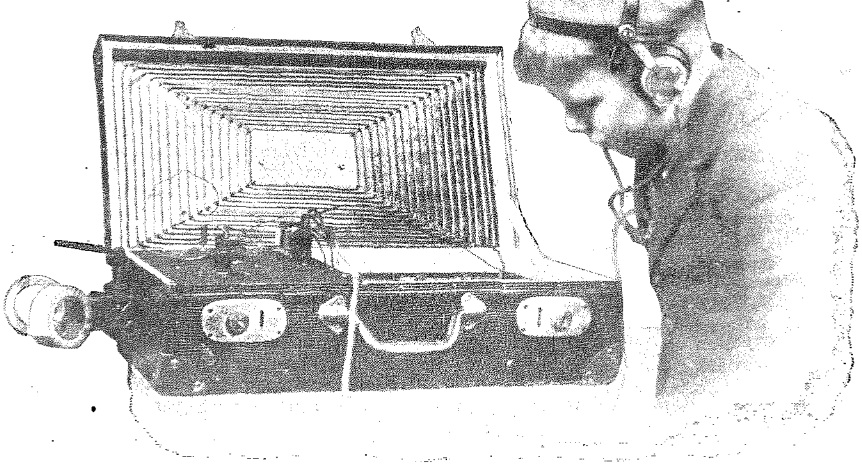
SHORT WAVE CALLS HEARD.

A correspondent asks if any of our readers can identify the following stations heard by him on wavelengths of 120 metres and less:—UKF, UIO, ZUAZ, HWF, ODJ, 4T1, and RJBA. The last, which appears to be an Argentine station, was calling AVOL.



A two-valve portable receiver made by the scholars of St. Paul's school, Dorking, on view at the Schools Radio Society Exhibition.

RECEIVING STATIONS AT FORNEBO.

The new receiving station erected by the Société Française Radiotelegraphique for the Norwegian Government is now completed, and satisfactory communications have been received from Buenos Aires, Honolulu, Tananarivo, Saigon, and other distant stations. This station, which is situated at Fornebo, will handle the incoming traffic which has, up to now, been dealt with by Stavanger.

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EARLY MORNIN GRECITAL.

Another correspondent states that on Sunday, March 8th, from 2 to 3.30 a.m., he heard a station transmitting pianoforte solos on a wavelength of about 400 metres. He was unable to distinguish the call-sign, but the fact that Grieg's "Morning" was transmitted at 2.50 a.m. may enable the station to be identified. Our correspondent will be very grateful for information which will put him in touch with the owner of the station.

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MERCHANT SHIPPING (EQUIVALENT PROVISION) BILL.

In moving the second reading of this Bill on March 12th, Viscount Peel explained that its main object was to make reciprocal arrangements with France or other countries not only with regard to wireless, but to other matters as they might arise. It would be extremely useful as a bargaining power with foreign countries.

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TESTS FOR OSCILLATION NUISANCES.

The Transmitters' Section of the Bristol and District Radio Society are conducting a series of tests to ascertain the range of disturbance of an oscillating receiver. Certain members of the Society will send out a specified number of dots at stated times from oscillating receivers, and listeners in the neighbourhood are asked to report to the operator of each station heard, who will, in turn, report to the Hon. Secretary of the Society. By this means it is hoped to collect some interesting data which will be of service in minimising the oscillation nuisance.

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NEW STATION IN FILMLAND.

A new private broadcasting station is being erected in front of the film studio owned by Messrs. Warner Bros. in Hollywood, California. The call-sign will be KWB.

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10 AMERICAN STATIONS IN TWO HOURS.

Mr. J. MacIntosh, of Inverness, writes that during the night of December 27th to 28th between 0109 and 0310 G.M.T. he heard the following stations:—KDKA, 68 metres; WSAI, Cincinnati, 309 metres; KDKA, 326 metres; WBZ, Springfield, Mass., 337 metres; WJAR, Providence R.I., 360 metres; WGY, 380 metres; WOR, Newark, N.J. 405 metres; WFI, Philadelphia, 395 metres; PWX, Havana, Cuba, 410 metres; and WIP (WOO?), Philadelphia, 509 metres. He was using a 2-valve (dual) set of his own design, and thinks that this must constitute a record for distant broadcast reception on a 2-valve set.

DEATH OF Mr. W. W. BRADFIELD.

All who are concerned in the world of shipping and in the wireless and electrical industry will hear with the deepest regret of the death of Mr. W. W. Bradfield, general manager of the Marconi International Marine Communication Co., Ltd., which took place in a London nursing home on March 17th. Mr. Bradfield was born in London on March 18th, 1879, and thus passed away on the 45th anniversary of his birth.

Practical radio telegraphy owes much to Mr. Bradfield, whose connection with the Marconi Company dates from September 3rd, 1897, when he entered what was then known as the Wireless Telegraph and Signal Co., Ltd. For over a quarter of a century, therefore, Mr. Bradfield has been concerned with the de-

The late Mr. W. W. Bradfield.

velopment of wireless, particularly in connection with shipping, and it may fairly be stated that he was largely responsible for the efficiency of the maritime wireless services and the high standard which they have now reached.

In both business and social life, Mr. Bradfield revealed a character which gained for him innumerable friends, and his delightful personality endeared him to business friends, clients, and colleagues.

An associate member of the Institute of Electrical Engineers, Fellow of the Institute of Radio Engineers (America), and an associate of the American Institute of Electrical Engineers, Mr. Bradfield followed keenly the progress of every phase of the great science with which he was for so long connected. During the war he devoted his entire energies to the support which the Marconi companies gave to the Services, and he was decorated with the C.B.E. for war service.

The funeral will take place at 12.30 on Friday at Abney Park Cemetery, Stoke Newington.

BROADCAST STATIONS IN AUSTRALIA

The Queensland Government have completed arrangements with Amalgamated Wireless (Australasia), Ltd., for the erection of a 5 kw. "Class A" broadcasting station at Brisbane, which it is hoped will be in operation for the coming winter.

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BRITISH WIRELESS DINNER CLUB.

The annual dinner of the British Wireless Dinner Club was held at the Trocadero on Saturday, March 14th, and, as usual, there was a very full attendance. Senatore Marconi, President, communicated his regret that owing to indisposition he was unable to be present. Admiral of the Fleet Sir Henry B. Jackson, K.C.V.O., F.R.S., past president, was in the chair, whilst the guests of the evening were General Gustave Ferrié, C.M.G., and Air Vice-Marshal Salmond. General Ferrié, in replying to the toast of the President of the French Republic, expressed his pleasure at the opportunity of meeting so many with whom he had come in contact in France during the period of the war. He said he hoped that the time would shortly come when the French Government would be able to make arrangements for organising wireless development on lines which would bring about the same satisfactory results which he saw evidenced in this country.

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MISSUSE OF CALL-SIGN.

Mr. D. Douet (5AQ), of Putney, wishes it to be made known that he is not transmitting speech at present, but believes that some experimenter is making illicit use of his call-sign. We shall welcome any information which will enable us to trace the offender.

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UNITED STATES NAVAL PATENTS WILL BENEFIT MANUFACTURERS.

The United States Navy Department has decided to issue licences, under the German patents purchased by the Navy during the war, to reputable American manufacturers who are actively conducting radio research work and who hold patents, the rights of which they will exchange with the Navy in return for the use of the Navy patents. The action of President Coolidge in throwing these patents open to the use of manufacturers eliminates the danger of a radio monopoly, and encourages competition, by which the listener will greatly benefit.

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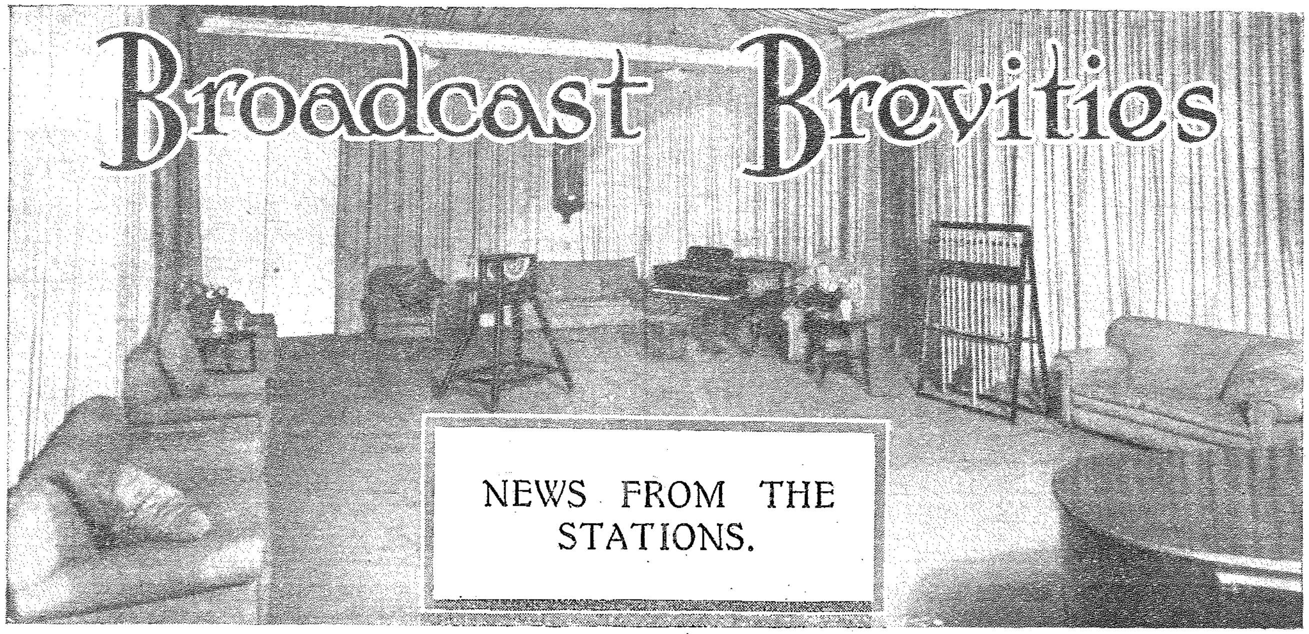
DINNER TO AMERICAN AMATEURS.

On the occasion of the visit to this country of the American wireless amateurs in April, it has been decided to give in their honour a dinner, which will be held in London under the auspices of the T. and R. section of the Radio Society of Great Britain. The function will take place on April 24th, and those members of the T. and R. section and the R.S.G.B. who are desirous of attending, are invited to send their names to the Hon. Secretary of the T. and R. section of the R.S.G.B., 53, Victoria Street, S.W.1 Tickets will probably be 12s. 6d. each.



Broadcast Brevities

NEWS FROM THE STATIONS.

No Extension of Broadcast Hours.

Despite many rumours, it is reported that the B.B.C. does not intend to inaugurate a regular broadcasting service as from 11 o'clock in the morning "for the benefit of night-workers and invalids." The powers at Savoy Hill already have their hands pretty full in filling the present-time schedule, and, as everyone knows, there are other and more pressing matters in connection with development which are engaging their attention.

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Broadcasting 'Lyons.'

The music from Lyons' Popular State Café is to be broadcast from the B.B.C. Station at Manchester. This is a new departure for Manchester, but is already being done elsewhere, and may be extended eventually to other parts of the country.

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A Parliamentary Critic.

Apropos last week's note on the broadcasting of Talks about Parliament, we are now able to state that Mr. W. R. M. Pringle is to act as Parliamentary Critic. Mr. Pringle knows Parliament inside out, and is familiar with the personalities of all the Members.

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An Unrehearsed Incident.

An unrehearsed incident occurred during the recent performance of "The Pilgrim's Progress." In beating time, Mr. Joseph Lewis, the conductor, accidentally struck his hand on the music desk and reopened an old wound, which bled profusely. The accident happened just at the moment when Hopeful was singing the following line:

"But, sir, behold thy hands!
Defiled with blood, ——," etc.

Fortunately, Mr. Lewis carried on without a pause.

Sir Edward Elgar.

Sir Edward Elgar will be a great attraction for listeners on March 31st, when he will broadcast to all stations of the B.B.C. from 2LO a programme of his own works. The eminent composer, who is entirely a self-made man in the world of music, will then come into line with other leaders in Art circles in recognising the value of the new Science in reaching far larger audiences than is possible by any other means.

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Paderewski.

One of the most pathetic incidents which have occurred in the Studio at 2LO was witnessed on that memorable night when M. Paderewski gave us a demonstration lasting for more than an hour of his superb artistry. During the playing of his own Nocturne it was noticed that the tears were flowing freely down his cheeks. The great master, free from the gaze of a visible audience, gave vent to an emotion which was probably due as much to a rush of memories connected with his composition as to the volume of harmony which had been born in his heart.

M. Paderewski at the piano during his recent broadcast recital.

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A Broadcast Tour.

Full of special interest will be a series of programmes from the Glasgow Station, the first of which will be given on Wednesday, March 25th, when listeners will be taken on a tour by broadcast through Canada, and efforts will be made to visualise the vast extent of the Dominion. One place to be visited will be Jasper Park, one of the many magnificent open spaces which the Dominion Government has provided for the recreation of Canadians.

Round and about London there are upwards of one hundred parks and open spaces, by far the largest being Richmond Park, consisting of an area of four square miles. Jasper Park covers an area of four thousand square miles, and everything else in the Dominion is on the same scale of magnificence.

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The New 2LO.

B.B.C. engineers had a rough passage in connection with the preparation of the new permanent 2LO station. There was one minor trouble at first, and when this was put right, other defects developed in the apparatus, resulting in patchy reception over fairly large areas, but listeners will ultimately be very well satisfied with the Station, and the engineers will not grudge them a little grumble in the meantime, justified as the complaints have been. It cannot be too strongly emphasised that although the new station has a higher power, the strength of reception will remain unaltered, but the effective range for crystal users will be about twenty-five miles.

Paderewski Gramophone Records.

The correspondence received by headquarters at 2, Savoy Hill, in connection with the auction sale of gramophone records autographed by M. Paderewski throws an interesting and amusing sidelight on the attempt to popularise "star turns" among the masses of listeners. One man enclosed a penny stamp for the records, and expressed his displeasure at the recital in unqualified terms. Incidentally, he clearly did not know the difference between a pianoforte recital and a solo on an ocarina. An Aberdonian sent three penny stamps, and seriously hoped that his might be the highest bid.

Obviously the B.B.C. is faced with a big problem in trying to cater for all tastes.

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A Wireless Competition.

Listeners should make a point of picking up, if possible, the evening programme from Bournemouth Station on Saturday, April 4th. The programme will be entitled "Requests and Guessing," and a prize of three guineas will be awarded to the listener who sends in the greatest number of correct answers to the following:—The names of the vocalists; the names of the songs sung, together with the names of the composers; the names of the instrumental solos, together with the names of composers and instruments; and the names of the different items played by the orchestra, together with the names of the composers.

oooo

Wireless v. Gramophone.

On a recent evening, when several stars of considerable magnitude were scheduled to broadcast from London, and some of the principal European stations, a disciple of radiotelephony was challenged by a neighbour who advocated the superiority of the gramophone, to a contest. The idea was to prove that a selection of gramophone records would provide more entertainment than any number of broadcast programmes that could be picked up in one evening. The radio enthusiast obtained eighteen stations in all, British and Continental, and the gramophone enthusiast played more than fifty first-class records. Probably the gramophonist had the advantage both in the quality of his machine and of the records. At any rate, the result was declared a draw.

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Wireless on Tap.

Apropos the remark of a certain politician that he "looked to the time when every house will have its wireless set and loud-speaker," a correspondent asks why every new house that is built in future should not have wireless laid on like gas and water? Already a Massachusetts electricity supply company is exploiting a similar idea by presenting a wireless set with all new house wiring orders. Of course, the B.B.C. would like to know that wireless had been installed in every home, but it would obviously be necessary to wait until the tenants had moved in before the wireless man called with the presentation set. And would the vendor of the house supply the initial licence?

FUTURE FEATURES.

Thursday, March 26th.	
5XX, 7.30 p.m.	Chamber Music Evening.
Cardiff, 7.35 p.m.	An Hour with Beethoven and an Hour of Light Music.
Manchester, 7.30 p.m.	The Hallé Orchestra Pensions Fund Concert, conducted by Hamilton Harty. S.B. to other Stations.
Aberdeen, 7.35 p.m.	Music and Drama.
Friday, March 27th.	
London and 5XX, 7.30 p.m. ...	Band of H.M. Grenadier Guards. S.B. to Belfast.
Birmingham, 7.30 p.m.	Ballad Programme.
Bournemouth, 7.30 p.m.	"Bournemouth Calling Belgium."
Cardiff, 7.30 p.m.	"A Night of Adventure."
Manchester, 7.30 p.m.	Symphony Concert.
Aberdeen, 7.30 p.m.	Brahms and Schumann.
Glasgow, 8 p.m.	John Ireland Recital. S.B. to Aberdeen and Belfast.
Saturday, March 28th.	
Birmingham and 5XX, 7.30 p.m.	Light Symphony Programme.
Newcastle, 7.30 p.m	Music and Drama.
Aberdeen, 7.30 p.m.	The Barnado Musical Boys.
Sunday, March 29th.	
London, 3 p.m.	Chamber Music.
London, 9 p.m.	De Groot and the Piccadilly Orchestra.
Manchester, 3 p.m.	Light Orchestral Programme relayed to 5XX.
Monday, March 30th.	
Bournemouth, 3.45 p.m. ...	Chamber Music.
Manchester, 7.30 p.m.	"The Gamblers."
Glasgow, 7.30 p.m.	Popular Concert.
Belfast, 7.30 p.m.	"The Merchant of Venice."
Tuesday, March 31st.	
London, 7.30 p.m.	Sir Edward Elgar will conduct a programme of his own works. S.B. to all Stations.
5XX, 7.30 p.m.	Military Band Night.
Wednesday, April 1st.	
London, 7.30 p.m.	Liza Lehmann Evening.
Birmingham, 7.30 p.m.	Radio Fantasy No. 4: "For the Crown."
Cardiff, 7.30 p.m.	"A Night Out."
Newcastle, 7.30 p.m.	Scenes from "The Song of Hiawatha."
Glasgow, 7.35 p.m.	"Pole to Pole."
Edinburgh, 7.30 p.m.	Operatic Programme.
Leeds, Bradford, 7.30 p.m. ...	*Yorkshire Evening News* Concert.

oooo

International Wireless Conference.

What was in the nature of an informal talk on the chief problems connected with British and European broadcasting was held last week, in London, at a conference convened by the British Broadcasting Company. Naturally, the preliminaries were dealt with after the principle had been established that an international bureau should be set up to perform the double function of a clearing-house of information and of an instrument for the adjustment of technical difficulties of an international character. The countries represented were Norway, Holland, Belgium, Germany, France, Italy, Spain, and Czecho-Slovakia; the representation being either direct or by agents in London. In view of the international character of questions of mutual interference, allocation of wave-lengths, power, etc., it is obvious that the discussions must presently assume an increasing importance in international law, and there is no doubt that when an international bureau is formed its meetings will be held at Geneva under the auspices of the League of Nations.

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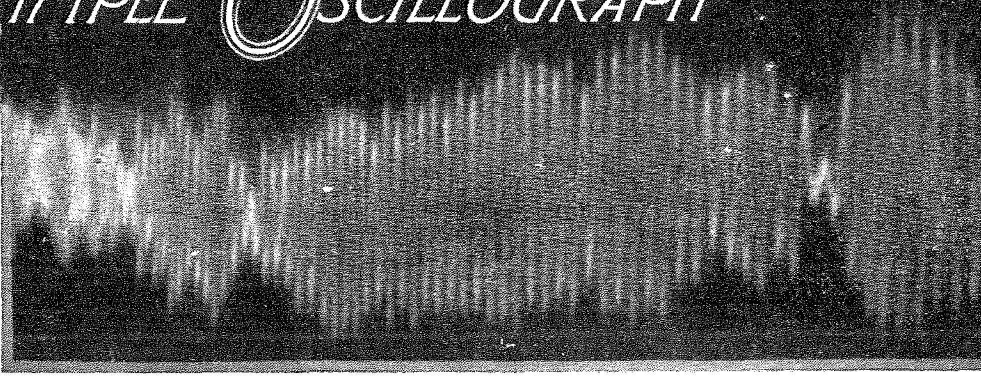
New Zealand Signals Still Strong.

The outstanding feature of long-distance work during the past week, has been the extraordinary increase in strength of transmissions from the New Zealand station 4AG, and, although the period during which New Zealand stations come in has now dwindled to approximately half-an-hour, it seems that the strength has gone up in proportion to the narrowing of the period of audibility.

A SIMPLE OSCILLOGRAPH



A Method of Photographing Wireless Signals.

By
A. CASTELLAIN,
B.Sc., A.C.G.I.

IT would obviously be of great assistance if the actual wave form of the currents in circuits could be seen by experimenters studying, for instance, the question of amplification and distortion, and in the course of ordinary experimental work it is frequently desirable to know more or less exactly the wave form of the currents used. For example, a valve oscillator may be used to generate currents of pure sine wave form, or an A.C. generator may be the source. If care is not taken, misleading results may be obtained by assuming the wave form of the currents to be sinusoidal, whereas, in fact, they are not. A device for producing such records is not difficult to construct and operate. Such an arrangement is generally termed an oscillograph, and the one described here was built from the simplest material.

The operation of the oscillograph may be understood by referring to the following figures. Suppose, as in Fig. 1, that a current is passed through the coils of a telephone earpiece. As the current increases from zero, in a direction to oppose the magnetism of the permanent magnet of the earpiece, the diaphragm is released; after reaching its maximum value the current falls, the demagnetising effect of the current reduces, and the diaphragm gradually returns to its normal position. Then, when the current commences to grow in the opposite direction, the diaphragm is pulled towards the magnets of the earpiece, and so on. If a short bar is fixed to the centre of the diaphragm, it will move up and down somewhat as indicated by the arrows on the right of Fig. 1.

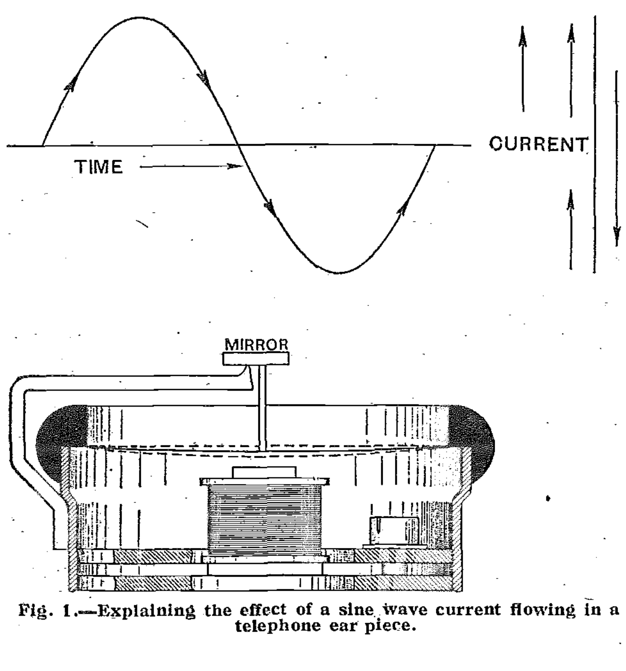


Fig. 1.—Explaining the effect of a sine wave current flowing in a telephone ear piece.

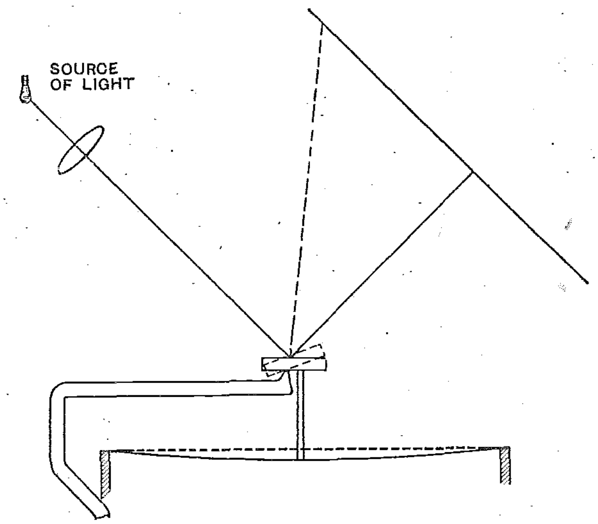


Fig. 2.—The wave form of the current can be found by this simple arrangement if a photographic plate is allowed to fall at right angles to the beam of light.

Suppose now that a small mirror is attached to a support, as indicated in the figure, leaving the bar fastened to the diaphragm free to tilt it. When the sinusoidal current is passed through the earpiece the mirror will rock, and if a beam of light is directed on the mirror, Fig. 2, a line will be traced out on a screen arranged at right angles (*i.e.*, vertically) as suggested by the sketch. The line will merely be an enlargement of the line representing the up and down movement of the bar on the diaphragm. Further, if a photographic plate is allowed to fall at a uniform speed at right angles to the beam—that is, vertically (or downwards through the

A Simple Oscillograph.—

paper), a line showing the actual wave form of the current will be indicated on the plate.

When it is desired to project the beam on to a screen, it is necessary to employ a device for spreading out the line made by the vibrating mirror. There are several methods, but perhaps the simplest is to rotate or rock a second mirror by means of an electric motor, as suggested by Fig. 3. Here the beam of light is projected on to the mirror of the oscillograph (on the left of the sketch), and the moving beam is reflected by the rotating (or rocking) mirror on to the screen. Hence the line traced out on the screen by the vibrating mirror is a visual picture of the current flowing through the coils of the earpiece of the oscillograph.

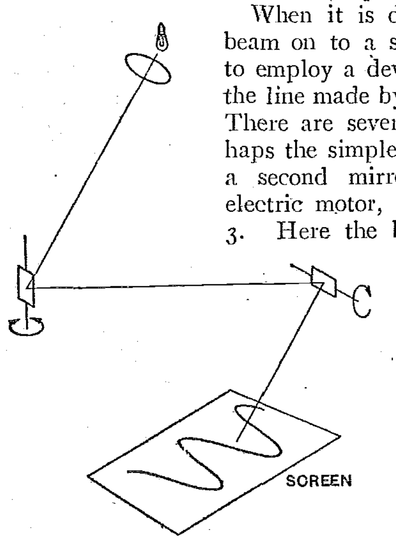


Fig. 3.—A method of projecting the beam of light on a screen to give a visual indication.

Construction.

An ordinary reed type telephone earpiece is employed, and is modified slightly as shown by the photograph of Fig. 4. The reed is removed, and a small piece of brass rod soldered to the end of it and filed away, as shown at A, Fig. 5. This additional piece is of the same width as the reed, and of such a length that when the reed is in position the edge of the projecting piece A is about level with the inner edge of the case of the receiver. A second piece of brass strip is now shaped as shown at B, Fig. 5, and screwed to the side of the case. The case should be filed flat to allow piece B to bed firmly. Pieces A and B, therefore, almost touch, but the gap separating them should not be so small that the reed is not quite free to move—a separation of about ten thousandths of an inch is satisfactory. A small mirror, M, is now stuck with rubber solution to the edges of the pieces A and B. The mirror can be seen in the photograph of Fig. 4, in Fig. 5, and in Fig. 6. It will be necessary to fix the mirror very carefully and allow half an hour or so for the rubber solution to dry. The mirror should be quite tightly fixed, and not wobble in use.

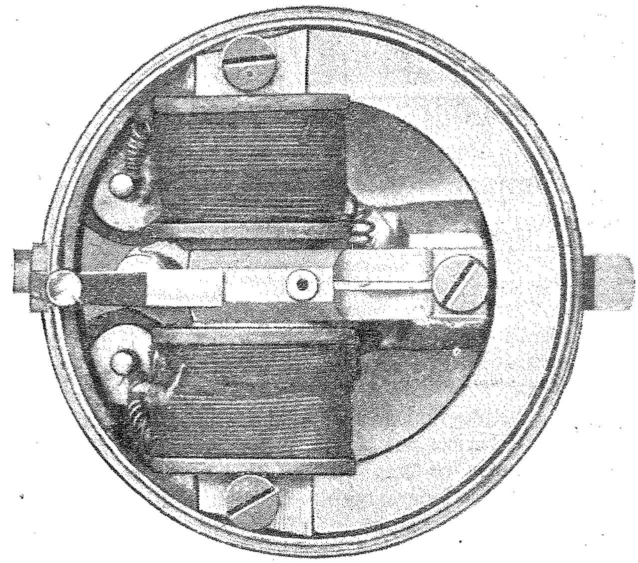
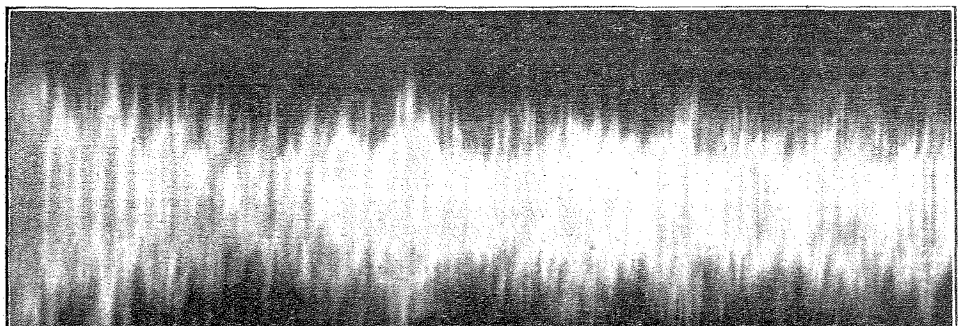
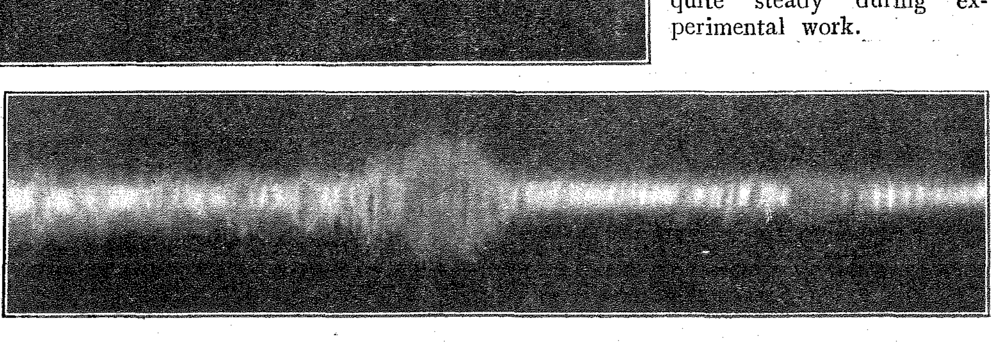


Fig. 4.—The complete earpiece. On the left is the small mirror.

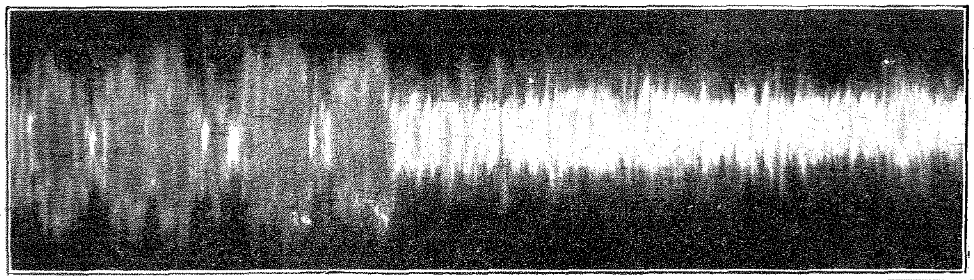
Finally, mount the earpiece in a bracket such as that of Fig. 6. This bracket is made of brass strip, and two screws are fitted to support the earpiece. If desired, a more elaborate mounting, with arrangements for tilting the earpiece in any direction, can be used. Suitable devices may safely be left to the reader, but it should be remembered that it is essential to provide a mounting which will hold the earpiece quite steady during experimental work.





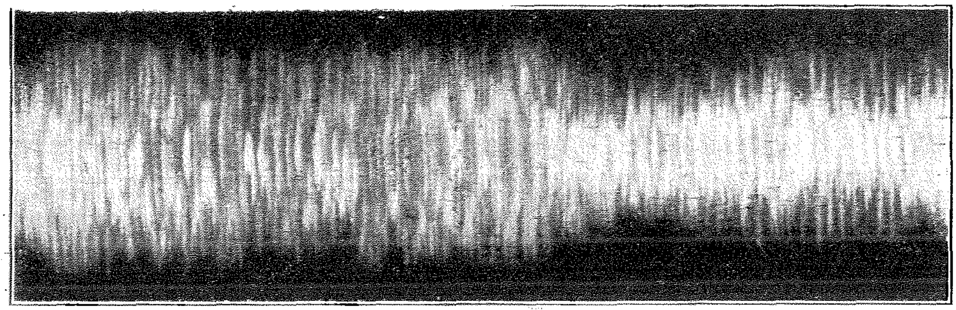
Top, (A), The current set up in a wireless receiver tuned to 2LO during a violin piece with orchestral accompaniment.

Right, (B), Result of the announcer speaking.



(Left.) An opera singer with light orchestral accompaniment.

(Below.) The opera orchestra only.



The illustrations show the interesting results which can be obtained with the instrument by the falling plate method. An ordinary receiver tuned to the London station was used, and the earpiece connected in the plate circuit of the last valve.

Setting Up the Apparatus.

The optical system employed by the author is sketched in Fig. 7. A "Pointolite" was used, as it gives a good strong, steady light. The cylindrical lens is not absolutely essential, but merely a refinement.

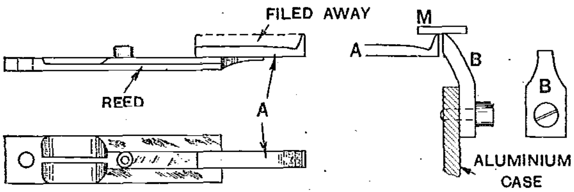


Fig. 5.—Explaining the construction of the additional pieces fitted to the earpiece; M is the mirror.

A simple slide arrangement is used for guiding the photographic plates. This is sketched in Fig 8, and consists of two grooved pieces of wood, which are screwed

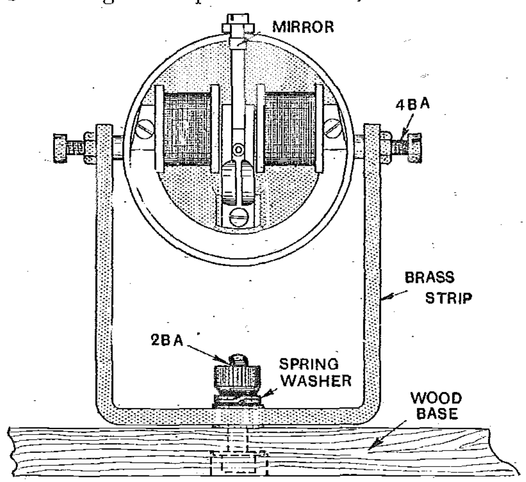


Fig. 6.—The earpiece mounted in a convenient support.

to a wooden framework. Rubber pads are secured to the bottom of the framework to take the shock of the falling plate.

A number of examples of the results obtained with this instrument are reproduced here. In photograph A, we have the wave form of the current produced in a

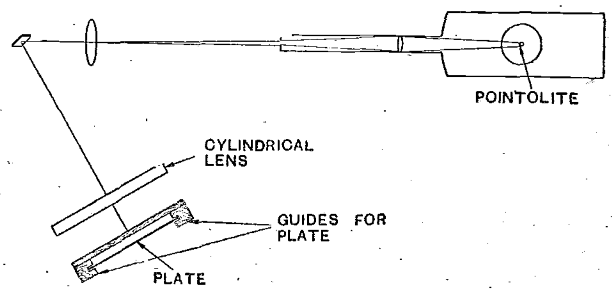


Fig. 7.—Arrangement of the apparatus. The cylindrical lens is not essential.

receiver by a violin with orchestral accompaniment from 2LO. In B we have the result of the announcer speaking about this item. These illustrations show but one of the uses of the oscillograph.

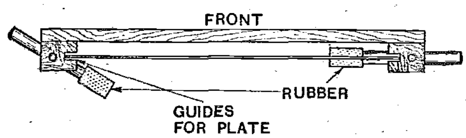


Fig. 8.—The device for guiding the photographic plates.

Numerous experiments can be carried out with this simple instrument. If the earpiece of the oscillograph is connected in the plate circuit of the last valve of a receiver, for instance, it is easy to demonstrate the effect of applying wrong grid and plate voltages to the valves. When a relatively large grid bias is used with insufficient plate voltage a strong signal is partially rectified. This result is easily seen. If then the grid bias is reduced, and the signal is above a certain strength, the peaks of the signal are cut off. By further reducing the grid bias it may be seen that the positive peaks of the signal are levelled, while the negative valves are faithfully reproduced.

AMATEUR TRANSMITTING RECORDS.

A Talk from 2LO Given on March 19th.

By E. J. SIMMONDS.*

IT was in December, 1923, that the first two-way amateur transatlantic communication was established with America, using wavelengths of the order of 100 metres, and powers not exceeding 150 watts. These experiments first took place with American stations situated comparatively close to the Atlantic seaboard, but as the technique of both transmitters and receivers improved, gradually the ranges were increased, until, by March, 1924, British amateur stations had been received on the Pacific coast of America, nearly 6,000 miles away.

These tests provided valuable evidence of the extraordinary efficiency of short wavelengths, and clearly demonstrated that reliable communication with small powers, could be maintained under most adverse conditions. Large numbers of test messages were handled, and the experience thus gained was of enormous value, and excellent training for the outstanding developments which took place in the autumn of 1924.

With the coming of summer, the conditions became more difficult, owing to the shorter nights and increased amount of electrical disturbance of the atmosphere, and consequently no startling advances were made until the fall of 1924.

October 18th, 1924, will long be remembered as marking the culminating achievement in amateur long-distance working, when two-way communication was established with New Zealand for the first time in history. This was an event of outstanding importance, being so extraordinary and unexpected, that it has astonished the scientific world, and has provided valuable data and evidence of the efficiency of short wave transmission which may necessitate modifications of the existing theories relating to short wave propagation.

This success was quickly followed by two-way direct communication with Australia on November 13th, when messages were taken for His Majesty the King from the Wireless Institute of Australia.

Since then, by continued application and perseverance, amateur international communication has developed, until there are now few places inhabited by wireless experimenters which are not linked up with amateurs in Great Britain.

During recent months the development of apparatus for speech transmission and reception on short waves has received increased attention from amateurs, and great strides have been made in this important application.

It may be of interest to mention that on February 8th last speech was received in this country from the Australian Amateur Station 3BC of Melbourne, and twice during the last month, under favourable conditions, intelligible speech has been received in New Zealand from a British amateur station using powers under 150 watts (one-tenth of the power used by the main stations of the B.B.C.).

This short summary of amateur work is sufficient to show how far-reaching the efforts of the amateur worker have been during the past year, and how important it is that these same private investigators shall be given adequate facilities for continuing their researches in the future.

Calls Heard.

Extracts from Readers' Logs.

Clapton Common. (To Feb. 9th.)

French:—8BA, 8CO, 8EE, 8EU, 8MAR, 8NK, 8OM, 8TK, YZ. *Dutch:*—OZN, PC1. *Mosul.*—GHH1. *German:*—1CF. *Swedish:*—SSMZ. *Finish:*—1NA, 1ND, 1NT. *Swiss:*—9BR. *Italian:*—1AM. *Danish:*—7TI, 7ZM. *Belgian:*—4AS, 4LOV, 4SB. *Canadian:*—4CA. *American:*—1AF, 1BER, 1BES, 1CAB, 1CMP, 1CB, 1HN, 1ML, 1PL, 1RD, ISE, IXMI, 1XZ, 1YB, 1YZ, 2BOG, 2BR, 2BY, 2CLA, 2CQ (?), 2CXY, 2DD, 2KX, 2LE, 2RK, 2WR, 3AP, 3BQ, 3BWT. 3BY, 3HQ, 3LW, 3OT, 3QS, 4FZ, 4SB. 4TJ, 8DOO, 8KC, NKF. *Australian:*—3BD.

(0-v-0.)

Douglas H. Johnson (G6DW).

Trondhjem, Norway.

England:—2DX, 2FM, 2KF, 2KT, 2KZ, 2LP, 2LZ, 2MB, 2MO, 2MQ, 2MX, 2NB, 2NM, 2NN, 2OD, 2RB, 2SH, 2SZ, 2TF, 2UV, 2WD, 2WY, 5GS, 5CW, 5LS, 5NN, 5OK, 5PZ, 5RZ, 5TZ, 5UL, 5XN, 6EC, 6FG, 6GM, 6GH, 6KK, 6NF, 6RM, 6RY, 6YM. *France:*—AIN, 8AB, 8AC, 8BF, 8BO, 8CP, 8CT, 8DC, 8DE, 8DI, 8EU, 8FE, 8EN. 8FK. 8FLJ. 8GG, 8GK, 8GL. 8GO. 8GI. 8HS, 8II, 8LMT, 8MAR, 8NI, 8NK, 8OK, 8PL, 8RLH, 8RO, 8RI, 8SG, 8SSC, 8SSU, 8ST, 8UD, 8UK, 8UU, 8VV, 8WZ, 8XP, 8XR, YZ. *Holland:*—NCP1. NOBA, NOBQ, NOFL, NOGC, NOGG, NOLL, NONL, NOKX, NORE, NOZN, NOFP, PC1GK. *Belgium:*—BAO, BYAS, BYAU, BYALS, BK2, BW2. *Sweden:*—SMPL (?), SMXR, SMXV. *Denmark:*—DFBN, DFEC. *Italy:*—I1AM, I1ER, I1KK, I1KX, I1MT, I1RT, I1RE, I1AF, I1WB, I2MB, I3MB. *Finland:*—FN1NCB2 (?), FN2NN, FNPC1. *American:*—UNERK1, WGH, WJR, NKF, 1ARY, 1BDX, 1BGO, 1CA, 1CM, 1CR, 1FD, 1KX, 1PL, 1SF, 1SZ, 1XM, 1XW. 2BY, 2GK, 2TP, 3HH. *Mosul:*—GHH1. *Germany:*—POX. *Luxemburg:*—LOAA. *Unknown:*—C1CF, CEIJ. OCDJ, MB3, FSSC, ELHF, JAG, V3MB.

(0-v-1.)

S. Saxegaard and J. Saure.

Buenos Aires, Argentine. (To Jan. 25th.)

Canada:—1DD, 3X1. *England:*—2OD, 2SZ, 5LS, 6RY. *Holland:*—ONL.

Carlos Braggio (CB8).

Baltimore, U.S.A. (To Jan. 30th.)

British:—2JF, 2KZ, 2NM, 2OD, 2RB, 2SZ, 5LF, 5NN, 6NF. *French:*—8SM, 8SSC. *Dutch:*—ONL. *Chilean:*—9TC. *Brazil:*—WJS. *Argentine:*—4AF, CB8, NZ, 4AA. *Mexican:*—1AA, 1AF, 1N, 1X, 9A. *Cuban:*—2MK. *Costa Rican:*—S.J. *Porto Rican:*—4SA. *Canadian West:*—4BB, 4CR. 4DQ, 5AN, 5GO. *Miscellaneous:*—3BEPM, NERK1.

Harold Harvey (3TE, 3XAQ, 3DN).

Jersey, C.I. (90-120 m.)

British:—(Speech), 5WZ, 6OX, 6PU, 2AFO (or KFO?) (Morse), 2KW, 2OD, 5NN, 5SA, 6NF, 2FK, 2CF, 5LL, 6TD, 6UY, 2JF, 5TZ, 2DF, 2FU, 5MA. *French:*—8ML, 8DP. 8TR, 8FJ, 8II, 8AS, 8MN, 8BL, 8BG, 8RLH, 8HC, 8ALG, 8TK. *Swiss:*—9BR. *Various:*—YF1, 3BK, AVY, 1FP, 1DO, 1CF, 3BQ, AFU, RRR (twice).

(1-v-1.)

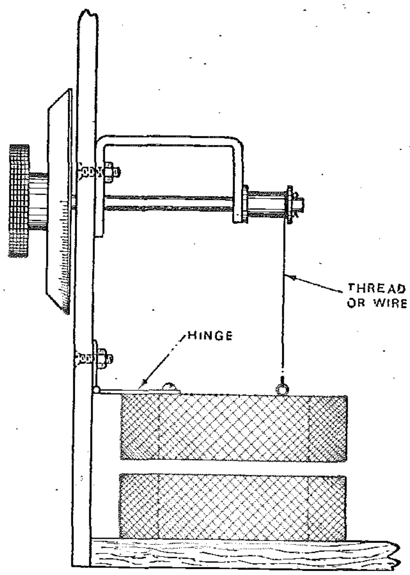
A. M. Houston Fergus (2AZU).

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

AN ADJUSTABLE COIL HOLDER.

A very critical adjustment of coupling can be obtained by mounting the movable coil on a hinge above the fixed coil, the latter being carried on a platform and producing the movement with a thread, winding upon a small drum. A spindle is set up behind the panel in a suitable brass bracket, and is rotated by means of a condenser knob and dial. The small wooden bush which is attached to the end is arranged to provide the lift for the moving coil. If the movable coil is not sufficiently heavy to maintain the thread in a taut condition, a light spring should be inserted in the hinge.—E. L. O.



A method of providing critical coupling between coils mounted behind the instrument panel.

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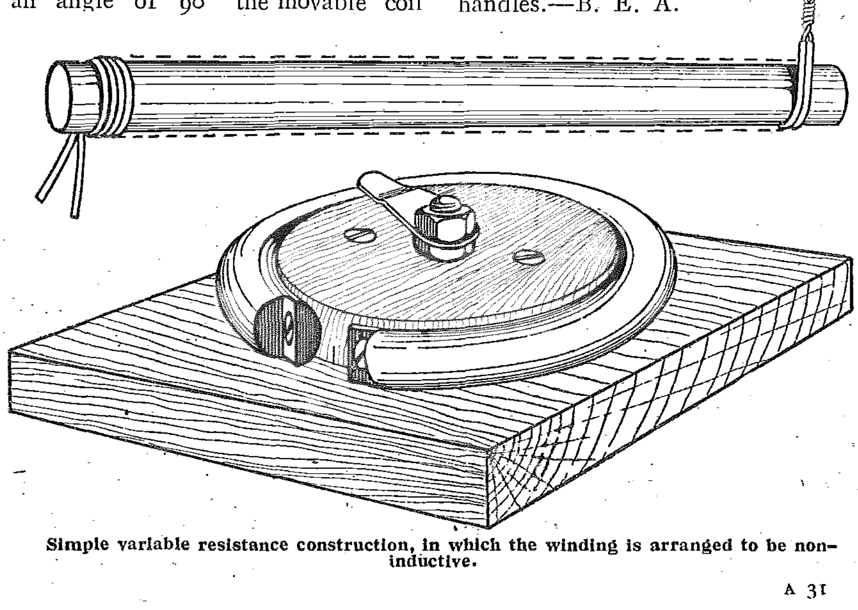
A NEW METHOD OF WINDING VARIABLE RESISTANCES.

A variable resistance such as is connected in the filament circuit of a valve or is used as a potentiometer consists of a resistance wire winding, over which a rubbing arm makes contact so that a suitable number of turns of resistance wire can be included in circuit. The resistance can be rendered non-inductive, however, by arranging a double winding so that the moving arm produces a short circuit across alternate wires and thus varies the length of wire in circuit. —G. C. P.



Simple variable resistance construction, in which the winding is arranged to be non-inductive.

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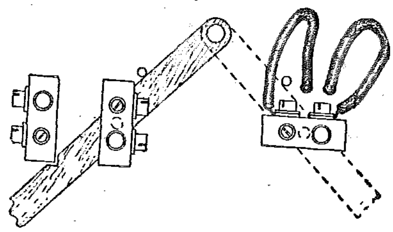
A VARIABLE COIL HOLDER.

The following method of mounting plug-in tuning coils has many advantages over the usual three-coil holder, and should prove useful on the experimental bench or in receivers where sufficient space is available.

The movable coil holder is mounted at an angle of 45° to the axis of a pivoted arm. The coil holder may be fixed directly to the arm or mounted on an extension bracket as shown. With the latter arrangement a closer coupling with the fixed coil will be obtained. When the arm is rotated through an angle of 90° the movable coil will take up a position at right angles to, and on the same axis as, the fixed coil, thus making the mutual coupling between the coils theoretically zero. In practice it is often desirable to make the angle greater than 90°, and the stop should be arranged accordingly.



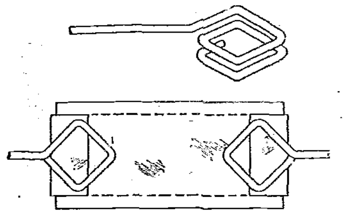
A two-coil holder, in which the moving coil in travelling away from the fixed holder rotates through 90°.

For a three-coil tuner two arms, one on each side of the fixed coil, would be necessary.

A fine control over the degree of coupling and a reduction of hand capacity effects can be obtained with this method of mounting when the arms are lengthened to form extension handles.—B. E. A.

CLIPS FOR FIXED CONDENSERS.

The addition of a fixed capacity to a finished set is frequently necessary in order to obtain stable operation.



Temporary connections for fixed condensers.

If the condenser is light in weight, as in the case of mica condensers of the home-made variety, it may be bridged across the appropriate connections by means of wire clips. Hard drawn brass or bronze wire should be used if obtainable, but No. 16 or 18 S.W.G. tinned copper wire will be satisfactory if previously stretched.—J. A.

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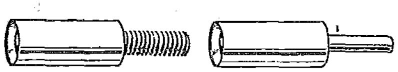
IMPROVED TELEPHONE TAGS.

Tag connections for the ends of telephone leads can be very easily made from ordinary valve sockets.



Telephone tags filed down from valve sockets in the handbrace.

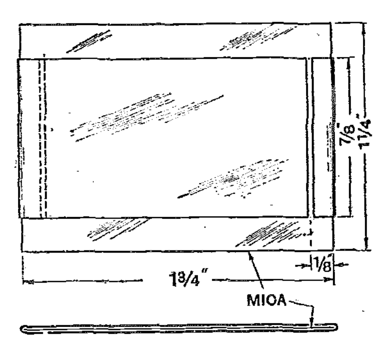
A geared handbrace is to be found in nearly every constructor's equipment, and this should be gripped in the vice in such a way that it may be used as a miniature lathe. Holding the upper part of the socket in the three-jaw chuck, the threaded portion may be filed down while the chuck is rotating to a diameter suitable for insertion in the telephone terminals. The telephone leads may be sweated into the hollow end of the socket with Wood's metal or solder. —W. M.

o o o o

FIXED CONDENSERS UNITS.

For experimental work fixed condensers built up from small units are very useful when the required value is not previously known. Units of this type can conveniently be constructed from tin plate and mica in the following manner :—

Procure some mica sheets about 0.005 inch in thickness and treat, if necessary, with best quality shellac varnish to give strength and toughness. Any sheets treated in this way should receive a prolonged baking to drive off moisture at a temperature not sufficiently high to blacken the shellac. A convenient size for the mica is $1\frac{3}{4}$in. × $1\frac{1}{4}$in., while the tin plate, which may be cut from empty cocoa tins, may be $1\frac{5}{8}$in. × $\frac{7}{8}$in. A strip $\frac{1}{8}$in. wide should be turned over at one end of the tin strips, which may then be clamped on to the mica separator in the vice. Connecting wires may be soldered to the folded edges of the tin at each end.



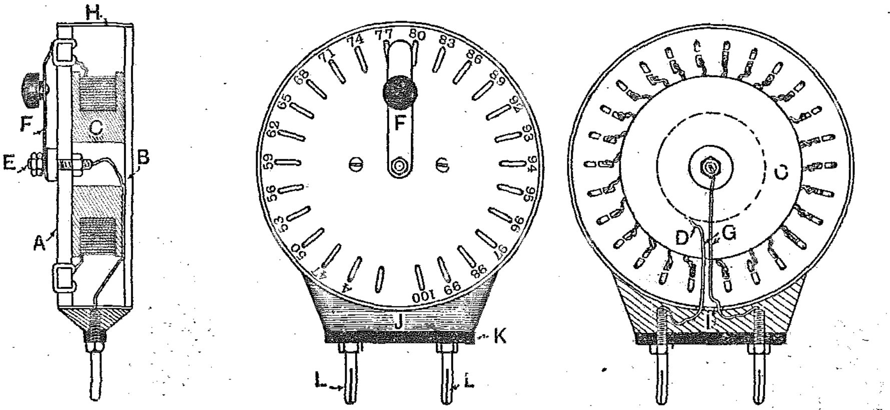
Condenser unit for building up experimental fixed condensers.

A unit built to these dimensions should have a capacity of approximately 0.0003 mfd.—G. A.

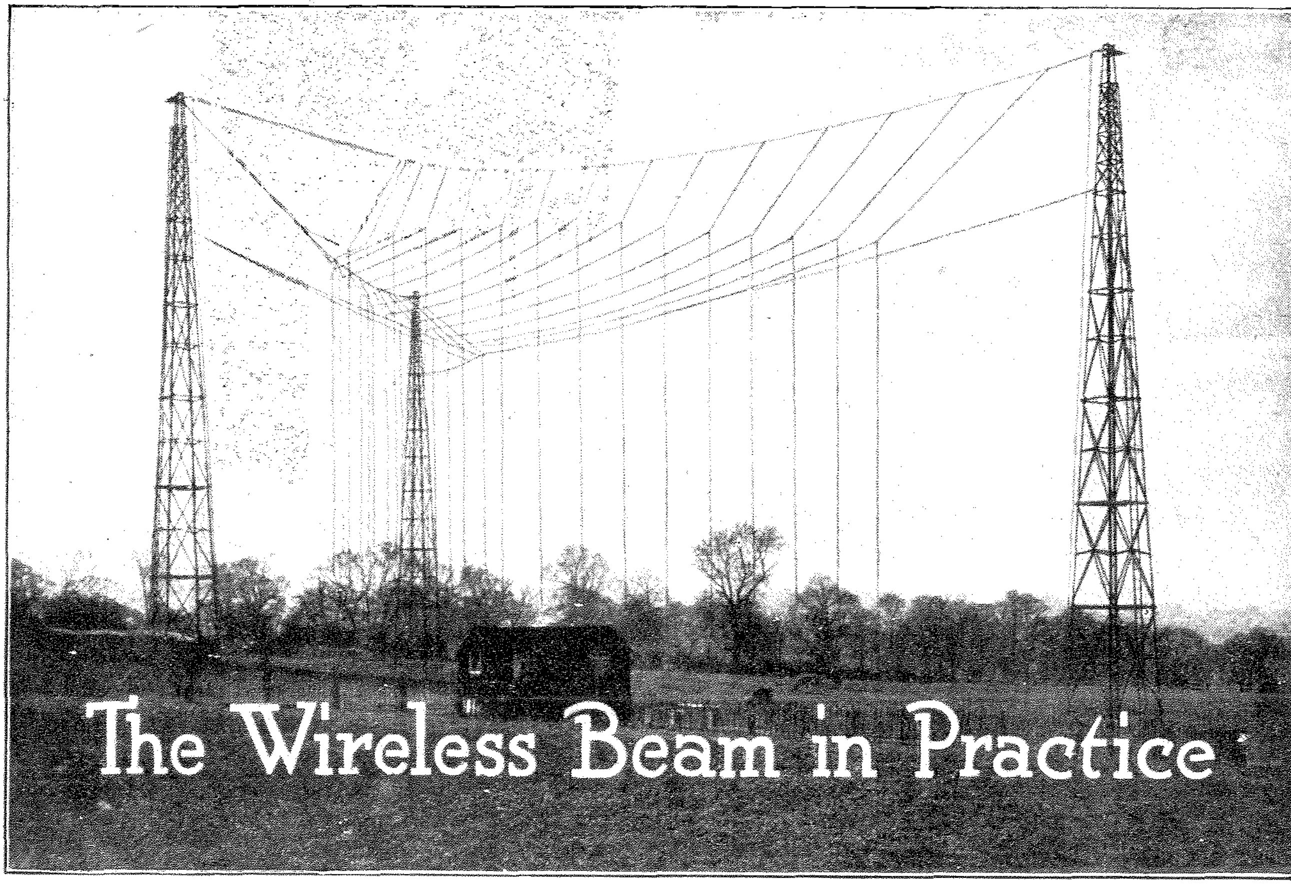
o o o o

TAPPED PLUG IN COIL.

The drawing shows a home-made plug-in tapped coil which was originally constructed for use as the tuned anode inductance of a three-valve set. The coil is of good appearance, and the one from which the drawing was prepared was built with white Erinoid. The front of the coil consists of a disc (A) $3\frac{1}{4}$in. in diameter × $\frac{3}{16}$in. in thickness. Two circles are scribed on the front disc to diameters of $2\frac{3}{8}$ and $2\frac{7}{8}$in. Twenty-five equal divisions are then marked round one of the circles for the twenty-six contacts, and scratch lines are made to indicate the positions for the wire contacts. Holes are drilled through to take No. 16 S.W.G. copper wire, and the wire loop must be bent to shape before attachment to the disc. The wire is carried on a bobbin (C), which is $2\frac{1}{8}$in. in diameter with a groove $\frac{7}{16}$in. deep × $\frac{7}{16}$in. wide, and a $\frac{1}{2}$in. hole is made through the centre to give clearance to the spindle. The wire used for winding the inductance may be No. 26 D.C.C. Forty turns are wound on to the bobbin spacing each layer with a piece of silk or paper. At this stage the wire is twisted to produce a small loop which forms the first tap. Three more turns are then wound on and the wire twisted as before, and so on until ninety-two turns are completed. Taps are then made at every turn until the hundredth turn is reached. The method of fitting up the switch arm (F) is apparent from the drawing. The spool is attached to the front plate, and carries the switch by means of two screws, whilst the back is secured to the wooden spool with celluloid cement. The outer rim (H) is a strip of opaque celluloid which should be left a little wider than required in order that it may be trimmed or filed down true after it has been allowed to dry out and become securely attached. The base piece (J) is made from wood or ebonite, and carries two valve pins (L). It is glued to the outer face of the coil, and will be found to hold quite securely.—W. P. G.



Constructional details of a tapped plug-in coil.



The Wireless Beam in Practice

An Account of Results Obtained in Experimental Work on Stations Already Erected.

By R. H. WHITE, M.I.E.E.

EXPERIMENTAL stations employing the Beam principle have been erected by the Marconi Co. at Hendon, Birmingham, Inchkeith, the South Foreland, and at Poldhu. The pioneer work carried out at Hendon, Birmingham, and Inchkeith was described by Mr. C. S. Franklin in a paper before the Institution of Electrical Engineers in May, 1922.

In 1919, experiments with valve transmitters were carried out at Carnarvon. Experiments were first made with waves of a hundred metres or so, and gradually, step by step, the length was reduced, until waves were produced which could be employed in conjunction with reflectors of moderate dimensions.

Wavelength of 15 Metres Chosen.

Finally, a wave of 15 metres was selected, and efforts were then made to increase the power which might be transmitted and to improve the receiver.

The distance over which speech could be transmitted was very small at first; it was, in fact, some time before the stations could be separated more than a few miles apart. The struggle went on steadily, and at last substantial improvements, principally in the receiver, made it possible to jump from some three miles to a distance of twenty miles.

Next a receiver was fitted up at Holyhead, twenty miles from the Carnarvon station, and the strength of speech received there was so encouraging that permission to install a receiver on one of the Dublin Steam Packet Co.'s boats was sought and obtained. The ship steamed away from Holyhead to Kingstown, Ireland, and speech was heard right up to and after entering that port.

An interesting point was that there was no reduction or cutting off of these short waves (15 metres) even when the ship was well down over the horizon from Carnarvon. This distance was seventy nautical miles over sea. It was now decided to experiment entirely over land.

A site for a station was selected at Hendon, and a reflector erected pointing towards Birmingham. This reflector is illustrated in the photograph at the head of this article.

A receiver was installed in a motor car, a fishing rod was carried to serve as a mast, and the car started towards Birmingham, making halts by the roadside and testing with Hendon. The speech was excellent up to Edge Hill, but after that it began to fall off somewhat. In general, it would be fair to say that very good speech was obtained up to sixty miles, and fair speech when on high land even as Birmingham was approached.

Finally, a good site was selected at Frankley, near

The Wireless Beam in Practice.—

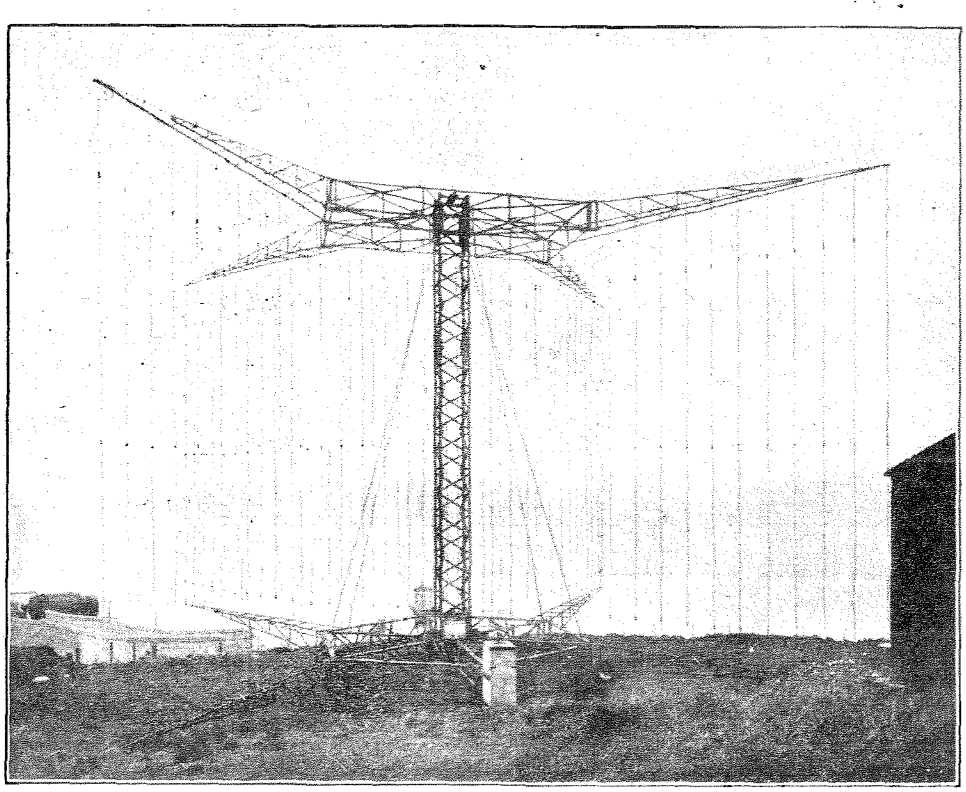
Birmingham, a distance of ninety-seven miles from Hendon, and a station similar to the one at Hendon was erected.

The power used at Hendon was some 700 watts, and this was supplied at 4,000 volts to two medium-sized transmitter valves in parallel. With this input and reflectors at each end, good duplex working was established.

Absence of Interference on Beam Wavelength.

It was noticed when working on these wavelengths (at that time) that at last a wavelength had been found where there was no jamming, and, best of all, practically no atmospherics, except when a thunderstorm was actually in sight. A minor new trouble was, however, discovered, which was that many motor cars radiate a wave of the order of 15 metres from their magnetos, and the click, click of their regular firing was often heard whilst cars were passing in front of the reflector, but was cut off as they passed behind the reflector.

At the same time that this experimental work was going on at Carnarvon on 15 metres, work was also being carried out with spark transmitters and valve receivers on a 4-metre wave. The spark transmitter with its short aerial was installed in the focus of a small revolving reflector of parabolic construction. This reflector was arranged so that it could be slowly rotated, and as it reached predetermined points of the compass definite call letters corresponding to that point of the compass were sent out.



The revolving beam reflector at Inchkeith. A spark signal of 6.3 metres is transmitted.

The experiments were successful, and finally the consulting engineers to the Northern Lights, and the Commissioners of the Northern Lights, gave permission for a revolving beam reflector to be erected on the Island of Inchkeith, in the Firth of Forth.

The wavelength of this transmitter was fixed at 6.3 metres, and a parabolic reflector was employed having an aperture of rather more than two wavelengths—i.e., 13 metres.

It will be seen from the photograph on this page that the structure consists of a revolving platform carrying a central tower, with two cross-arms at the top. Below these cross-arms, and fixed to the revolving base, are four projecting beams, so arranged that these four beams are exactly under the four ends of the two top cross-arms. The whole structure, comprising base, tower, and cross-arms, is rigidly bolted together and rests on a circular track in such a manner that it may be easily rotated by a small motor.

Suspended from the two cross-arms are two parabolic reflectors, arranged back to back, whilst a transmitter is mounted at the focus of each of these parabolas.

Automatic Transmission.

Two reflectors are employed instead of one, since, by this means, a more symmetrical construction is accomplished, and the reflector has only to revolve at half the speed which would otherwise be necessary. The whole structure is arranged to rotate once in two minutes, so that any ship fitted with a suitable receiver would come into line with the maximum radiation of the beam once every minute.

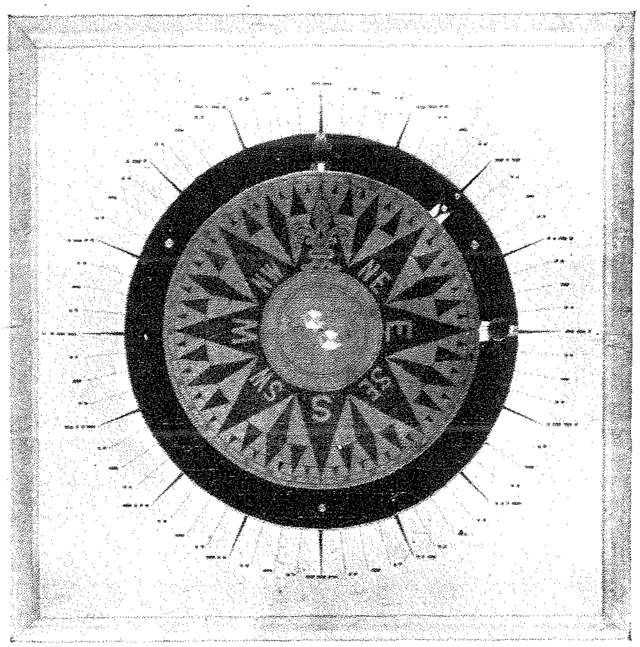
Transmission is automatic, since all around the base of the structure contact plates are bolted, which are arranged in such a manner that when either reflector is pointing, say, north, the Morse code signal M is sent out. For south the signal is S; for east, G; and for west, W. The reason for the selection of these letters is more apparent when they are written as Morse characters, for east and west are opposite, and so have reversed Morse characters — — - and - — —, whilst the signals — — and — — —, north and south respectively, are very characteristic and unlikely to be mistaken for any other signal. The other signals are in general given on the east side by one Morse letter, and on the west by that letter reversed, as shown in the accompanying illustration of the compass card.

The Wireless Beam in Practice.—

Between each of the primary points of the compass come the letters **I.T.I.**; these not only designate the intermediate points of the compass, but serve to distinguish this beam station from any other.

The transmitter itself is most interesting, consisting as it does of a remarkably compact unit entirely enclosed in a substantial waterproof cover. It is cylindrical in construction, and contains a condenser, spark gap, and inductance. The whole apparatus is air-tight, and is pumped up to a very high pressure.

As the air within the container never changes, the oxygen is soon burned up by the spark, and no further oxidisation of the spark gap can take place. The result is that a most reliable and constant transmitter is obtained; in fact, many of these have been in experimental



Compass card. The Morse characters printed opposite the various points of the compass are automatically transmitted.

commission for upwards of two years without attention, and if overhauled and pumped up once a year should give satisfactory service.

The power supply is taken to the oscillator by a waterproof cable and sockets, which connect a Tesla transformer to it. This transformer is energised from the operating hut by means of a ¼ kW. motor alternator.

Brass Rods as Aerials.

For the reception of these short wave signals, aerials of the ordinary type become unnecessary; they are, in fact, replaced by two stout brass rods, bolted one on each side of the bridge of a ship. The reason for employing two of these rod aerials instead of one is so that both aerials can never be screened at the same time by the bridge structure, which might otherwise cause reflection or absorption of the incoming waves.

The high-frequency currents from these aerials are taken by means of special cables to a receiver situated on the bridge, or into the chart house. The receiver itself is made in such a manner that there are no adjustments required, there being only one control handle which operates switches controlling the current to the valves, and also the amount of amplification of the received signals.

Taking a bearing by means of this apparatus is simple in the extreme. The navigation officer switches on the receiver, places the telephones on, and listens. After a few seconds he hears a weak Morse letter, a moment after a louder signal, one still louder—then two getting fainter. He reduces the strength and listens again. This time, having cut down the sensitivity of his receiver, he hears only three letters. The centre one is the bearing of Inchkeith, and, from the chart which is supplied with the instrument, and by taking two or three bearings, he can find his position and go on plotting it as he proceeds up the Firth.

The Inchkeith reflector having now been in successful operation intermittently since the first experimental reflector was demonstrated to the Northern Lights Commissioners in the autumn of 1920, and having proved most reliable, the time has come to extend the system, and a new beam station is just being completed at the South Foreland.

The Poldhu Beam Station.

The beam station on which most attention is at present focussed is that which is in use within the precincts of the historic Poldhu wireless station.

The new beam station was illustrated at the head of the article on the theory of the beam which appeared in last week's issue of *The Wireless World.* Here a large parabolic reflector is supported by four steel masts, and with it the first really long-distance tests of the beam were made.

Direct telephony was conducted between this station and Australia when, on May 30th, 1924, intelligible speech was sent out from Poldhu, and received at Sydney.

For these tests, however, no reflector was employed at Poldhu, and the total power supplied to the valves was approximately 28 kW., of which only some 18 kW. went to the main oscillator valves.

The wavelength was 92 metres, and it is calculated that there would be some 189,000 complete waves between England and Australia, which constitutes a record at that time for the ratio of distance to wavelength.

Results Obtained.

Amongst other places with which successful communication has been established by the Poldhu experimental short wave station are:—

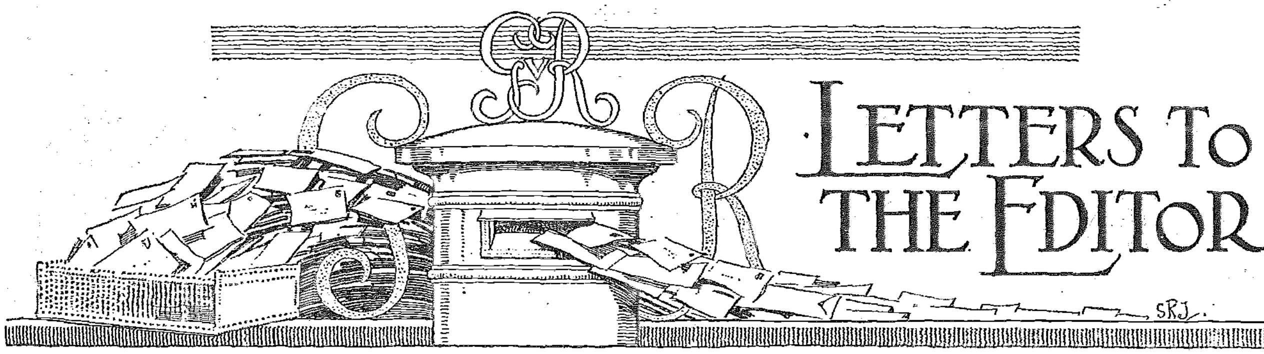
Buenos Aires, in the Argentine, 5,820 nautical miles.

Rio de Janeiro, 4,810 nautical miles.

Montreal, New York, and Glace Bay, Nova Scotia.

Much of the experimental work at Poldhu was carried out on a wavelength of about 100 metres. The day ranges were reliable, whilst the night ranges were greater than had been anticipated.

Commercial beam stations are now being erected in England, Canada, and South Africa, whilst within the year it is probable that the Marconi Company will put up others in Australia and India.



Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," 139-140, Fleet Street, E.C.4, and must be accompanied by the writer's name and address.

DON'TS FOR TRANSMITTERS.

Sir,—The letter from "A Radio Engineer since 1912," in the March 11th issue of the *Wireless World*, cannot be allowed to pass without comment on some of the remarks contained therein. In it he states that "quite a number of amateur telephony transmissions are of decidedly better quality than some of those of the B.B.C.," and further goes on to state that he "is afraid that the B.B.C. have still a lot to learn about the efficient transmission of speech and music." This paragraph must have been regarded by many as providing one of the best radio jokes yet. As an old radio engineer, your correspondent must surely know that in radio there will always be a lot to learn, and it would be nonsense for the B.B.C. to state that they know all that there is to know. Your correspondent's letter seems to suggest that many amateur transmitters have effectually solved the many problems associated with the efficient transmission of speech and music. If they have, I have yet to hear the results, or even hear an amateur transmission of music that can compare favourably with the worst stuff put out from 2LO. The amateur's idea of "music" seems only to extend to badly worn gramophone records, varied at times, by one well-known amateur, with selections by a jazz band, consisting of a piano and a number of people humming through combs covered with tissue paper. Whatever may be said of the work done by the amateurs in other directions, they are absolutely not in it when it comes to music transmissions, and to assert that some can do better than the B.B.C. is nonsense. W. R. C.

Isleworth.

BRITAIN BEHIND IN BROADCASTING.

Sir,—New York has 16 broadcasting stations, Chicago 8, and London only one. Even Paris, where broadcasting is not so popular, has four stations.

Why are we so behind in this regard? A listener-in may be more interested in the hibernation of vegetables than in the perorations of politicians, or vice versa. In America he always has a choice of programmes, and listens-in where he desires.

How would the citizens of London like to be dependent upon one solitary place of entertainment, in which, at the discretion of the management, a lecture was given one night, a musical comedy the next, and a classical concert on a third?

I would pity my constituency if it were not kept healthily alive by the competition of the many managers whom I know to work so hard for the recreation of their fellow citizens.

Now that broadcasting programmes are improving, sales of wireless sets are increasing daily, experts are everywhere, and more programmes from which to select are vitally necessary.

Within the next five years every house will have its loud-speaker, and I look to the day when this great invention will be shared and enjoyed by all who desire to do so.

PARK GOFF.

THE OSCILLATION NUISANCE.

Sir,—I was interested to read a reply to my letter on "The Oscillation Nuisance" in your issue of March 4th, a copy of which I found on a bookstall in Milan. May I add a few words at the risk of being myself an "undamped nuisance"?

The great result of my proposals would be the enormous multiplication, as well as considerable substitution, of harmless crystal sets. These would be perfectly satisfying for all the mere "broadcast" listeners if more relay stations and fewer programmes were adopted—and the Continental stations would not be heard of, or sought. As a matter of fact, the "romance of distance" would soon become a distant romance and not a fact which would matter.

Furthermore, "my *wireless* friends" are usually but little concerned with "broadcast," which is for the more general multitude; and they can, I hope, be trusted to behave themselves ethereally even if they do suffer from the terrible title of "distance-getter." (By the way, *can* you "get" distance?)

Finally, it is precisely "at least 365 concerts all for 10s." at which I grumble, as being cheap mass mediocrity, the curse of civilisation. "What on earth some people *do* expect for 10s. per annum" is something a little elevating from the aerial, and not a frequent emphasis (with frequent whistling solos!) of what a cheap bargain it really is! And the B.B.C. would find consistent better quality, with the absence of "padding" and consequent greater interest, vastly easier to attain if they had but two programmes at a time to prepare instead of up to twenty.

I am sorry none of my wireless friends, to my knowledge, are "pirates," so that I am unqualified to observe their special effect on the oscillation nuisance. No doubt it is great—at Penzance. M. PROCTER-GREGG.

Blackburn.

WIRELESS RECEPTION IN NATAL.

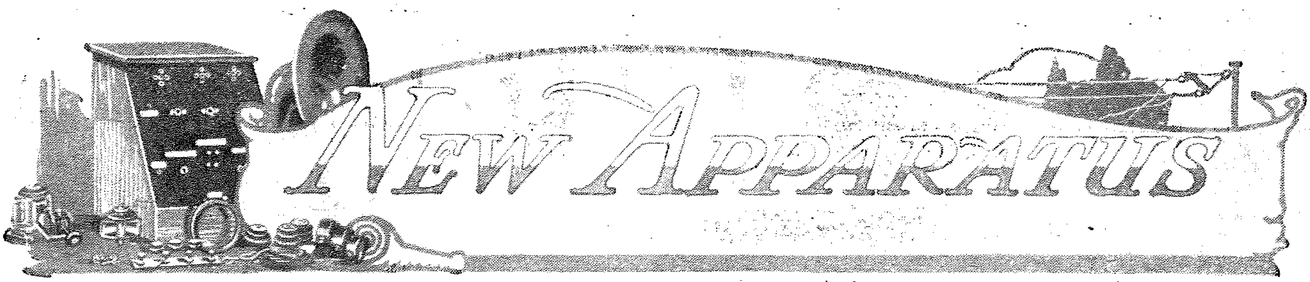
Sir,—Being a past subscriber of *Wireless World*, and having constructed a four-valve set from a diagram in your issue of August last year, No. 263 (No. 22, Vol. XIV.), I thought perhaps you would be interested to know what results I have had. The diagram in question was taken from "Readers' Problems," Fig. 1.

I am able to pick up land stations on two, three, and four valves, the stations being Johannesburg, 350 miles; Cape Town, approximately 400 miles; and Durban, 50 miles. Durban naturally comes in very strong, though Johannesburg is not far behind. On one occasion I was able to pick up Bournemouth very well at 'phone strength, and heard a play relayed from His Majesty's Theatre. My best results for long distance were Pittsburg KDKA, America, on 65 metres, and I have heard this station at least fourteen times, and each time has been better. Even at loud-speaker strength I could hear everything that was said at 60 yards away. I have on several occasions entertained visitors in the early hours of the morning, including two who come from America, and have often listened to KDKA there.

Atmospherics at this time of the year are very annoying, and prevent us from picking up English stations. However, winter will soon be here, and perhaps we shall then have better results.

C. M. LEFEVRE.

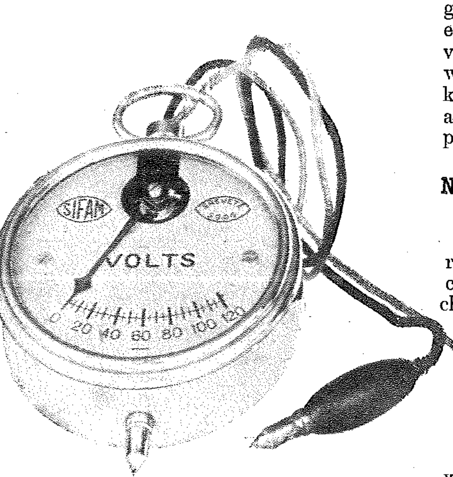
Natal, South Africa.
January 7th, 1925.



A Review of the Latest Products of the Manufacturers.

BATTERY TESTING VOLTMETERS.

A very useful series of pocket type meters are now available with scales suitable for testing both high and low tension batteries. These instruments, although very low in price, are well constructed, and the movements rival those of high grade instruments. The pointer is maintained at zero setting on the scale by



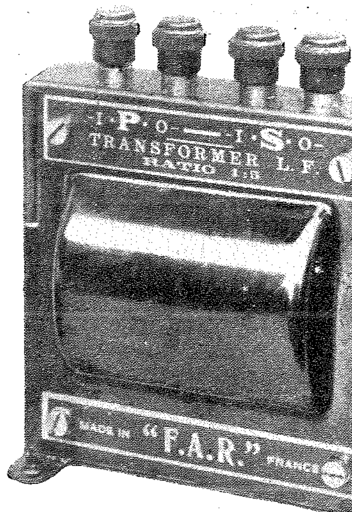
An indispensable instrument for testing high tension batteries. It is obtainable also with a double scale for filament potential tests.

means of a large polarising magnet, and the small armature upon which it acts is influenced by the field produced by the applied current. Unlike many low-priced instruments, it will thus be seen that the pointer is well damped and does not oscillate across the scale, while a deflection is only obtained when the terminals are correctly connected to the positive and negative battery leads. With this form of construction it is not necessary to use fine springs to maintain the position of the pointer, and the spindle is set up in plain bearings with the pivots ground to fit. Additional damping is provided by a small aluminium cylinder, which also moves between the poles of the polarising magnet.

All instruments are fitted with silvered metal scales, and the containing cases are nickelled, giving a high class finish. These meters, as well as a wide range of switch-board instruments, are obtainable from the Sifam Electrical Instrument Co., 95, Queen Victoria Street, London, E.C.4.

THE "F.A.R." TRANSFORMER.

It will be remembered that some while ago the French valve was exceedingly popular among experimenters, and more recently attention is being turned to intervalve transformers of French manufacture. One of the most popular types is the "F.A.R.", a product of Messrs. Maurice Bodin, 21, Warwick Lane, Ludgate Hill, London, E.C. It is not only externally a well-made job, but is provided with liberal primary and secondary windings. The core dimensions are in keeping with the standard British types, and the metal side plates provide complete and effective screening.



French type intervalve transformer.

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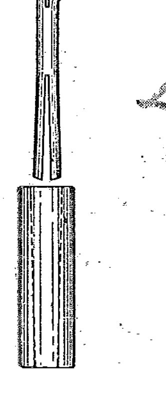
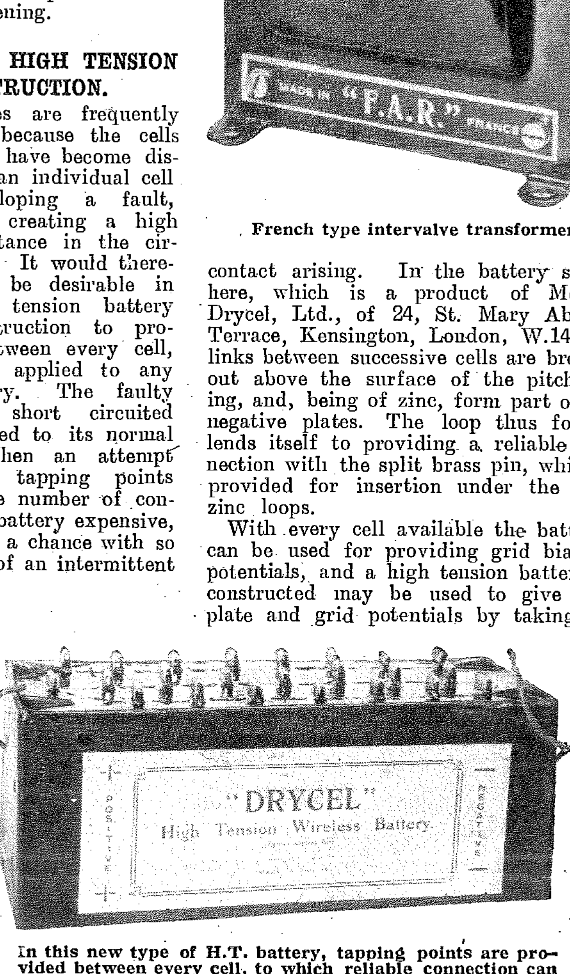
NEW FEATURES IN HIGH TENSION BATTERY CONSTRUCTION.

High tension batteries are frequently rendered useless, not because the cells composing the battery have become discharged, but owing to an individual cell developing a fault, and creating a high resistance in the circuit. It would therefore be desirable in high tension battery construction to provide tapping points between every cell, so that tests can be applied to any section of the battery. The faulty cell can then be short circuited and the battery restored to its normal working condition. When an attempt is made to provide tapping points at every cell, the large number of contacts required makes a battery expensive, and in addition there is a chance with so many connecting wires of an intermittent contact arising. In the battery shown here, which is a product of Messrs. Drycel, Ltd., of 24, St. Mary Abbotts Terrace, Kensington, London, W.14, the links between successive cells are brought out above the surface of the pitch filling, and, being of zinc, form part of the negative plates. The loop thus formed lends itself to providing a reliable connection with the split brass pin, which is provided for insertion under the bent zinc loops.

With every cell available the batteries can be used for providing grid biassing potentials, and a high tension battery so constructed may be used to give both plate and grid potentials by taking the





In this new type of H.T. battery, tapping points are provided between every cell, to which reliable connection can be made by means of the split spring clip.

filament connection to a point on the battery a few cells away from the negative terminal.

The type of pin connector used is of simple, yet reliable, construction, and is provided with an ebonite sleeve, which in sliding into the stem of the pin produces a firm grip on the flexible lead. The slot holds the end of the flexible wire after the manner of a vice, making a secure and reliable connection. The cells of which the battery is composed are constructed to give long life.

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THE "RADIOTESTER."

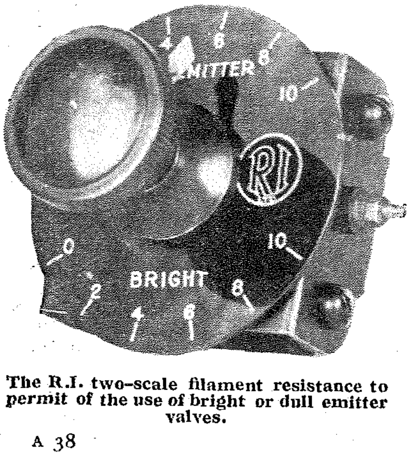
Every amateur must at some time or other have felt the necessity for a cheap piece of testing apparatus which will quickly indicate any fault in wiring, provide a check as to the functioning of each component, and give a rough indication of the state of low tension, high tension, and grid bias batteries in his set.

The "Radiotester," manufactured by The British and Colonial Industries Association, Ltd., 317, High Holborn, W.C.1, fulfils the above conditions and consists of a dry cell, indicating lamp, and a series of contacts connected in such a way that continuity of wiring in a set can be proved, and the proper functioning of the following components ascertained: — Coils, variometers, valves, variable condensers, rheostats, potentiometers, etc.

By means of suitable terminals a pair of high resistance 'phones can be interposed in the "Radiotester" circuit with a view to obtaining a sensitive check of the insulation in grid condensers, blocking condensers, coupling condensers, and reservoir condensers, etc., also a break in the high resistance windings of L.F. transformers, chokes, 'phones, and loudspeakers is quickly discovered.

Should the experimenter possess a millimeter, much useful information can be obtained concerning the relative resistances of components between, say, 1,000 and 2,000 ohms.

There should be room in every experimenter's workshop for this useful little instrument, which retails at 5s. 9d.



The R.I. two-scale filament resistance to permit of the use of bright or dull emitter valves.

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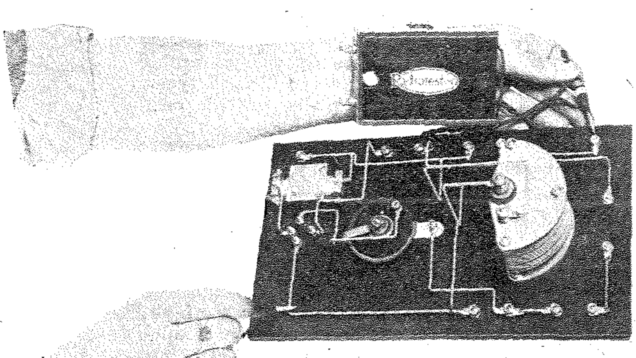
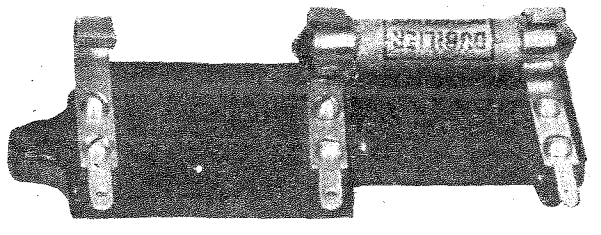
THE R.I. FILAMENT RESISTANCE FOR BRIGHT AND DULL EMITTER VALVES.

There is a need in receiver design to provide interchangeability between bright and dull emitter valves, and usually necessitates the fitting of two separate filament resistances which are brought into operation by the action of a switch. Messrs. Radio Instruments, Limited, are now placing on the market a two-range filament rheostat which will permit of valves with either bright or dull emitter filaments being interchanged.

In the illustrations it will be seen to consist of two sections, one of which is a filament resistance having a maximum value of about 5 ohms, whilst the other section has a resistance value up to about 25 ohms. A plated bronze spring operated by the centre spindle is made to sweep across either of the resistance windings, providing a range of adjustment so that either high or low resistance filaments may be controlled. The contact, which sweeps across the surface of the resistance windings, is of bronze, and makes a good and reliable connection, particularly as it is attached to a spindle which passes through a bush which is at least ⅜in. in length. The resistance spools, which are wound on a hard insulating material, are carried in a heavy brass bracket, to which the bearing for the spindle it attached. The bearing piece is threaded on the outside to provide one hole fixing, and a very substantial oxidised collar in screwing down on to the face of the panel holds the dial in position. The dial has a polished finish which gives a good appearance against the dull matt surface of an instrument panel. The metal parts are finished dull black oxidised, very much resembling the treatment applied to camera fittings, and this departure from lacquering or nickelling adds considerably to the appearance of any receiving set to which this useful component may be fitted.



Rapid tests for continuity can be applied to instrument wiring by means of the "Radiotester." Provision is also made for easily testing the insulation of condensers. Methods for verifying the operation of other wireless components are described in an instructive pamphlet which accompanies the instrument.



The Dubilier clip and mounting piece for use when the grid leak does not bridge the grid condenser.

DUBILIER'S NEW GRID LEAK ATTACHMENT.

A grid condenser with spring clips provides a convenient method for supporting the leak resistance with which it is shunted. When, however, it is desired to connect the leak resistance between the grid of the valve and the positive battery terminal, amateurs have found it necessary to solder wires on to the caps of the grid leak itself. This difficulty is overcome by the use of a mounting clip, which is held in position by one of the screws used for attaching the grid condenser.

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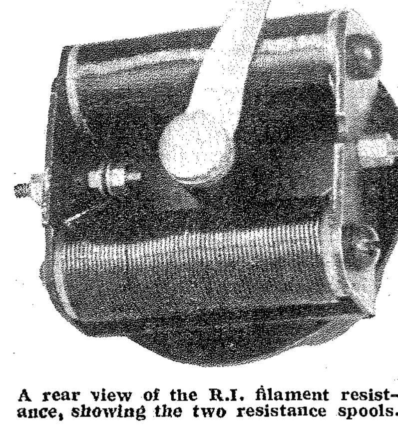
A USEFUL SOLDERING HINT.

Unless one is fairly accustomed to soldering this is often one of the most trying processes in the construction of sets, and therefore any method which will simplify the work is likely to be welcomed by the amateur. It is most essential that the flux used should not be of a corrosive character, and therefore a combined solder and flux which is available either in paste form or as stiff wire and sold under the name of Britinol is the new product which is likely to be very popular.



A rear view of the R.I. filament resistance, showing the two resistance spools.

NEWS from the CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest.

Ilford and District Radio Society.

We are now able to give full particulars of the visit which Capt. Eckersley is going to pay us on Thursday, March 26th.

The meeting will be held at the Town Hall, Ilford, and Capt. Eckersley, who is well known to all wireless enthusiasts as the chief engineer of the British Broadcasting Company, will lecture on "The Story of Broadcasting in Britain." The chair will be taken by W. H. Eccles, D.Sc., F.R.S., who will be supported by Sir Frederic Wise, M.P., and a number of prominent representatives of public and scientific bodies.

The public address system of the Marconiphone Co., Ltd., will be used, and a short wireless programme given.

The meeting is a public one, and tickets are obtainable at popular prices at *The Ilford Recorder* Offices, High Road, Ilford. The lecture commences at 8 o'clock, but the doors will be opened at 7.15 p.m.

Mr. D. S. Richards, 50, Empress Avenue, Ilford, is the hon. organising secretary in connection with this matter.

Barnet and District Radio Society.

At the monthly meeting of the society, held in the Radio clubroom, Barnet, on Thursday evening, February 19th, Mr. H. B. Gardner, Barnet's first amateur transmitter, gave an instructive talk on "Transmission." He explained the operation of the transmitter, and, with the help of diagrams on the blackboard, described a number of circuits with which he had obtained good results. He showed also how the amateur transmitter had overcome a great many difficulties met with in the early experiments. The non-technical manner in which Mr. Gardner gave his talk made it readily understandable by all, and the members thoroughly appreciated the lecture, which was followed by an informative discussion. Mr. Gardner was afterwards accorded a hearty vote of thanks.

The secretary reported that, following a communication from the parent society he had drafted a letter to Col. Fremantle, M.P. for the St. Albans division, pointing out that certain clauses in the Wireless Bill now before the House of Commons were likely seriously to retard the progress of radio, and urging the revision of the Bill. The letter was approved, and the secretary was instructed to forward it to Col. Fremantle.

The society hopes to arrange another visit to 2LO, and it is anticipated that both Capt. Eckersley and Mr. A. R. Burrows will soon pay return visits to Barnet at the invitation of the society.

Hon. secretary, J. Nokes, Sunnyside, Stapylton Road, Barnet.

The Golders Green and Hendon Radio Society.

At a well-attended meeting of the society on March 4th, Mr. Maitland, a representative of Messrs. Leslie McMichael, gave a very interesting lecture on "High Frequency Amplification," which was followed by a lively discussion.

A most interesting evening is looked forward to at our next meeting on March 18th, when Mr. Maurice Child will give a demonstration and lecture on "High Frequency Currents and Electric Wave Production."

Applications for membership of the society should be addressed to the hon. secretary, Mr. W. J. T. Crewe, "The Dawn," 111, Princess Park Avenue, N.W.11.

Dublin Wireless Club.

A meeting of the above was held on Thursday, the 5th inst., Mr. H. J. Duncan in the chair. Mr. J. C. Mangan delivered a very instructive lecture on "The Use and Abuse of Reaction."

The lecturer explained fully the various methods of obtaining reaction, and described circuits such as the Reinartz and Flewelling. He showed how to make intelligent use of reaction.

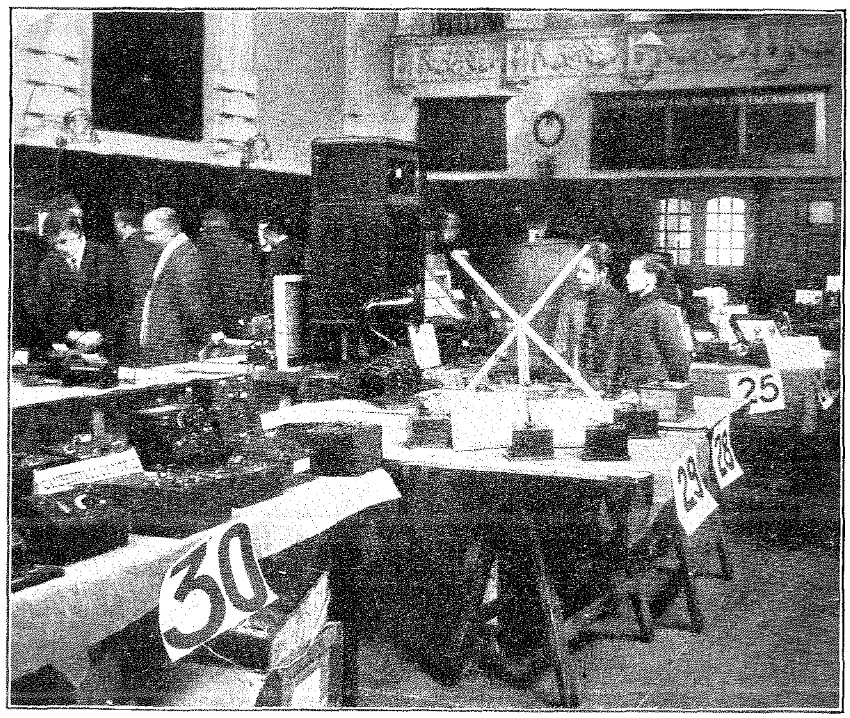
Liverpool Co-operative Radio Association.

At a recent lecture on "Radio Transmission and Amateur Transmitters," under the auspices of the Liverpool Co-operative Radio Association, Mr. H. Hardy outlined the history of wireless transmission of signals, describing the open aerial spark system, tuned spark and coupled systems with quenched gaps.

The arc C.W. circuit was drawn on the blackboard and explained, and the method of keying such a circuit was mentioned. The use of a valve as an oscillator was next dealt with, and a simple oscillatory circuit drawn and details explained, after which a demonstration was made on a low-power transmitter.

The choke control method of modulation was explained in detail, and the various points were demonstrated on the transmitter.

The apparatus used was an R5V valve



A view of a corner of the Exhibition at the Beaufoy Institute, Princes Street, S.W., organised by the Schools Section of the Radio Society of Great Britain. The exhibition was open from March 14th—18th.

as oscillator in a Hartley circuit and an AR valve as modulator. A small motor chopper run from the filament battery fed a transformer for tonic train transmission, and a 90 volt dry battery for C.W. and telephony high tension.

Questions were asked and answered. The damping effect of a large mass near the oscillator was demonstrated by comparing signals on a wavemeter. The I.C.W., C.W., and W/T tests were received on a four-valve set 1-v-2 and loud-speaker, twenty feet from the transmitter, which was working on a dummy aerial.

Hon. Secretary: Mr. Jas. Kearns, 107, Walton Breck Road, Anfield, Liverpool.

Croydon Wireless and Physical Society.

A most instructive lecture on Dual Amplification was recently delivered by Mr. P. G. A. H. Voigt. The lecturer dealt with the history of this form of amplification, and explained and illustrated by numerous diagrams the gradual improvements effected upon the original valve-crystal circuit. Condenser or capacity control reaction was also discussed. Two sets of dual receivers, one having resistance capacity and the other a transformer coupled L.F. amplifier were brought by the lecturer, by which he demonstrated distortionless reception of 2LO on a frame and also an indoor aerial. Three different makes of loud speakers were tried and compared, and the improvement by the addition of proper grid bias was most noticeable. The songs sung by Madame Tetrazzini and other famous artists were thoroughly enjoyed. A good discussion took place, and a hearty vote of thanks was accorded the lecturer for his much-appreciated lecture and demonstration.

Hon. Secretary: H. T. P. Gee, 51 and 52, Chancery Lane, W.C.2.

The Kensington Radio Society.

The March monthly meeting of the above society took place on the 5th inst. Dr. Gordon Wilson was in the chair.

Captain Tingey gave a most interesting and instructive lecture on "Two Distinct Types of Super Heterodyne," the English and American types.

The attendance was very good, and all had a most enjoyable evening.

Hon. Secretary: Herbert Johnson, 36, Cromwell Grove, W.6.

Eastern Metropolitan Group Radio Lecture Society.

At a meeting held on March 16th, at St. Bride Institute, London, E.C., Captain Ian Fraser, M.P., in the chair, Mr. P. W. Willans delivered a lecture on "The Design and Construction of Superheterodyne Receivers." In discussing the circuit principle he explained that the principal difficulties existed in the design of the intermediate frequency amplifying equipment and in the process of heterodyning. At the onset he dealt with the considerations involved by the use of a high-frequency amplifying stage in front of the first detector valve. Such a valve introduced an additional adjustment, unless a semi-aperiodic circuit is employed. The system he described made use of a single valve functioning as a heterodyne oscillator and detector, and in explaining the circuit principle he, of course, pointed out that either a frame or outside aerial could be employed equally effectively.

He showed by means of simple calculations that unless the intermediate amplifier operates on a long wavelength, or the signal being received is on a very low wavelength, difficulty will be experienced in obtaining sufficiently tight coupling with the oscillator without producing changes of tuning as adjustments are made. With a coupled oscillator very little energy is transferred to the aerial circuit, for the two circuits are mistuned to produce the necessary heterodyne effect. The extent of mistuning is, of course, wider the longer the wavelength of reception, and if very tight coupling is required as a result of an appreciable difference in the wavelength of detector and separate oscillator circuits, then it is to be expected that tuning changes will result whenever either the circuits are altered as regards wavelength or extent of mutual coupling. He recommended that the coupling between the two circuits should be arranged into the grid lead of the detector valve by means of interposing a separately tuned circuit between aerial terminal and grid condenser, though on short wavelengths this was not entirely satisfactory owing to valve capacity. He described the principles of second harmonic working in which the oscillator is tuned to twice the required frequency and is arranged to produce oscillations rich in harmonics by the use of tight reaction coupling. A difficulty arises here, inasmuch as other harmonic frequencies will render the receiver responsive to other wavelengths than that on which reception is required, and jamming, as a result, may occur.

The circuit which he recommended consisted of connecting the lead from the aerial side of the aerial-tuned circuit to the centre point of two series connected inductances which are joined with the parallel condenser. Spaced between these two inductances is the reaction coil and the plate circuit of the detector oscillator valve. One end of this intermediate tuned circuit is connected to the grid by the usual grid condenser and leak, and the other to the earth and filament lead through a small condenser used for balancing out valve capacity. Such an arrangement practically eliminates the transference of energy to the aerial circuit, and a receiver arranged in this way can almost be regarded as being non-interfering.

In referring to the intermediate frequency amplifier, he recommended the use of a wavelength of the order of 14,000 metres. Higher wavelengths than this can scarcely be used as the frequencies to which the circuits are tuned border on the higher musical note frequencies. It is also obvious that greater amplification per stage is obtainable the longer the wavelength of the intermediate amplifier. His intermediate circuits were tuned anodes contained in copper boxes and the coils were Igranic No. 1250.

In discussing the selectivity of the intermediate stages, Mr. Willans pointed out that a certain degree of damping was very necessary in order to embrace the side bands produced by telephony transmission and thus to maintain good speech quality.

In demonstrating his receiver at a distance of about half a mile from the London Station, he was able to tune in clearly, with good quality and absence of interference, both the Brussels and Birmingham Stations, indicating that a high degree of selectivity had been obtained, accompanied by great sensitiveness, with amplifying equipment almost free from distortion.

The next meeting of the Society will be held on April 20th (meetings being held on the third Monday of each month), when a lecture will be given describing the preliminary steps to be taken in setting up a short wave telegraphy transmitter. These meetings are open to wireless enthusiasts resident in the Eastern Metropolitan Section of the Radio Society of Great Britain, and a welcome is extended to all interested to be present at this next meeting, which will be held at St. Bride Institute at 7.40 p.m.

Inland Revenue Radio Society.

The above is the name of a new society which has been formed for the benefit of permanent, temporary, and retired members of the Inland Revenue Department. Meetings are held at 2, South Place, London, E.C.2, on the first and third Fridays in each month during the winter, and on the first Friday in each month during official Summer Time.

Hon. Secretary: Mr. J. O. Claxton, 570, Salisbury House, London Wall, E.C.2.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 25th.

Manchester Radio Scientific Society.—Open Evening.

Radio Society of Great Britain.—At 6 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C., Testing and Measurement of Wireless Components. By Mr. P. K. Turner.

THURSDAY, MARCH 26th.

Radio Society of Highgate.—At 8 p.m. At Highgate 1919 Club, South Grove, Highgate, N.6. Broadcasting from Within. By Mr. J. F. Stanley.

Derby Wireless Club.—A.C. Rectifiers. By Mr. Dyer.

Luton Wireless Society.—At 8 p.m. At Hitchin Road Boys School. Experimental and Demonstration Evening for Beginners.

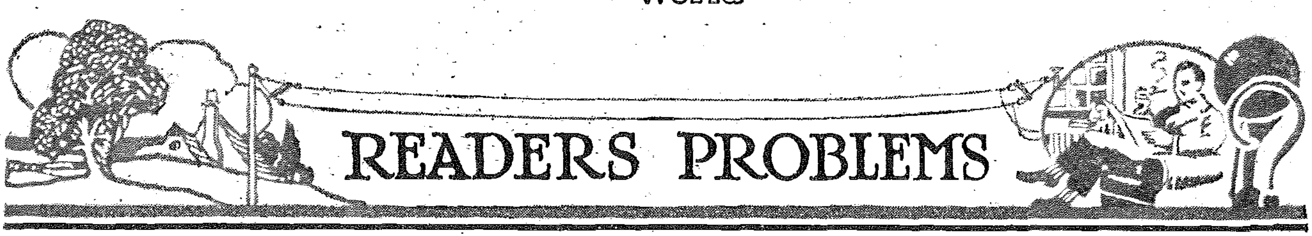
Hampstead and St. Pancras Radio Society.—At 8 p.m. At the Headquarters, Crogsland Road. General Meeting.

FRIDAY, MARCH 27th.

Sheffield and District Wireless Society.—At 7.30 p.m. At Department of Applied Science, St. George's Square. Elementary Lecture: "The Valve." By Dr. Walls.

TUESDAY, MARCH 31st.

Liverpool Co-operative Radio Association.—At 137, Oakfield Road, Liverpool. Marine Wireless. By Mr. B. Benson.



READERS PROBLEMS

Readers Desiring to Consult "The Wireless World" Information Dept. should make use of the Coupon to be found in the Advertisement Pages.

The Importance of a Low Resistance Earth Connection.

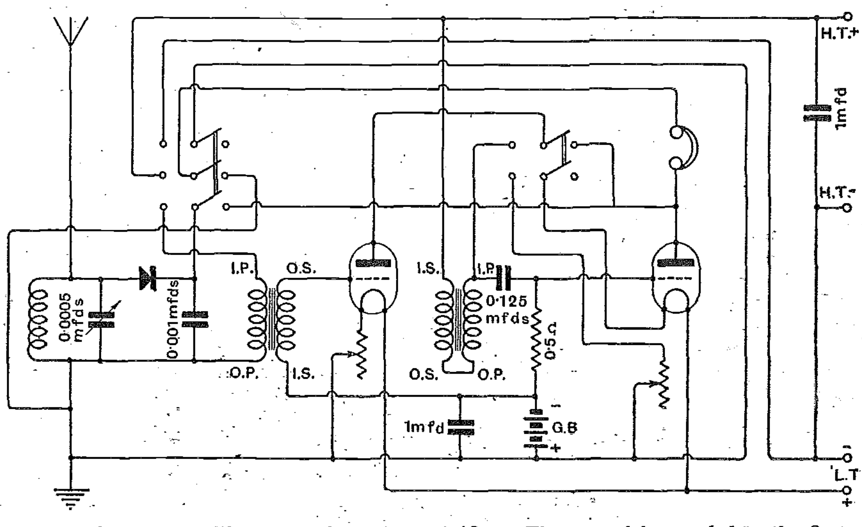
A CORRESPONDENT who, some little while back, submitted to this department full particulars of his receiver, complaining of instability and difficulty in receiving distant stations, now writes to say that as a result of carrying out certain suggestions made by us, he now obtains very good results indeed.

Since the cause of the trouble which our reader was experiencing is probably also the cause of unsatisfactory results obtained by many other readers, it will not be out of place to detail the circumstances of this case. In the first place, since our correspondent assured us that the set was correctly wired up, and all components were in order, we suggested that he arrange to test his set on a friend's aerial. This was done, and he reported very good results indeed. He then tested his friend's set on his own arial, and results were very poor. The supposition immediately arises that his friend possessed a lofty, unscreened aerial in comparison to his own, but actually the reverse was the case. We suggested that he examined his earth connection. His earth consisted of the usual waterpipe connection, and at our suggestion he abandoned this in favour of a buried earth consisting of a perforated bucket filled with coke, several wires being *soldered* to this bucket at various points. As a result he reports that the former instability has disappeared, and now, in spite of the poorness of his aerial, he obtains results fully equal to those obtained by his friend, who has a good aerial and also a good earth.

The importance of having a good low resistance earth cannot be overemphasised. It is quite obvious that if the earth connection has a high resistance, it is simply equivalent to deliberately placing a resistance of perhaps fifty ohms or more in the earth lead. In many cases where readers complain that the set howls immediately the hand is placed on the tuning dials, or that distant stations which have been carefully tuned in disappear upon removing the hand from the controls, it is simply due to the fact that the whole of the set is considerably above earth potential, owing to a high resistance earth lead. Anybody already possessing a satisfactory earth can readily prove this by connecting a filament resistance of the carbon compression type in their earth lead.

In many cases waterpipes travel a great distance before reaching the earth, and this form of earth is not advised in cases where the meanderings of this pipe are a doubtful quantity.

It is most important that the connections to the earth plate be soldered, and not connected by any arrangement of terminals. The earth connection should be examined periodically during the year, since it will be found that in certain districts buried earth plates disintegrate more rapidly than in others, owing to traces of acid in the soil. It is highly inadvisable to use several earth connections simultaneously, such as a connection to a water tap and to a buried earth plate, since flat tuning and poor selectivity may result, owing to the inequality in the L.C. value of each earth lead. In many cases where it is found impossible to erect a really good aerial, a carefully made earth connection will amply compensate for this deficiency.



A crystal receiver, with a two-valve note magnifier. The crystal is coupled to the first valve by a transformer and the second valve is coupled by a choke.

Obtaining Good Quality Reproduction from the Local Station.

A CORRESPONDENT asks for a design of an efficient two-valve amplifier suitable for adding to a crystal receiver, in which good quality reproduction can be obtained without resorting to the use of resistance-capacity coupling.

Accordingly we illustrate above a diagram of a crystal receiver followed by a two-valve amplifier, suitable switching arrangements being included in order to cut out one or both stages of amplification in accordance with requirements of volume. When the usual type of high-impedance valve is employed for rectification purposes, followed by an amplifier, it will be found that best results are obtained when the anode circuit of this valve contains a high impedance. This can be accomplished by using a transformer having a large number of turns in the primary winding, which is usually the case with the instruments sold by good class manufacturers under the name of "low ratio" transformers. A still better method of accomplishing this is to connect the two windings of a transformer in series and use it in the well-known choke method of coupling. When using a crystal rectifier, however, there is no need for this high impedance choke in the circuit, and a transformer may be used with perfect confidence. A further advantage of using a transformer to follow the crystal is that a step up in voltage is immediately obtained which is a great advantage, since the output of a crystal detector, even when at a moderate distance from a broadcasting station, is not very great. In the second stage of this amplifier choke coupling is used in order to obtain high quality reproduction, the choke consisting of an intervalve transformer connected in the manner previously described. It is essential that for best results valves of the type known as power valves be used with their anode and grid voltages suitably adjusted. This receiver contains no H.F. amplification and consequently its range is limited, but it will be found most excellent for giving loud and clear loud-speaker reproduction from either the local or the high power station. If, however, incoming signals tend to be weak, either owing to distance or to a badly screened aerial, it is recommended that the crystal be preceded by a stage of H.F. amplification, since it will be found that it is possible for considerable distortion to be produced when the ratio of input to output of a low-frequency amplifier is large.

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Reconstructing an H.F. Amplifier.

A CORRESPONDENT who has a three-valve H.F. amplifier which employs resistance coupling for the purposes of long-wave amplification wishes to know if this can be used for L.F. amplification by placing it after the detector valve.

This instrument cannot be used for the purpose named, since the impedance of the coupling condensers, although entirely suitable for transferring the H.F. potential differences developed across the anode resistances to the grid of the succeeding valve, is far too high to deal in a similar manner with audible frequencies. It is necessary to remove the coupling condensers and grid leaks and replace them by others having approximate values of 0.2 mfds. and 0.5 megohm respectively. The anode resistances in the H.F. amplifier will in all probability be of the grid leak type, and better results will be obtained if they are substituted by non-inductive, wire-wound resistances. It will be seen, therefore, that it is not possible to convert this instrument without almost entirely rebuilding it.

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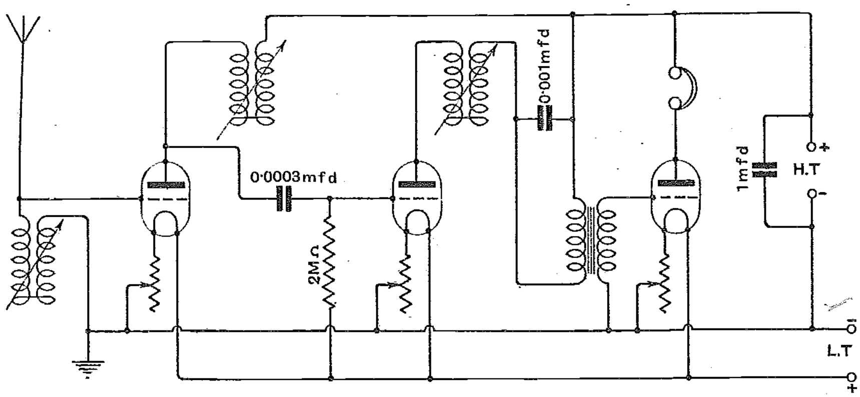
An Easily Tuned Three-valve Set.

A CORRESPONDENT is desirous of constructing a three-valve set embodying one stage of high-frequency amplification, in which tuning of both the aerial and H.F. valve anode circuit is accomplished by means of variometers, a third variometer being included in the plate circuit of the detector valve, in order to obtain regenerative effects.

The circuit which we give on this page fulfils these requirements. It will be found that this circuit is remarkably easy to tune, very smooth reaction effects being obtained by bringing the plate circuit of the detector valve into resonance with the other two circuits. Great care must be taken, however, to space the three variometers well apart, otherwise erratic results will be obtained, owing to the magnetic coupling between the windings of the three variometers, which will in certain positions of the rotors act in opposition, whilst in other positions the reverse will be true. In the case of the two anode variometers it must be remembered that if they are of the same type as the aerial variometer, it will be necessary to shunt them with a fixed condenser of 0.0002 or 0.0003 mfd. When all three variometers are attuned the set should oscillate, and it will be necessary to slightly detune the reaction variometer. If the losses in the circuit are high, however, oscillation may not be produced even when all three circuits are in tune, and it may become necessary to connect a small fixed condenser of, say, 0.00005 mfd. from the anode of the detector valve to the aerial terminal in order to effect a transference of energy from this anode circuit to the grid circuit of the



A three-valve receiver, with variometer tuning, giving one stage of H.F., valve detection and one stage of note magnification.

first valve. Loading coils may be added in series with all three circuits in the usual manner, or, of course, if variometers of suitable dimensions are employed, a change from short to long waves may be accomplished by placing the variometer windings from parallel to series by means of suitable switches. The third valve in this set is a low-frequency amplifier employing transformer coupling.

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Obtaining Reaction with a Frame Aerial.

A CORRESPONDENT who has been a constant user of the conventional single-valve receiver with plug-in coils for aerial tuning and for reaction recently commenced experimenting with a frame aerial, and has experienced difficulties in obtaining reaction when using the set in this manner. He first attempted to obtain results by connecting the frame aerial in parallel with the aerial tuning coil, but found that this reduced his wavelength considerably, and it was not possible to tune up to the wavelengths he desired to receive, even when a larger coil was substituted for the aerial coil. Upon withdrawing the aerial coil this defect was remedied, but it was no longer possible to use reaction.

In most cases where a frame aerial is connected across the aerial and earth terminals of an existing set it becomes necessary to remove the aerial coil, since it must be remembered that when two inductances are connected in parallel, the total inductance of the circuit is considerably reduced, and assuming a case where a number of inductances are connected in parallel but not in mutual inductive relationship with each other, the total inductance in the circuit can never be above that of the smallest inductance in the circuit. The inductance of a frame aerial of the ordinary type is not very great. This is an advantage in one way, since it enables us to add a coil in series with the frame aerial, and we can then arrange to couple the reaction coil to this for obtaining reaction effects in the ordinary manner. It is important to bear in mind that the degree of coupling necessary to produce reaction is not so great when a frame aerial is used, owing to the effective resistance of the frame being so much less than that of the ordinary aerial and earth system. Many people prefer to obtain regenerative effects by connecting a variable condenser of small capacity between the anode and grid of the detector valve, whilst others prefer to wind one or two turns of wire over the frame aerial, the turns being, of course, connected in the anode circuit of the detector valve, but the disadvantage of this latter method is that it is not possible to vary conveniently the amount of reaction produced. In using a frame aerial in conjunction with a four-valve set of the conventional type employing the tuned anode method of H.F. valve coupling it is very convenient to carry reaction on to the anode coil, since the resistance of a frame aerial is low, and there is not the same necessity to introduce reaction into the aerial circuit as when an ordinary aerial and earth is used. Usually it is better to introduce reaction into the aerial circuit when an ordinary aerial and earth is used rather than into the anode circuit. It is therefore a great advantage when constructing a set containing a stage of tuned anode coupled high frequency amplification to arrange for the reaction to be carried either on to the aerial coil or on to the anode coil, according to whether it is desired to use a frame aerial or not. This may be accomplished by using a two pole throw-over switch.