The Wireless World AND RADIO REVIEW

No. 299. WEDNESDAY, MAY 6TH, 1925. VOL. XVI. No. 13.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - - - - Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4. - Telephone: City 2847 (13 lines).

Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 10 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries abroad, £1 3s. 10d. per annum.

SUMMERTIME WIRELESS.

IN anticipation of the arrival of warmer weather, when outdoor interests and recreations will replace the fireside, we have arranged for the next issue of *The Wireless World*, dated May 13th, to be devoted largely to wireless out of doors. Special articles will appear, giving full constructional details for really portable receivers suitable for use on a car, on the river, or anywhere where compactness and portability of a receiver have to be considered.

For the reason, it may be, that our summers are so often disappointing, wireless out-of-doors has not yet come into its own in this country, but we feel sure that the cultivation of a habit of associating outdoor life with wireless will quickly encourage the use of the receiver under such conditions. Many people who have become accustomed to broadcasting at home will not wish to be deprived of it during their summer holiday, and yet most probably the receiver they at present use is unsuitable for transportation elsewhere.

Motoring, which from all indications is likely to break the record in popularity this summer, also provides a special opportunity for the advantages which a wireless receiver provides. With the car, the case for lightness is not quite so important as the necessity for compactness, and special consideration to compactness of a receiver for car use has been given in one of the articles which will appear next week.

In other countries, where perhaps the climate is more favourable for the purpose, wireless achieves even greater popularity in the open air than it does at home. But in this country, it would seem, manufacturers have rather neglected the question of portable sets, and one can only call to mind two or three examples which are purchasable on the British market.

CONTENTS.

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BROADCASTING THE KING'S SPEECH.

THE speech of His Majesty the King on the occasion of the opening of the second British Empire Exhibition at Wembley, is to be broadcast from all stations. It will be remembered that at the opening last year the speeches of the King and of the Prince of Wales were broadcast, and this event alone did much to assist in bringing about the immediate success of the Exhibition.

The number of persons who are able to listen-in this year to the speech, as compared with those who had receiving sets last year, is very great, whilst, in addition, extensive arrangements are being made for reproducing the King's speech to large audiences in different parts of the country. *The Wireless World*, in conjunction with the Capitol Picture Theatre, Haymarket, London, is arranging for loud-speakers to be equipped in the Capitol Theatre to reproduce the King's Speech for the benefit of those who are able to attend the theatre at that time. No charge will be made for admission, and those of our readers who are able to do so are cordially invited to be present. The theatre will open at 10.30 a.m.

SUPERHETERODYNE RECEIVERS.

Principles of the Harmonic Oscillator.

By W. JAMES.

THE superheterodyne system of reception combines the great advantages of enormous sensitivity and selectivity with ease of operation. Most receivers of this type have two main controls, one being for the adjustment of the set to the wavelength of the desired signal, and the other the setting of the oscillator to produce oscillations of a frequency to give the intermediate frequency for which the intermediate-frequency amplifier is adjusted. Sometimes there is a control which enables one to alter the degree of amplification. This may take the form of a potentiometer, or perhaps the desired effects

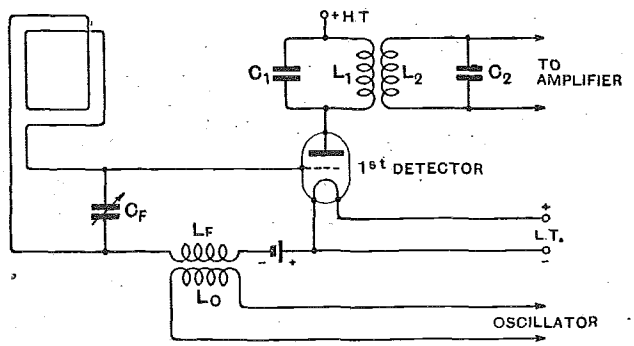


Fig. 1.—Explanatory diagram of the ordinary superheterodyne receiver.

can be obtained merely by regulating the filament current of the valves in the amplifier; occasionally a scientifically designed volume control is employed.

Superheterodyne Action.

Readers of this journal are no doubt familiar with the principles of superheterodyne action. Signals are tuned in the ordinary way with an aerial and tuner, or a frame aerial and tuning condenser (Fig. 1), and in one system the oscillations are applied to a valve which is set to rectify either by connecting a grid condenser and leak to the grid of the valve, or by using a suitable valve with a negative grid bias and appropriate plate voltage. A local oscillator is employed to induce oscillating currents into the grid circuit; hence in the grid circuit of the rectifier are the oscillations representing the incoming signal and those due to the oscillator. (In Fig. 1, coil L_0 of the local oscillator is coupled to coil L_F in the grid circuit of the rectifier.) The valve rectifies these currents, with the result that a current, modulated according to the incoming signal, and having a frequency equal to the sum (or difference) of the frequency of the incoming and locally generated oscillations, flows in the plate circuit of the rectifier.

A circuit, $C_1 L_1$ (Fig. 1), tuned to the new frequency of the currents, is connected in the plate circuit and passes on the currents to the amplifier. In the figure, circuit $C_1 L_1$ is coupled to a second circuit, $C_2 L_2$, the tuned coils forming a tuned high-frequency transformer. If the transformer is suitably designed, it will pass to the amplifier currents of the new frequency and the modulating (side) frequencies only. Such a sharply tuned transformer is often termed a "filter," and will be referred to here as such, although the writer does not like the name, and uses it only because it serves to distinguish it from the transformers or other couplings of the high-frequency amplifier, which usually are deliberately bluntly tuned.

The most suitable intermediate frequency depends partly on the degree of selectivity desired, but mainly on the type of valve employed in the amplifier. It is obvious that an amplifier employing ordinary tuned couplings for a frequency of, say, 150,000 cycles (2,000 metres) with valves of the D.E.5 or D.E.5.*b* class will either be troublesome through instability, or else give a relatively poor amount of amplification. With valves of this class it is desirable to employ an intermediate frequency of, say, 60,000 cycles (5,000 metres) or more, depending on the form of coupling. On the other hand, it is quite possible to use fairly effectively an intermediate frequency amplifier for 150,000 cycles when valves such as the D.E.R. are employed. In many cases it is desirable to go as low as 30,000 cycles, but with this frequency trouble will probably be experienced through interference. Examples have been worked out in earlier articles[1] and should be consulted by those who desire further information on these points.

Relationship of the Frequencies.

A little thought will show the relationship of the three frequencies—the incoming, the locally generated, and the resulting intermediate frequency. If it is decided that the amplifier is to work on a frequency of 60,000 cycles, the locally generated oscillations should be 60,000 cycles

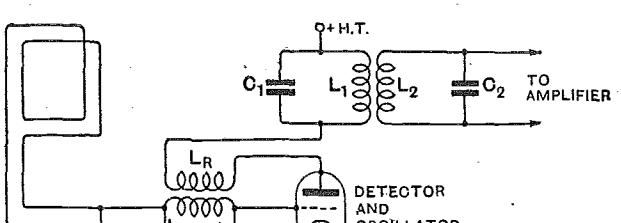


Fig. 2.—The harmonic frequency changer.

higher or lower in frequency than the incoming signal. Thus, if the signal tuned by the aerial is 1,000,000 cycles (300 metres), the local oscillator should be set to

[1] *The Wireless World*, January 21st, p. 553.

Superheterodyne Receivers.—

1,000,000 ± 60,000 cycles; that is, 1,060,000, or 940,000.

One-Valve Frequency Changer.

With the object of getting as much as possible out of the valves, attention has been directed to arranging the first detector in such a manner that it will produce the local oscillations as well as rectify—that is, to dispense with the oscillator of Fig. 1 and to cause the detector to rectify and produce oscillations of the necessary frequency. It might be thought that the valve could be made to oscillate in the same manner as in the usual regenerative receiver, but this involves mistuning the tuned circuit by the amount of the intermediate frequency. The net result of doing this is a reduction in the signal strength compared with the two-valve frequency changer, combined with exceedingly tricky operation, as the mistuning necessarily weakens the incoming signal. Several practical schemes which give the desired economy have

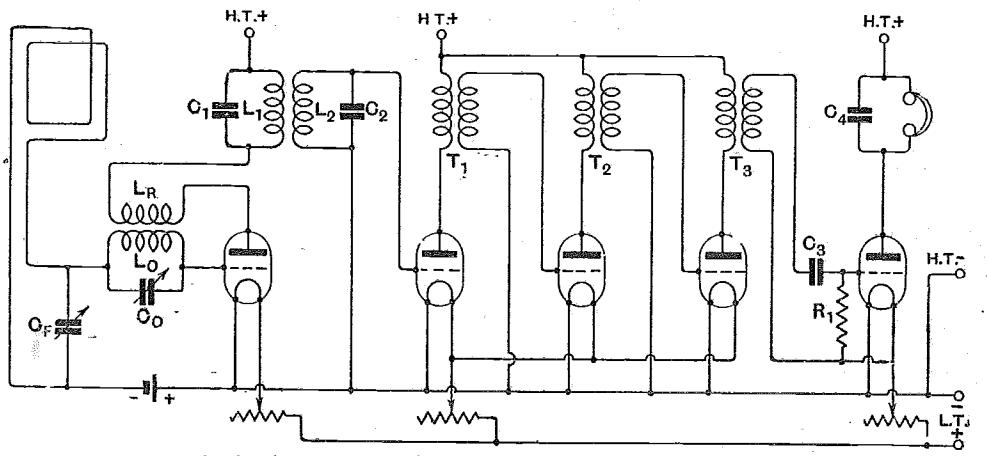


Fig. 3.—A complete receiver with a harmonic frequency changer.

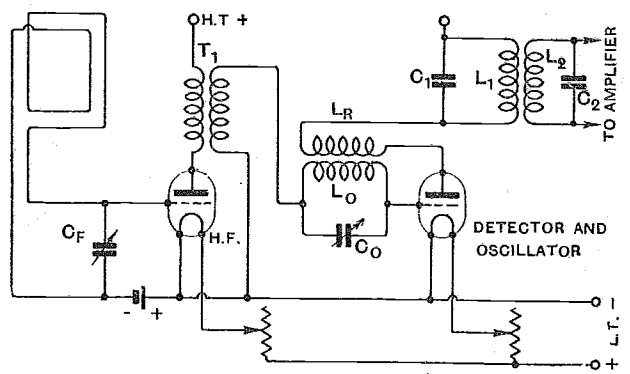


Fig. 4.—Connections when a stage of untuned H.F. is added.

been worked out, however, and one of them, due to Messrs. Armstrong and Houck, may be understood by referring to Fig. 2. In this arrangement is a second tuned circuit, $C_0 L_0$, to which is coupled a reaction coil L_R. With the valve properly adjusted and the coupling right, oscillations are generated in the tuned circuit, and their frequency is decided (practically) by the constants of $C_0 L_0$. As C_0 is adjustable, the frequency can be set to any suitable value. When this frequency differs considerably from that of the incoming signal, the arrangement is perfectly stable; the tuning of one circuit does not affect that of the other, and the locally generated oscillations are not radiated from the frame or other aerial to any appreciable extent. But for superheterodyne action, oscillations differing in frequency from the incoming ones by a relatively small amount are necessary. These are obtained by working the valve in such a manner that strong harmonics are produced. It might be arranged, for instance, that the second harmonic be relatively strong. Then, if the frequency of the circuit $C_0 L_0$ be so adjusted that the second harmonic beats with the incoming signal to produce currents of the right intermediate frequency in the plate circuit $C_1 L_1$, superheterodyne action is obtained. Thus, if the intermediate frequency is 60,000 cycles, and the frequency of the signal is 1,000,000 cycles, the second harmonic should have a frequency of 1,060,000 or 940,000 cycles. The fundamental or natural frequency of the tuned circuit $C_0 L_0$ should be half the frequency of the incoming signal, *plus* or *minus* half the intermediate frequency, in this instance 530,000 or 470,000 cycles.

A Typical Receiver.

The operation of a typical receiving system (Fig. 3) may be explained as follows. The desired signal is tuned by the frame (or other aerial) and condenser C_F, and is applied to the grid of a valve set to rectify. In the grid of this valve is a circuit, $C_0 L_0$, condenser C_0 being variable, and in the plate circuit is a reaction coil, L_R, and a circuit, $C_1 L_1$, tuned to the intermediate frequency. A second circuit, $C_2 L_2$, is coupled to $C_1 L_1$, and connected to the three-valve H.F. amplifier, the valves of which are coupled by transformers T_1, T_2, and T_3. The last valve is set to rectify, having a grid condenser and leak, $C_3 R_1$, and its plate circuit contains telephones and a bye-pass condenser, C_4; or a note magnifier may be connected in the usual way. Transformers

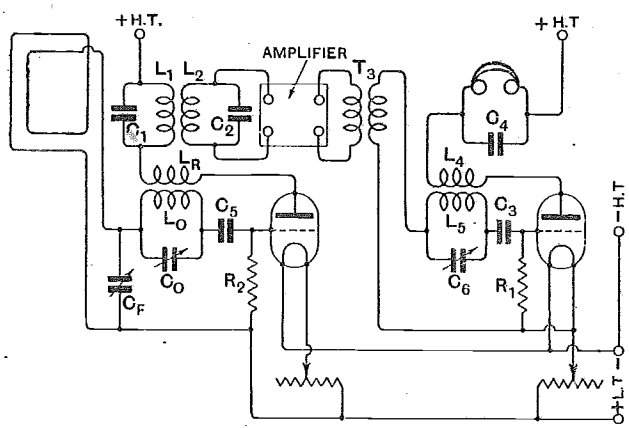


Fig. 5.—Connections when the receiver is intended for the reception of C.W. signals.

Superheterodyne Receivers.—

T_1, T_2 and T_3 may be bluntly tuned; circuits C_1 L_1 and C_2 L_2 form a sharply tuned transformer or "filter." Circuits L_R, C_0 and L_0 cause the valve to oscillate at the frequency determined by C_0 L_0, and because of the arrangement of the circuit, harmonics are produced. Of these, we assume the second is the strongest; and by adjusting C_0 its frequency can be made to differ from that of the incoming signal to give in the plate circuit C_1 L_1 currents of the desired intermediate frequency. As circuit C_0 L_0 is tuned very approximately to half the frequency of the tuner C_F and the frame aerial, adjustments of C_0 do not react on the tuner and make it necessary for a readjustment of C_F. The oscillations impressed on the amplifier are of course magnified and rectified, and actuate the telephones in the plate circuit of the last valve.

It will be understood, of course, that should it unfortunately happen that harmonics besides the second one are of sufficient strength to beat with the incoming signal

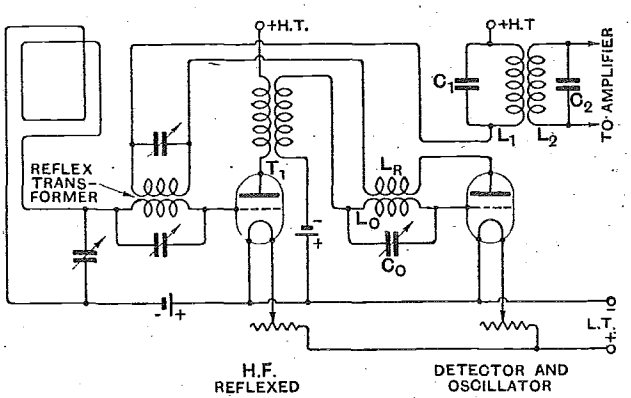


Fig. 6.—The intermediate frequency may be reflexed through the first valve, as shown here.

and produce currents of the intermediate frequency, these will be amplified. In practice, however, the circuit can be made to generate a strong second harmonic, and little trouble is produced by other harmonics.

To generate oscillations having strong even harmonics, the reaction coupling should be much tighter than the critical amount necessary for the production of oscillations, and the mean grid voltage should be made higher than or lower than the voltage which would make the anode current half its maximum value. If grid condenser and leak rectification is used, it is advisable to employ a low value of grid leak, or if this is not used, but a potentiometer is employed, the potentiometer should be adjusted to give anode rectification.

Receiving C.W. Signals.

The circuit described is of course only suitable for the reception of modulated waves, such as telephone signals. To receive continuous wave telegraph signals it is customary to employ a separate oscillator tuned to a frequency differing by, say, 1,000 cycles from that of the high frequency amplifier, and to couple it to the grid circuit of the second detector. A separate oscillator may be dispensed with, if desired, by arranging the second detector to produce oscillations and harmonics as well as to rectify, in the manner described above. In Fig. 5 is the harmonic superheterodyne receiver of Fig. 3, but with the second detector arranged to produce oscillations. The oscillations are produced by the reaction coil L_4 and the circuit L_5 C_6; when the second harmonic is utilised, the latter circuit is tuned to a frequency which is equal to half the frequency of the intermediate frequency *plus* or *minus* half the frequency of the L.F. beat note desired.

Adding H.F. and Reflexing.

In some instances better results are obtained by employing a stage high-frequency amplification between the aerial and the first detector. The coupling may be of the type which does not require exact tuning, and should of course be designed to be effective over the range of wavelengths of the signals which may be received. A plug-in coupling unit may be used here with advantage. In Fig. 4 a high-frequency transformer T_1 is shown as the coupling, and its secondary winding is connected to the grid of the first detector, which is arranged on the harmonic system described in connection with Figs. 2, 3 and 5.

It has been found possible to reflex the intermediate frequency through the first valve with a corresponding economy of valves by the method of Fig, 6. On following out the circuit it will be seen that the incoming signal is amplified by the first valve and its H.F. transformer, and that in the grid circuit of the second valve it combines with the oscillations generated by circuits C_0 L_0 and L_R, and produces currents of the intermediate frequency in the plate circuit of this valve. These currents pass through the primary winding of the reflex transformer, and influence the grid of the first valve through the secondary winding. They are then passed by transformer T_1 to the grid of the first detector, and increase the efficiency of this valve, producing stronger currents in the "filter" C_1 L_1, C_2 L_2, than would be produced if the currents were not reflexed. It is a matter of some difficulty to arrange a circuit which will give a worth-while increase in the signal strength without adding considerably to the complications of the circuit.

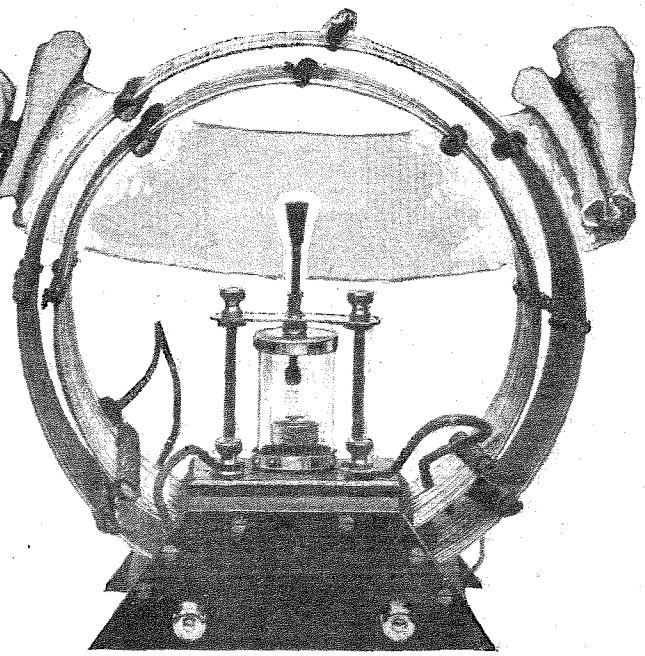
THE INTERNATIONAL BROADCASTING BUREAU.

NINE countries are represented in the Committee of the new Broadcasting Bureau, the members of which will carry out the task of maintaining touch between the various broadcasting enterprises in Europe. The nine members are:—

Admiral Carpendale, for the British Broadcasting Company.
M. Robert Tabouis, for the Compagnie Française de Radiophonie.
M. H. Giesecke, representative of the German Wireless Telephony enterprises.
M. A. Hubert, for Radio-Belgique.
M. E. Ivoboda, for Radio-Journal, Prague.
M. A. Dubois, for Dutch transmissions.
M. Maurice Rambert, for Radio-Geneva.
M. Skottun, for Scandinavian Broadcasting.
M. Guillen Garcia, for Spanish radio-telephony.

The management of the Bureau, it will be remembered, has been entrusted to Mr. A. R. Burrows, formerly of the B.B.C. The institution of this representative body should go far to ensure harmonious working between stations in the interests of listeners of all nations.

A Novel Crystal Set



An Inexpensive Set of Unusual Design, Giving Excellent Results.

By STANLEY CURSITER, O.B.E.

THE circuit used in this crystal set is very simple and gives excellent results.[1] It contains no expensive components, but offers scope for craftsmanship in making up. It is particularly suited to conditions which are more or less permanent, such as receiving the local station on a definite aerial and earth system, as it can then be tuned to the desired wavelength and all connections soldered. If adjustability is necessary, the two connections "*a*" and "*b*" (Fig. 1) can be made of flex ending in clips, as shown in the photograph, but it will then have the attendant disadvantages of less perfect contacts and possible dead-end losses. The position of the two contacts "*a*" and "*b*" will vary with the constants of the aerial-earth and the crystal-phone circuits, but it is seldom that the best results will be got with "*a*" and "*b*" coinciding. When "*a*" has been adjusted to tune to the desired wavelength, "*b*" should be moved until the loudest signals are heard. This will usually be found below the point "*a*," but will vary according to the "load" imposed by the crystal and phones, and may come above. Altering the position of "*b*" will not materially affect the tuning arrived at in the placing of "*a*."

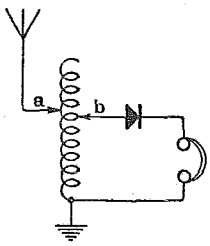


Fig. 1.—Connections of the crystal set.

The ideal tuning coil should be of the low-loss air-spaced type wound with No. 14 or No. 16 S.W.G. copper wire in one continuous length, but with a diameter of even 8in. this makes a large and cumbersome coil, so it was decided to divide the inductance into two sections arranged concentrically. The arrangement of the completed set is shown in Fig. 2, but intending constructors may have to make slight modifications, as the arrangement really depends on the form assumed by the inductances.

[1] See *The Wireless World*, April 30th, 1924, "What is the Best Circuit for Crystal Reception?" by F. M. Colebrook, B.Sc.

Two half-pound reels of No. 16 tinned copper wire are required, and it was found that the particular wire available when wound on formers $4\frac{1}{4}$in. and 5in. gave coils $5\frac{3}{8}$in. and $6\frac{3}{8}$in. respectively when released from the formers.

The wire should be stretched out in one continuous length and pulled over the edge of a piece of wood to remove all kinks and bends. Having selected a tin or other cylindrical object of the right diameter as a former, pass a few turns of string round one end and attach to a loop on the extreme end of the wire. Then, keeping the wire taut, wind it on by revolving the tin.

When removing the wire from the former it is necessary to release both ends simultaneously, as otherwise the coil will be larger at one end than the other.

The turns are spaced with a cotton string of about the same thickness as the wire. If a thin strip of ebonite

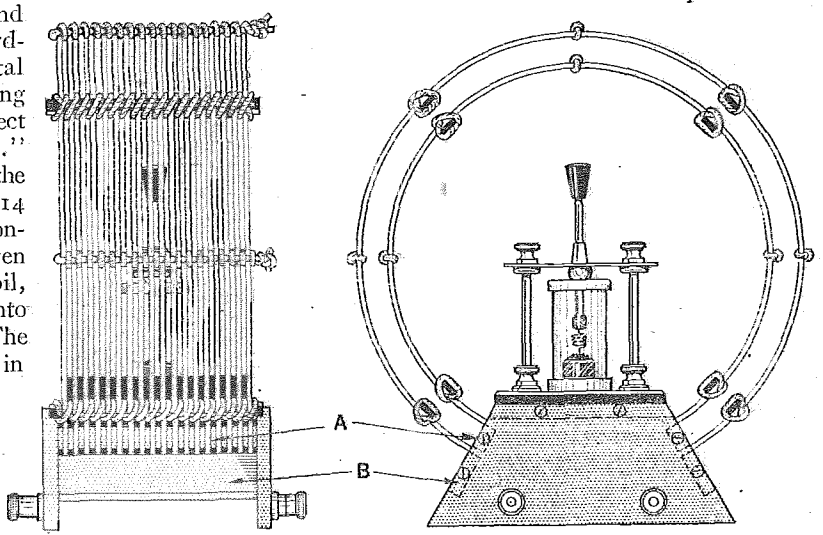


Fig. 2.—Arrangement of the coils, mounting, and detector.

A Novel Crystal Set.—

or wood is placed under the wire at alternate bindings, the coil can be made quite substantial and rigid. The method should be quite clear from Fig. 3.

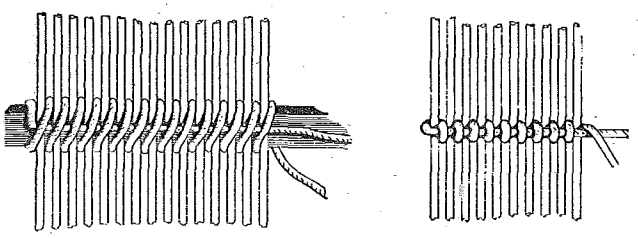


Fig. 3.—Method of securing the turns of wire to make the coil rigid.

In the set described there are 25 turns in each coil, but it is better that the exact number to suit the particular circumstances should be determined by an experimental assembly before final arrangements are made, so that, if necessary, the coils may be reduced to the exact number of turns required and dead-end losses eliminated. The number of turns and thickness of the spacing string will determine the width of the ebonite base. In this set it is 3¼in., and Fig. 4 shows how it was cut, with a fret saw, from a 6in. × 6in. × ¼in. panel. It was put together with ordinary wood screws; the holes were drilled a little on the large side and plugged with wood. The crystal detector is electro-plated, as are the terminals, so with the tinned copper coils the whole set makes a not unpleasing scheme of silver and black.

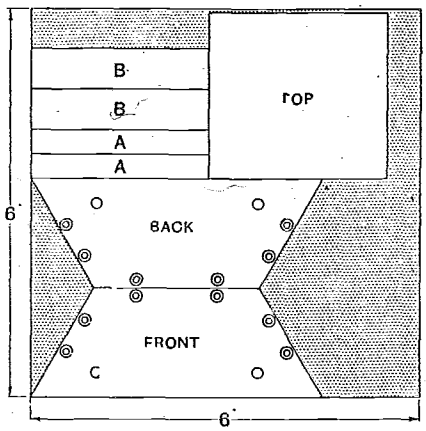


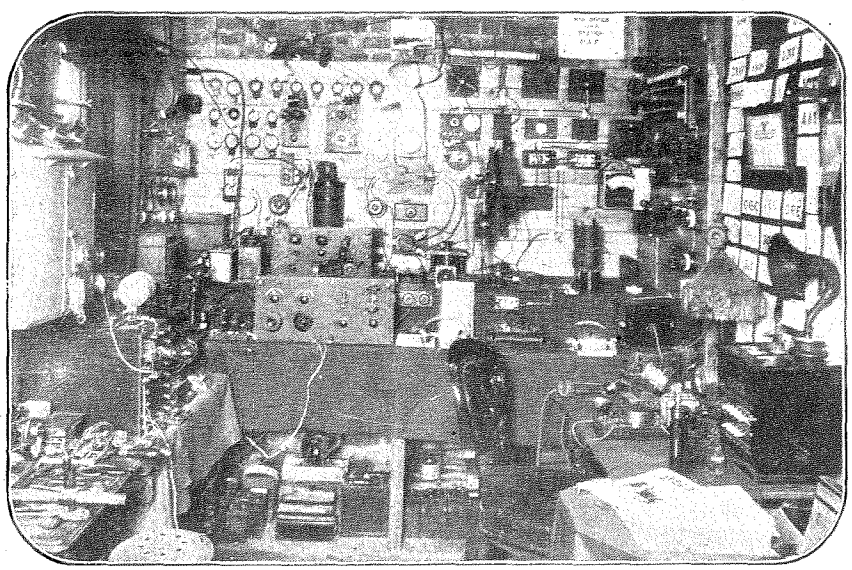
Fig. 4.—The ebonite parts are cut from a sheet as indicated here. Pieces A and B are marked in fig. 2.

AN EFFICIENT AMATEUR STATION.

Details of G2FM.

THIS interesting station, operated by Capt. F. C. McMurray and Mr. R. E. Laurence Beere, is situated at Thornton Heath, Surrey. The transmitter, a coupled Hartley, can be seen to the right of the photograph, for which the main H.T. supply is derived by means of a step-up transformer giving 5,000 volts with an electrolytic rectifier consisting of 60 cells, using aluminium and lead electrodes with a 20 per cent. solution of Amonium phosphate as the electrolyte, the supply being smoothed by means of chokes and condenser banks giving an output of 3,500 volts D.C. to input of the oscillator for C.W. working.

A D.C. generator (the controls for which can be seen in the middle foreground) is used for telephony working on the transmitter seen in the left foreground of the photograph. On the right can also be seen apparatus for sub-control, consisting of a relaying sounder and galvanometer connected to land line.



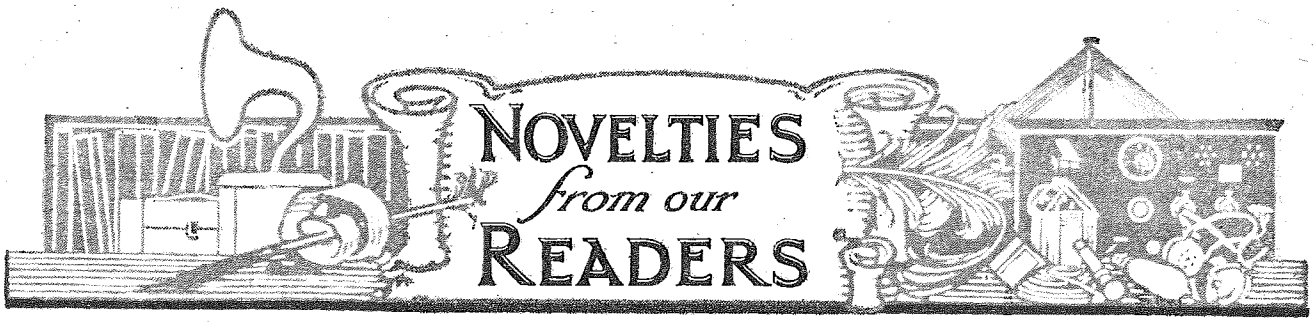
A view of the imposing array of equipment at G2FM.

On the left are three receivers, two being used for short wave work and the other for the 200-2,000-metre band. The station in the past was well known for speech transmissions, frequently to be heard on the 150-200 and 440-metre band, and during the past four months has been working C.W. on a wavelength of 98 metres

Good DX Work.

G2FM has been successful in effecting two-way communication with over a hundred American and Canadian stations, together with stations in every country of Europe. In addition, the station has been heard in Urderband, India, and has received Australian and New Zealand amateurs.

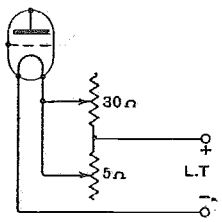
Incidentally, it was one of the first stations to work GHH, Mosul, Iraq, forwarding a message to the Air Ministry, London, and communicating on many subsequent occasions.



A Section Devoted to New Ideas and Practical Devices.

FILAMENT RESISTANCES IN PARALLEL.

The system of connections given in the accompanying diagram, in which two variable filament resistances are connected in parallel, has several useful properties. If both resistances are provided with "off" positions, bright or dull emitter valves may be used with one of the resistances in circuit and the other switched out.



Filament resistances of 5 and 30 ohms, connected in parallel, provide for interchanging bright and dull emitter valves and giving critical control.

When both resistances are switched on, the net resistance will not exceed 5 ohms, but the 30-ohm resistance will provide an excellent vernier adjustment. The fine control of resistance obtained in this way is of great value in adjusting the filament temperature of "soft" detecting valves. —H. W. W.

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WINDING DUOLATERAL COILS.

Hand-made duolateral coils are generally wound on a cylindrical wooden former provided with two rows of pegs spaced at suitable intervals. The pegs are withdrawn from the completed coil after it has been treated with paraffin wax and an attempt is then made to slide the coil off the former without damaging the inside layers. There will be no risk of doing this if, before commencing the coil a single layer of enamelled wire is wound between the rows of pegs on the former. Over this layer of wire wind a strip of paper equal in width to the distance between the spokes. For a former 2in. in diameter the length of the strip may be about 20in., which will enable it to be wrapped round the former three times. This paper when stiffened by the wax, forms a strong foundation for the coil which is easily slipped off the former after pulling out the layer of enamelled wire underneath.—L. C.

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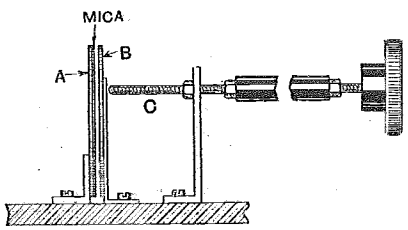
A VERNIER TUNING CONDENSER.

A vernier condenser giving a very fine adjustment may be constructed by arranging two brass plates in the manner indicated in the diagram. The plate A is rigidly supported on a strong bracket, but the plate B may be moved towards A by the pressure of the adjusting screw C. The rate of change of capacity will depend upon the distance between the point where the screw touches the plate and the bottom of the flexible bracket.



Simple form of construction for a vernier condenser.

A sheet of mica should be stuck on to the plate A with shellac varnish to prevent short circuiting, and an ebonite extension handle will be found a great convenience on short wavelengths.—G. C. D.

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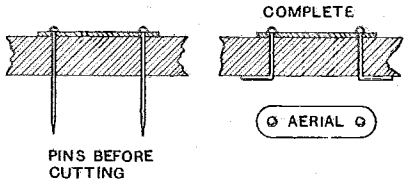
SECURING NAME TABS.

The small celluloid and xylonite tabs used to distinguish battery, aerial, and earth terminals are generally cemented to the panel with glue or varnish, which does not always hold. A much better method of securing the tabs is to use rivets made from ordinary pins. The panel is drilled with a fine Morse drill, and pins are selected which are a good fit in the holes. With the tab and pins in position, the shank of each pin is cut off, leaving about ¼in. projecting below the panel. When the pins are bent over at right angles, the tab will be permanently secured in position.—J. C.



Small celluloid labels can be secured to the panel face by means of pins bent over on the underside.

oooo

PRESERVING TELEPHONE WINDINGS.

It often happens that Brown "A" type telephone bobbins when rewound do not last for very long. After rewinding one of these earpieces three times, the writer came to the conclusion that the failure was due to strains imposed on the interior of the winding by a slight movement of pole-piece laminations when they were screwed to the permanent magnet, combined with the pressure exerted by the outer layers of the winding.

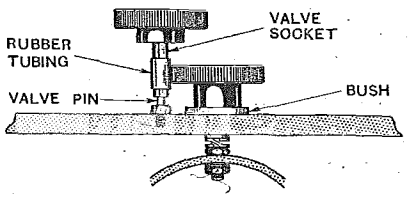
Accordingly several layers of soft tissue paper were wound on to the laminated core before commencing the winding, with the result that the present winding has been giving successful service now for more than a year.—F. M.

oooo

A SLOW MOTION DEVICE.

A slow-motion adjustment that works directly on to the tuning knob is shown in the accompanying diagram. Another tuning knob is fitted to an ordinary valve socket over

which is stretched a short length of thick-walled rubber tubing. A split valve pin is screwed vertically into the panel near the edge of the tuner knob, so that when the socket is pushed on to it, the rubber band will come into contact with the knob.



A simple device for providing critical adjustment.

As the diameter of most knobs is small, this method of adjustment can be recommended only in the case of freely moving condensers and variometers.—H. W. W.

oooo

CORRECTING FILAMENT SAG.

Before the importance of mounting a valve vertically was realised many receivers were built with the valve-holders mounted on vertical or sloping panels. In existing receivers of this type, or in cases where it is impracticable to mount the valves vertically, it is an advantage to reverse alternate valve-holders. Then, if valves are interchanged periodically the direction of sag will be reversed and any previous displacement of the filament will be corrected.—E. L. B.

oooo

REMOVAL OF SULPHATE FROM ACCUMULATOR PLATES.

Very badly sulphated accumulators, which will not yield to the usual treatment of a prolonged slow charge, may be saved from the scrap heap by the following method.

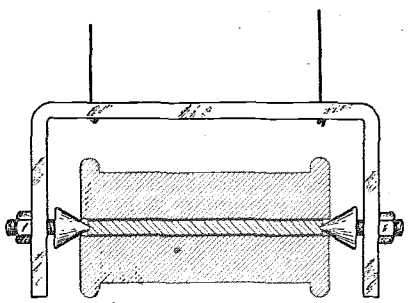
The acid is emptied out and the cell is filled with distilled water and allowed to stand for several hours in order that any acid held in the paste may have time to diffuse out. The cell is then filled with a solution of *pure* sodium sulphate (Na_2SO_4 $10H_2O$). The concentration is not important, but 200 grams per litre may be mentioned as a guide. The cell is then put on charge in the usual way, when the sulphate will gradually disappear. Before refilling the cell with acid it is most important to remove all traces of the sodium sulphate solution by prolonged soaking of the plates in distilled water, two or three changes of water being made before the washing process is regarded as complete.

The action of the sodium sulphate is attributed to the fact that the solution on electrolysis becomes acid in the neighbourhood of the positive plate and alkaline near the negative plate, and that a higher voltage is necessary to liberate oxygen in the acid solution and hydrogen in the alkaline solution. There is a tendency, therefore, for the lead sulphate at the negative plate to be reduced to lead, and at the positive plate to be oxidised to lead peroxide. —F. F.

oooo

WINDING WITH FINE WIRE.

The greatest difficulty encountered in rewinding high-resistance telephones is the continual breaking of the fine wire. This is due to overlapping turns and joints in the supply



Method of supporting spool for paying out fine wire.

spool and to temporary seizure of the spool on its bearings. The following method of suspending the spool of wire resulted in a complete solution of the difficulty.

An ebonite rod a little shorter than the length of the spool was centred at each end and inserted in the hole running through the centre of the spool. A frame was then constructed from brass sheet about $\frac{1}{8}$in. thick and fitted with two adjustable brass centre cones. When the spool and ebonite mandrel are supported by these centres, the spool will rotate with the minimum friction.

If the frame is suspended by string so that it can swing freely, a seizure of the wire will be indicated by the movement of the spool towards the telephone bobbin, and unless the spool is very heavy, the winder can be stopped in time to save a breakage.—H. L. O.

oooo

AVOIDING KINKS IN AERIAL WIRE.

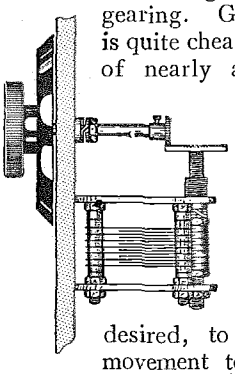
The bronze and copper wires usually employed for aerial construction are, when purchased, obtained in the form of a hank, and difficulty is sometimes experienced in uncoiling the wire owing to the tendency it has to spring into loops and when pulled tight create kinks.

This is particularly the case with hard bronze wire, and many amateurs being aware of this take the precaution, when uncoiling, of rotating the hank through their hands. This method is rather slow, and a much better way of avoiding kinks is to remove the wire in the form of loops, but in so doing reversing the coil so that an equal number of loops are taken from each side. Two loops might be allowed to fall off from one side of the coil, after which it should be turned round so that the next two, in falling off from the opposite side, produce a twist on the wire in the opposite direction to that created by the first two. By this process the wire will be found to lay out flat along the ground without the slightest tendency to spring into loops.—N. C.

oooo

A VERTICAL CONDENSER MOUNTING.

If considerations of space do not permit the fixing of a variable condenser with its spindle perpendicular to the panel, it may be mounted parallel with the panel if the spindle is actuated through bevel or crown gearing. Gear of this type is quite cheap and forms part of nearly all "Meccano" sets. The gear ratio may be chosen, if desired, to give a vernier movement to the condenser.



Vertically supported condenser operated through bevelled gearing.

A distinct advantage of this method of mounting is that the moving vanes do not tend to alter their position under their own weight.—F. J.

TESTING FOR DISTORTION.

Some Instructive Experiments of Practical Value.

By A. P. CASTELLAIN, B.Sc., D.I.C.

Many interesting experiments can be made with a home-made oscillograph. A particularly instructive series is to examine the effects of wrong operating conditions of a valve amplifier. Conditions which result in distortion can readily be found and a number of examples are illustrated.

IN a previous issue[1] of *The Wireless World* the writer described the construction of a simple oscillograph, and mentioned one or two ways in which the instrument might be used, without, however, giving any practical details of experiments which could be done with quite a small amount of apparatus.

It is proposed in this article to give a description, together with the theory, of a very interesting and instructive series of experiments which have been carried out on a low-frequency amplifier with the help of this oscillograph.

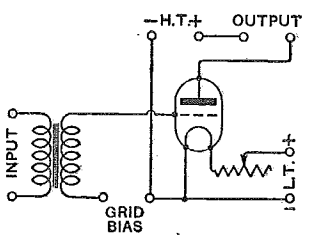


Fig. 1.—Layout of the apparatus used in the tests.

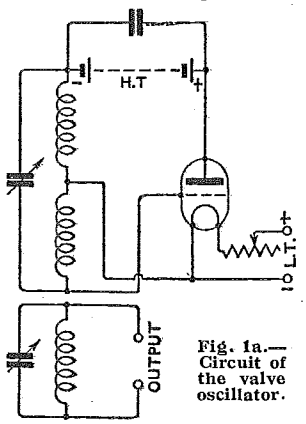


Fig. 1a.—Circuit of the valve oscillator.

Briefly, the experiments consisted of applying a pure waveform to the input of an amplifier and seeing what happens to the output waveform when various adjustments are made to the amplifier, and in this way finding the conditions the valve must satisfy for distortionless amplification.

The amplifier consisted of a good intervalve transformer, valve socket, and filament resistance, all mounted on a board so that the parts are all accessible, as suggested by Fig. 1.

The source of pure waveform was a valve oscillator, connected as in Fig. 1a, with a tuned output circuit giving a pure sine waveform at about 300 cycles per second. Oscillogram A shows the shape of this current, which is supplied to the amplifier.

There are several things that require attention when first using an amplifier, even assuming that all the batteries and valves are in good order—namely, a value for the high tension suitable to the valve in use must be chosen, and the corresponding negative grid bias found. In practice, of course, the amplifier is tested as follows: The valve is run at its full rated filament voltage, and the maximum rated plate voltage (say 120) is applied. A milliammeter is put in series with the telephones or loud-speaker, and the local broadcast tuned in. Various values of amplifier grid bias are tried until one is found which gives no visible indication of the broadcast on the milliammeter, although the loud-speaker is working. This will be found to give the best quality results with the loud-speaker, for the reasons given below.

Most readers will be familiar with the ordinary grid volts-plate current characteristic curve of a valve (Fig. 2), which consists of three parts—a bottom bend, a central straight portion, and a top bend. If the filament voltage is kept constant and curves plotted for several fixed values of plate voltage, these curves will all be found to have practically the same shape, but displaced more and more to the left as the plate voltage increases.

The essential function of an amplifier is, of course, to reproduce the input waveshape exactly to a larger scale in its output circuit, and hence the only part of the characteristic curves that is of interest from an amplifying point of view is the straight portion. This, perhaps, will be made clearer on reference to Fig. 3. If the curved part is used, then the output waveshape cannot

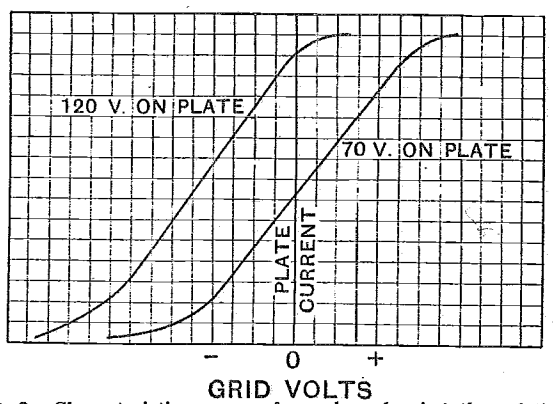


Fig. 2.—Characteristic curves of a valve, showing the relationship of plate current to grid volts.

be the same as the input. Also it is obvious that the operating point should be in the centre of the straight part to get the full use of the latter.

Another very important point is to use a sufficiently high plate voltage, which should be enough to bring all the straight part of the characteristic curve to the left of the zero grid volts ordinate. If the whole straight part is to be used, and if some of it is on the positive side of the zero grid volts ordinate, then during part of the time the grid will be positive, and hence grid current will flow. For small positive values of grid voltage the grid

[1] *The Wireless World*, March 25th, page 225.

Testing for Distortion.—

current is small, but it rises as the grid voltage increases. Fig. 4 shows how grid current varies with grid voltage.

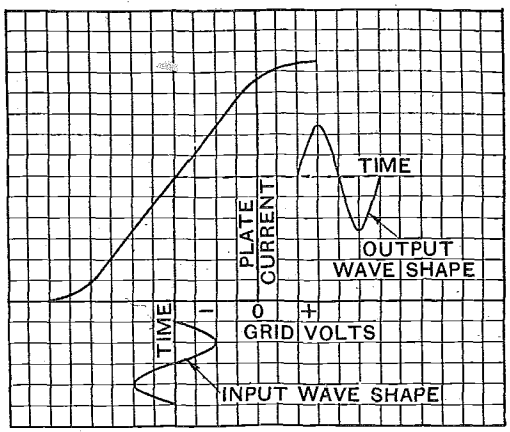


Fig. 3.—Explaining the valve amplifier.

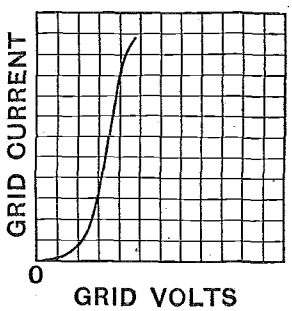


Fig. 4.—Grid current-grid voltage curve of a valve.

Hence, in the case under consideration, there would be pulses of grid current every time the grid became sufficiently positive. These pulses of grid current flow through the secondary winding of the input transformer and will usually be quite sufficient to overload it, with a consequent drop in secondary voltage, and so will flatten the top of the corresponding output wave, as shown in Fig. 5.

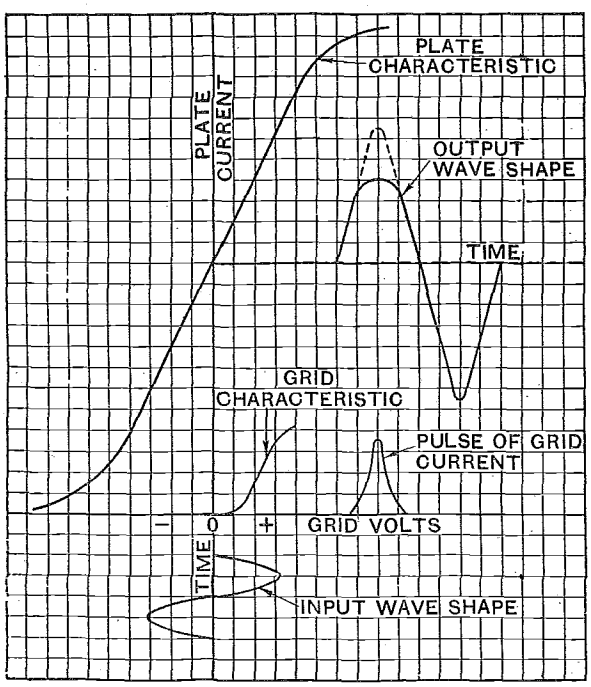
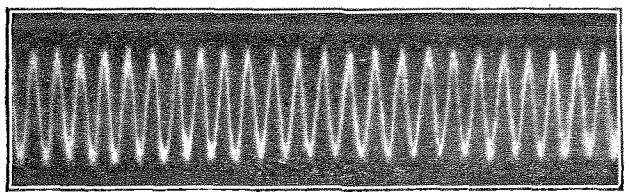


Fig. 5.—Showing the distortion caused by grid current.

In this diagram the plate and grid characteristics of Figs. 3 and 4 are drawn to the same scale, and a sine wave input assumed with the operating point on the zero grid ordinate (*i.e.*, no grid bias), which corresponds in this case to the centre of the straight part of the plate characteristic.



(A) Oscillogram of the input current to the amplifier.

The output waveform which would be obtained if there were no grid current is found by projection off the plate characteristic in the usual way, and is shown dotted in Fig. 5. The grid current wave shape is obtained in the same way from the grid characteristic, and is plotted to the same time scale. Owing to the pulse of grid current occurring every other half cycle, the output wave would be flattened during these half cycles, somewhat as shown by the full line in Fig. 5.

If the correct value of high tension is used, but either too much or too little negative grid bias, then the output waveshapes corresponding to the larger inputs will be distorted, either the top or the bottom of the waves being

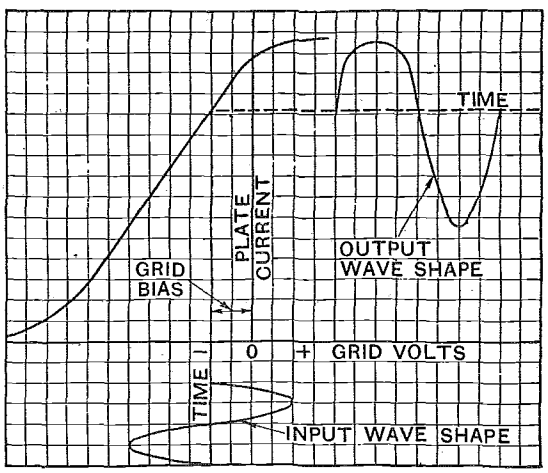


Fig. 6.—The effect of using too little grid bias.

flattened. Figs. 6 and 7 show what would be expected for too little and too much grid bias respectively, while the two oscillograms, B and C, show what actually does happen to the output waveshapes. What this really amounts to is that if a wrong value of grid bias is used, then there is not so much of the straight part of the characteristic available, and therefore that the possible output of the valve is diminished.

It will probably be argued by some that they have not found the value of grid bias to be very critical, judging either by results on the loud-speaker or by the milliam-

Testing for Distortion.—

meter test referred to previously. The obvious reason for this is that they are considerably under-running the valve—in other words, there is a lot more straight part

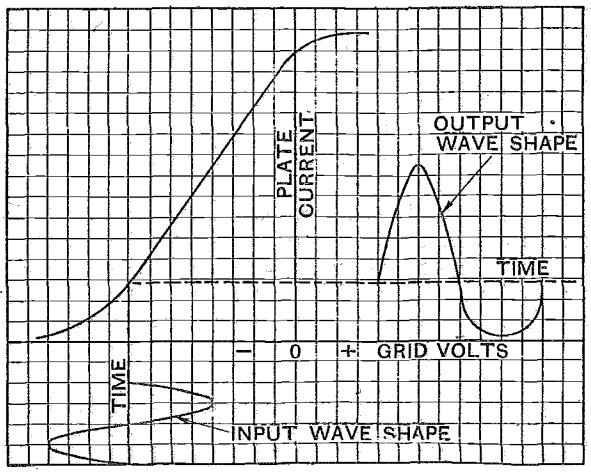
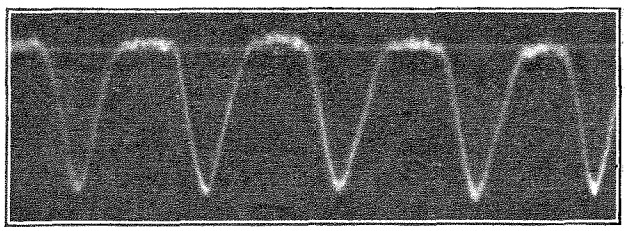


Fig. 7.—The effect of using too much grid bias.

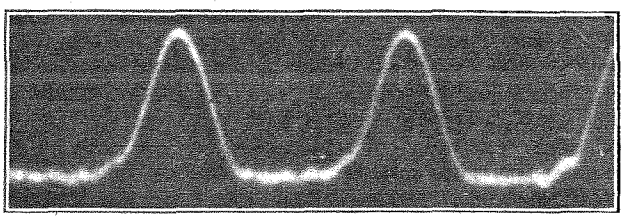
of the characteristic than is required. Now the factor which controls the length of the straight part of the characteristic is the filament emission—the hotter the filament, the greater is the saturation current, and hence the longer is the straight part of the curve. Fig. 8 shows



(B) Showing the effect of using too little grid bias—the valve is rectifying and flattening the top of the current waveshape.

four curves taken at the same plate voltage, but at different filament temperatures.

From the foregoing remarks it would obviously be more economical to reduce the filament voltage until there was sufficient straight on the curve (allowing, say, 10 per cent. margin for safety) and then adjust the grid bias to make the operating point come at the middle of the



(C) The effect of using too much grid bias, showing bottom bend rectification.

straight part. This would apply chiefly to the first valve or valves in an amplifier, more especially when the same type is used throughout.

In order to avoid the use of a potentiometer to obtain critical adjustment of grid bias, it is more convenient and perhaps better to adjust the grid bias to the nearest cell (*i.e.*, to nearest 1.5 volts), and then to alter the value of the high tension until the correct value (as given by the milliammeter test) is reached. Thus, instead of keeping the characteristic curve fixed and altering the

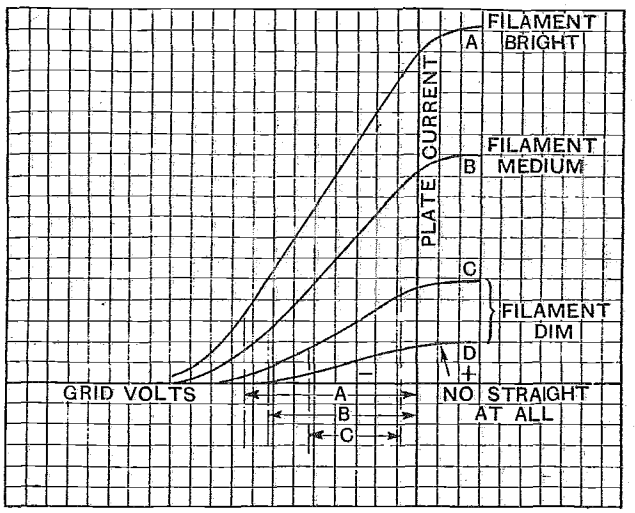


Fig. 8.—Characteristic curves with different filament temperatures.

grid bias until the operating point coincides with the centre of the straight part, we are fixing the grid bias and moving the characteristic until the centre of the straight part coincides with the operating point.

This method has the advantage of giving quite fine adjustment without the use of a potentiometer. For example, let us suppose that the valve has an amplification factor of 10. This means that one volt change on the grid has the same effect as, or corresponds to, 10 volts change on the plate. Now, quite a lot of high-tension batteries are tapped every three volts, which gives

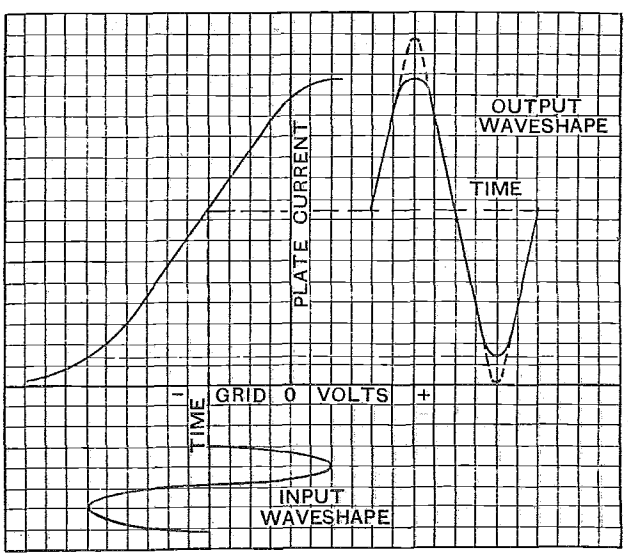
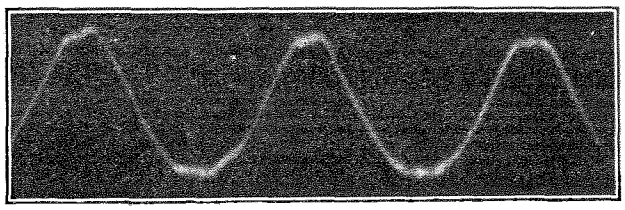


Fig. 9.—The effect of overloading the valve.

Testing for Distortion.—

an equivalent variation of grid bias on our valve of 0.3 volt. Hence, altering the high tension by three-volt steps is equivalent to altering the grid bias in 0.3-volt steps, so that there would be five equivalent tappings of grid bias in this way between every actual 1½ volts in the grid battery.

Just as it is possible to under-run the valve, so it is easy to over-run it. If the filament voltage is already the maximum permissible, then the only remedy is to use a larger valve. Fig. 9 shows what output waveshape

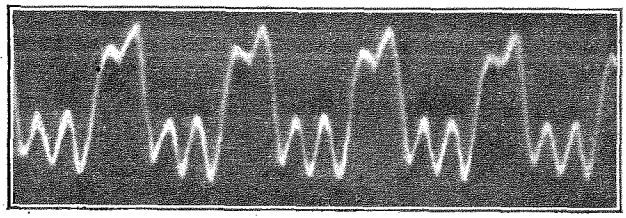


(D) When the valve is overrun the top and bottom of the current waveshape is flattened.

would be expected when the valve is overrun, and the oscillogram (D) shows the waveshape obtained.

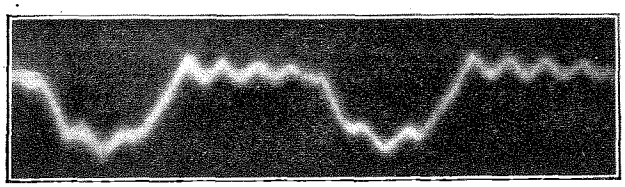
The two remaining oscillograms (E and F) show what happens to an input waveshape containing the fundamental and one harmonic when the grid bias and filament temperature are wrongly adjusted.

In the foregoing article the writer has discussed the conditions that must be satisfied by the valve for distortionless amplification, and these, of course, are only part of the conditions to be satisfied in an amplifier, as practically no consideration has yet been given to the way the valve gets its input and how its output is passed on.



(E) The effect of using too large a grid bias when the input current contains a harmonic.

Perhaps it would be as well to summarise the conditions that have already been discussed: (1) The valve must have sufficient straight part of its grid volt-plate current characteristic to deal with the maximum input voltage it is to receive. (2) The plate voltage must be sufficient to give a characteristic curve with all the straight part on



(F) This curve was taken when the valve had much too small a negative grid bias, and shows the waveshape of the current in the output circuit when the input current contained one harmonic.

the left of the zero grid ordinate (*i.e.*, no grid current). (3) The grid bias used should bring the operating point on the centre of the straight part of this characteristic curve.

PROFESSOR A. S. POPOFF.

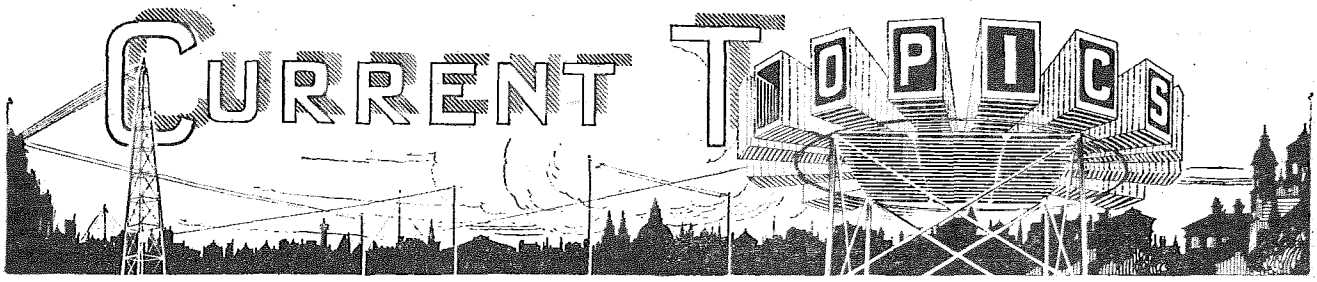
Thirtieth Anniversary of a Wireless Milestone.

MAY 7th marks the thirtieth anniversary of the first successful transmission by the Russian wireless engineer, Alexander Stepanowitch Popoff, of a communication by means of electro-magnetic waves. It was on May 7th, 1895, that this engineer gave a practical demonstration before the Chemical Society of Russia in the Chemical Laboratory of the St. Petersburg University. The receiving station, on the occasion of this experiment, was located at a distance of 40 metres from the transmitter. As each signal in Morse code was received, the President of the Society wrote the corresponding letter on the blackboard, and the enthusiasm of the audience was very great when the words "Heinrich Hertz" were eventually spelt out.

Professor A. S. Popoff.

A coherer was made use of in this early experiment with a relay included in the circuit to operate electrical devices. During some later experiments carried out in the spring of 1895, Prof. Popoff ascertained that the reception improved when a vertical conductor several metres long was employed, and he arranged distant-control apparatus whereby electric bells included in the receiving circuit were caused to ring when the transmitter was operated in different parts of the Naval School in Kronstadt. Later in the same year a series of experiments were carried out to ascertain the nature of thunderstorm discharges, and from his practical experiences Prof. Popoff gained some valuable information regarding the conductivity of the atmosphere. He published a description of these experiments in the proceedings of the Russian Physical Society in 1896, and a summary of this article appeared in the *Journal de Physique* in November, 1897. Many early experiments conducted by Prof. Popoff constituted valuable contributions to the development of the science.

Prof. Popoff was born in 1859 in Bogoslovsky Zawod, in the Ural district, where his father was a priest, and his scientific career began in 1877, when he entered the University of St. Petersburg.



Events of the Week in Brief Review.

2OD's DAYLIGHT TRANSMISSION TO AUSTRALIA.

Unknown to him at the time, a new European transmitting record was established by Mr. E. J. Simmonds (2OD), of Gerrards Cross, Bucks, on the morning of April 27th. He has since received cable confirmation that at 6 a.m. (B.S.T.) on that date his signals on 22 metres were picked up by Mr. C. D. Maclurcan (A2CM), of Strathfield, N.S.W. It will be remembered that A2CM is the Australian transmitter whose 20-metre signals were recently heard in this country.

We hope to report shortly that two-way working has been accomplished under similar conditions.

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CAN YOU RECEIVE DURBAN ?

Reception of the Durban broadcasting station is not a commonplace in this country, but reports on a talk on "Brighton," to be delivered at that station this evening (Wednesday) at 8.15 (B.S.T.), will be welcomed by Mr. Henry D. Roberts, M.B.E., Director of the Publicity Department, Public Library, Brighton. The speaker will be Mrs. Grace Sutton, Editor of the *South African Woman's Weekly*.

The wavelength of the Durban station is 450 metres.

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ROUMANIAN LISTENERS MUST BE BAPTISED.

Morality appears to be the main qualification for a receiving licence in Roumania, according to a bill which has just been presented to Parliament at Bucharest. The Bill states that all private persons desirous of possessing receiving licences must apply in person, bringing with them their baptismal certificate, a proof of their Roumanian citizenship, and a statement as to their high moral character from a priest or other responsible religious leader.

Free licences, according to the Bill, will be issued to schools, churches, municipal and national organisations, and to ships and aeroplanes.

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20-METRE ACTIVITY.

Australian and New Zealand transmitters are getting very active on the 20-metre wave, as is shown by the following extracts from the log of Mr. E. J. Simmonds (G2OD), of Gerrards Cross :—

April 25th.—0725 G.M.T., A2CM calling G stations; 0730 G.M.T., Z4AG calling CQ.

April 26th.—0640 G.M.T., A2CM working U6TS; 0755 G.M.T., A2CM calling G stations at intervals; 0745 G.M.T. U6TS calling A2CM. All these were on waves between 20 and 23 metres.

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PORTABLE TRANSMITTER IN THE PYRENEES.

An excursion in the Pyrenees with a portable transmitter is being carried out by Swedish SMYY and Brazilian 1AC, according to a report we have received from Mr. E. T. Manley, of Wimbledon Park, who recently picked up their signals. The travellers are using a wave length in the neighbourhood of 80 metres, and transmit in good English with a pure DC note. Their signals have been heard at 1.30 a.m. (G.M.T.).

THE KING'S SPEECH.

In connection with the broadcasting of the speech of H.M. The King at the opening of the British Empire Exhibition, read the special announcement in the Editorial columns of this issue.

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A NEW QSL CARD.

Many non-transmitting amateurs who desire to send QSL cards to American transmitters may welcome the idea of Mr. S. Jamieson, of Brixton. Although not having a call sign he has produced a QSL card which bears quite the traditional appearance. Details of the transmission heard, and particulars of his own receiver are displayed in the usual manner, and in the centre of the card, in place of the usual call sign, the letters DX are printed in large capitals, with the word "London" superimposed in smaller characters.

The effect is decidedly arresting, and when we first glanced at the card we thought we had been heard in Kamchatka.

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WEATHER REPORTS FOR SHIPS.

For the benefit of mariners, a special 600-metre "spark" retransmission of the C.W. long range weather reports from the Air Ministry is to be carried out as from June 1st. The stations selected for this purpose, are Valencia, Seaforth, Niton, and Cullercoats.

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BRITISH DX WITH ITALY.

Two-way working on 20 metres was established on Sunday, April 19th, between G2FN (Mr. L. M. Baker, Rudding-ton, Notts.) and 1IRG (The Radiogiornale, Lake Como, Italy). The power input at 1IRG was 100 watts, with an aerial current of 0.2 ampere.

1RG transmits every Sunday at 3 p.m. (G.M.T.) on 20 metres, and at 4 p.m. on 40 metres. Reports should be addressed to the Radiogiornale at Viale Maino, 9, Milan.

THE R 33's CREW. Soon after their historic flight, the crew of the truant airship paid a visit to the Air Ministry to receive the congratulations of the Chief of Staff, Sir Hugh Trenchard. The above photograph was taken on this occasion. (Left to right): Mr. S. T. Keeley (wireless operator), Sergt. Hunt (coxswain), Lieut. Booth (commander), and Mr. Gent (chief engineer).

AMERICA–NORWAY WIRELESS DEVELOPMENTS.

It will soon be possible to receive in Oslo an express telegram three minutes after it has been handed in to a New York telegraph station. This speedy transmission will take place when the new receiving station at Fornebo, near Oslo, is opened.

Up till now the receiving station for radio telegrams to Norway from the United States has been at Nerland, on the south-west coast. The new arrangement will make it possible to write down the telegram in the wireless department of the Telegraph Building in Oslo the moment it is received by the Fornebo radio station.

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BLAMING THE AMATEUR.

Members of the American Radio Relay League are fighting a battle against the popular belief that all Morse interference with broadcast reception emanates from the amateur transmitter. The League points out that interference comes from ship and commercial stations as well as amateur transmitters, and to prove its sincere desire to overcome the trouble as far as amateurs are concerned the League is appointing a number of vigilance committees. These committees, which will work in co-operation with radio clubs and newspapers, will solicit complaints of interference and track offenders to their lairs. Where an amateur transmitter is found to be at fault strenuous measures will be taken, culminating in extreme cases to a petition to the Department of Commerce to enforce the culprit's silence.

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IMPROVEMENTS AT JOHANNESBURG.

South Africa's first broadcasting station has eliminated all the early technical troubles, writes a Johannesburg correspondent, even to cutting out the slight generator hum that worried ultra-sensitive ears. The annual licence fee is two guineas, and as the Government is now handing over the amounts collected, the station is catering for a larger circle of supporters.

The evening orchestra is permanently increased to ten performers, five of whom possess international credentials, and the repertoire now embraces classical, popular and dance music.

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THE RADIO WORLD'S FAIR.

With true American thoroughness the organisers of the New York "Radio World's Fair," to be held in the autumn, are already busy concluding their plans. This will be the second Radio World's Fair, and will be held in the 258th Field Artillery Armoury, Jerome Avenue and Kingsbridge Road, New York. Described as the "largest and most comprehensive industrial exposition ever held in America," it will embrace 250 American exhibits and 50 foreign displays, and will stage "extraordinary public demonstrations every afternoon and evening."

Two large sections will be devoted to new inventions and amateur-built sets, open to experts of all nations, and awards will consist of gold medals, silver cups, and cash prizes. Entry forms and full particulars are obtainable from the General Manager, James F. Kerr, Suite 1500, Times Building, New York City.

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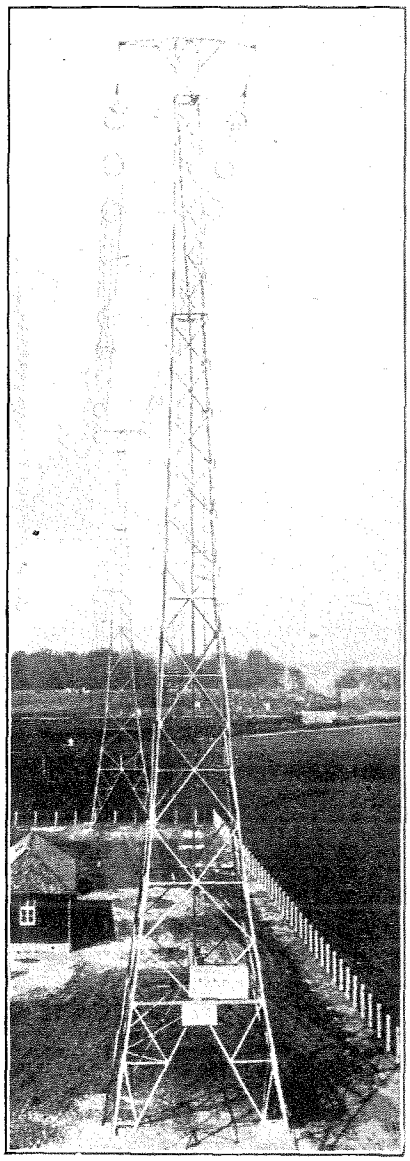
A RECEIVING VALVE RECORD.

The Edison Swan Electric Co., Ltd., have recently received back from one of their customers one of their A.R. valves. Although this well-known type of valve is only intended for use as a receiving valve, this particular one has been in constant use as a transmitting valve with 500 volts on the plate, and frequently up to as much as 7 volts on the filament.



WIRELESS AND THE AIRWAYS. A view of the aerial system of the new wireless station erected at Basle aerodrome by the Marconi Company.

At a very conservative estimate the valve had a life of not less than 350 hours. It did not burn out then, but the valve was accidentally dropped, much to the regret of its owner, a resident in the Birmingham area, who states that it was used regularly in two-way telephony with Aberdeen.

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THE R.S.G.B. DINNER.

American, Canadian, and French wireless amateurs, who were the guests of the Radio Society of Great Britain after the recent International Conference of Radio Amateurs held in Paris, were entertained at dinner by the transmitting and relay section of the society at the Waldorf Hotel on April 24th Mr. H. Bevan-Swift, chairman of the section, presiding. Mr. G. Marcuse proposed the toast of "The International Amateur Radio Union," and Mr. Hiram Maxim responded. Captain Ian Fraser, M.P., proposed the toast of the American Relay Radio League, which, he said, had 18,000 licensed amateur transmitters. The Secretary of the American Relay Radio League (Mr. Kenneth Warner) responded, and Captain Durrant, the operator of the Air Ministry station at Mosul, Mesopotamia, also spoke.

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DX SCHEDULE FROM SOUTH AFRICA.

Regular test transmissions are to be carried out during May and June by Mr. J. S. Streeter (A4Z), of Myrtle Grove, Irwell Street, Observatory, Cape Town.

Mr. Streeter's schedule is as follows:—

Wednesdays: 4 a.m. to 5 a.m.
Thursdays: 8.45 p.m. to 9.30 p.m.
Saturdays: 5.15 p.m. to 5.45 p.m. (calling X4AG). 8.0 p.m. to 9.0 p.m.

The times given are G.M.T., and transmissions will be made on a wavelength of 95 metres.

Mr. Streeter employs a four-coil Meissner transmitter with an aerial current of one ampère. The aerial is a single wire "L," 50 feet high, top portion 38 feet long, and a fan counterpoise is used consisting of six wires, each 55 feet long. There is no earth connection. The wave is pure C.W. Mr. Streeter's telegraphic address is "Streeter, care Sidleth, Cape Town.

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MARCONI SILVER JUBILEE.

The silver jubilee, celebrated at the end of April, of the Marconi International Marine Communication Co., Ltd., serves to recall that the record of this Company is practically the history of wireless at sea.

One of the Company's first contracts was from the British Admiralty for the installation of wireless apparatus on 26 warships, and at six Admiralty coast stations. Primarily, however, the Company's business has been in connection with the mercantile marine, and since 1900 no fewer than 6,000 ships have been equipped with Marconi apparatus. Over 5,000 lives and much valuable property have been saved by wireless during times of peace, apart from the thousands of lives saved at sea during the war.

A wireless telegraph service of news to ships at sea was inaugurated from the Poldhu station on August 22nd, 1903, and

from it has sprung the present efficient service of ocean newspapers.

Over 200 British vessels are now carrying Marconi direction finders.

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TRANSMISSIONS FROM THE McMILLAN EXPEDITION.

Mr. John L. Reinartz (U1XAM), the well-known American experimenter, will accompany Commander Donald B. McMillan's arctic expedition this year, according to information received by Mr. F. Charman, of Bedford. The plans of the expedition were briefly dealt with in our last issue.

The expedition will leave America on June 15th, presumably on the s.s. "Bowdoin" (WNP), the same vessel as last year, although this is unconfirmed. Regarding wireless transmissions, Mr. Reinartz states that he will use 500 watts D.C. and 500 cycle A.C., and will use the following wavelengths:—20 metres, mostly at noon; 40 metres, mostly at night; and 80 metres on odd occasions. The expedition is scheduled to return on September 20th.

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GERMAN SHORT WAVE TESTS.

Readers who have picked up transmissions from German A8 may be interested to learn that this station is operated by Dr. Rochau, of the Lorenz Co., Berlin. Reports from British amateurs are welcome, and particulars regarding receiver used, strength, type of aerial, weather conditions, and the exact time, would be greatly appreciated. The wavelength at present used is from 45 to 50 metres, but a reduction will shortly be made to between 20 and 25 metres. The times of transmission for the following day are given at the end of each transmission.

We are indebted for this information to Mr. T. Walker, 34, Ontario Buildings, Prestons Road, Poplar, E.14, who requests that all reports be forwarded to him. He cables to Germany every Saturday.

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ERRATA.

We regret that two errors occurred in the description of "A Standard Multivibrator Wavemeter," by W. H. F. Griffiths, in our issue of April 15th. The following corrections are necessary.

Line 22, column 1, on page 310, should read:—"The fork frequency is adjusted by reducing the length of the prongs by grinding, the frequency, of course, being inversely proportional to *the square of* the length of the prong from its extremity to its nodal point."

On line 34, column 2, on page 310, for "diminishing" read "lengthening."

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Mr. E. H. SHAUGHNESSY.

The recent appointment of Mr. E. H. Shaughnessy, O.B.E., of the Post Office, to the newly created post of Assistant Engineer-in-Chief in charge of Wireless Services, recalls the varied work which he has carried out in the field of radio telegraphy.

At the commencement of the late war Mr. Shaughnessy was solely responsible for the organisation for the detection of unauthorised wireless transmissions, later being appointed to control D.F. stations for home defence. For these services he was awarded the O.B.E.

In 1920 he was a member of the Wireless Telegraphy Commission to enquire into the question of Imperial Wireless Communications, and in the following year he acted as a British delegate at the Inter-Allied Technical Conference on Wireless Telegraphy held in Paris.

At the present time Mr. Shaughnessy occupies many important posts. He is Examiner in Telegraphy for the City and Guilds of London Technical Institute, a member of the Radio Research Board, and of several committees and panels of the British Engineering Standards Association. For the past two years he has occupied the chair of the Wireless Section of the Institution of Electrical Engineers, and he is also a Vice-President of the Radio Society of Great Britain and the Schools Radio Society.

EBONITE.

The address of Messrs. The Electrical & Chemical Ebonite Co., Ltd., referred to on p. 362 of our issue of April 22nd, is 150, Southampton Row, London, W.C.1, and not as stated.

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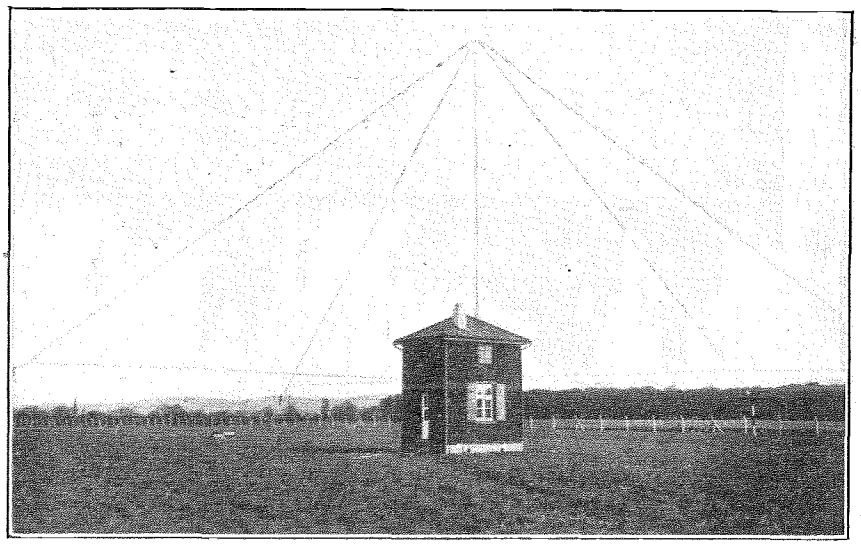
CARDS FOR 2AUC.

Mr. L. F. Aldous (2ZB), of 48, Harpenden Road, London, S.E.27, would be glad to hear from 2AUC, for whom he has several cards which he would be pleased to forward.



DIRECTION FINDING FOR AIRCRAFT. The immense value of wireless communication in connection with the Continental Airways has been recognised in the erection of the new Marconi station at Basle aerodrome. This photograph depicts the wireless compass installation at Basle.

PORTABLE SETS.

The issue of the "Wireless World" for next week, dated May 13th, will be specially devoted to wireless out-of-doors, with details for building portable sets, and will contain a special wiring supplement.

WHO IS OCDB?

A Bath reader inquires as to the identity of OCDB, heard transmitting in French on April 20th at 8.31 p.m. (G.M.T.), using a wavelength of 90 metres.

ITEMS FROM THE TRADE,

As a result of business extension, Messrs. N. V. Webber and Co., the well-known constructors of amateur apparatus, have now moved to new premises at Vale Road, Oatlands Park, Weybridge, under the title of N. V. Webber and Co., Ltd. The firm specialises in the manufacture of apparatus to the designs of customers, and gives particular attention to the requirements of transmitting amateurs.

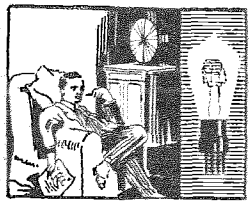
* * *

"What Every Wireless User should Know about the Crystal" is the title of an interesting little booklet by E. L. Fry, issued by Messrs. Harding, Holland and Fry, Ltd., of 52, Queen Victoria Street, London, E.C.4. A copy of the booklet will be sent free on receipt of a postcard.

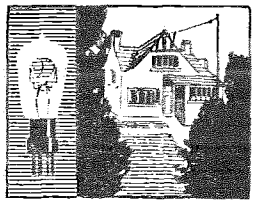
* * *

Messrs. The Dubilier Condenser Co. have appointed the following firms as their sole agents in the Union of South Africa:—

Burndept of South Africa.	Cullinan Buildings, Johannesburg.
British General Electric Co., Ltd.	Corner of Loveday and Anderson Streets, Johannesburg.
Western Electric Co., Ltd.	Cam. Buildings, Simmonds Street., Johannesburg.
Wireless Agency, Ltd.	62a, Strand Street, Capetown.



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.

Woolwich Radio Society.

An entertaining paper entitled "Radio Terminological Inexactitudes" was recently read by Mr. F. Fraser. Abbreviations and terms in radio, said Mr. Fraser, are often interesting, sometimes quaint, and frequently misleading. We speak of "H.T." and "L.T.", but seldom mention the type of battery. The terms "High Frequency" and "Low Frequency" are distinctly inferior to the American "Radio Frequency" and "Audio Frequency"; the latter designations do give an idea of the limit of frequencies implied.

What does a condenser condense? Is there any syllable in the word that expresses its radio meaning?

Many other misnomers were mentioned, and Mr. Fraser certainly caused his audience "furiously to think."

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The Tunbridge Wells and District Wireless Society.

A lecture entitled "Efficient Design of Receiving Apparatus" was recently delivered by Mr. W. Reverson, B.Sc. Mr. Reverson gave a very lucid explanation of some of the pitfalls that beset amateurs in the design of their receivers, and the members benefited by a very useful discussion which followed. The lecturer also dealt with the characteristic curves of valves and their bearing on distortion, and very clearly explained, with the aid of diagrams, the method of finding the various curves; at the same time he demonstrated the correct working points for the purpose for which the valves are required.

On April 3rd the Society was honoured by the presence of Mr. L. F. Fogarty, A.M.I.E.E., who lectured on "Distortion in Broadcast Speech and Music." The difficulties that are met with in the transmission of speech and music formed the principal subject on this occasion, and the members gained a considerable insight into the work and problems of the engineers who are responsible for the transmission of pure and undistorted speech. The evening was much enjoyed by all present, and a very good attendance was recorded.

Headquarters: 9, Vale Road, Tunbridge Wells.

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FORTHCOMING EVENTS.

WEDNESDAY, MAY 6th.

Institution of Electrical Engineers (Wireless Section).—At 6 p.m. (Light Refreshments at 5.30.) At the Institution, Savoy Place, W.C.2. Captain H. J. Round, M.C., and Messrs. T. L. Eckersley, K. Tremellen, and F. C. Lennon, of the Research Dept., Marconi's Wireless Telegraph Co., Ltd. "Report on Measurements made on Signal Strength at Great Distances during 1922 and 1923 by an Expedition to Australia."

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, Golders Green, N.W.11. Informal meeting.

THURSDAY, MAY 7th.

Kensington Radio Society.—Lecture (illustrated): "The Manufacture and Uses of Condensers for Radio and Other Purposes." By Mr. H. Andrewes, B.Sc., of the Dubilier Condenser Co.

WEDNESDAY, MAY 13th.

Radio Society of Great Britain.—Informal meeting. At 6 p.m. Discussion opened by Mr. R. H. Kidd, B.A., on "An Attempt at Quantitative Experiments on Modulation."

MONDAY, MAY 18th.

Eastern Metropolitan Group Radio Lecture Association (R.S.G.B.).—At 7.30 p.m. (Tea at 7.) At St. Bride's Institute, Bride Lane, Ludgate Circus, E.C.4. Lecture: "Short Wave Transmission." By Mr. F. H. Haynes.

Tottenham Wireless Society.

Good attendances marked two meetings held during Easter. The first meeting took the form of a demonstration of loud speakers, and was arranged by Mr. F. E. R. Neale. He first outlined the theory relating to distortion in loud speaker sets, paying particular attention to horn resonance, and to the correct interpretation of transformer curves. A large number of loud speakers were then demonstrated. A standard three-valve receiver without reaction and suitably grid biased was used for this purpose. At the second meeting a lecture was given by Mr. R. F. G. Holness on "High Frequency Coupling," and proved of great interest both to the beginner and to the advanced experimenter. On Wednesday, April 22nd, a lecture on "The Manufacture of Copper Wire," illustrated by lantern slides, was given by one of the British wire experts, Mr. E. L. Wildy, Technical Engineer to the London Electric Wire Co. and Smith's, Ltd. Mr. Wildy carefully explained all the stages through which the copper passed from the ore to the finished reel of wire. Illustrations of the crushing mills and refining furnaces were reinforced by copious descriptions.

A very large range of samples was exhibited, and Mr. Wildy answered many questions which arose during the subsequent discussion.

Hon. Secretary: Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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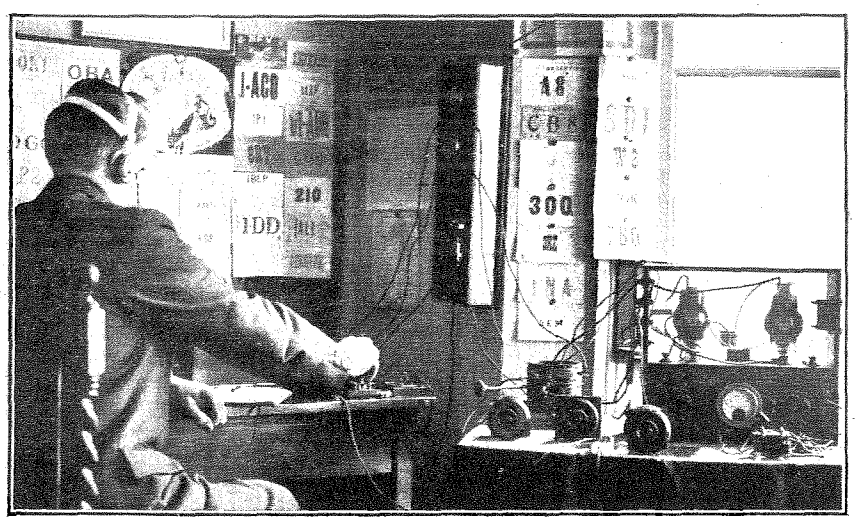
Swansea and District Radio Society.

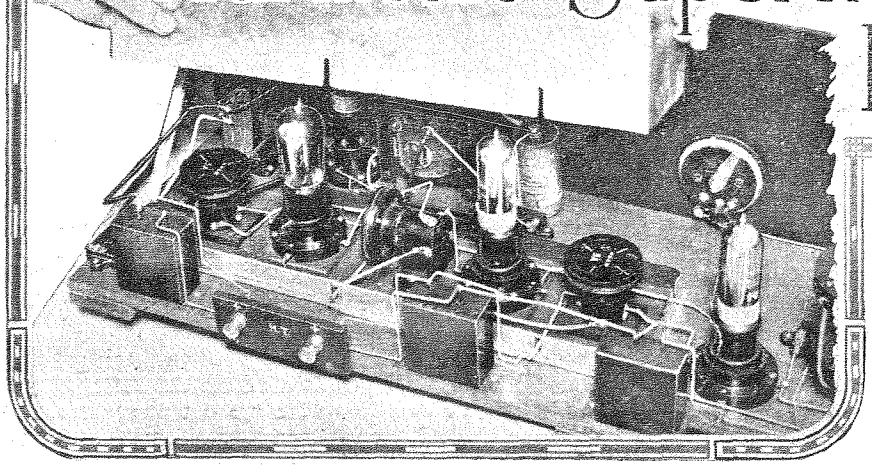
Mr. Russell Peacock gave an instructive demonstration of a Reflex Circuit at the Society's meeting on April 22nd. The set was of great interest to the experimenter, and one of its important features was the ease with which circuits could be changed in a remarkably short time.

The hon. secretary of the Society is Mr. E. H. White, 100, Bryn Road, Swansea.



DAYLIGHT SIGNALS FROM CONNECTICUT. Mr. R. W. Bloxam (5LS), of Blackheath, has been successful in picking up daylight signals on 20 metres from Mr. J. L. Reinartz (U IXAM), of South Manchester, Connecticut, U.S. Mr. Bloxam is here seen in his "den." Note the interesting array of QSL cards.

Harmonic Superheterodyne Receiver.



Constructional Details of a Reflexed Second Harmonic Five-valve Receiver.

By W. JAMES.

IN the receiver to be described, the second harmonic principle is employed, and the audio output from the second detector is reflexed through a stage of the H.F. amplifier. The circuit of the receiver is given in Fig. 1 and 6. To the terminals A B a frame aerial or tuning coil may be connected, and is tuned by condenser T. Coil L_1 and condenser O form the tuned circuit which decides the frequency of the locally generated oscillations; L_2 is the reaction coil. The first valve is therefore a combined detector oscillator, and is arranged to produce strong second harmonics in the circuit L_1 O. A grid condenser and leak, C_1 R_1, are employed for rectification. In the plate circuit of the rectifier is the tuned coil L_3 C_2, which is coupled to L_4 C_3 in the grid circuit of the intermediate frequency amplifier. Three stages of H.F. amplification are employed, having transformer couplings T_1, T_2, and T_3. Transformer T_3 supplies the second detector, having the grid condenser and leak, R_2 C_6, and the audio currents pass through transformer T_4 in the plate circuit. The secondary winding of this transformer is joined in the grid circuit of the fourth valve, consequently this valve magnifies the audio currents which pass through the telephone transformer T_5.

A frame aerial or a small open aerial may be employed with the set. If the reader prefers to make his own frame aerial, he is referred to *The Wireless World* for April 22nd, page 343. When a small open aerial is used, it is recommended that the tuner be of the type having a "fixed-tune" aerial circuit; one could, for instance, use one of the Lissenagon coils, or an Igranic Unitune Major. On the left-hand end of the set are two terminals. The frame should be connected to these—the outside end of the frame to the top terminal. When an open aerial is used, the ends of the tuning coils are connected to these terminals.

From the illustrations it will be seen that the front ebonite panel, which measures 30in. × 7in. × ¼in., carries the two tuning condensers, two filament resistances, terminals for the tuner or frame, and for the telephones. Details for the drilling of this panel are given in Fig. 2. If the reader uses components which are not of the same make as the writer's, he must, of course, carefully mark out and drill the panel accordingly. It should be noted that the frame tuning condenser is of the square law type and has a vernier, and that the condenser tuning the oscillator coil is of the geared type. The adjustment of the oscillator condenser is extremely critical, and it would be well if the reader can afford it, to install condensers

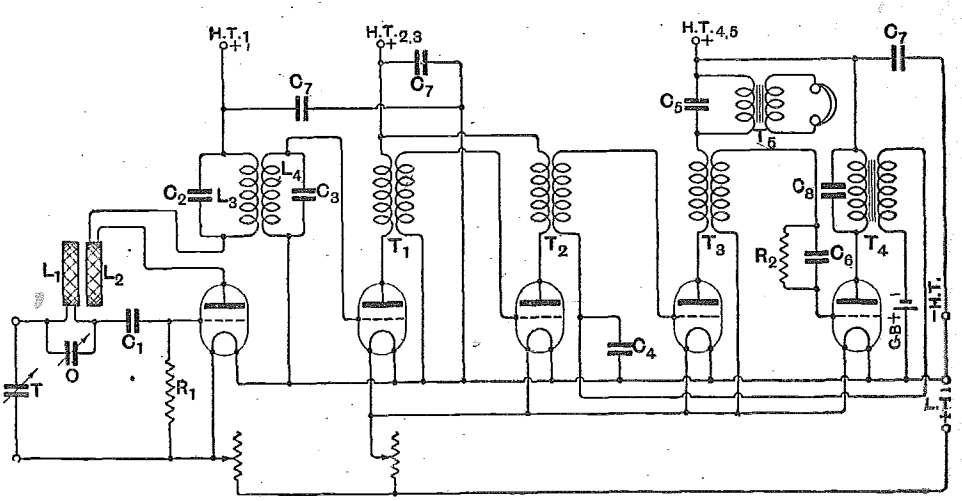


Fig. 1.—Theoretical connections of the second harmonic superheterodyne receiver.

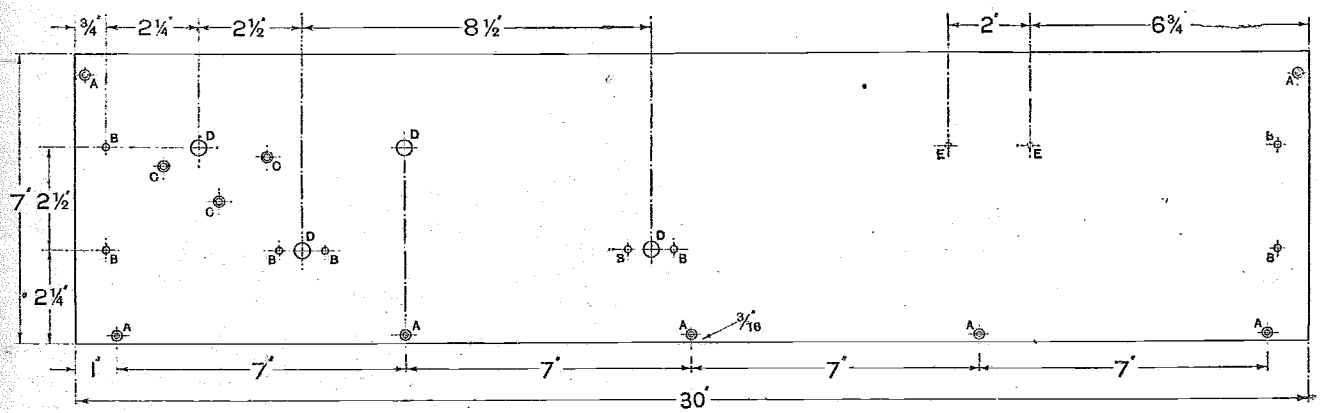
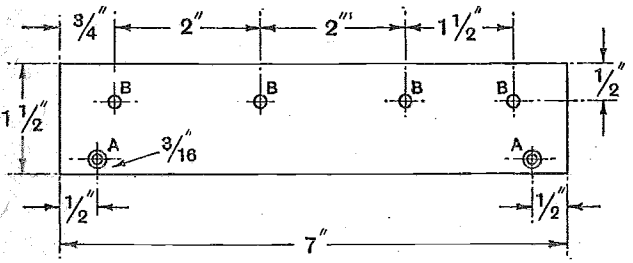


Fig. 2.—Drilling of front panel. A, ⅛in. dia. for No. 4 wood screws; B, 5/32in. dia.; C, 5/32in. dia. for No. 4 B.A. screws; D, ¾in. dia.; E, tapped No. 6B.A. on underside of panel.

of ordinary design and fit them with geared knobs. Suitable geared knobs (or dials) are advertised in this journal. One of the filament resistances controls the filament current of the first valve only. If this valve is of the 60 *m*A. type and a 4-volt battery is used, the maximum resistance of the rheostat should be about 30 ohms. The filaments of the remaining valves are in parallel; hence a rheostat of about 5 ohms of fairly thick wire is suitable —the dual rheostats used can be recommended.

Details of the baseboard and the arrangement of the parts thereon are given in Fig. 6. It will be noticed that two brackets are employed to hold the base and panel at



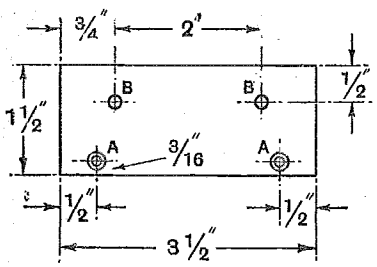


Fig. 3.—Drilling of terminal strips. A, ⅛in. dia. for No. 4 wood screws; B, 5/32in. dia.

right angles. Two small terminal strips are employed, and details of these are given in Fig. 3. On the left-hand end of the base are two coil sockets. These are for the oscillator coils, and near them are the grid condenser and leak of the first detector. The H.F. transformers are of the pin type, and are fitted to ordinary valve holders. These are indicated in the drawing. A tinned iron box is employed to screen off interfering signals; details for this appear in Fig. 4. A relatively thick tinned sheet iron is employed (No. 26 gauge), and is rather difficult to cut with the ordinary tinman's shears, but the pieces are easily cut with a hammer and chisel.

The bottom may be made first, screwed to the base, the parts mounted, and the positions of the connecting wires marked. Pieces about ¼in. wide are cut away to allow a clear space for the connecting wires which have to terminate on apparatus outside the screen. The upper part of the box is made to fit the base fairly tightly, and, of course, pieces are cut from the bottom edges to correspond with the base. The edges of the box and base are soldered where necessary.

It will be noticed that the transformer connected between the third and fourth valves is mounted at right angles to the others. This is to reduce magnetic coupling between the transformers. A valve holder of the type used for mounting valves behind a panel is employed. Small pieces of ebonite, ¼in. thick, are fitted beneath the components mounted on the base of the screening box. This serves to raise the wires above the tinned iron, which should be earthed or connected to the filament battery.

With the parts assembled, it is an easy matter to wire them. Many of them are only a few inches long; a few are several inches in length. Those wires which pass through the slots in the base of the screening box, and those which run near it, should be covered with sistoflex tubing. The wiring diagram is Fig. 9.

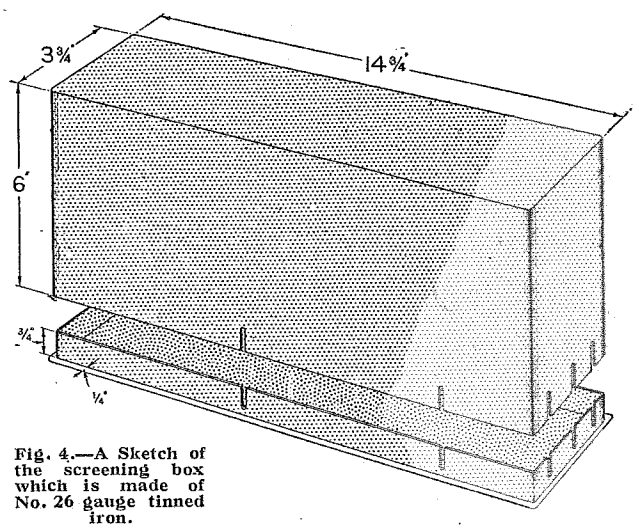


Fig. 4.—A Sketch of the screening box which is made of No. 26 gauge tinned iron.

Harmonic Superheterodyne Receiver.—

Three pin-type H.F. transformers (Sullivan No. 5A) having a natural wavelength of 4,000 metres, are used. When these are put into circuit, the wavelength will depend on the capacity of the holder and that of the valves with which they are associated. With valves of the D.E.5 class, the wavelength increases by several hundred metres; but when valves of the 60 mA. type are employed, the natural wavelength of the amplifier is just a little above 4,000 metres. Hence the "filter" circuit, having primary and secondary coils L_3 and L_4 and fixed

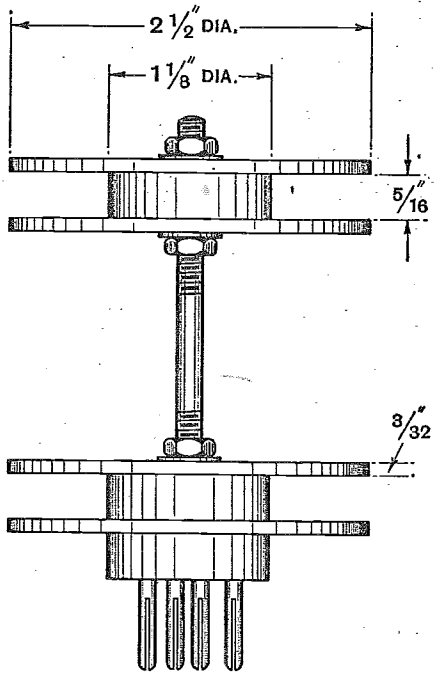


Fig. 5.—Arrangement of the coils of the "filter" transformer.

condensers C_2 C_3 of 0.0005 mfd., should be tuned to this wavelength. The arrangement of the coils is given in Fig. 5. The two bobbins are mounted on a piece of brass rod screwed No. O B.A., which is 2½in. long. On one end is fastened a four-pin plug. These bobbins are wound with No. 30 D.S.C. copper wire until, with

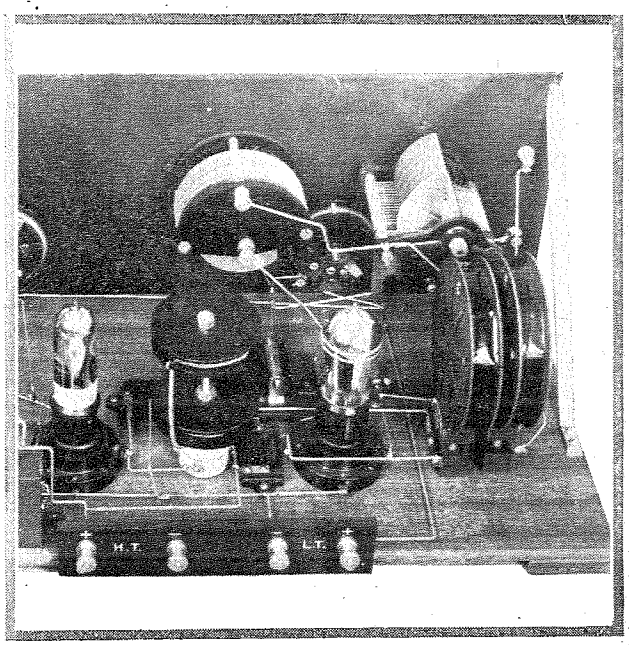


Fig. 7.—View of the right-hand end of the back of the set. The two tuning condensers can be seen, and also the two coils of the oscillator. Between the two valves is the "filter" transformer.

the coils connected in circuit, they are exactly in tune with the remainder of the amplifier. A buzzer wavemeter can be used. This instrument should be coupled to the lower (primary or C_3) coil of the filter, and adjustments made to the number of turns until the buzzer is heard at a maximum strength in the telephones. Approximately 350 turns are required in each slot, and the coils are connected to the pins of the four-pin plug supplied with the bobbins. The distance between them is varied until the desired selectivity is obtained.

This set will work with any of the usual dull emitter valves; it was primarily intended for valves taking a filament current of 60 milliamperes. Mullard D.06 L.F. (green ring) valves may be used in the first and fourth valve holders, and M.O. D.E.3.*b* valves in the second and third holders, and as the second detector. When using these valves a four-volt accumulator may be used

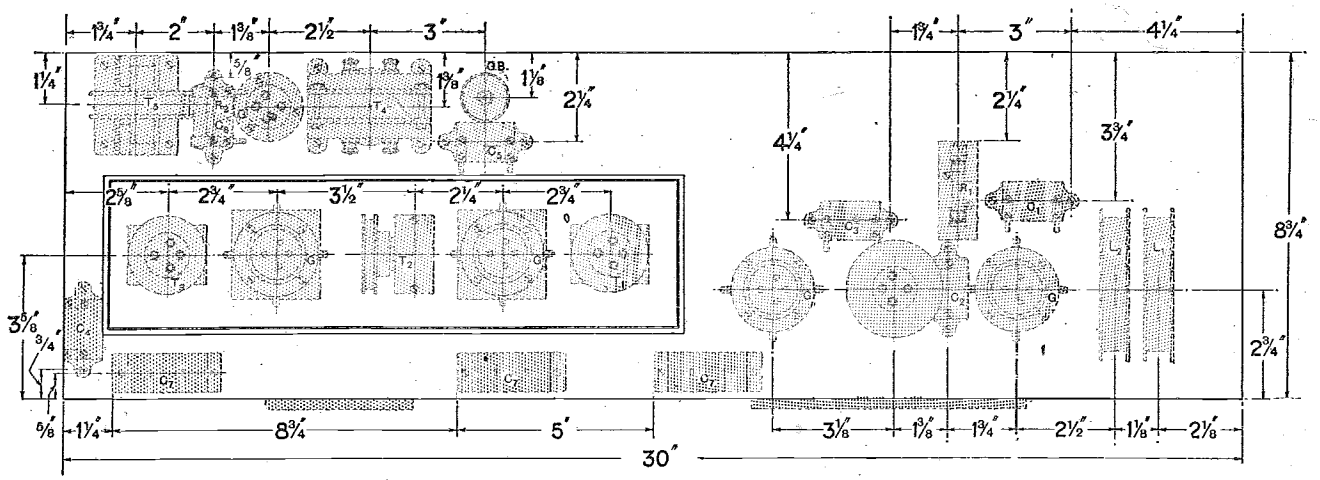


Fig. 6.—Layout of components on base.

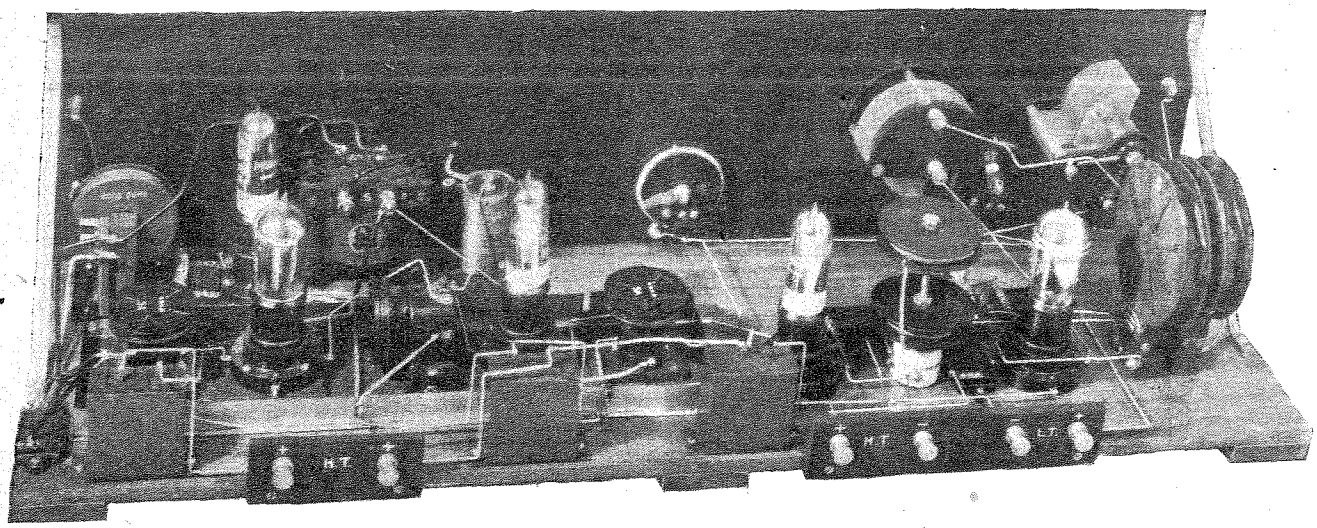


Fig. 8.—View of the back of the set with the top of the screening box removed. Notice the three H.F. plug-in transformers; the centre one is fixed at right-angles to the others.

for filament heating; about 30 volts H.T. for the first valve, 45 volts for the second and third, and 60 volts for the fourth and fifth. Should the H.F. amplifier oscillate, reduce the plate voltages. Excellent results can be obtained with a plate voltage of only 20 for valves two and three.

To test whether the first valve is oscillating over the whole range of the tuning condenser, connect the frame aerial, put a milliameter in the plate battery circuit (between H.T.+1 and the H.T. battery) and touch the side of the tuning condenser going to the grid condenser. The pointer of the milliameter should move when the condenser is touched. By watching the instrument a good idea of the relative strength of the oscillations over the range of the tuning condenser is obtained. If the valve does not oscillate, the connections to the reaction coil

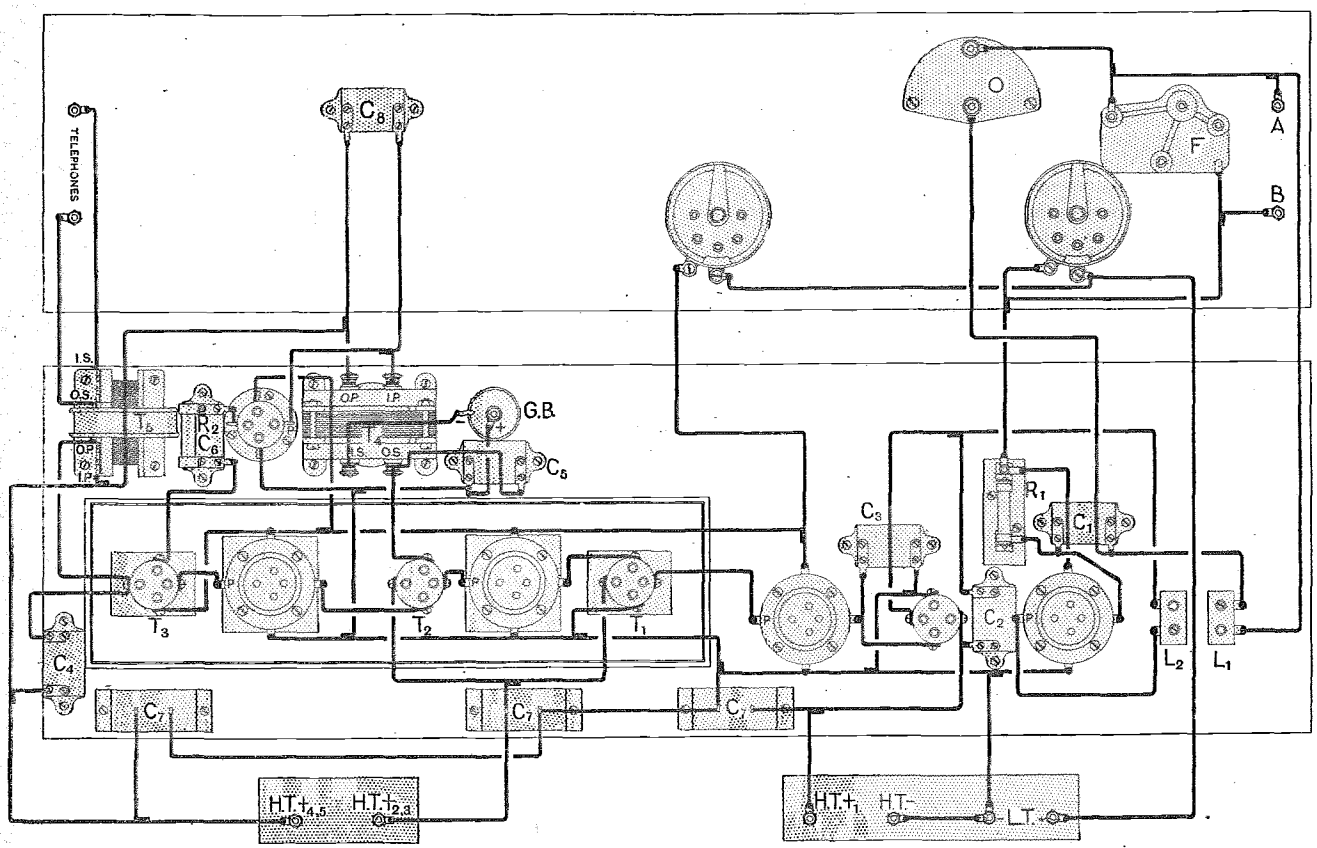


Fig. 9.—The wiring diagram. The parts are lettered to correspond with the theoretical diagram, fig. 1. T, 0·0005 mfd.; O, 0·0003 mfd.; L_1, L_2, Gambrell E and D; C_2, C_3, 0·0005 mfd.; C_1, 0·0002 mfd.; R_1, 0·25 megohm; T_1, T_2, T_3, Sullivan No. 5A H.F. transformers; L_3, L_4, filter transformer; C_1, C_5, C_8, 0·002 mfd.; C_6, 0·00025 mfd.; R_2, 2 megohms; C_7, 2 mfds.

THE FOLLOWING PARTS ARE REQUIRED FOR THIS RECEIVER.

1 0·0005 mfd. "square law" tuning condenser with vernier (T) (Sterling).
1 0·0003 mfd. geared tuning condenser (O) (Naylor).
1 0·0002 fixed condenser (C_1) (Dubilier).
1 0·25 megohm grid leak (R_1) (Dubilier), with holder (Marconiphone).
1 Plug-in coil, Gambrell E (L_1).
1 Plug-in coil, Gambrell D (L_2).
2 Plug-in coil sockets for above.
2 0·0005 mfd. fixed condensers (C_2, C_3) (Dubilier).
2 H.F. transformer bobbins, 2½in. dia. by $\frac{5}{16}$in. wide (L_3, L_4) (Edison Bell).
Small quantity of No. 30 D.S.C. wire (for L_3, L_4).
3 H.F. transformers, pin type (T_1, T_2, T_3) (H. W. Sullivan, No. 5A), having a natural wavelength of about 4,000 metres.
1 0·00025 mfd. fixed condenser with clips (C_6) (Dubilier).
1 2 megohm grid leak (R_2) (Dubilier).
1 Intervalve transformer (T_4) (Radio Instruments).
1 Telephone transformer, for high resistance telephones (T_5) (Pye).
3 2 mfd. Mansbridge condensers (C_7) (Burndept).
3 0·002 mfd. fixed condensers (C_4, C_5, C_8) (Dubilier).
5 Valve holders, antiphonic (Burndept).
3 Valve holders (for H.F. transformers).
1 Valve holder (for H.F. transformer) (Aermonic).
2 Dual filament rheostats (Burndept).
1 Single cell grid battery.
1 Ebonite panel measuring 30in. × 7in. × ¼in.
1 Base board measuring 30in. × 8¾in. × ⅜in.
Quantity of tinned sheet iron, No. 26 gauge.
2 Pieces of ebonite, measuring 7in. × 1½in. × ¼in. and 3½in. × 1½in. × ¼in.
2 Brass brackets.
1 Frame aerial (Burndept).

should be reversed, or a larger coil be used. Also adjust the H.T. voltage and filament current.

The London (2LO) station of the B.B.C. has a wavelength of 365 metres, or a frequency of approximately 822,000 cycles. Hence, when receiving this station, the oscillator circuit should have a frequency of ½ (822,000 ± 75,000); that is, 448,500 or 373,500 cycles. The corresponding wavelengths are about 670 and 800 metres. As the condenser tuning the oscillator circuit (O) has a maximum capacity of 0.0003 mfds., a Gambrell coil, E, or a No. 150 Igranic coil, may be used at L_1. Coil L_2 may be a Gambrell D or a No. 100. To receive station 2LO, therefore, the frame aerial is tuned to the correct wavelength, and the oscillator circuit tuned to either about 670 or 800 metres. Tuning should be done with extreme care, as a slight adjustment of the oscillator condenser may be sufficient to bring in or cut off the station. Once the station is heard, adjustments of filament current and plate voltage should be made to secure the best results. Having found them it will usually not be necessary to change them unless the valves are changed.

A large number of stations, main and relay, can be received with this set at a place four miles from 2LO. Continental stations, whether main or relay, are received at good strength. The selectivity of the set is remarkable, and, as there are but two tuning controls, tuning is an easy matter, provided the condenser dials are turned very slowly. Valves of the D.E.5 class have been used in this set, and give very good results, once the correct plate voltages have been found. Twenty volts is sufficient for the first valve, 36 for the second and third, and about 45 for the fourth and fifth.

TWO NEW BOOKS FROM THE CONTINENT.

A FRENCH WIRELESS BOOK.

M. JOSEPH ROUSSEL, the Secretary of the Société Française d'etude de Télégraphie et Téléphonie sans fil, has written a clearly expressed and interesting book for the use of amateurs under the title of "Mon Poste de T.S.F.," published by Messrs. Vuibert, of Paris.

The author does not trouble his readers with mathematical calculations or formulæ, but takes them along the path he himself has trodden in his studies, giving clear directions for the practical construction of each piece of apparatus and indicating the pitfalls and "snags" to be avoided. Starting with the simple crystal receiver and microphone amplifier, he conducts his readers by easy stages through the standard simple or "classic" types of valve receivers to the more complex.

The second section is devoted to a similar description of amateur and experimental transmitting apparatus. Chapter IV deals with the practical construction and use of measuring and testing instruments, and the work concludes with an appendix describing the method of charging accumulators off an A.C. supply, the crystadine and the detection of faults.

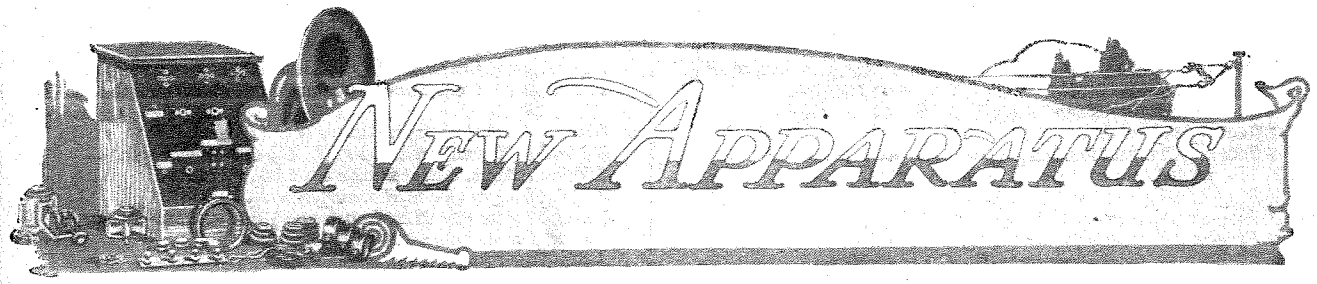
"Mon Poste de T.S.F.," by Joseph Roussel. Published by Vuibert, Paris. 192 pp. with 156 diagrams. 10 francs.

TECHNICAL VOCABULARY IN FIVE LANGUAGES.

AN excellent Vocabulary of Wireless Terms in five languages has recently been published by the Franckh'sche Verlagshandlung of Stuttgart, and bears the somewhat imposing title "Fünfsprachenwörterbuch für Radioamateure." The book is of convenient size for ready reference, and contains a complete list of the technical terms used in wireless telegraphy in English, French, German, Spanish, and Italian in alphabetical order. A great merit of the polyglot arrangement is that the various languages are not separated into different sections; thus "practice buzzer" with its equivalents in German, French, Italian and Spanish, is immediately followed by "Précision Syntonique," with its equivalents in the other tongues.

The hypercritical may, of course, discover errors—it would be practically impossible to compile a work of this kind without minor mistakes unless the Editor and printers were absolutely conversant with the technicalities of all the five languages equally; but a general and somewhat careful inspection of the contents does not reveal any serious errors as regards the English words, and, presumably, the same care has been taken with the other languages.

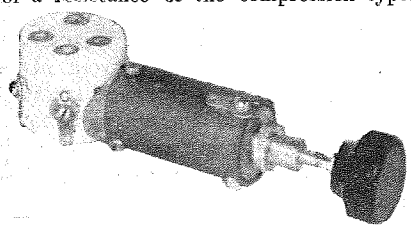
Hans Günther, Franckh'sche Verlagshandlung, Stuttgart.



A Review of the Latest Products of the Manufacturers.

A COMBINED VALVE-HOLDER AND RESISTANCE.

The use of a special shelf for valve-holders may be obviated by the substitution of the combined valve-holder and control resistance manufactured by the Athol Engineering Co., Cornet Street, Higher Broughton, Manchester. A porcelain valve-holder, which is already well-known to readers, is mounted at the end of a resistance of the compression type.



Athol combined filament resistance and valve-holder bracket.

We found this resistance very satisfactory for both bright and dull emitter valves. The control was quite smooth, and no hissing noises due to irregularities in resistance were present. It is interesting to note that one of the common filament connections to the valves may be made by clamping a brass or copper strip between the base of the units and the panel.

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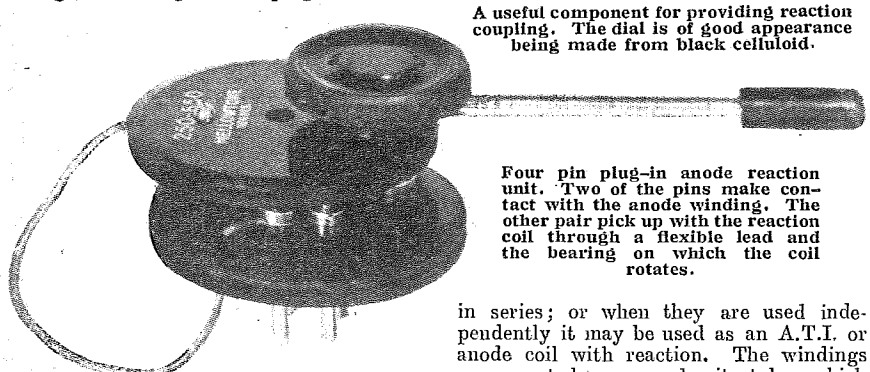
AN ANODE REACTION UNIT.

The Mellowtone reaction unit produced by the Midland Radiotelephone Manufacturers, Ltd., Brettell Lane Works, Stourbridge, is designed to plug in to an ordinary valve socket. The ends of the fixed anode coil terminate on two of the legs, and the remaining legs are connected to the reaction coil; on one side through the bearing spindle and on the other by a short length of rubber covered flex. The reaction coupling may be adjusted by a knurled knob or by the short extension handle provided. Four sizes are available, which together cover a wavelength range of 80 to 3,000 metres.



Four pin plug-in anode reaction unit. Two of the pins make contact with the anode winding. The other pair pick up with the reaction coil through a flexible lead and the bearing on which the coil rotates.

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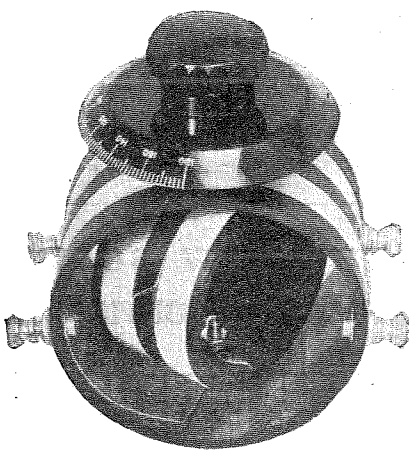
THE SEAMARK REGENERATIVE REACTANCE.

This component is essentially a variometer in which the outer and inner windings are separated and brought out to two pairs of terminals. The component may therefore be put to a variety of uses.

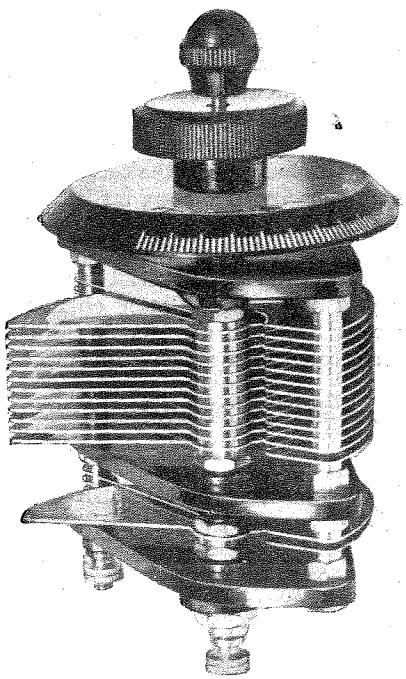
For instance, it may be used as a variometer when the windings are connected in series; or when they are used independently it may be used as an A.T.I. or anode coil with reaction. The windings are mounted on pure ebonite tubes which are grooved to prevent movement of the turns. The retail price is 10s., and supplies are obtainable from Messrs. C. E. Needham and Bro., Ltd., Change Alley, Sheffield.



A useful component for providing reaction coupling. The dial is of good appearance being made from black celluloid.

THE MINILOSS AIR DIELECTRIC CONDENSER.

The Miniloss Company, 122, Pentonville Road, London, N.1, are to be congratulated on the production of a square law condenser of sound design and construction. The end plates are cut from an insulating material which has been specially chosen for its mechanical strength and toughness. They are unaffected by changes of temperature and will not cause the plates to touch by warping. The friction washer is of special shape, cut from phosphor bronze sheet and nickel-plated. The condenser is secured to the panel by the usual "one hole" method of fixing. An unusually thin securing nut is employed, and it is therefore possible to fit the graduated dial flush with the panel if necessary.



The Miniloss condenser.

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A NEW FUSIBLE ALLOY.

A special alloy of low melting point has been placed on the market by Messrs. George Mallins, Fibre Works, Fordrough Lane, Birmingham. The alloy is sold under the name of "Mallins Crystic Solder," and is an excellent medium for fixing rectifying crystals in their holders.

THE CRYSTAL AS AN H.F. AMPLIFIER.

Practical Details of a Receiver having a Crystal Detector and an Amplifying Crystal.

By L. L. BARNES.

THE oscillating crystal is passing rapidly from the stage of a scientific novelty to that of practical use.

Details as to the nature of the crystal, the values of resistance, voltage, etc., have already been dealt with in past numbers of *The Wireless World*. The principle of crystal oscillation has also been described. It can be summarised as follows :—

Referring to Fig. 1, the condenser C discharges through the inductance L and the crystal Z, causing oscillating currents in the circuit. This oscillating current is prevented from passing through the battery circuit by means of the inductive resistance R.

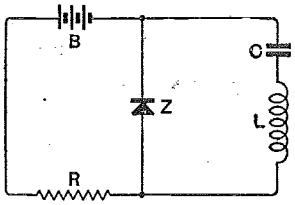


Fig. 1.—Explaining the crystal oscillator.

Now the oscillating crystal offers "negative resistance" to oscillating currents, and if this negative resistance more than counterbalances the positive resistance of the circuit, the oscillations, instead of being damped, will increase in amplitude to a maximum, and the circuit will continue to oscillate indefinitely at that final amplitude.

A resistance can be called negative when, instead of absorbing energy, it gives out energy, which in this case is supplied by the battery B.

When the crystal is being used as an amplifier, it must be just off oscillating : *i.e.*, the negative resistance of the crystal must be just insufficient to balance the positive resistance of the rest of the circuit. This is adjusted by altering the voltage applied to the crystal.

A Practical Circuit.

If, now, the condenser C is substituted by an aerial and earth (which is, of course, nothing more than a condenser) and the inductance tapped with a detecting crystal and phones, we obtain the circuit shown in Fig. 2.

This circuit, although less selective than the one to be described later, has the advantage of comprising only one tuned circuit, and hence is considerably easier to operate. A condenser provided with a series-parallel switch must be included for tuning.

The detecting crystal D should be of the high-resistance type, the zincite-copper pyrites combination with a light contact being the most satisfactory; 8,000 ohms telephones are strongly to be recommended. Results obtained from the circuit are very satisfactory, especially on long wave reception. Besides amplifying spark and telephony, the circuit can be used for receiving C.W. The crystal will not oscillate at *any* frequency for one adjustment of the potentiometer. The higher the wavelength of the tuned circuit, the lower must be the value of applied potential.

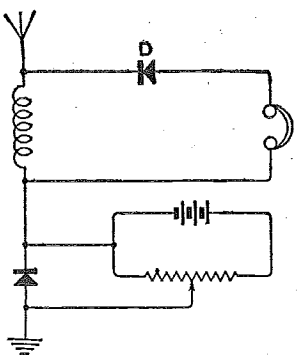


Fig. 2.—The oscillating crystal connected to a crystal set.

A Selective Arrangement.

The circuit shown in Fig. 3 is slightly more complicated, but a considerable improvement on the last, being very selective, and less likely to radiate. In this arrangement two tuned circuits are used, and the effective resistance of the secondary circuit is made to approach zero by adjusting the voltage across the amplifying crystal Z. Both inductances should be of approximately the same value. Condenser C_1 should have a capacity of 0.0005 to 0.001 mfd., and C_2 about 0.0002 or 0.0003 mfd. (depending on the capacity of the aerial; for equal value of inductances,

$$\frac{I}{C_2} = \frac{I}{C_1} + \frac{I}{C}$$

where C = capacity of aerial).

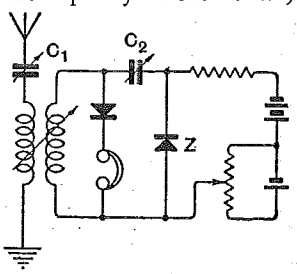


Fig. 3.—A selective receiver having an amplifying crystal Z.

Results obtained with this circuit are as good as an H.F. valve with crystal detector. The writer, who is situated 10 miles south of London, has received all the main stations of the B.B.C., besides a number of Continental stations.

The oscillating crystal is remarkably stable both electrically and mechanically.

The usual method of adjustment by causing the crystal to oscillate in a heavily tuned circuit, and then switching over to one of radio-frequency is, in the writer's opinion, unsatisfactory, as the fact that adjustments are suitable for oscillation at an audible frequency does not necessarily mean that oscillations will occur at a frequency hundreds of times as great. The best and simplest method is to listen with the telephones, detecting crystal, etc., in their normal positions in the circuit, switch on the current from the battery, and adjust the steel contact of the oscillating crystal until a mush is heard in the phones. The potentiometer is then adjusted for best results.

It is usual to have only part of the battery shunted with the potentiometer, as is shown in Fig. 3. But it is important to remember that once a sensitive point on the crystal has been found, the battery circuit should not

The Crystal as an H.F. Amplifier.—

be broken while current is flowing in it, otherwise the crystal will have to be reset. In order to obviate this inconvenience, the arrangement shown in Fig. 4 has been devised. While receiving, the double-pole switch A is kept closed and B left open. When it is required to switch off the current from the battery, the shunt S is introduced by means of the switch B; A is then opened and then B opened. If this precaution is taken, the crystal will remain set for several days (even weeks) without readjustment. This is an important consideration, since the adjustment of the oscillating crystal is much more troublesome than that of the ordinary detecting crystal.

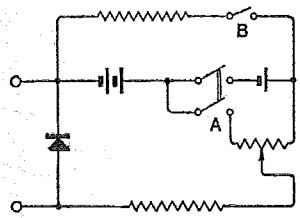


Fig. 4.—A convenient arrangement of switches to prevent spoiling the sensitivity of the amplifying crystal.

The method hitherto adopted of bringing the crystal off the point of oscillation has been to adjust the potentiometer to give the required critical voltage. It will be found more practicable, however, to adjust the potentiometer so that the voltage is just sufficiently great to cause the crystal to oscillate, and then to make the final adjustment by means of a variable resistance placed in the oscillatory circuit. The crystal oscillates owing to excess of negative resistance; the net resistance can be made to approach zero not only by decreasing the negative resistance (*i.e.*, by reducing the voltage applied to the crystal), but also by increasing the positive resistance of the circuit. In the case of the circuit shown in Fig. 2, for example, this principle is best carried out by connecting a variable resistance in series with the earth lead.

The value of the negative resistance of the crystal depends, of course, on the applied voltage, but it can be as much as -120 ohms, or even more.

It will be noticed that in the two circuits discussed expensive apparatus, such as transformers, accumulators, etc., have been avoided; the running costs are almost nil, since three flash-lamp batteries are all that is required, the maximum consumption being less than 0.04 watt, which is less than the consumption of the average valve by H.T. alone.

Experiments with the crystal used as a low-frequency amplifier have so far not resulted satisfactorily. Nevertheless, the oscillating crystal can be looked upon as being a device which gives out energy proportional to small changes of current passing through it, and this is an underlying principle of amplification, whether H.F or L.F.

Calls Heard.

Extracts from Readers' Logs.

Mablethorpe.

Australian:—2DS, 2YI, 3BD, 3BQ. *American*:—1GS, 1II, 1YD, 1SW, 1KX, 1FD, 1AF, 1NA, 1NG, 1QM, 1XU, 1DL, 1YB, 1SF, 1KY, 1RP, 1XZ, 1RC, 1XN, 1JS, 1GA, 1CX, 1PL, 1AAY, 1CKI, 1AKZ, 1BKR, 1BNT, 1ABP, 1AJG, 1ALX, 1BZP, 1CMX, 1BAL, 1BBE, 1BHM, 1ZIN, 1BDS, 1AID, 1BWX, 1WUN, 1BKQ, 1AUS, 1AUF, 2SZ, 2BM, 2MC, 2MU, 2CE, 2BUM, 2BRC, 2ABGG, 2CYF, 2BSC, 2ACO, 2BIG, 2CQO, 2ABT, 2AMO, 2BOX, 2CYJ, 2CEI, 2CGB, 2CPX, 2CTQ, 2CPK, 2CUB, 2CYQ, 2CXY, 3ASH, 3KU, 3LG, 3CF, 3DYL, 3AIC, 3JW, 3AUY, 3NF, 3AHP, 3OQ, 3CA, 3HS, 3CB, 3BUY, 3CHG, 4EQ, 4TJ, 4FS, 4BX, 4JR, 5UK, 8YT, 8VQ, 8CY, 8CDA, 8AOL, 8CYI, 8JBL, 8CBP, 8ICM, 8BYH, 9BR, HII. *Italian*:—IAF, IMT, IRB, IRT, ACD. *Canadian*:—1EI, 2AX. *Argentine*:—CB8. *Mosul*:—GHH. *C.S.*:—OKI.

(0-v-1.) A. C. Simons.

Ealing, London.

American.—1BES, 1WY, 1II, 1AXN, 1AWY, 1AAY, 1AID, 1RA, 1GS, 1IBF, 1AVF, 1SW, 1AAP, 1BCC, 1BIE, 1CRE, 1ABF, 1AEY, 1RR, 1AF, 1BDX, 1AQM, 1APK, 1AJG, 1CAB, 1ATJ, 1XW, 1XZ, 1XJ, 1XAX, 2BW, 2BM, 2XJB, 2CJ, 2XAQ, 2BRK, 2CUB, 2BSK, 2BSC, 2CEP, 2ADK, 2CYW, 2CXY, 2CJW, 2BGG, 2AVG, 2VA, 2CFT, 2CNS, 2ALE, 3BZ, 3CJN, 3XX, 3WX, 3BG, 3CA, 3WN, 3BC, 3SN, 3CHG, 4TJ, 4TB, 4DU, 4UK, 4JW, 5IU, 8ALY, 8CED, 8AOL, 8BSF, 8CJB. *Canadian*.—1AI, *Mosul*.—GHH.

C. A. P. Warlow.

Lichfield, Staffs.

American:—1AID, 1AJX, 1AVW, 1AVX, 1AXN, 1BCC, 1BDX, 1BV, 1BWX, 1BZP, 1CMJ, 1CPK, 1CPV, 1CRE, 1ER, 1GLX, 1GS, 1II, 1ND, 1PL, 1SE, 1WA, 1YB, 2AVG, 2BGG, 2BW, 2CGB, 2CJB, 2CJX, 2CUB, 2EB, 2FC, 2GK, 2IS, 2KU, 2RK, 2XI, 2ZL, 3BTQ, 3CK, 3JO, 3LZ, 3OQ, 3OT, 4DU, 4TH, 4TJ, 8ALY, 8BAU, 8BGG, 8DGL, 8UT, WIR, NFX, WJS. *Italian*:—3MB, IRT, ICF. *Swiss*:—9LA, 9BR, *Dutch*:—QXC, ONTZ, OGC, OZN. *Danish*:—7ZM, 7ZF. *Belgian*:—4RS. *Finland*:—INA, 2NM, 2NN, 2NB, 2NCB. *German*:—IRB. *Australian*:—2DS, 3BQ. *Mexican*:—IDH.

G. S. Samways (60H).

Cachar (India). (During November and December, 1924.)

English.—2NM, 2SZ, 2YT. *French*.—8BF, 8QL, UFT2. *Swedish*.—SMZI, SMZY. *Australian*.—2YG, 2DS, 3BQ, 3JU, 3DB. *New Zealand*.—2AC, 4AA, 4AG, 4AK. *American*.—4OA, 1AAC, 5MI, 1CMP, 2AX, 6AHP, 6RU, 5GO, 1BD, 1ANA, 2RK, 2YI, 2BRB, 2BGI, 3AEC, 3ADB, 3JO, 3CKL, 5CN, 5LS, 6AAO, 6OI, 6AWK, 6AWT, 6BVW, 6EW, 9DMJ, 9BHX. *Canadian*.—5BA.

(Receiver 2 H.F., D.)

G. W. G. Benzie, 2BG.

Newcastle-on-Tyne.

American.—1AID, 1ALK, 1ARY, 1ATJ, 1AWW, 1AXB, 1BDX, 1BES, 1BGD, 1BCQ, 1BKR, 1BLX, 1BV, 1CAK, 1CMP, 1CRU, 1DD, 1FD, 1FL, 1FP, 1GS, 1II, 1KC, 1MY, 1MW, 1PL, 1SF, 1SZ, 1WL, 1XU, 1XZ, 1ZE, 1ZT, 2AG, 2AGQ, 2ANM, 2AX, 2AXF, 2AZY, 2BQ, 2BQH, 2BQU, 2BR, 2BRC, 2BUM, 2BUY, 2BW, 2BY, 2CD, 2CE, 2CEE, 2CU, 2CVF, 2CVJ, 2CXY, 2CYM, 2CZR, 2WIU, 2DD, 2GK, 2KU, 2TP, 2TZY, 2ZB, 3AB, 3ACH, 3ADB, 3BCO, 3BUY, 3BW, 3CC, 3CDG, 3CHG, 3HS, 3MF, 3OQ, 4BQ, 4GW, 4SA, 4XE, 8ADG, 3ALY, 8AUD, 8AUL, NERKI, NSF, WGH, WGY, WJS. *Canadian*.—1AF, 1AR, 1EB.

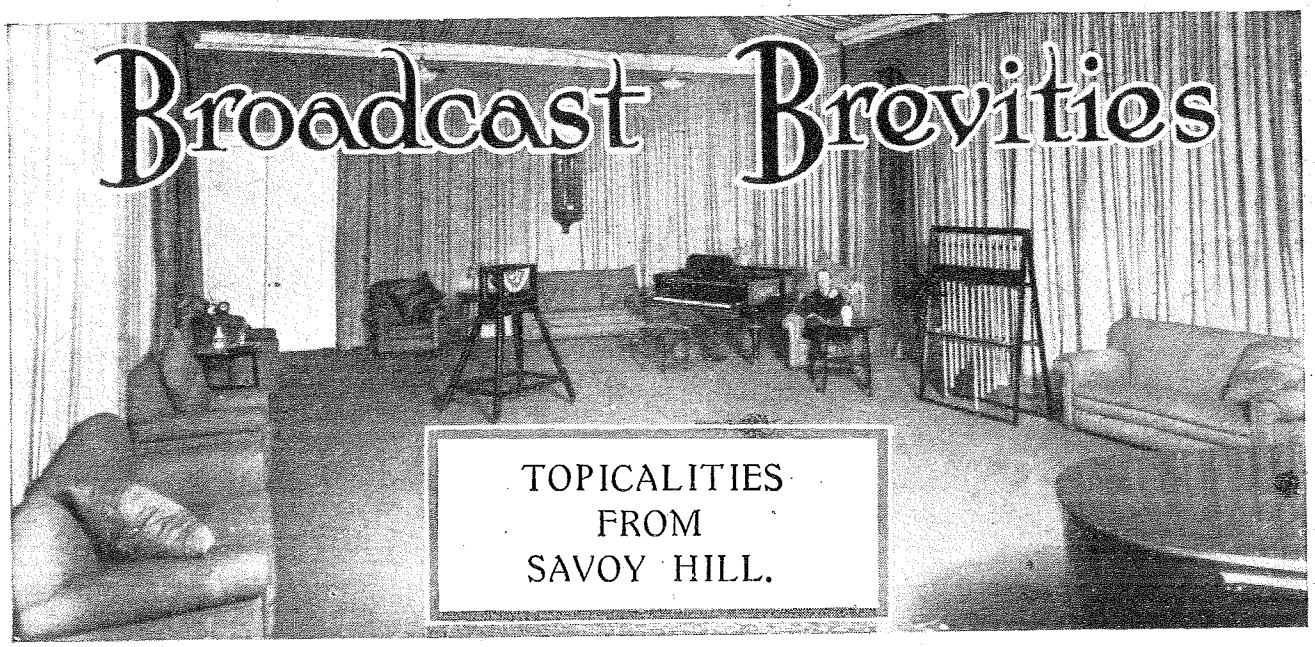
(Reinartz 0-v-0 with aperiodic aerial.)

F. Thompson (2AWK).

S. Croydon.

French.—8BF, 8DE, 8DP, 8EE, 8EU, 8GK, 8GO, 8HGV, 8XP. *Belgian*.—4LOV, 4AU. *Italian*.—1AF, 1CO, 1RT, 1AM. *Swedish*. — SMXV, SMZU, SMZV. *Dutch*.—OGC, OKN. *Danish*.—7ZM. *American*.—1AAO, 1AAP, 1AD, 1AF, 1AJX, 1ARY, 1AVF, 1AWY, 1AXN, 1BDX, 1BES, 1BGC, 1BKR, 1BWX, 1CAK, 1CKP, 1DA, 1ER, 1HN, 1II, 1LW, 1ND, 1PL, 1PY, 1RD, 1XAV, 1XZU, 1YB, 2AAY, 2AD, 2ADK, 2AG, 2AGB, 2ALE, 2ANA, 2AWF, 2AZY, 2BGW, 2BSC, 2BY, 2CEE, 2CJX, 2CLG, 2CNS, 2CTH, 2CVF, 2CVJ, 2CXY, 2FZ, 2GK, 2MU, 2RK, 2WL, 3ADB, 3AEW, 3BTA, 3BGJ, 3CHG, 3HG, 3HS, 3JO, 3KU, 3LW, 3OT, 5LU, 5OK, 8ACM, 8ALY, 8BCP, 8BEN, 8DGL, 8RY. *Canadian*.—1AR. *Others*.—GHH, 2XAM (clg. LPZ and ABC), WIZ, 1VR. *American*.—5UK, 8AV, 8KC.

(0-v-0 or 0-v-1.) E. C. Packham.



Broadcast Brevities

TOPICALITIES FROM SAVOY HILL.

Extended Powers Needed.

If broadcasting is to develop as is hoped, it will be necessary for the powers of the B.B.C. to be extended as regards both the erection of new stations and the increase of power of certain main stations.

oooo

New Stations.

Plans are ready for two new stations—one to serve the London area; but I understand that there is a fly in the amber and the Post Office will need a lot of coaxing before the Postmaster-General's consent to their erection is obtained. In the meantime Kentish listeners consider that they are catered for in a far less satisfactory manner than any other county in the kingdom.

oooo

Main Stations *v.* Relay Stations.

From time to time representations are made by listeners in the various localities where a relay station exists as to the necessity of, and justification for, a main station of their own. Some of the towns with relay stations are admittedly important enough for translation to the greater dignity, but my information goes to show that no relay station town is likely to become a main station town for a considerable time ahead.

oooo

What Wales Wants.

A pretty little argument is developing between a Welsh town which considers that is has a strong claim to a main station and the city where a main station already exists. The town in question is one of importance, and it has brought forward many arguments as to why it should be the head and fount of broadcasting in the Principality. Indeed, say the supporters of that particular town's claims, the B.B.C. could serve not only the Welsh mining districts better, but certain English towns, such as Bristol, equally as well as they are at present served.

oooo

Daventry.

The B.B.C. engineers, however, apparently regard the matter from an altogether different point of view from the merely patriotic one. Daventry, they tell me, will achieve the aim which they have chiefly in view, and will cater quite adequately for the needs of mid-Wales as well as areas of England south of Cardiff.

oooo

Post Office Restrictions.

Under the agreement between the Postmaster-General and the British Broadcasting Company, each broadcasting station is limited to a power input to the main high-frequency generator not exceeding a maximum of three kilowatts. The present value at each station is 1½ kilowatts, with the exception of 2LO and 5XX, and a strong feeling is expressed that to afford the fullest development a power of ten kilowatts per station should be permissible.

oooo

Rugby *v.* Daventry.

The electrical apparatus for the new 5XX—that is, the high power station at Daventry which will replace Chelmsford about the middle of June—is now arriving on the site, and it is being carefully guarded by the engineers. A casual visitor to Daventry the other day observed that from the height of the hill the masts of the Government super-power station at Rugby seemed but a short distance away, and he enquired anxiously whether the extensive use to which the Rugby station was to be put would not interfere with the broadcast service from Daventry!

Broadcasting in Public

It has been suggested that a phase of future development will be the abolition of studio performances, and that all broadcasting will be done from public halls so as to attract large audiences apart from wireless listeners, but the immediate problem is that of acoustics in the studios in which the bulk of performances now take place.

oooo

—And an Alternative.

I am told that if the research work now in progress is successful it is not unlikely that considerable structural alterations will have to be made to studios in order to secure a satisfactory compromise on performances from large halls—that is, methods will be adopted of making sounds in small rooms carry as if they were made in large rooms.

oooo

Broadcasting and the Entertainment Industry.

An agreement with the theatrical managers is under way The point of interest to listeners is that the length of a broadcast performance from individual plays will probably be limited to twenty-five minutes. In this space of time an excerpt from any one act may be given, or alternatively, the period may be divided up so that a small extract from each act in the play can be broadcast.

oooo

The New 2LO.

Amid the stir over the new 2LO, it is clear that a good deal of re-radiation is going on. We have not heard so much about oscillation recently, as the use of the new station to some extent overcomes this, but when, as part of the experiments, the old station was put into operation again, the oscillation was noticed to have become worse, not only in Croydon, Ealing, Streatham and East London dis-

tricts, but also in more distant parts of the country. Signal strength in the East End of London is markedly better from the new station than the signal strength of the old.

oooo

Improved Reception.

By the average listener the smaller details—important though they are in the mass—no doubt pass unnoticed, but many keen musicians have already observed, and reported accordingly, that the details of orchestration have been much clearer since the new 2LO got to work. "At last," wrote one listener, "Tchaikovsky by wireless is worth listening to. Drum taps and low stringed instruments used to be blurred, but the various instruments now broadcast well nigh perfectly."

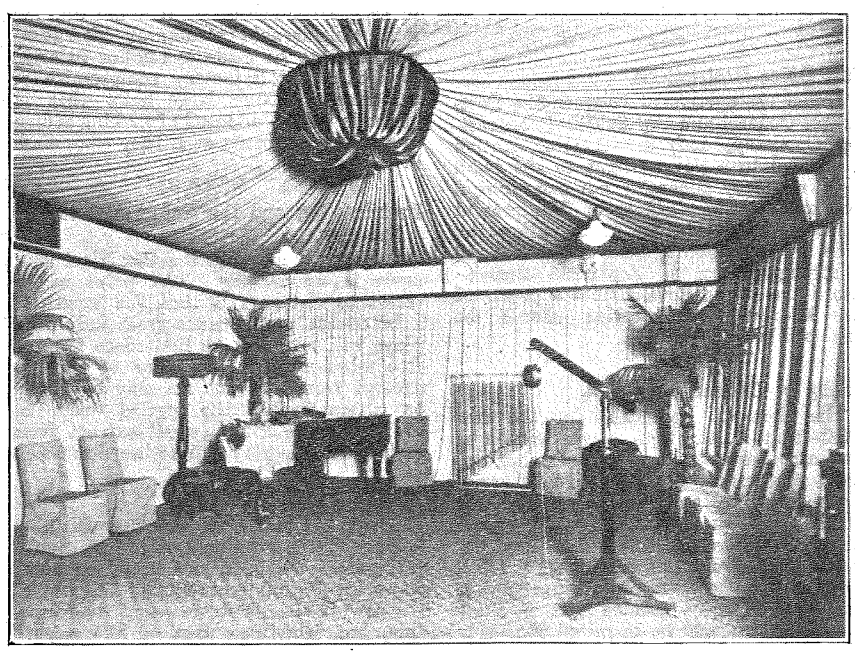
oooo

Copyright Law.

The net of the copyright law is being more tightly drawn since broadcasting came along to help forward the success of songs and other musical compositions which might otherwise have been doomed to a precarious popularity. The Performing Rights Society safeguards the interests of authors and publishers in this country, and a lump sum is paid for broadcasting rights. The Society is now turning its attention to South Africa, where wireless is commencing a regular boom. The London secretary of the Society has been touring the Union to tighten up things. It is rumoured that the broadcasting authorities of South Africa will not be so fortunate in the agreement which they made with the Society as the British broadcasting authorities were; much higher fees will probably be demanded.

FUTURE FEATURES.

Sunday, May 10th.		
London and 5XX, 4 p.m.	...	"Manfred" (Lord Byron), with Schumann Incidental Music. Declaimed by Henry Ainley, conducted by Percy Pitt.
London and 5XX, 9 p.m.	...	"The J. H. Squire Celeste Octet" with Winifred Fisher, Horace Stevens, and Irene Scharrer.
Birmingham, 4 p.m. ...	...	Orchestral and Solo Items.
Monday, May 11th.		
London and 5XX, 8 p.m.	...	"The Merry Month of May."
Glasgow, 8 p.m.	...	Empire Phono-Flights, No. 2, Australia.
Belfast, 7.30 p.m.	...	Prize-winners of the Belfast Musical Competitions.
Tuesday, May 12th.		
5XX, 8 p.m.	...	Chamber Music.
London, 8 p.m.	...	Music, Grave and Gay, by the Band of H.M. Scots Guards.
Wednesday, May 13th.		
London and 5XX, 8 p.m.	...	Sullivan Programme, conducted by Geoffrey Toye.
Cardiff, 8 p.m.	...	Sullivan Night.
Glasgow, 8 p.m.	...	Operatic Programme.
Thursday, May 14th.		
5XX, ...	...	Radio Fantasy, No. 4, relayed from Birmingham.
London, 8 p.m.	...	Chamber Music and Drama.
Manchester, 8 p.m. ...	...	Chamber Music.
Aberdeen, 8 p.m.	...	Band of H.M. Grenadier Guards.
Friday, May 15th.		
London and 5XX, 8 p.m.	...	Romances of the Dance.
Bournemouth, 8 p.m. ...	...	Russian Night.
Newcastle, 8 p.m.	...	Musical Comedy.
Glasgow, 8 p.m.	...	Band of H.M. Grenadier Guards.
Saturday, May 16th.		
London	...	Military Band Programme.
Manchester	...	The Band of H.M. Grenadier Guards.



THE STUDIO AT KDKA. Careful attention is given to acoustical problems in the studio of the famous Pittsburg station, even to the shrouding of the chairs. It is doubtful, however, whether the form of microphone suspension is so good as the method adopted in this country.

Teaching the Young Idea.

The programmes from American stations are not invariably of a kind suitable for the delectation of the young. In a letter to a member of the Senate a boy of fourteen asks him to use his influence to shut down a certain station which transmits rather racy bills of fare.

"Until you do this" quoth the boy, "my mother will not allow me to have a radio set in case I should hear this station."

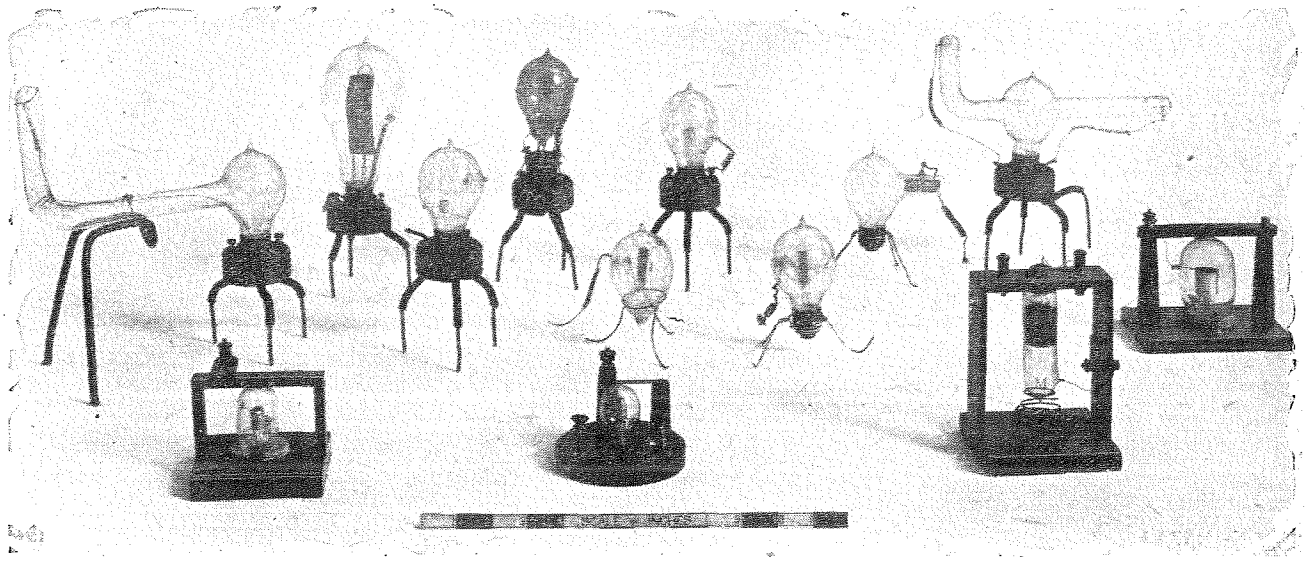
The station does not appear to have closed down as yet.

oooo

Prince's Portable Station.

H.R.H. The Prince of Wales is able to pass away many tedious hours at sea during his tour by the use of the expensive wireless receiving set which has been installed in his saloon on the Repulse.

Seeing that his set remains on British territory it is interesting to recall the definite regulation incorporated by the Post Office in the form of reminder issued to licensees in connection with the expiry of their licences, namely, that a fixed station and a portable station must each be licensed separately. His Royal Highness will not be required to hold a separate licence for his set on the Repulse, but he has, of course, the usual licence for his set at York House.



WIRELESS AT THE SCIENCE MUSEUM.

Interesting Exhibits in the Electrical Communication Section.

By R. P. G. DENMAN, B.A., A.M.I.E.E.

IT is probable that among the readers of *The Wireless World* there are many who at some time or other have discovered the group of corrugated iron and other buildings (erected "temporarily" at South Kensington for the Exhibition of 1862) which until recently served to accommodate the whole of the third largest Museum in the United Kingdom. Like the writer, they may have retained youthful memories of afternoons spent in roaming delightedly among the sixty or seventy scientific collections, paying not the slightest attention to the carefully worded descriptions which accompany each model, but with eyes alert to mark down those specially attractive exhibits which are provided with "press-buttons" for the use of visitors.

The object of this short article is to remind these readers that in the Science Museum they may find, thrown open to them daily free of charge from 10 a.m. until 6 p.m. (Sundays 2.30 p.m. till 6 p.m.) the finest exhibition of scientific and technical machinery and apparatus of its kind in the world. In each section of the Museum there is shown a series of objects which are of special interest, as marking important stages in its development, while numerous other objects of modern types are added in order to show the application of scientific research to current practice, as well as the direction in which modern improvement is tending. The whole museum is so large that only a small section should be taken in one visit, or one is certain to experience that peculiar combination of mental and physical fatigue which is apt to make museum-going unpopular.

The museum has been fortunate in securing during the past year or so a large number of important wireless acquisitions. A catalogue has recently been published[1] which is illustrated, and contains full technical descriptions of over two hundred objects in the section, together with an introductory survey, which it is hoped will be found useful to those whose acquaintance with wireless telegraphy is of recent date, and who would like to know something of its development since 1865.

How to See the Exhibits.

Those who come to see the collection should begin by inspecting the early experimental apparatus, which by the time these lines appear should be found in Room 42

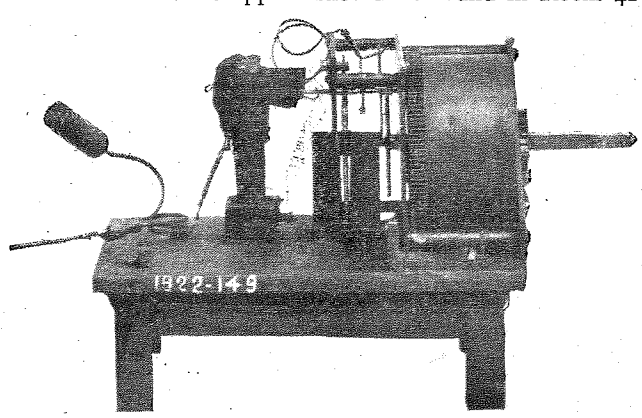
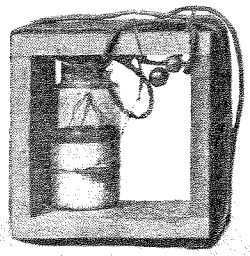


Fig. 1.—The clockwork mechanism used by Hughes in his early experiments to "key" an oscillator.

[1] This catalogue is obtainable on application to the Director, The Science Museum, S. Kensington, S.W.7, price 1s. 2d. post free.

Wireless at the Science Museum.—of the new building, to which the whole of the Electrical Communication Section will presently be transferred.

It is well known that in a remarkable lecture "On the Work of Hertz" in 1894, Sir Oliver Lodge transmitted signals from a small oscillator in the library of the Royal Institution to the lecture table, where they were received on a coherer of his own design. The original apparatus which was used on this occasion, as well as some of even earlier date which is practically identical with that used by Hertz himself, may be examined, together with what is thought to have been the first coherer of all—the Hughes microphone. In 1879, the inventor, while walking up and down Great Portland Street, heard in a telephone receiver signals emitted by a clockwork oscillator which he had previously set working in his rooms above. It is depressing to read how distinguished scientists who witnessed many of Hughes's experiments eventually dismissed them as ordinary induction phenomena, so leading him to abandon the research. In the photograph, Fig. 1, may be seen the clockwork mechanism which he used to interrupt the current to the oscillatory circuit, while Fig. 2 is the "coherer"—in this case a microphone consisting of a steel needle hanging in loose contact with a block of gas carbon.



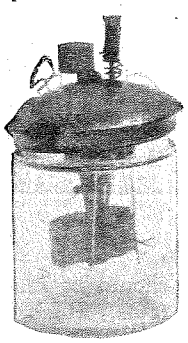


Fig. 2.—The Hughes microphone, or "coherer."

Following these examples of the work of the first amateurs come those of the first wireless engineer, Senatore Marconi. A most interesting collection lent by the Marconi Company includes the 18in. induction coil used at the Needles Station in 1898, by means of which Lord Kelvin despatched the first paid wireless message, and a whole series of objects relating to the first coupled and tuned circuit arrangements which culminated in the famous "7777" patent of 1900. Part of Marconi's first tuned transmitter is shown in Fig. 3, and it is interesting to note that this same 10in. induction coil was once again brought into use as recently as 1921, in connection with experiments on the Beam system! Among many other objects in the Marconi collection will be found the actual apparatus used at Newfoundland in 1901 by Senatore Marconi and his assistants, Messrs. G. S. Kemp and P. W. Paget, when they received the first transatlantic wireless signals.

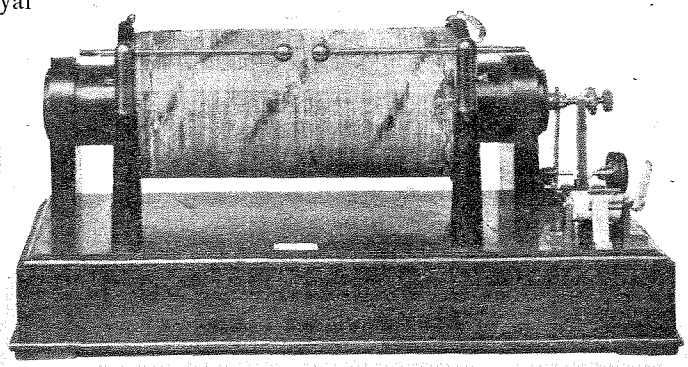


Fig. 3.—Early Marconi spark apparatus.

Thermionic Valves.

The collection of thermionic valves in the Science Museum is of special interest. Beginning with the complete series of vacuum tubes (illustrated at the head of this article) out of which, in 1904, Prof. J. A. Fleming evolved the first two-electrode valve, there may be seen the De Forest Audion (three-electrode soft valve) and the Lieben-Reisz relay (Fig. 4), which was the first tube to be used as a telephone repeater. Modern hard valves began with the Pliotron designed by Irving Langmuir in 1914. This also is shown, and a number of intermediate tubes of all kinds lead up to representative examples of those in use at the present day, with a special collection of naval valves, which includes the largest silica valve so far produced—a three-electrode transmitter rated at 20 kilowatts and capable of handling 50 kilowatts in all.

The development of portable sets for field use is well illustrated in a series lent by the War Office; aircraft wireless practice is at present shown in the aeronautical collection (which should certainly receive a separate visit).

A section devoted to radio telephony includes an early Poulsen arc, which was used by Mr. H. J. Round in 1910, and several broadcasting microphones. The electro-magnetic diaphragm type, used by the B.B.C. in 1923, and from which the present marvellously successful Round-Sykes magnetophone was developed, should be carefully compared with the original telephones of Graham Bell, which are to be found in the Telephony Section. The principle of the two instruments is, of course, identical.

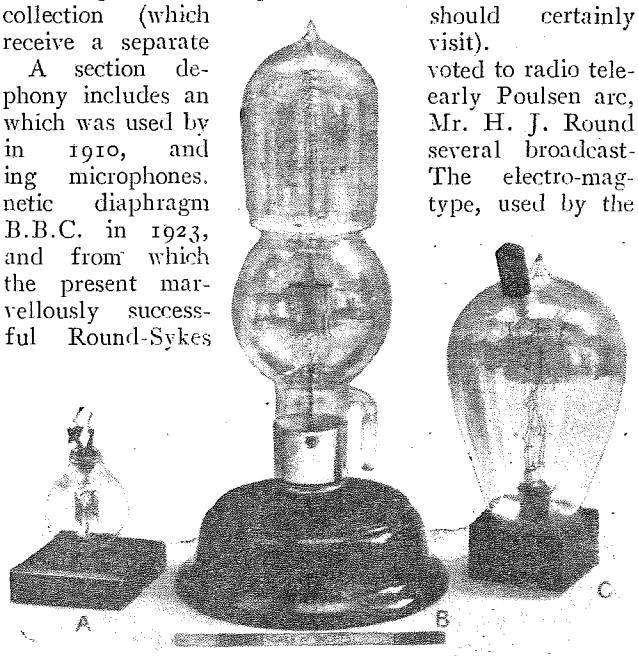
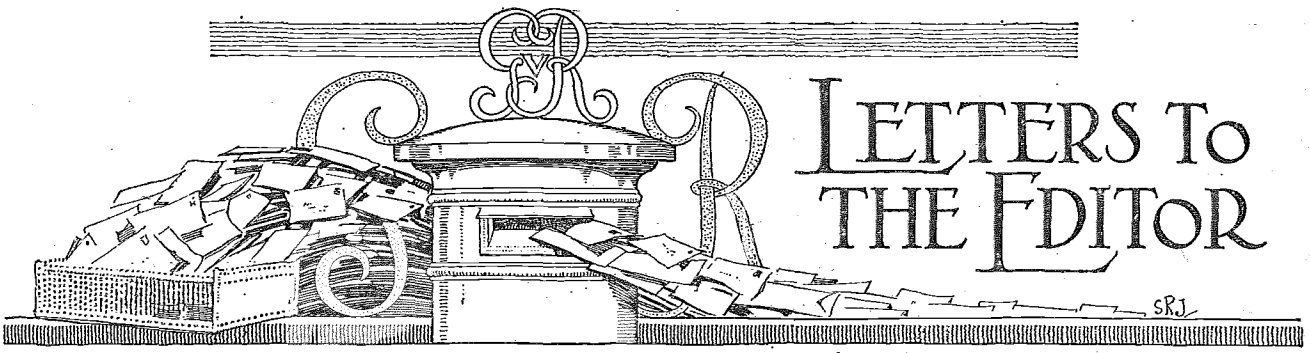


Fig. 4.—Three early valves of three-electrode pattern.



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,—I note with interest your correspondent's remarks in *The Wireless World* of March 11th signed "A Radio Engineer since 1912."

Now I am not a radio engineer, nor have I been acquainted with wireless since 1912, but as an experimenter interested in the scientific side of radio problems, with some little experience, I feel myself competent to challenge your correspondent. At one time or another I have listened to amateur transmissions from most countries of the world, and I find that ninety-five per cent. of them may be divided between the following two classes :—

(a) Those who transmit bad C.W. or I.C.W. on a varying wavelength, badly keyed;

(b) Those who transmit appalling telephony.

How anyone who has ever listened in on amateur wavelengths, or even on wavelengths not intended for amateurs, particularly round London or in the Midlands, and has heard the babel of badly modulated, inconstant, improperly smoothed carrier waves, can dare to say that amateur telephony is superior to the excellent transmissions of the B.B.C., I really do not know. In my experience, many of the amateur attempts at modulation are barely intelligible, and it seems to me to be utterly fatuous for an amateur, with the limited amount of time, money, and apparatus at his disposal, to parody what can be done so very much better by the B.B.C.

I do not wish it to be thought that I am against all amateurs —five per cent. of them *do* know how to transmit, and I strongly advise the majority to follow their example; but before attempting telephony let them learn to use a Morse key properly, and then to remember that an amateur transmitting licence is not given for broadcasting purposes.

Emmanuel College, Cambridge. JOHN MELLANBY,

EAST AFRICAN AMATEUR ACHIEVEMENTS.

Sir,—With reference to a letter from Mr. Abdul Rashid headed "East African Wireless Achievement" in your issue of the 18th February, 1925, I note with surprise that Mr. Abdul Rashid claims to be the Wireless Pioneer in East Africa.

Surely the pioneers of wireless experimenting are the enthusiasts in late German East Africa, who succeeded in picking up signals from POZ during 1913 or 1914 (actual dates not to hand). Apart from this the various members of the naval, military and government services who carried out experiments during and after the war deserve some mention.

In the realm of amateur wireless I consider that I have a prior claim, as a paper on reception in East Africa with a four valve resistance-capacity coupled amplifier, written by me in 1921, was read before the Radio Society of Great Britain in July, 1923. Even as regards broadcasting, concerts from South Africa, England and America were received six months before Mr. Abdul Rashid started experimenting.

There is no desire on my part to belittle the work of a fellow amateur, but I suggest that something useful might be accomplished if the amateurs in East Africa would carry out experiments over a protracted period, which could be compared periodically, using some sort of measuring apparatus, even if only the humble shunted telephone. From this some data as to fading, blind spots, summer and winter variations, etc., might be deduced. Haphazard experimenting by single enthusiasts will accomplish nothing, combined effort will do much.

MOMBASA.

DISTURBANCE ON KDKA's SHORT WAVELENGTH.

Sir,—With reference to Mr. Gordon Ritchie's letter in *The Wireless World* of April 8th, I have recently noticed an incredible amount of interference on KDKA's short wave transmission. During the last five weeks I have been carrying out experiments nightly on the dinner-hour transmission from KDKA (commencing at approximately 11.15 p.m., G.M.T.), and on four occasions, viz., March 30th, and April 2nd, 3rd, and 4th, the programme has been completely obliterated by a perfect barrage of shrieks, yells and groans. There appeared to be over a dozen oscillators at work.

It is remarkable that on nights other than those mentioned above there has been absolutely no heterodyne interference whatever.

I listened on March 31st to a "Query" programme similar to the one mentioned by Mr. Ritchie, and noticed no interference at all. It is therefore doubtful if these transmissions were relayed by radio.

I have also noticed recently that static interference on waves below 100 metres has been very considerably greater than on the broadcast band. L. STUART BIDMEAD.

Fulham, S.W.6.

OVERCROWDING THE ETHER.

Sir,—I cannot help feeling that your attitude towards high-power broadcasting should receive reconsideration.

On purely electrical grounds you are doubtless right—the ether is full to overcrowding already. But the B.B.C. state clearly that their object is to serve the poor man's crystal set first, and those of us who work among the poor have little room for doubt as to the benefits conferred.

The agricultural weekly wage here is less than the price of a Marconi-Osram D.E.5, and large families have to be fed and clothed!

As a medical man I have seen sufferers transformed into new beings by their interest in the doings of the world at large, where previously they only lived in their village.

I submit that the case for commercial signals is entirely different.

For commercial reception long-range valve sets are available, also the money to pay for them.

As I have said, on purely scientific grounds you are right; but look at the case from the other fellow's point of view.

E. SHIRLEY JONES, M.R.C.S., L.R.C.P.

Bentley, Hants.

TUNING TO SHORT WAVELENGTHS.

Sir,—I read with interest 2GN's letter in the March 11th issue of *The Wireless World*. He thinks that with two turns of wire on a three-inch former he is in the region of 6-10 metres, but I think he is wrong.

I have been down below 60 metres, and as low as 10 metres, for the last four months, and the following coil data might be of interest. Using a three-coil holder and coils wound "Burndept" pattern with 6 turns on the primary, 12 turns on the secondary, and 10 turns on the reaction gives 50-100 metres; using 2 turns on the primary, 3 turns on the secondary, and 3 turns on the reaction gives about 30-50 metres; but with only 1 turn on the secondary, 3 turns on the reaction and no aerial coil, motor car ignition can be heard, and *I think the wavelength of this coil is from* 10-25 *metres*. These coils are wound with 16 S.W.G. The set I use is a 0-v-1, and I have used D.E.R. valves down to 30 metres, but below that low-capacity valves of the "C" type were used. All coils were wound on a three-inch former.

2GN also stated that stations working on 20-40 metres do not give their call signs. I think he is mistaken, as I have only four transmissions recorded in which no call sign was given.

Could any reader tell me the whereabouts of SVA? I have heard him on two occasions, somewhere about 75 metres, on one valve. He was working on March 15th at 7-7.30 p.m.

T. WALKER.

THE PARIS CONFERENCE AND ESPERANTO.

Sir,—I note on page 380 of your issue of April 29th some remarks about the Paris Conference, in which you state that "although the motion for the adoption of Esperanto was carried, Mr. P. K. Turner (England) and Mr. K. B. Warner (United States) voted against certain of the proposals, while the Scandinavians voted against its adoption."

In order to prevent any possible misapprehension I shall be glad if you will make it clear to your readers that:—

(1) I voted not as an individual but under the instructions received from the official English delegates.

(2) I did not vote against any of the proposals but abstained from voting on some of them, while voting in favour of others.

P. K. TURNER.

VALVE NOMENCLATURE.

Sir,—In a recent issue you commented in your leading article on the discrepancies in the naming of various makes of valves with the same general characteristics.

May I suggest a system by which any possible confusion should be avoided? All valves designed for a certain purpose should have a number allotted to them—*e.g.*, 2 for a general purpose valve, 3 for H.F. work, 4 for a detector, 5 for a L.F., 6 for a power valve, 7 for resistance-capacity amplification. This number would be absolutely independent of the filament current of the valve; which would be indicated by a letter—e.g., B for a 3v. .06 amp. valve, D for a 2v. .35 amp. valve, F for a 5 to 6v. .25 amp. valve, J for a 3v. .12 amp. valve, M for a 1v. .1amp. valve, and so on.

With this classification of valves the amateur would know that no alteration of batteries or rheostats would be necessary if he wished to substitute an Ediswan 6J for a B.T.H. 6J; or to substitute a Mullard 3B for an Ediswan 3B. At present it requires quite a mental effort to think of the special purposes and filament current of the PV8DE, B6, Double Red Ring D.06, and AR06HF, respectively.

I will admit that any system will be difficult to adopt if it involves wholesale alterations of makers' type numbers; but, as we see at least one new type of valve each week, will it not be still more difficult if the change is delayed indefinitely?

Sheffield. HENRY O. RIGG.

NOT A NEW DESIGN.

Sir,—I would draw your attention to the fact that the variometer described by "G.C." in the issue of *The Wireless World* dated April 22nd is covered by a patent of my own, No. 227,567.

Liverpool. R. W. TARRANT.

ADAPTER FOR FOUR PIN VALVES.

Sir,—In your issue of April 8th, p. 280, is an illustration of an adapter to fit four-pin valves on to an Ora B or a V24 fitting. A similar adapter was shown a few weeks ago.

I desire to point out that this design was registered about 2 years ago in the joint names of myself and Messrs. Auckland.

Earl's Court, J. H. REEVES.

London, S.W.5.

THE OSCILLATION NUISANCE.

Sir,—During a series of tests which have been made lately with regard to the oscillation problem, one or two very prominent points have been proved. The fact emerges that at a well-known seaside resort on the South Coast, there are two periods during which reception is interfered with very badly; the first is about 5 p.m., and the second is when anything extra is put on by the B.B.C. I refer in particular to the half-hour tests on Monday night from one B.B.C. station only. Now, if I may be so very bold, I make the humble suggestion that in the majority of cases, the women folk are responsible for the trouble in the afternoon.

I think it is quite reasonable to suggest that the women like to show off the set to their friends during afternoon tea, and it is only a fair question to ask, do the majority understand exactly what happens when they turn the knobs?

With regard to the later hour, if a test is published beforehand the majority of listeners are searching on an unknown setting of their instruments, and pushing reaction much too far, simply causing chaos. More than ample proof of this can very often be found, a late transmission from a station that has either not been published, or has been overlooked by most people; the result is almost a freak reception, it is so clear.

Let all users of radio instruments remember that there are such things as S.O.S. calls from ships, both sea and air, and these calls come first at all times, and must be dealt with by certain stations. This interference is not playing the game, and the warning issued by the P.M.G. ought to be taken to heart by every user of wireless apparatus.

TRANSFORMER.

LOW POWER TRANSMISSION.

Sir,—With reference to previous correspondence, the following details of low power tests carried out at this station may be of interest:—

On March 26th, 1925, a communication was established with Finnish 2ND, who was using 3 watts, and low power tests were carried out by this station. Power was reduced and transmissions made on inputs of 14 watts, 8 watts, 4 watts, 2 watts, 1 watt, and finally 0.8 *watt*. Finnish 2ND reported the strength of reception as varying from R6 to R3 for the lowest power used.

On April 5th, 1925, tests were carried out with Swedish SMWF, and transmissions on power inputs of 12 watts, 9 watts, 5 watts (no alteration in strength of reception being noticeable by SMWF on these powers), 2 watts, 0.8 watt, and finally 0.4 *watt*. Transmission on this last power was received in full by SMWF except where jamming was experienced from Finnish 2ND. The last power input was 125 volts at 3 milliamps.

The aerial system used for both these low-power tests was the same as used in the transatlantic test, where communication was maintained with an input of 2 watts, and detailed in my letter of March 19th, and published in *The Wireless World* of April 8th. C. L. NAYLOR (G5SI).

RECEPTION OF HVA.

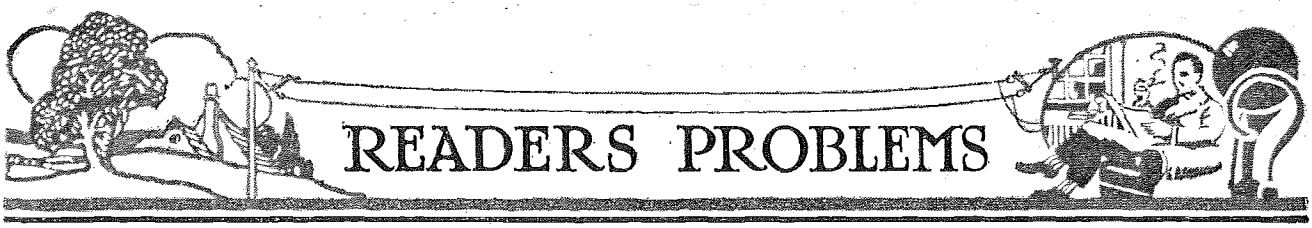
Sir,—With reference to Mr. Davidson's letter in your issue of April 1st, I heard HVA on April 7th, strength R4, when using a one-valve Reinartz receiver in London. There was remarkably little fading.

May I ask anyone who hears 5FT to send a report to the Secretary, F.S.W.S., School House, Felstead, Essex?

5FT's wavelength is at present about 180 metres.

Yarmouth, I. of W. J. C. EVERETT.

[A number of readers have kindly reported the reception of HVA.—ED.]



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

Constructing an Amplifier for Experimental Purposes.

A CORRESPONDENT wishes to construct a four-valve set embodying four stages of resistance-coupled amplification for providing large volume and high quality loud-speaker reproduction from his nearest broadcast station, which is thirty miles distant, but at the same time he has in mind the construction of a super-heterodyne receiver for long distance reception, and wishes to be able to couple the output of this instrument quickly and conveniently to the amplifier portion of the four-valve receiver.

This is quite a useful idea, which will appeal to many readers, since it often occurs that a receiver is constructed embodying many expensive components, designed to give the most perfect reception possible from the nearest station, and it seems a pity not to use the amplifier portion of this circuit to amplify in the best manner possible the various transmissions which may be picked up from time to time by means of roughly constructed experimental receivers. This point has been brought into greater prominence during the past few months, when so many amateurs have constructed special sets for the reception of KDKA and other stations working on similar wavelengths.

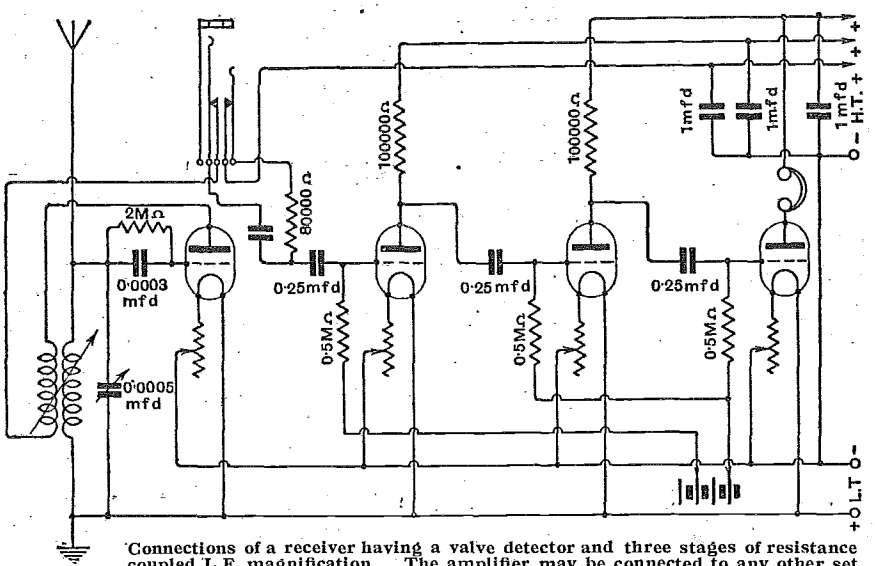
If the circuit illustrated in the diagram is carefully followed, it will be seen that the output of any receiver can be quickly and conveniently coupled to the amplifier embodied in this receiver. It is only necessary to fit the instrument with a jack in the manner illustrated in the diagram. If the output terminals of any experimental receiver are now attached to a plug, it will clearly be seen that the insertion of this plug will disconnect the detector valve embodied in the set, and so enable the output of any experimental receiver to be passed to the input side of this amplifier. At the same time the appearance of the jack in the panel will in no way detract from the appearance of the receiver, and moreover the withdrawal of the plug will instantly restore the receiver to its normal state and enable a temporarily interrupted programme to be continued on this set.

oooo

Electrical Properties of Ebonite.

A READER who is undertaking the construction of a receiving set which will require a rather larger panel than is customarily in use seeks our advice concerning the nature of the material that he should use for the panel, since he has found that ebonite varies considerably in its electrical properties.

Good ebonite should be practically unaffected by the humidity or otherwise of the atmosphere, and it is not improbable that our reader has been making use of vulcanized fibre in mistake for ebonite. Of course, ebonite varies very considerably in quality, and under certain atmospheric conditions certain types of poor quality ebonite may be inferior to fibre or wood in their insulating properties. Good ebonite should be absolutely free from flaws on the surface, and be quite flat. It should machine well, not easily fracturing during the process of sawing, filing, or drilling, provided that reasonable care is exercised. Inferior grades of ebonite may be made from discarded rubber, which often contains traces of metals. It is not meant by this that pieces of metal will actually be found in the ebonite, although this is not entirely unknown, but rather that combined metallic substances may be present, which tend to destroy the insulating properties. It must not be forgotten that the polished surface of most ebonite when received from the makers contains a certain percentage of tinfoil, and the panel must therefore be carefully rubbed down in order to remove this polished surface. Nowadays it is possible to obtain guaranteed brands of ebonite which are of high insulating properties and are already prepared for use, and readers should therefore have no difficulty in obtaining good quality ebonite. In cases where expense is of primary importance wood may be used as a material from which a large panel can be constructed. Provided that a hard wood such as oak is used, and that it be well dried, it is often found on test that its insulating properties are satisfactory. Soft wood, such as satin wood should, however, never be used.



Connections of a receiver having a valve detector and three stages of resistance coupled L.F. magnification. The amplifier may be connected to any other set by inserting a plug carrying the appropriate connections in the jack.

Correct Number of Turns in a Reaction Coil.

CORRESPONDENTS frequently enquire as to the best value of reaction coil for the reception of various stations when using valve receiving apparatus of the conventional type.

This is one of those points to which a definite answer cannot be given without a knowledge of various doubtful factors, such as the resistance of the aerial circuit and the amount of stray capacity existent in the receiver. It may be said, however, that probably the majority of valve set users make a great mistake in this respect, and this is probably one of the chief contributory causes to poor results obtainable on distant stations,

since the use of an excessively large reaction coil causes the set to be extremely difficult to handle, and almost vetoes any fine control over regeneration. It seems to have become a fixed idea with many people that a No. 75 coil is the correct one to use for the broadcast band of wavelengths, whereas actually the rule is to use the smallest reaction coil with which it is possible to bring the set into a state of oscillation, when the aerial and reaction coils are closely coupled. Many people who are at present using a very large coil in the plate circuit of their detector valves will be agreeably surprised in the improvement in the tuning-in of distant stations manifested by their set if they will pay more attention to this component. The reason for the difficulty of fine control when an excessively large coil is used is quite obvious if a moment's consideration is given to this problem. As is well known, the degree of regeneration obtained is proportional to the degree of magnetic coupling existing between the aerial and reaction coils. It is obvious that the amount of this coupling, if the reaction coil is excessively large, is changed to a far greater extent by the movement of the reaction coil through an arc of one degree than would be the case if a small coil were moved through several degrees. It is therefore clear that a far finer adjustment can be made when the movement required to effect a given change in the degree of reaction is large. Furthermore, it will be found that when an unnecessarily large coil is used in this position a considerable amount of "backlash" is present, which evinces itself by the fact of the set going into and coming out of oscillation with a loud plop, oscillations continuing when the reaction coil is moved back far beyond the point at which they commenced, whereas under proper conditions reaction control should be smooth, the set gliding almost imperceptibly in and out of oscillation.

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Connections of Telephone Receivers.

A READER wishes to connect twenty pairs of headphones to the output of a four-valve receiver, in order that reception can be carried on simultaneously in various rooms of a large menage, and he wishes to know whether they should be connected in series or in parallel.

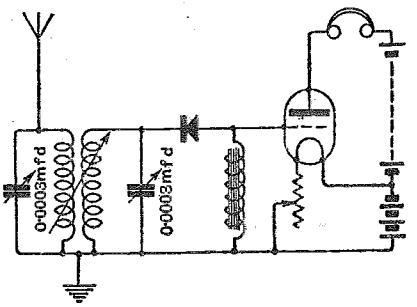
If the telephones are connected in series it must be remembered that any slight deficiency developed in one pair or in any pair of telephone leads will disagreeably affect the reception in each pair of headpieces, and for this reason alone it is desirable to connect them in parallel. It will be evident, however, that if such a large number of headpieces are connected in parallel, the total resistance in the circuit will be reduced to 200 ohms, assuming the use of the conventional 4,000 ohm telephones. This is obviously a very unsuitable value to place in the anode circuit of the final valve, but the difficulty can be surmounted by connecting an ordinary step-down telephone transformer in the circuit, which will have the effect of adjusting this matter, and will at the same time provide the additional advantage of keeping the steady anode current out of the telephone windings. In many cases where a single pair of 4,000 ohm telephones of the ordinary type is used it is very desirable to use an output transformer, but owing to the fact of its low resistance secondary the ordinary type of step-down telephone transformer is obviously not suitable for use with a conventional pair of high resistance telephones. However, it is now possible to obtain an output transformer of 1 : 1 ratio in order to obviate this difficulty.

oooo

Adding a Stage of Choke-Coupled L.F. Amplification to a Crystal Set.

A CORRESPONDENT who is desirous of adding a stage of low frequency amplification to his crystal receiver wishes to know if there is any method by which he can utilise the secondary windings of a transformer whose primary has been burnt out.

Provided that the secondary windings are intact, it will be found that a very useful amplifier can be constructed, using the circuit given below. The choke shown in the diagram connected between the grid and the negative side of the filament is formed by the secondary of this transformer. Quite good amplification will be obtained, combined with excellent quality.



A receiver having a crystal detector and a single-valve choke-coupled amplifier. The choke may be the windings of an intervalve transformer connected in series or the secondary winding alone will suffice.

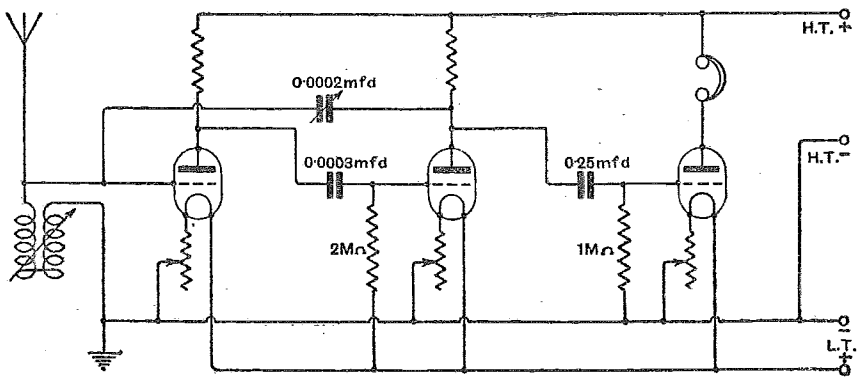
There is, of course, nothing to prevent the use of the secondary of an undamaged transformer for this purpose, but care must be taken not to connect the two primary terminals together, otherwise, of course, the inductance of the secondary will be considerably reduced, with disastrous results both to signal strength and quality.

oooo

An Easily-adjusted Receiver for the High-power Stations.

A CORRESPONDENT wishes to construct a three-valve receiver for the reception of the high-power station in which resistance-coupled amplification is carried out at both high and low frequency, regenerative effects being also obtainable.

The circuit which is given below will be found to amply fulfil all these conditions with suitable valves, a reasonable amount of amplification will be obtained, and as there are but two tuning adjustments the operation of the set will present no difficulty. The tuning of the aerial circuit is effected by means of a variometer, regenerative effects being brought about by means of a small variable condenser connected between the aerial terminal and the anode of the detector valve.



A simple three-valve set with 1 H.F., valve detector, and 1 L.F

The Wireless World AND RADIO REVIEW

No. 300. WEDNESDAY, MAY 13TH, 1925. VOL. XVI. No. 14.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4. - Telephone: City 2847 (13 lines).

Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 10 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries abroad, £1 3s. 10d. per annum.

WIRELESS OUT-OF-DOORS.

UNLESS the weather proves to be altogether disappointing, it seems certain that this summer will be a wireless season and that wireless will be used more extensively out-of-doors than ever before in this country. The mere novelty of broadcasting is beginning to wear off, and instead of being regarded as a supplementary interest or amusement, wireless in the majority of homes has now become almost a part of family life. So long as wireless was merely regarded as an amusement to be indulged in occasionally, it could be readily dispensed with on holidays or, in fact, anywhere out-of-doors, but now that it has become more than a passing amusement its absence is quickly felt by the vast majority of those who have become accustomed to listening-in almost every evening. It is not surprising, therefore, that enquiries are already beginning to come in from readers who are anxious to acquire a receiver specially suitable either on the grounds of portability or compactness for use out-of-doors, and suitable to be carried or to be fitted as an accessory to a car.

In the present issue we give designs and complete working instructions for building two sets of different types suitable for outdoor use. One has been specially designed so as to be as portable as possible, whilst the other is compact and sturdily built to withstand vibration when used on a car or any other form of transit. The problems of design of receivers to meet these two requirements are quite distinct, and special consideration has to be given to points involved in the construction according to the purpose to which the set is to be put.

Readers who contemplate building or using portable sets, are reminded that only in certain circumstances does their existing licence cover the use of a portable receiver. The attitude of the Post Office in regard to licensing portable sets does not appear to be generally known and, therefore, we have ascertained from the Postmaster-General the position with regard to the use of sets for reception out-of-doors.

There are three distinct licences obtainable at Post Offices, although the printed form is similarly worded as to the general conditions, and the special wording as it applies to different types of licences is added to the licence form in manuscript. The different licences are: (1) For a fixed station; (2) for a motor car station; (3) for a portable station used within a specified radius of a central point. The fixed station licence is, of course, that which is commonly obtained in connection with an ordinary broadcast receiver, and this requires no further consideration here except to say that it is not necessary for a temporary change of address of a fixed station to be notified, and, therefore, the occasional removal of a set from the address at which it is registered does not call for any notification to the Post Office authorities.

CONTENTS.

Where it is desired to make use of a portable set either in a motor car or to be carried by some other means, the Post Office requires that a separate licence should be taken out. The Postmaster-General does not agree that a single licence, for which a single fee is payable annually, should cover the use of wireless receiving apparatus at a fixed station and, at the same time, cover its use on a motor car as well as permitting the employment of portable apparatus at any place within the United Kingdom. It is, therefore, necessary to state when applying for a portable licence at a post office whether this is required for use on a motor car or for portable use within a specified radius of a fixed station.

It is stated that the reason for coupling portable licences with fixed station licences is in order to maintain the system under which wireless licences are at present issued, this system being intended to render possible the control of all stations in the United Kingdom used for wireless reception.

o o o o

PRICE REDUCTION OF VALVES.

WE have from time to time commented editorially in this journal on the high prices which have been maintained for valves, and we have pointed out that, in our opinion, the comparatively small reduction in the price of "general purpose" valves which has taken place since broadcasting was introduced was inconsiderable in comparison with the enormous increase in the demand. It is, therefore, with great satisfaction that, as we go to press, we learn of a substantial reduction in the prices of a large range of valves by most of the British manufacturers, and, although we feel that this reduction is long overdue, yet it is none the less welcome on that account.

We believe that the high price of valves has, in the past, been largely responsible for a limitation in the use and also the sale of valve receivers, and we hope that this all-round reduction in the price of valves may do much to counter what we believe to be the fallacious policy of the British Broadcasting Company in catering solely for the interests of the crystal-user and fostering his requirements rather than encouraging the use of valve receivers.

It is recognised, of course, that at present many readers habitually use only "general purpose" valves, but we hope that the present all-round reduction in the price of valves may enable many readers to acquire special types of valves which have been designed for particular purposes, and that thereby the efficiency of their receivers will be greatly enhanced, while, at the same time, the experience gained will be valuable in adding to their theoretical knowledge which will be illustrated by practical results.

A signal unit employing portable wireless apparatus. The mast is in effect a sectioned metal rod acting as the aerial, and proves very effective for use with short waves.

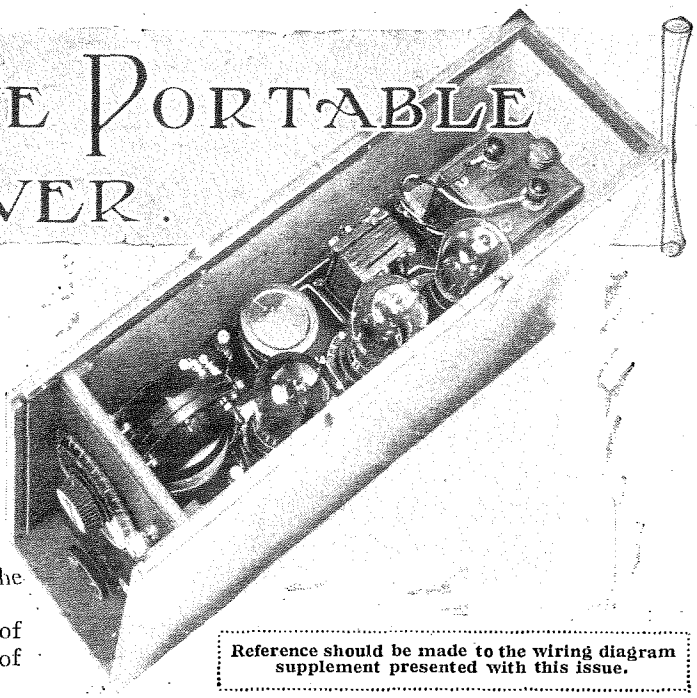
o o o o

EMPIRE AMATEUR ACHIEVEMENT.

PERHAPS the most remarkable record which it has yet fallen to the lot of an amateur to achieve is that reported to us in the news that Mr. E. J. Simmonds, 2OD, has succeeded in conducting two-way communication with Mr. Maclurcan, Australian 2CM. This achievement is of special importance, because it was no chance communication, but the result of a definitely prearranged test. A remarkable point regarding the communication is the fact that it was conducted under daylight conditions, the transmissions taking place between 5 a.m. and 7 a.m. G.M.T., and interest is added by the fact that the wavelength used was in the neighbourhood of 20 metres.

Various theories have been put forward regarding the relationship between wavelength and distance in communication, and the effect of daylight on wavelengths of varying order. The possibility has been suggested by more than one investigator that, whereas the longer wavelengths which can be used with success for communication over very long distances at night-time fail to give the same results by daylight, so in the reverse order very short wavelengths—as, for example, those of the order of 20 metres—may prove to be more effective during daylight than at night. Such a theory, if proved, would be of remarkable interest, but whilst there is not sufficient evidence to disprove it at the present time, we are not inclined to support the theory until further evidence is forthcoming. Amateurs in all parts of the world are interesting themselves in this problem at the present time, and it should be possible, at no very distant date, to produce sufficient data and evidence on this matter to establish a very definite theory to account for these surprising results.

THREE VALVE PORTABLE RECEIVER.



A 250-2,000 Metre Set for Outdoor or Indoor Use.

By W. JAMES.

WHEN considering the design of this portable three-valve receiver, the writer was guided by the following points :—

(1) The set should operate a loud-speaker from the local broadcast station and the 1,600-metre station.

(2) The receiver should be compact, self-contained, of a shape suitable for carrying, and, of course, be of reasonable weight.

(3) A temporary aerial and earth are generally much more effective than a small frame aerial.

(4) The desired results should be obtained with the simplest controls.

(5) The set should be equally suitable for indoor as well as outdoor work.

In the view of the writer, point (5) is the most important of all, as relatively few persons feel inclined to construct a set which may be very suitable for outdoor work, and yet be unsuitable, because of its design or appearance, for ordinary everyday use at home. This receiver was therefore constructed in such a manner that it is self-contained, works with an open aerial and earth, may be totally enclosed when carrying it, and is neat and unobtrusive in appearance. The case is of polished wood, and when the set requires adjusting, the front edge may be slid off; access is had to the aerial, earth, and telephone terminals, and to the valves, by removing the top of the case, which is also made to slide in grooves provided in the sides of the case. The dry-cell H.T. batteries and the 2-volt unspillable accumulator are arranged at the bottom and end of the case respectively.

Reference should be made to the wiring diagram supplement presented with this issue.

The simplicity of the arrangement may be seen by referring to the schematic diagram of connections printed on the loose sheet to be found elsewhere in the magazine.

Referring to the filament circuit first, it will be noticed that adjustable filament resistances have been dispensed with. Instead, a fixed resistance and an "on and off" switch are employed. The fixed resistance is of the screw-in type (Burndept), and has a resistance of 0.3 ohm. As valves of the D.E.R. type are employed, the total filament current for the three valves is about 0.9 ampere; the fall in voltage across the fixed resistance is therefore 0.27 volt, and the voltage across the valves 1.73 volts, which is a safe value for valves of this class. When the voltage of the accumulator falls, or when an exceptional volume of signal is desired, the fixed resistance may be removed, and a short-circuiting plug inserted in the holder.

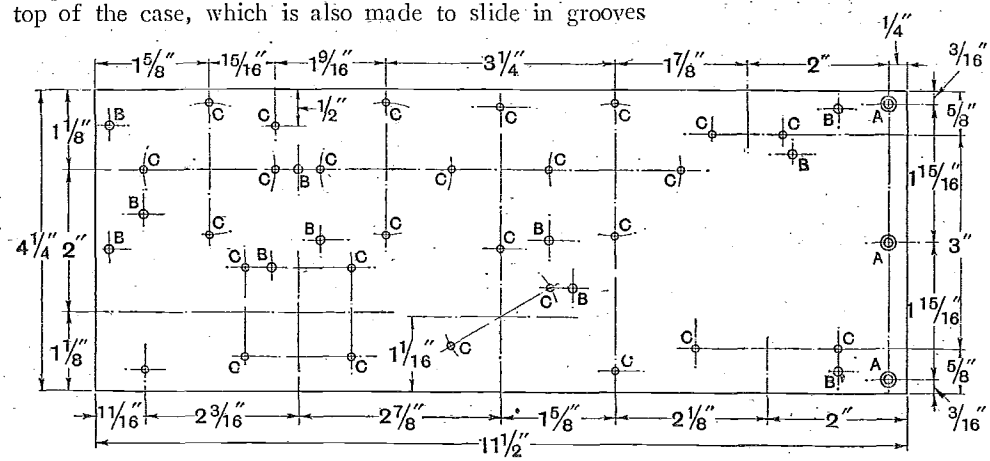
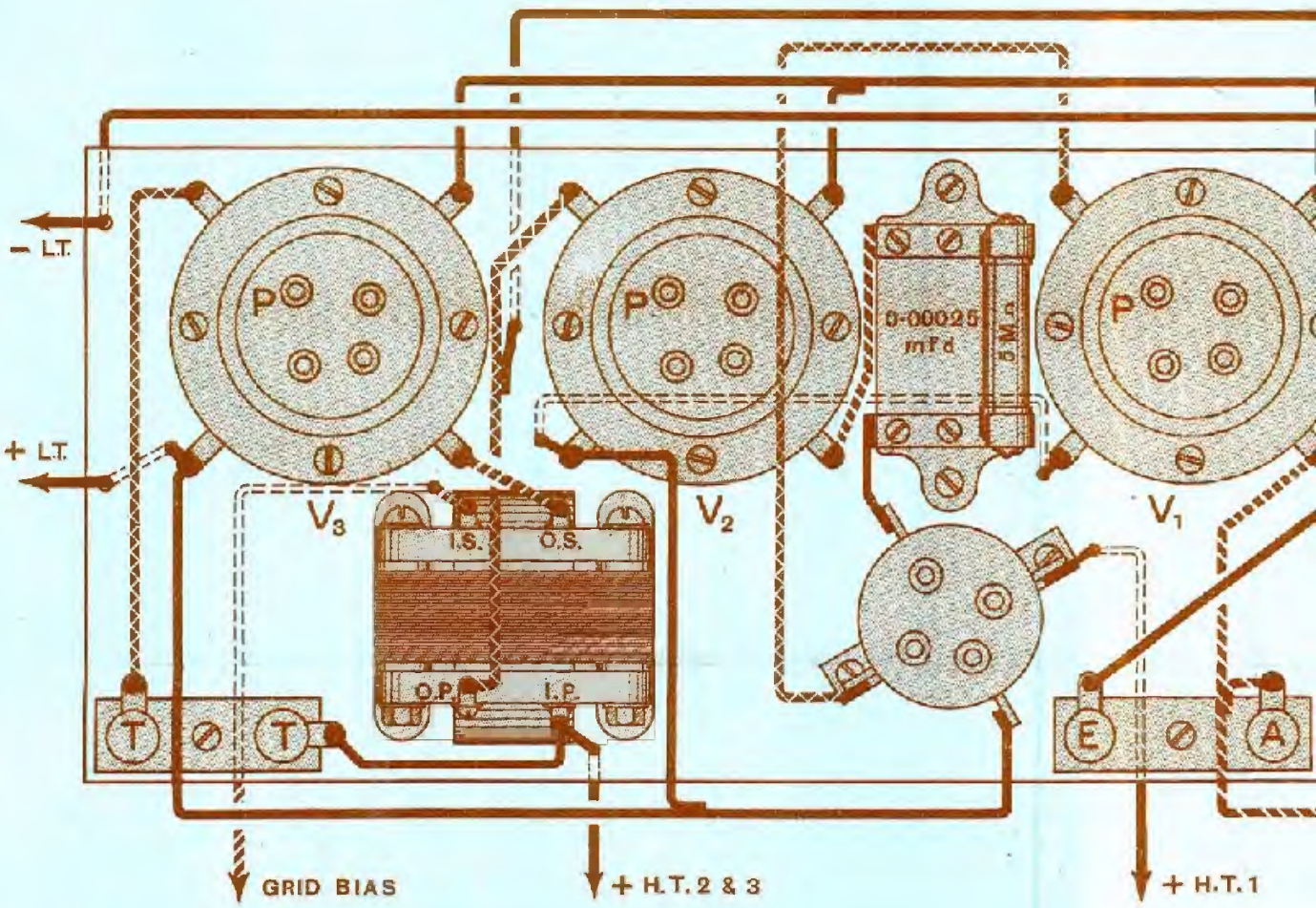


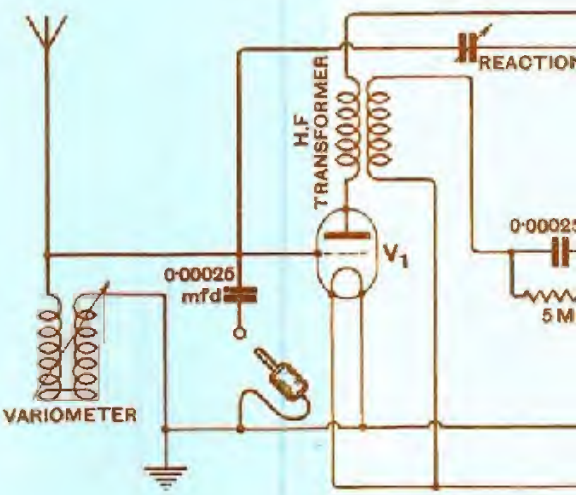
Fig. 1.—Details of the ebonite platform. The holes should be drilled as follows; A, ⅛in. dia. and countersunk for No. 4 wood-screws. B, ⅛in. dia. C, ⅛ in. dia. and tap for 4 B.A. screws. On this platform is mounted the valve holders, transformers, fixed condensers, filament resistance, and terminals.

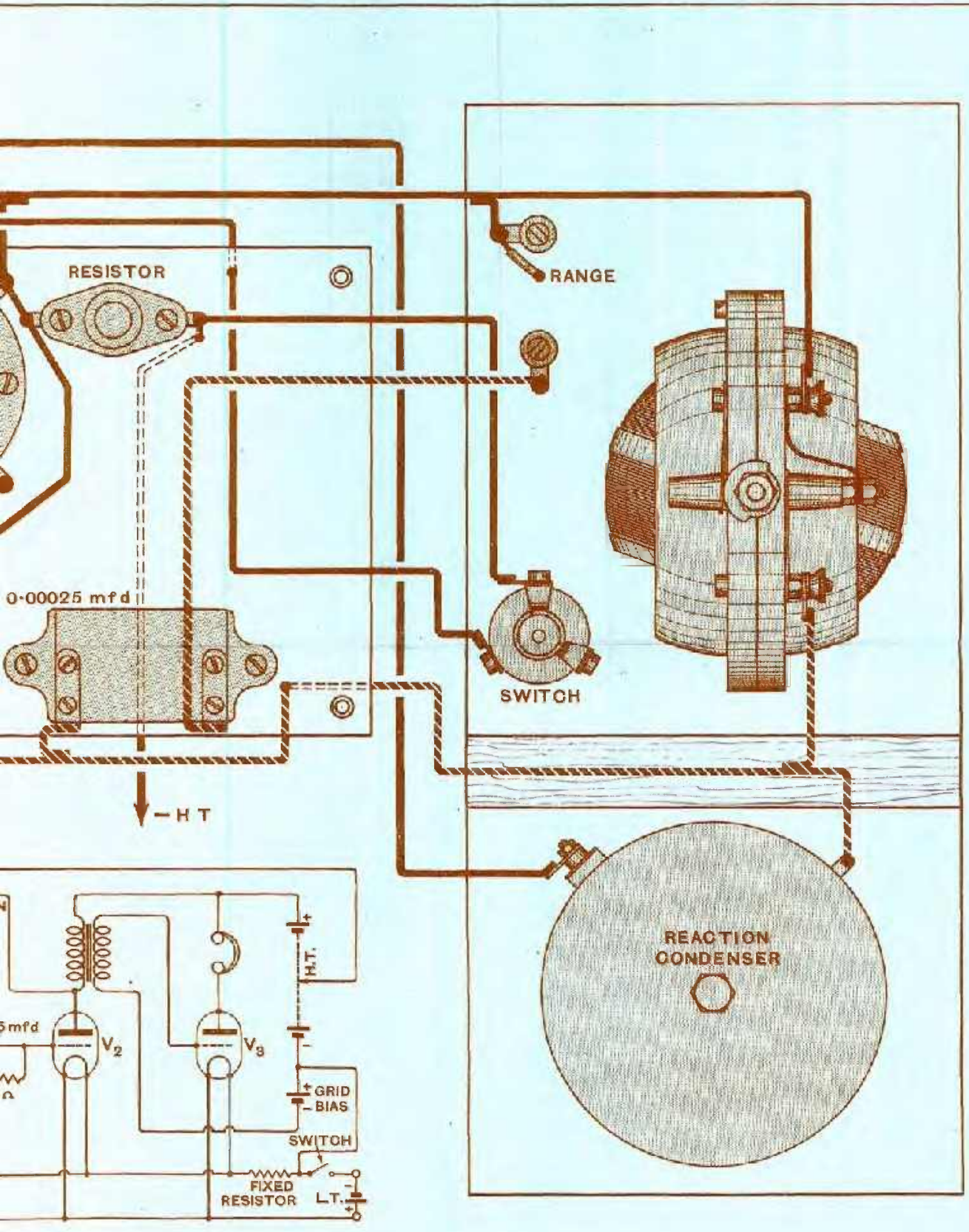
An H.F. transformer of the four-pin type (H. W. Sullivan, Ltd.) is employed to couple the first valve with the second. One transformer is used for the B.B.C. band, and another for the 1,600-metre station. Transformers of this type work quite effectively over a limited band of wavelengths without the aid of a tuning condenser. The reader should, of course, make sure he purchases H.F. transformers of a type which



THREE VALVE PORTABLE RECEIVER

The Wireless AND RADIO REVIEW World 13th May 1925





Printed in Great Britain by THE CORNWALL PRESS Ltd., 1-6, Paris Garden, London, S.E.1.

Three Valve Portable Receiver.—

do not require tuning. Such transformers are wound with fine copper or resistance wire, and the primary and secondary windings are situated close together to have a tight electrical coupling.

The set has one note magnifier, and this is transformer coupled to the detector. A low-frequency transformer of small dimensions is employed, as space is limited and weight is a consideration. This instrument should have a low ratio, such as 2 or 3 to 1. Grid bias for the last valve is obtained by connecting the flexible wire from the I.S. terminal of the intervalve transformer to the negative terminal of the H.T. battery, the negative H.T. connection wire (joined to negative L.T.) being plugged into positive three volts with respect to the negative terminal of the H.T. battery. Thus the grid of the last valve is given a negative bias of three volts.

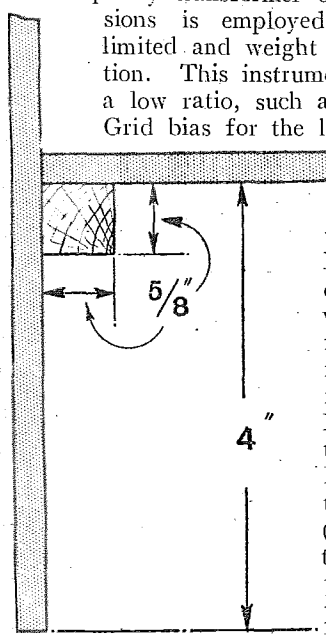


Fig. 2.—Method of fixing the ebonite platform to the ebonite front panel.

A particularly neat and effective device is employed to tune the aerial circuit. This is a variometer which is provided with a switch to put the windings in parallel when the knob attached to the rotor is turned from 0 to 180 degrees, and to put them in series when the knob is turned from 180 to 360 degrees. The switch is mounted on the end of the shaft of the rotor and operated automatically. Thus an aerial of the usual dimensions may be tuned from about 250 to 1,500 metres.

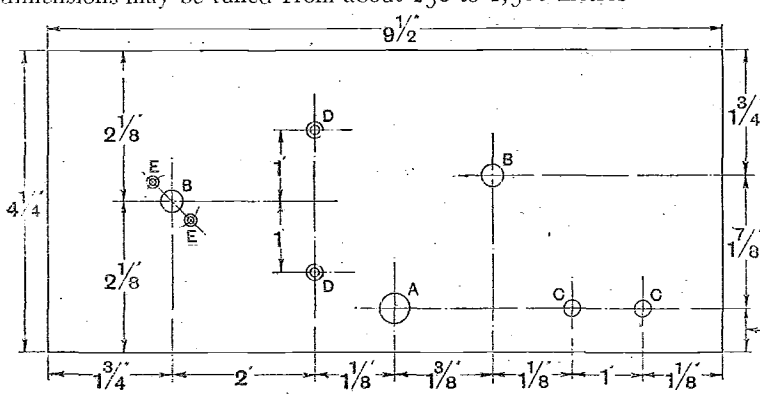
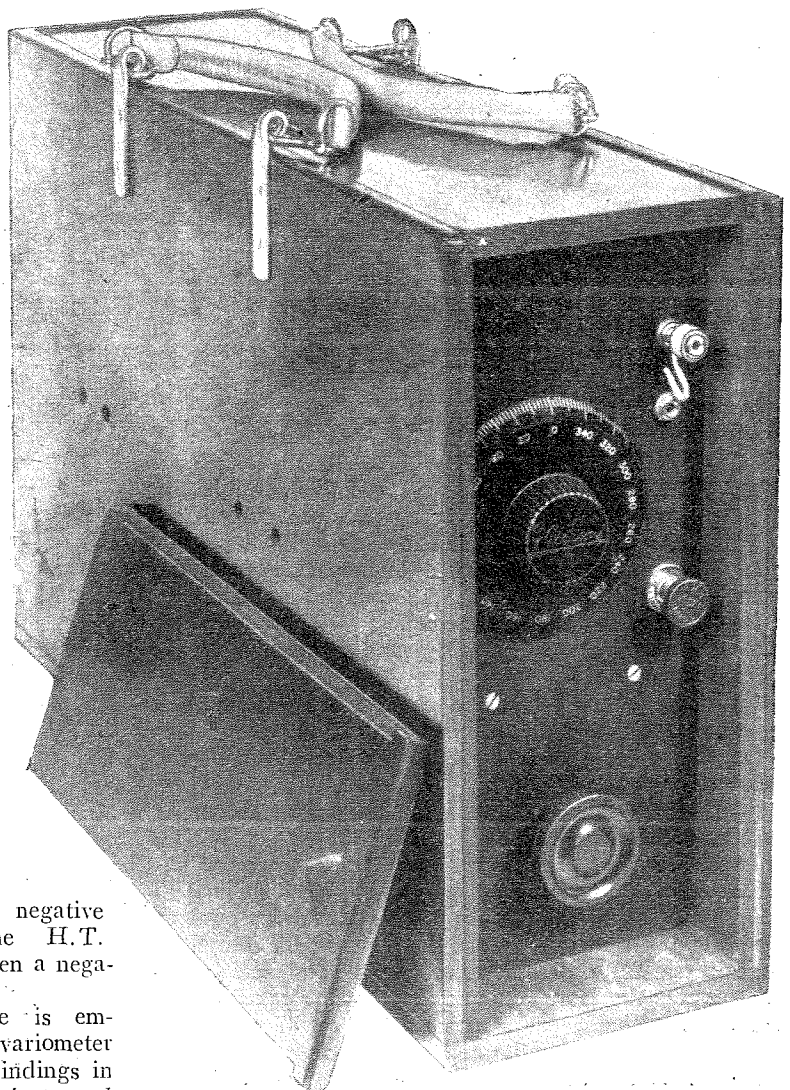


Fig. 3.—Drilling details for the ebonite front panel. A, $\frac{7}{16}$in. dia. B, $\frac{1}{4}$in. dia. C, $\frac{7}{32}$in. dia. D, $\frac{1}{4}$in. dia. and countersunk for No. 4 wood-screws. E, $\frac{3}{32}$in. dia. and countersunk for 8 B.A. screws.



View of the complete set with the front removed. Notice on the left of the case two holes for the telephone connections and two for the aerial and earth. The large knob is fastened to the shaft of the variometer, and the small one to the variable condenser. Just below the knob of the variometer is the filament switch, and above it, the Clix sockets and plug for connecting a fixed condenser across the variometer.

With a small fixed condenser in parallel, the range is extended. In this set a fixed condenser of 0.00025 mfd. can be put in parallel with the variometer by means of a plug and socket; the aerial can then be tuned to a wavelength considerably above 1,600 metres, which is an advantage, as under certain conditions a small aerial may be used. The variable condenser employed in the set is to provide a control of reaction. This condenser has a maximum capacity of 0.0005 mfd., and is connected between the detector and the aerial. By adjusting this condenser, the set can be made to oscillate on short or long wavelengths; the adjustment is not critical, as the condenser is of a type in which the knob is rotated several times when varying the capacity of the

Three Valve Portable Receiver.—

condenser between its minimum and maximum values.

The arrangement of the instrument can be seen from the photographs and figures. The valve holders, fixed condensers, H.F. and L.F. transformers and terminals are mounted on a piece of ebonite measuring 11½in. × 4½in. × ¼in., the fixing holes and holes for the wiring which passes through the panel being arranged as indicated in Fig. 1. On the end of this panel is fastened a front panel of ebonite which measures 9½in. × 4½in. × ¼in. The panels are fastened as indicated in Fig. 2, which shows a piece of wood 4½in. long by ⅝in. square screwed to the end of the longer panel and to the face of the shorter panel. Fig. 3 shows the position of the fixing holes for the variometer, variable condenser, filament switch, and the two Clix sockets mounted on the front panel.

It will be found convenient to employ a wire which is thinner than that usually used for wiring. In this set No. 22 tinned copper wire was used for the short wires, but the long wires connecting the variable condenser, the battery switch, etc., are of No. 18 tinned copper wire. Flexible wires terminating in plugs for the H.T. and spades for the L.T. are connected at the appropriate places as indicated in the special wiring diagram (supplement). Wiring is such a simple matter that, provided ordinary care be taken, the work should be satisfactorily completed in quite a short time. Care should be taken in connecting the valve socket, which serves as a mounting for the pin-type H.F. transformer, and also in running the grid and plate wires of the first and second valves.

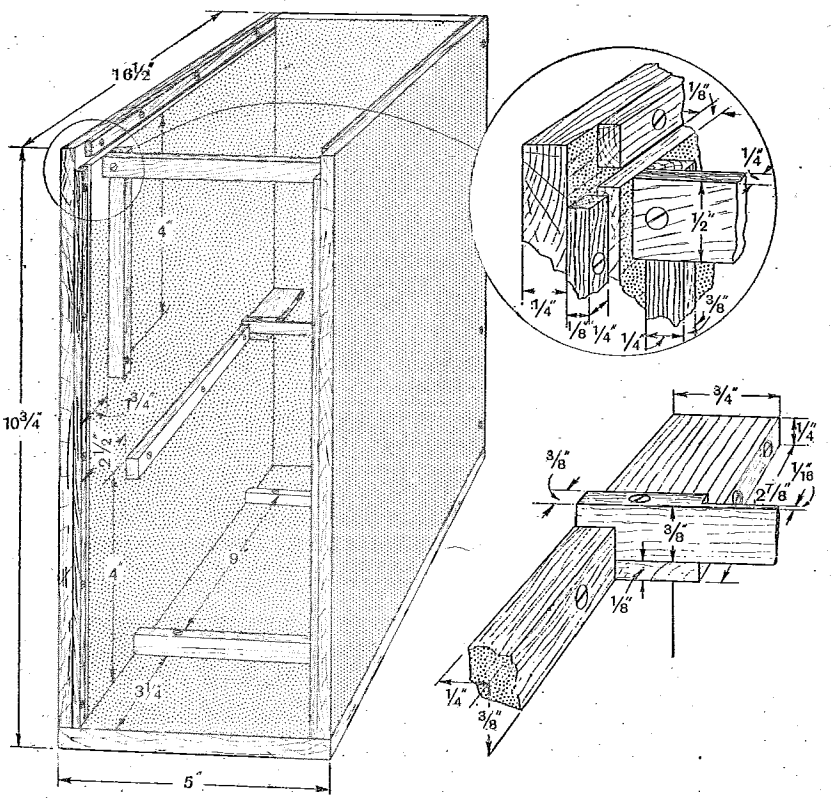
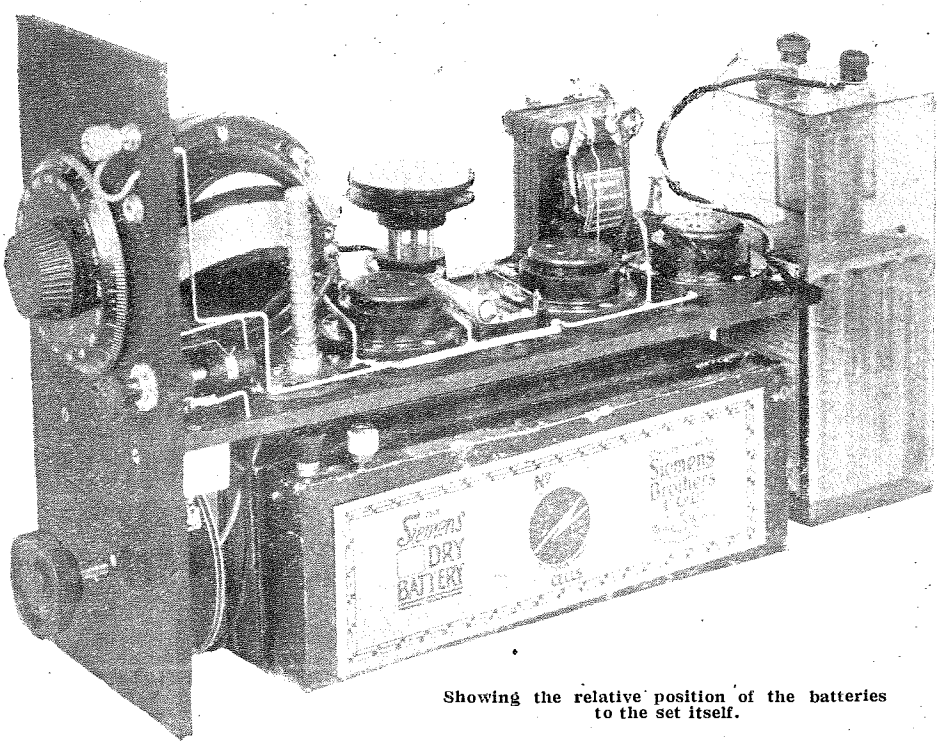


Fig. 4.—Constructional particulars of the containing case, which is of ⅜in. wood. A number of strips are employed to hold the batteries in position and to act as supports for the panels.



Showing the relative position of the batteries to the set itself.

No doubt the hardest piece of work is the making of the containing case. Details of this are given in Figs. 4 and 5. The wood is ⅜in. thick, and is fitted to form a box. Small pieces are screwed to the inner surfaces to act as a stop and rest for the panel, and other pieces are fitted to hold the H.T. battery and the accumulator in position. Details of the removable front and top are given in Fig. 5.

To operate the set, connect an aerial and earth and the telephones, fit three D.E.R. type valves, or appropriate valves of the Mullard D.3 (2-volt) class; connect the H.T. plug from the H.F. stage to about positive 36

THE MATERIALS USED IN CONSTRUCTING THE SET.

1 Variometer, long range type (Marconiphone Co.).
1 0·0005 mfd. Variable condenser (Baty).
1 Pin-type H.F. transformer for B.B.C. wavelengths (H. W. Sullivan, No. 1).
1 Pin-type H.F. transformer for 5XX (H. W. Sullivan, No. 4).
1 L.F. intervalve transformer, low ratio (Burndept Ltd.).
3 Anti-phonic valve holders (Burndept Ltd.).
1 Valve holder for base mounting with side projections for connecting.
1 Fixed resistor, 0·3 ohm. (Burndept, Ltd.).
1 Short-circuiting plug (Burndept, Ltd.).
1 Screw holder for fixed resistor (Burndept, Ltd.).
1 0·00025 mfd. fixed condenser (Dubilier).
1 0·00025 mfd. fixed condenser with grid leak clips (Dubilier).
1 5 megohms grid leak.
1 Filament switch (Lissen).
4 Terminals.
1 60-volt H.T. battery (4 15-volt units).
1 2-volt unspillable accumulator, 20 A.H. Type D.04 (Exide).
1 Ebonite panel measuring 11½in. × 4¼in. × ¼in.
1 Ebonite panel measuring 9½in. × 4¼in. × ¼in.
Leather carrying handles (or straps).
3 Valves of the 2-volt type (M.O. D.E.R., or 2 Mullard D.3.H.F. and 1 Mullard D.3.L.F.).

volts, and the H.T. plug from the detector and L.F. valves to positive 60 volts. Switch on the valves, and with a transformer of suitable size plugged in the H.F. stage tune in a signal by adjusting the variometer. Then adjust the reaction condenser for best results. It will be found that the readiness of the set to oscillate depends on the aerial-earth system. With a small aerial the set tends to oscillate much more readily than when a large aerial is used. The wavelength range is, of course, fixed by that of the variometer, and is approximately 250 to 2,200 metres. The set is easily handled and is quite stable, hand capacity effects being absent.

A temporary aerial consisting of an insulated wire with one end thrown over a branch of a tree, with a metal spike for an earth, will usually prove satisfactory. Sometimes better results will be obtained by using an insulated wire laid on the ground instead of an actual earth connection. In certain circumstances it may be found that best results are obtained when the aerial wire is laid on the ground, or is held a short distance above the ground.

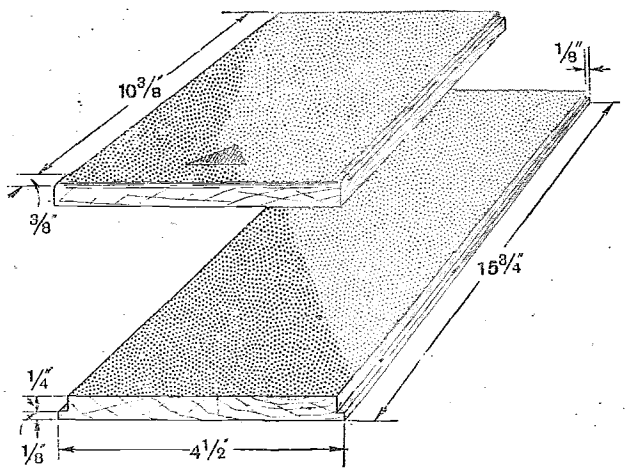
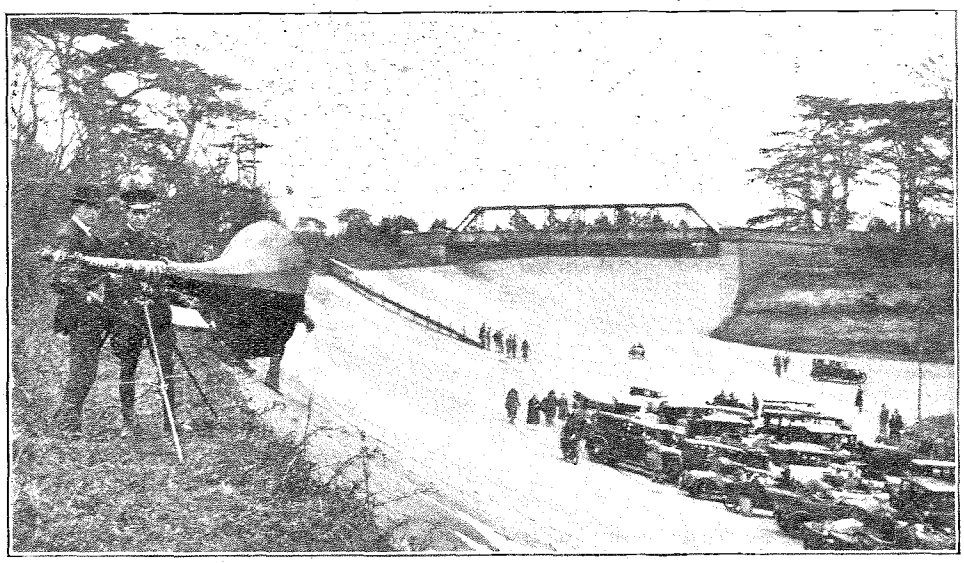


Fig. 5.—The removable front of the case (top) and the removable top. These are arranged to slide in grooves cut in the sides of the case.

BROADCASTING AT BROOKLANDS.

THE use of microphones and loud speakers is adding a new phase to sporting events where large crowds are assembled and it is necessary to advise progress occurring out of view of the spectators.



One of the many Amplion Loudspeakers installed at Brooklands

At the recent meeting of the Junior Car Club, held at Brooklands, the Amplion Public Address System was installed, with loud speakers liberally distributed about the course. The event was a durability and speed trial over a 100-mile course, and entrants were required to maintain a certain minimum speed depending upon the classification of their cars and to drive over a track which included a steep incline and a hairpin bend. The progress of the event was reported at intervals by the loud speaker equipment, information being given as to the cars disqualified and those unable to stay the course.

NEUTRODYNE RECEIVERS.

Some Aspects of "Neutrodyne" Devices in Relation to the Performance of Tuned Anode Circuits.

By P. W. WILLANS.

THE term "neutrodyne," first specifically employed by Hazeltine with regard to a certain group of methods for counteracting the grid-anode capacity coupling of a valve, has since been very widely employed in a broader sense as applying to all such methods, and it is in this sense that the word is used in the present article.

A general review of the various methods of counteracting capacity coupling was given by Mr. O. F. Brown in the April number of *Experimental Wireless*. This article, however, dealt mainly with the question of avoiding instability, which in itself is a matter of comparatively little difficulty in a two-valve receiver, though, of course, of importance in a multi-stage amplifier.

The Tuned Anode Circuit.

The writer's concern with neutrodyne methods is as providing means not solely for avoiding instability, but also for improving the sensitivity and selectivity when a single stage of high-frequency amplification is employed.

Considering the case of the well-known circuit of Fig. 1, in which reaction is applied by a detector valve to a tuned anode circuit, it is of interest to study the effect of the grid-anode capacity of the first valve in relation to the performance of the set.

In the first place, it is a matter of common knowledge that a two-valve receiver constructed with good coils has a tendency towards instability even without reaction on the anode circuit, and that very frequently some form of damping is needed on the first valve to control it satisfactorily. Why, then, trouble with anode reaction, or, why not carry the reaction back on to the aerial circuit, reversing it if necessary?

The answer to these questions, to be really effective,

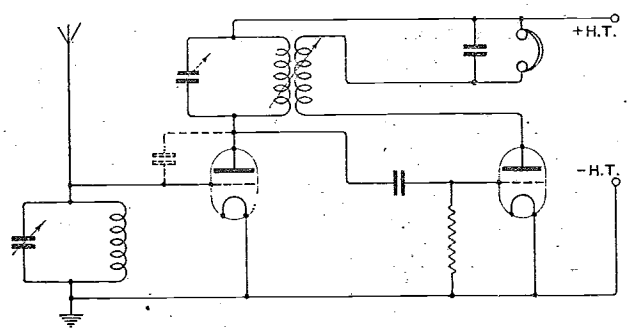


Fig. 1.—A two-valve receiver with a tuned anode circuit and reaction.

requires mathematical analysis, but a few of the main principles can be studied with advantage from a purely physical standpoint.

In Fig. 2 we are considering only the tuned anode circuit, in which a voltage, Vg, is applied to the grid, and a voltage, Va, obtained across the plate. The anode inductance and capacity are denoted by L' and C', and the losses within the circuit are considered as having the form of a shunt resistance, r', across the tuned circuit.

We have, moreover, to take into account the valve resistance ρ, which is also in shunt across the tuned circuits, and tends to blunt its tuning.

If reaction from another valve is applied to this circuit, r' may take the form of a negative resistance, though this does not necessarily mean that the circuit will oscillate, inasmuch as the valve damping is still present. If the internal losses of the circuit are exactly wiped out, r' is infinite in value; in this case the only damping in the circuit is that due to the valve resistance itself, and the measure of amplification obtained is exactly the amplification factor of the valve.

We may regard the effect of reaction as that of a "negative leak" placed in shunt across the tuned circuit. This leak has an "infinity" position, and can be reduced in value down to the point where it is equal (and opposite) to the valve internal resistance ρ. When this value is attained, all the damping on the circuit will be cancelled out, and it will generate oscillations.

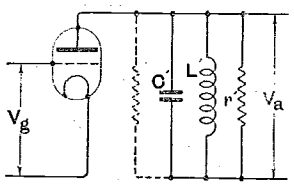


Fig. 2.—Explaining the tuned anode circuit.

Critical Reaction.

For settings intermediate between that corresponding to $r' = \infty$ and $r' = -\rho$, a value of amplification in excess of the amplification factor of the valve is obtained, and it is owing to this that it is of importance to use reaction on this circuit, since, whereas an aerial circuit can be made to have low damping by careful design, the anode circuit *must necessarily be damped by the valve to which it is connected.*

It is a matter of common experience that an excessive use of reaction produces a muffling effect on the quality of telephonic reproduction, owing to the inadequate amplification of the higher side waves, and that in consequence reaction cannot be used to an unlimited extent. This implies that in the circuit of Fig. 2 we must not reduce r' so as to have too low a negative value. Now the damping effect of a shunt resistance on a tuned circuit is greater the larger the inductance and the smaller the capacity; in consequence, the larger we make L', and the smaller we make C', the more reaction we can put on and the more amplification is obtainable. It can, in fact, be proved that the amplification which can be obtained is proportional to L'.

Returning now to the circuit of Fig. 1, it is interest-

Neutrodyne Receivers.—

ing to compare the setting of the reaction coil for oscillation when the first grid is short circuited, with that when the aerial circuit is operative and tuned in to the anode circuit. It is apparent that, long before the latter has reached the stage of critical damping, oscillations are being generated, and the frequency of these is, in general, more critically dependent on the aerial tuning than that of the anode circuit; in other words, before a sufficient degree of reaction can be applied to the anode circuit the aerial circuit oscillates.

Neutrodyne Circuits.

The methods of counteracting this state of affairs are many and various. In the first place, it is possible to damp the aerial circuit by means of grid current, or else an added resistance, and to experiment with various values of positive resistance in the aerial circuit and negative in the anode. The results of this procedure are that for a certain range of values of damping there is very little difference in the performance of the set, but certainly no increase in the signal strength. With more than a certain measure of damping, however, the performance falls off materially.

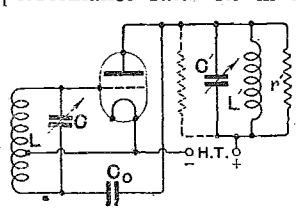


Fig. 3.—An arrangement for neutralizing stray capacity.

In the second place, it is possible to work with a double reaction circuit, two coils being placed in series with the detector valve anode, one coupled to the tuned anode circuit, and the other to the aerial. If the latter be reversed, it can be employed to control the oscillations as before, but no improvement of a material kind can be effected, nor is this possible if an element of the anode inductance is coupled in either sense to the aerial inductance.

Lastly, it is possible by means of any of the various circuits published from time to time to produce a correcting coupling which neutralises the valve capacity over a tolerably wide band of frequencies, and if such a course is adopted it will be found at once that a great improvement both in sensitivity and selectivity is obtained.

As an example of such a circuit, we may consider that shown in Fig. 3. Here the grid circuit is divided into two parts, the extremity of one being connected to the grid, and that of the other through a condenser, *Co*, to the anode.

If the grid circuit is equally divided, the condition for neutralisation is that *Co* should be equal to the grid anode capacity, and no considerations of frequency enter into the question.

It is found that with this circuit much more reaction can be applied to the anode circuit, and as a result the improvements above indicated are obtained.

This result is in sharp contrast with that afforded by damping or any of the previously mentioned counter-reaction methods. For example, in Fig. 4 oscillations can be stopped by a critical adjustment of the coupling coil, but no improvement results. This is essentially bound up with the fact that in this circuit the neutralisation is effective at only one frequency, and critically variable with the frequency.

A circuit employed by the writer which gives the correct neutralising effect in a very simple manner is shown in Fig. 5.

This arrangement is essentially different from Fig. 4, and should be carefully distinguished from it, by virtue of the fact that the coupling coil *l'* is now no longer a

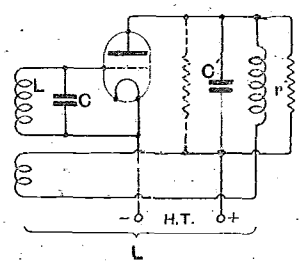


Fig. 4.—Oscillations can be stopped by adjusting the coupling coil.

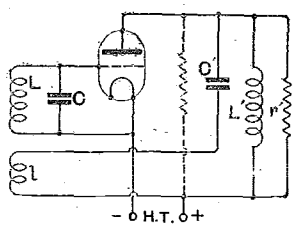


Fig. 5.—In this arrangement the coupling coil is included in the condenser circuit.

part of the anode inductance, but is included in series with the tuning condenser. If this coil has an impedance which is small in comparison with that of the condenser, the flow of current through it is entirely regulated by the latter and by the impedance thrown into the coil from the grid circuit.

It is now found that the tendency of the aerial circuit tuning to influence the reaction conditions of the set can be reduced to a minimum for a certain critical coupling between L and *l'*, and that with this setting considerably more reaction can be applied to the anode and greatly enhanced selectivity and sensitivity obtained.

It should be noted that with this arrangement the correct setting of the coupling coil depends on the setting of the condenser which tunes the anode circuit; consequently, if tuning is controlled by a variation of the latter, a different adjustment is required for every different station. This is a disadvantage in point of complexity, but not in point of performance, as the improvement is obtained in the same measure at all wavelengths over a wide range.

On the other hand, if the anode coil is tuned by a variation of inductance, then the same setting of the coupling coil is effective over a much wider range of wavelengths.

A WIRELESS MONUMENT.

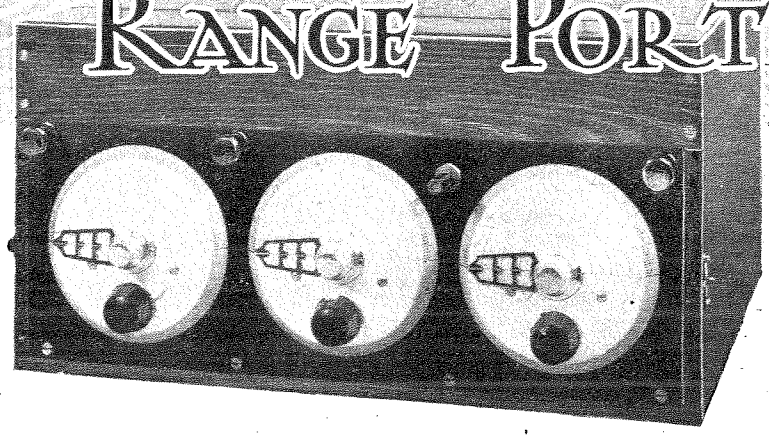
TO commemorate the transmission of the first wireless message across the sea, a monument is to be erected at Wimereux (Pas de Calais), according to a statement made by M. Michel Cepede, General Secretary of the Radio Club Universitaire de France.

It was from Wimereux, in 1899, that Mr. Marconi's famous cross-Channel message to M. Branly was received. In this message the Italian inventor stated that part of the credit for the feat was due to M. Branly for his remarkable work in connection with the coherer.

The monument will be erected by the Wimereux Municipal Council with funds to be raised by international subscription.

The MOTORISTS ALL RANGE PORTABLE

A Receiver for the Dashboard.



By F. H. HAYNES.

ANALYSING the requirements a receiver is expected to fulfil, and in drafting its design, certain facts become the essentials to be considered, and in the case of a portable set difficulties arise which have not to be contended with in the construction of a receiver for ordinary purposes. Owing to the wide appeal that the portable set is making at the present time, it has been a condition that this entire set can be constructed with the aid of screwdriver, hand brace, pliers, file, and soldering iron, provided the constructor procures a ready-made cabinet with ebonite panels fitted, though the making of the latter only necessitates the addition of a small tenon-saw and medium-cut file to the tool kit. In addition to this the making up of special component parts has been avoided, and the constructor will find that the building of the set entails no more than drilling the holes in the panel for attaching the two condensers and the coupling coil, and the screwing down of the parts to the baseboard to a simple and systematic layout. As it is intended that the portable set shall be capable of bringing in distant stations a high frequency amplifying stage has been included. There are other reasons, also, which support the fitting of a high-frequency amplifier.

The Circuit.

For working under differing conditions variable reaction coupling cannot be employed in the manner of the oscillating detector valve arrangement, and only through the use of a high-frequency stage and balancing condenser is stable reception obtained. It is on wavelengths up to 600 metres that the high-frequency amplifying valve, with tuned circuits connected to its grid and plate, breaks into uncontrollable oscillation. It is essential, therefore, for telephony reception, to employ a balancing condenser which feeds into the grid circuit potentials neutralising those set up through the inter-electrode capacity of the valve. A high-frequency inter-valve transformer can, of course, be used, as in the neutrodyne circuit, to develop suitable reversed potentials to control self-oscillation, but the only interchangeable transformers available cannot be made to cover the complete wavelength scale with a tuning condenser of capacity 0.0003 mfd. Plug-in tuning coils are obtainable, increasing in inductance by quite small values and with windings of much higher efficiency, producing as a tuned high-frequency stage the maximum degree of amplification. The neutralising potential is developed in a coil which is coupled to the tuned anode winding and fed

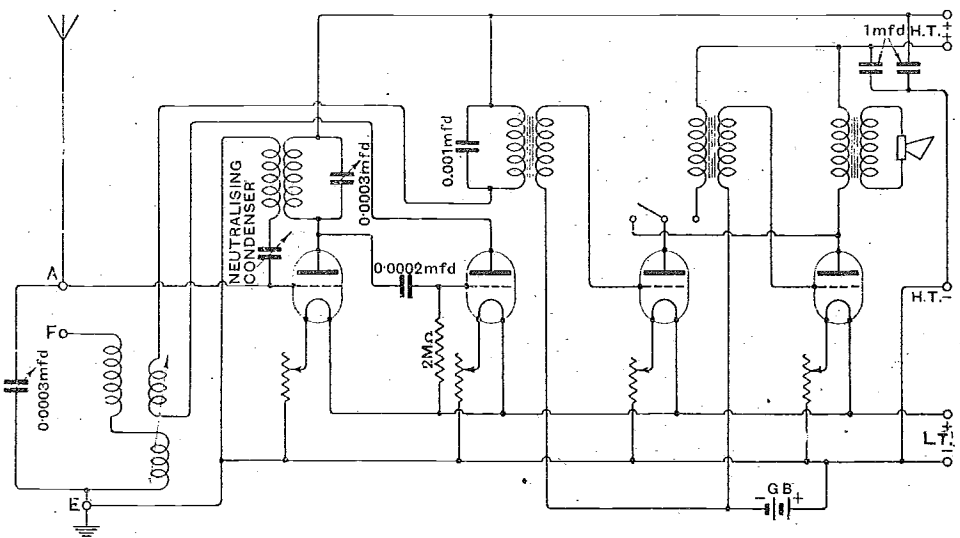


Fig. 1.—Terminals A and F permit of the use of frame or elevated aerials, and in the latter case must be bridged. The neutralising condenser renders the high-frequency amplifier stable under the varying conditions in which a portable set may be used.

All Range Portable.—

to the grid through a neutrodyne condenser adjustable from the front of the set. When receiving on wavelengths above 600 metres, neutralising is no longer necessary, and the neutralising coil may be removed, or in practice it will be found that a coil may remain in circuit suitable for an optimum wavelength of 300 metres, which, owing to its few turns, when compared with a long-wave coil, develops on a small feed back potential.

When self-oscillation is controlled by neutralising and detection is provided for by leaky grid condenser, it will be found that the tuning of the circuits will be rendered unduly flat owing to the appreciable resistance present in the

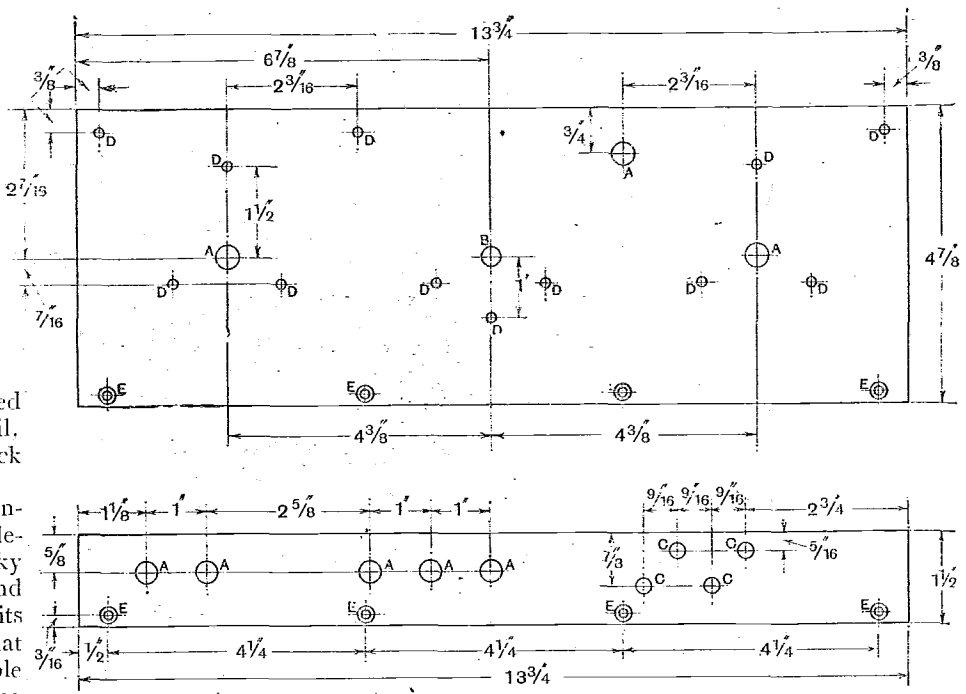


Fig. 2.—Dimensional drawing of the front panel and terminal strip made in $\frac{1}{16}$in. ebonite. Sizes of holes: A, $\frac{3}{8}$in.; B, $\frac{5}{16}$in.; C, $\frac{1}{4}$in.; D, $\frac{5}{32}$in.; E, $\frac{1}{4}$in. countersunk.

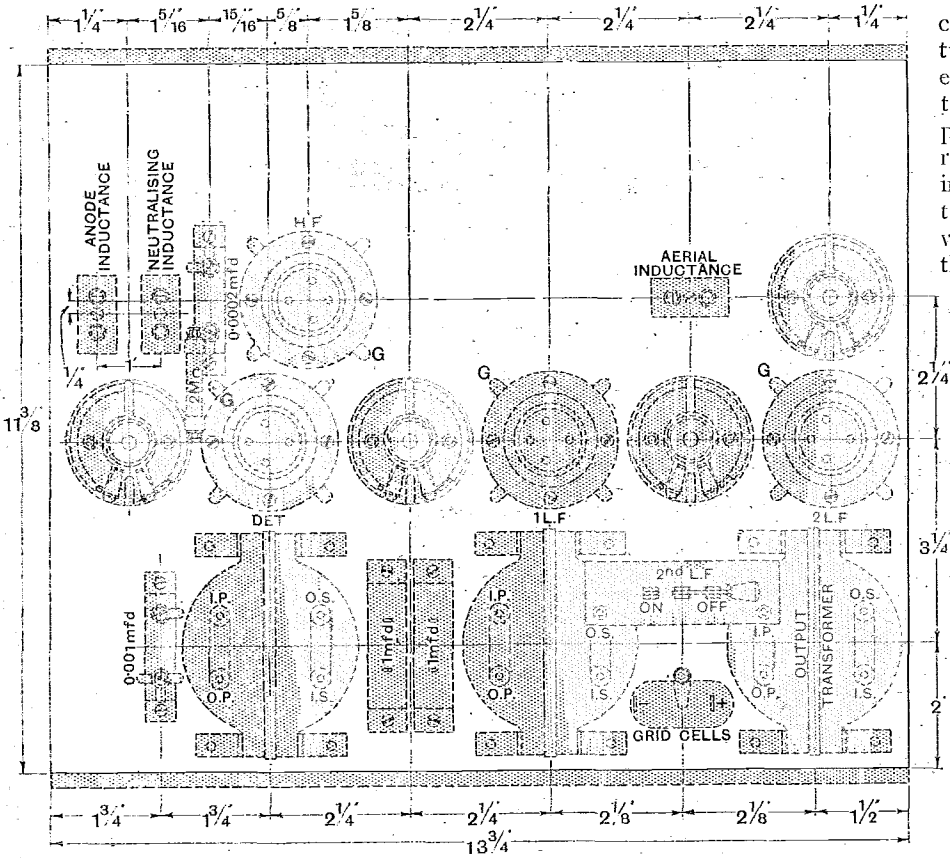


Fig. 3.—Dimensional layout of the components on the baseboard. The spacing between the centres of the valve holders and filament resistances is 2½in. throughout. Should the parts on the front panel be substituted by components of other make than those shown, care must be taken to ensure that they will not come into contact with the apparatus on the baseboard when assembled. The position of the coil holders gives clearance for Gambrell type inductances.

circuits even when employing tuning inductances of high efficiency, and also as a result of the grid current set up in the process of detection. This is remedied by the provision of inductive reaction coupling between the plate of the detector valve and the aerial circuit, and the special constructional details concerning this and its use in conjunction with the capacity feed back is referred to later.

The input to the high-frequency valve consists of a parallel tuned circuit. Series tuning must be avoided in portable receivers, for small stray capacities may represent an appreciable amount when compared with the low value tuning capacity produced by the series arrangement. In the parallel circuit stray hand capacities are small compared with the total tuning capacity, and therefore give rise to very little change in the tuning.

For loud-speaker operation out of doors two low frequency amplifying stages are essential, though for reception from a local station it may be desirable to switch

All Range Portable.—

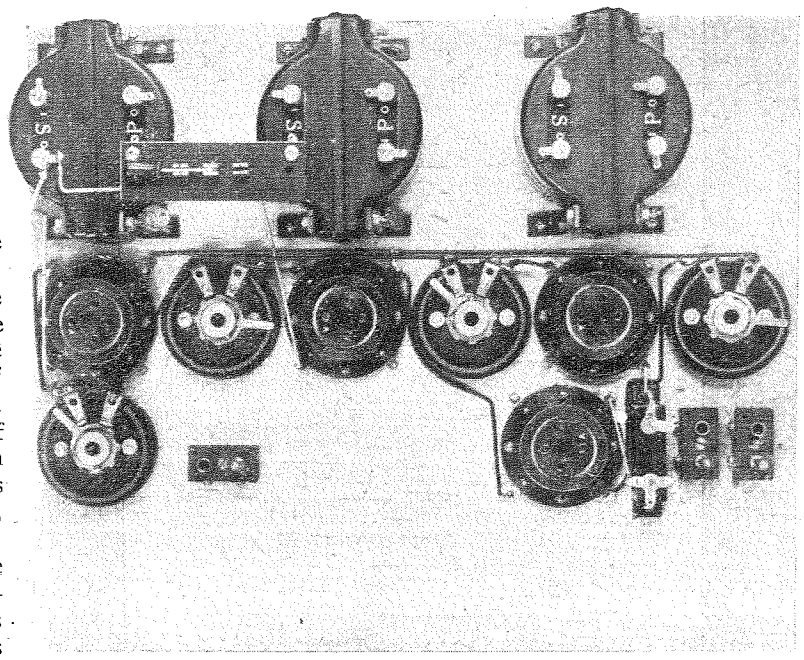
one amplifying stage out of circuit. A suitable grid biasing battery corrects the grid potential of the L.F. amplifying valves, and a separate H.T. tapping is provided.

Practical Details of Design.

Probably the most important consideration in portable receiver construction is the need to guard against the effects of vibration, which calls for robust construction, the fitting of good mechanical control of the tuning adjustments so that they can be critically manipulated while in a state of vibration and will maintain their settings, and also provision for the microphonic action of the valves. Special attention has been given to these considerations as this receiver was constructed essentially by the writer for use, when required, on a travelling car.

All woodwork is $\frac{3}{8}$in. mahogany and the ebonite panel is $\frac{5}{16}$in. The heavy transformers are held by 4 B.A. nuts and bolts to the baseboard, so that when the receiver is carried with dials uppermost these heavy components are at the bottom.

The tuning controls only are brought to the front of the instrument to limit, not only the number of adjustments, but the space occupied. It is intended that the receiver will be suitable for mounting on or beneath the dashboard of a car, and the style of controls adopted is in keeping with the appearance of the remainder of the dashboard equipment. Tuning adjustments are made through reduction gear, which greatly facilitates obtaining critical settings when the hand is unsupported and subjected to vibration and jolting. Moreover, and what is more important, this form of dial holds the spindles secure in any position and prevents them revolving under the influence of vibration. When the feed back condenser knob is unscrewed to permit of some degree of oscillation the reaction coupling may be rendered critical, and in order that it may be easily controllable within many degrees on the dial a 180° vario-coupler is fitted which makes it possible to easily bring reaction into operation, each revolution of the knob only producing a small change.



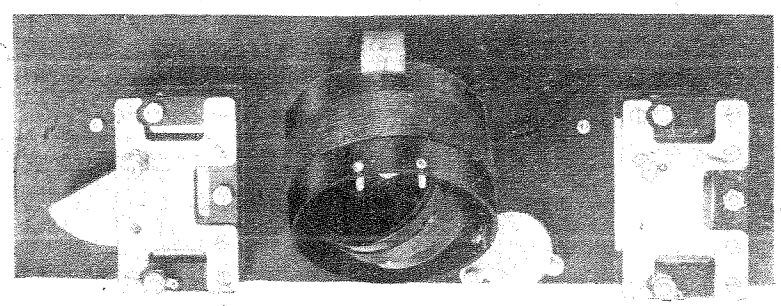


Fig. 4.—Baseboard and front panel with the components in position and ready for preliminary wiring.

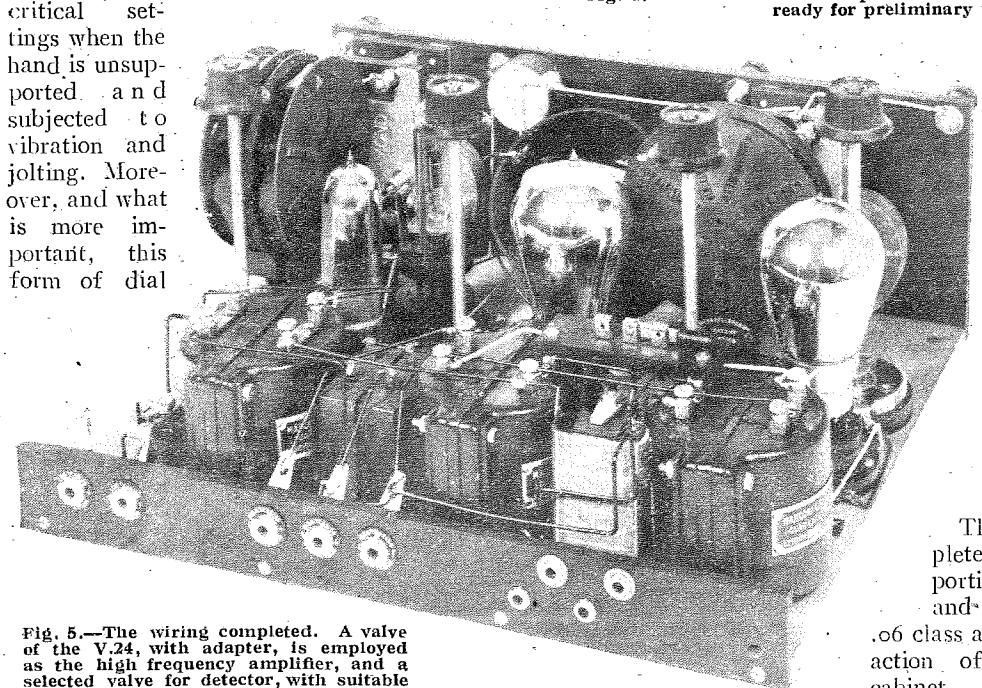


Fig. 5.—The wiring completed. A valve of the V.24, with adapter, is employed as the high frequency amplifier, and a selected valve for detector, with suitable first and second stage low-frequency amplifying valves.

The valves are rendered completely non-microphonic by supporting on " Sorbo " indiarubber and even valves of the dull-emitter .06 class are entirely uninfluenced by the action of blows delivered on the cabinet.

All Range Portable.—

Other points in design include the fitting of reliable plug and pin connectors at the back of the instrument for battery and output leads, the fitting of three ebonite shrouded terminals to the front panel for aerial, frame, and earth connections, and the inclusion of an output transformer to entirely disconnect the batteries from the loud-speaker or telephone leads, this being very necessary when one side of the filament battery is earthed. The output transformer is of the low ratio intervalve type, and although the secondary winding, which is normally of moderately high impedance, is connected in circuit with a low impedance valve, it must not be overlooked that the loud-speaker connected across the primary winding considerably reduces the inductance of the secondary winding which is connected to the plate of the valve.

As the filament resistances may, perhaps, be thought somewhat inaccessible on the baseboard their operating handles can be raised by the fitting of longer spindles. The lay-out of the components has been considered only with a view to giving simple wiring with the shortest possible leads. Viewed from the front the left-hand dial is the aerial tuning condenser, and its tuning inductance stands an inch away so as not to be influenced by the damping which might arise from the metal back plate. The circuit follows across the front of the instrument to the high-frequency valve, with the reaction control intermediate between aerial and anode circuits. The holder for the detector valve is connected with short leads *via* the grid condenser to the anode of the high-frequency amplifier, and the remainder of the circuit follows through in sequence with the valves alongside their respective transformers.

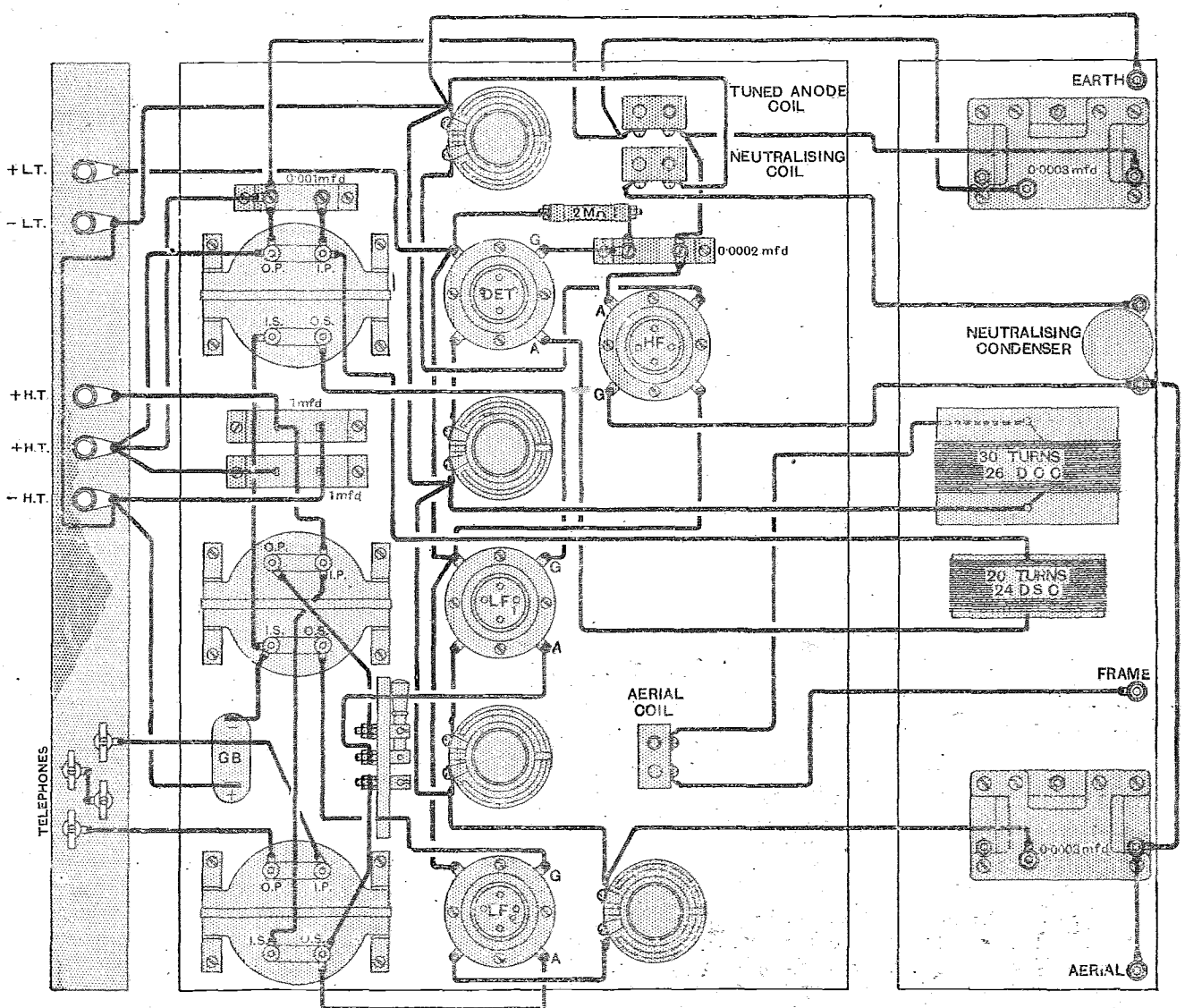


Fig. 6.—The layout of the components has been considered only with a view to rendering the wiring as simple as possible. Other than the filament circuit leads, which should be put on first and arranged near the surface of the baseboard, most of the connections will be found to be short and are run by the shortest path. Care must be taken to wire up the inductances in the manner shown, avoiding a reversal of connections, in order that both reaction coupling and neutralising condenser may operate correctly.

All Range Portable.—

Construction.

The reader is recommended to purchase the containing cabinet, although if he cares to construct it himself he will find that it is put together from a number of rectangular boards, and presents no special operations or difficulties so long as he works square. With the cabinet completed the front and back panels are carefully fitted and the baseboard adjusted to occupy the space between them, leaving the front panel raised $\frac{1}{16}$in. above the edges of the woodwork. The ebonite strip and front panel are each attached with four No. 5 by 1in. brass screws, and it is worth while obtaining these with raised heads and nickel plated. One screw in the centre of the front panel engages on a small extension filet and holds the front square with the base. Four 1in. by No. 4 B.A. brass screws with countersunk heads pass up through the underside of the cabinet and the baseboard, and when fitted with washers and nuts hold the entire equipment secure in the cabinet.

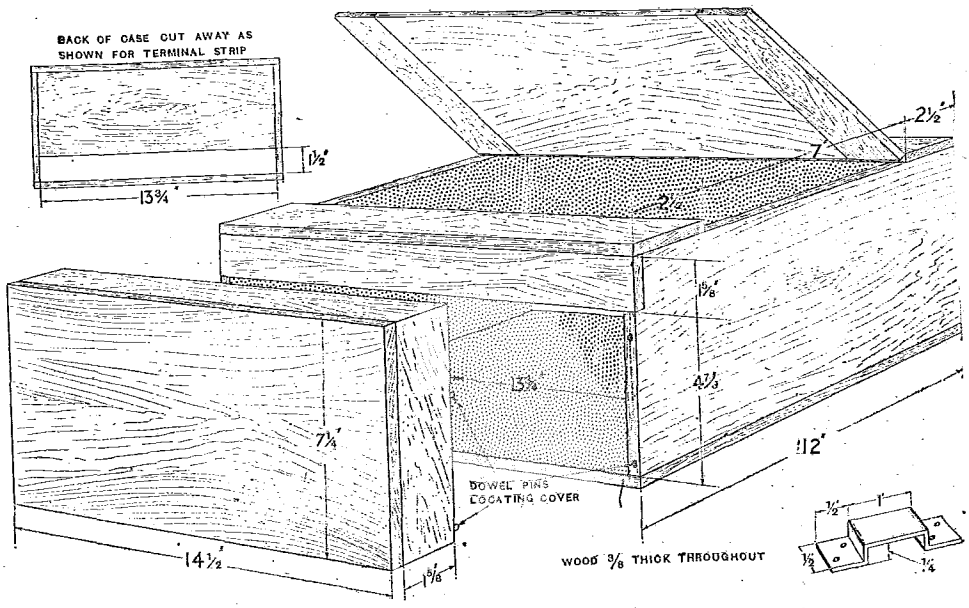


Fig. 7.—Constructional details of the containing cabinet and lid which gives protection to the tuning dials. A small brass bracket used for attaching a strap passing completely round the instrument for use when the instrument is to be carried is shown on a larger scale.

In fitting the variable condensers and the special geared dials it will be found that one of the holding down screws of the latter comes into contact with the condenser end plate, which may, in consequence, need some slight filing. The pairs of holes for securing the dials should give a loose fit to the screws so that a slight movement is obtainable for finally adjusting the boss of the dial to be in line with the condenser bearings. These screws must not be tightened up so as to bend the metal plate. The spindles of the condensers selected make a fairly good fit to the dials, and it is, of course, important to employ condensers with spindles on which there is no threading, not only to facilitate the fixing of the dials, but to avoid the shaky action which results from using condensers in which a threaded spindle passes through a plain bush. The vario-coupler spindle would appear to exactly fit the bush of the dial. This component is held to the panel by means of one screw, and it may be necessary to cut away the baseboard to a depth of about $\frac{1}{16}$in. to clear the lower portion of its metal frame, which, when secured down, serves as a bracket to the panel.

With all components in position the wiring up should prove a simpler operation than is usual in receivers of this type owing to the arrangement of the parts. For reliability in a portable set covered "Glazit" wire (red and black) is used. The ends of this

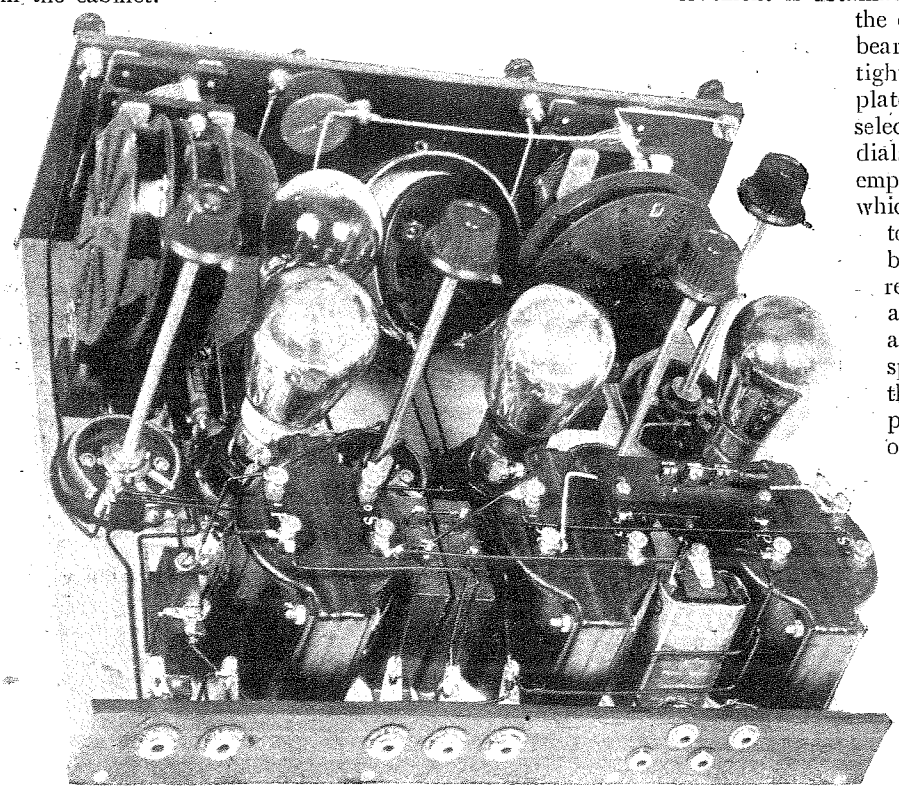


Fig. 8.—Another view of the finished set. The rheostat extension rods are not essential, but are easily constructed from ¼in. brass rod.

All Range Portable.—

covered wire are bared by burning in the edge of a flame and trimming with sharp scissors. The use of a clean iron and resin cored solder are essential to neat wiring. Tags are used under all terminals. The actual connections to the tuned anode and neutrodyne coils must be carefully followed, and a reversal of leads to either of the coil-holders guarded against. As purchased, the reaction winding (moving coil) of the vario-coupler consists of too few turns, and must therefore be re-wound with 30 turns of No. 24 D.C.C. wire, taking care not to reverse the direction of winding. The grid leak is of a type fitted with soldering tags to avoid overheating its contents. If required, extension rods for the rheostats are easily made up from $\frac{1}{4}$in. hard brass rod, which exactly fits the hole in the centre of the rheostats, and needs slightly filing down to engage in the hole in the knobs. A short screwdriver will be required for driving the grub screws home on to these extension spindles.

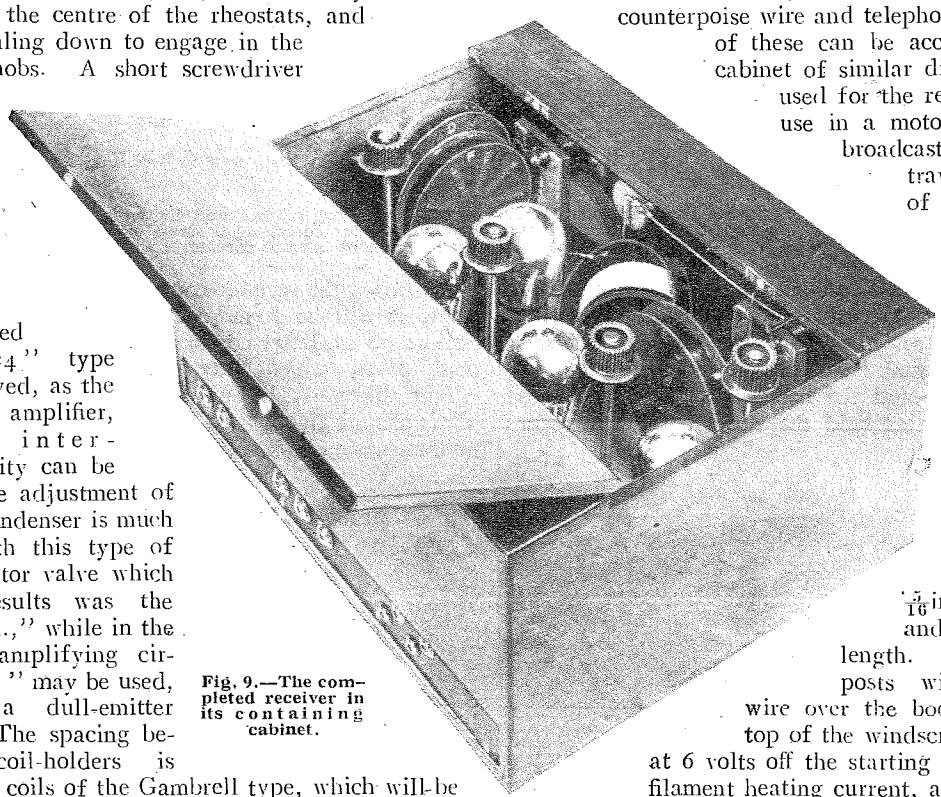


Fig. 9.—The completed receiver in its containing cabinet.

Operation.

It is recommended that a "V.24" type valve be employed, as the high-frequency amplifier, for, although inter-electrode capacity can be allowed for, the adjustment of the balancing condenser is much less critical with this type of valve. A detector valve which gave good results was the Ediswan "A.R.," while in the low-frequency amplifying circuits a "D.E.5" may be used, followed by a dull-emitter power valve. The spacing between the coil-holders is arranged to suit coils of the Gambrell type, which will be found particularly durable for portable set use. For 350 metres a "B" coil will probably be needed for aerial tuning with 80 to 100 feet of single wire and short earth lead, or a "C" coil when using a short mobile aerial of low capacity. For the tuned anode a "C" coil will produce a corresponding range, and the neutralising potential can be developed across an "A" coil. The neutralising condenser should not be left at a particular setting, but adjusted in the process of controlling reaction. As a preliminary step the aerial and anode circuits may be adjusted to the carrier wave of a distant station with the reaction dial at zero and the neutralising condenser at minimum. As the condenser spindle is screwed in, a position will be reached where self-oscillation stops and where by either increasing or decreasing the neutralising capacity distant carrier waves can be tuned in. This is the best working adjustment, and the reaction coupling can be brought into operation as required to increase signal strength and improve selectivity with the centre dial. With a minimum of signal strength, cut down, by receiving with only a short piece of indoor wire the tuned anode dial should be carefully calibrated, the neutrodyne condenser being in the position of correct balance and reaction coupling as near zero as possible. The three semicircles on the dial can be marked to indicate wavelength, station call sign, and the index letter of the anode tuning coil. It is thus only necessary to set this dial to the station required, search on the aerial tuning dial, and finally readjust both.

As a portable set a strap sling is fitted in brass brackets so that the three dials face upwards. The batteries are best carried with the remainder of the equipment, which includes aerial, insulators, earth spike or counterpoise wire and telephone receivers. All of these can be accommodated in a cabinet of similar dimensions to that used for the receiving set. For use in a motor car to provide broadcast reception while travelling, a length of wire extending from the bonnet over the body on to the rear of the car makes a good aerial. If of No. 26 enamelled wire, it is quite inconspicuous when supported by insulators made from $\frac{5}{16}$in. ebonite rod and about $\frac{3}{4}$in. in length. Ebonite binding posts will support the wire over the body or across the top of the windscreen. A tapping at 6 volts off the starting battery gives the filament heating current, and a large capacity dry cell H.T. battery can easily be accommodated in one of the lockers. Where the scuttle of the car is sufficiently deep, the receiver can be accommodated as part of the dashboard equipment or supported beneath it by means of two brass straps. The connections to the battery socket terminals can be flexible leads or, alternatively, a strip of plugs on ebonite will complete the circuits when the receiver is placed in position. When the lighting system operates at 6 volts, it is convenient to derive the filament current supply from the dashboard lamp wiring.

Installed in this manner and with an aerial seven and a half feet in length and earthed on to the petrol pipe and chassis, tests were made along the Great North Road up to 35 miles from London. Good reception of 2LO was obtainable on three pairs of telephones at all times, very little variation of signal strength occurring. Suspecting that the telegraph wires were responsible for the

All Range Portable.—

PARTS REQUIRED.

2 Ormond condensers, 0·0003 mfd.
Variocoupler (Messrs. Henry de Leeuw, Sentinel House, Southampton Row.)
3 "Ultra Vernier" dials (Unique Wireless, 50, Strand, London, W.C.2.)
3 4 B.A. Sterling terminals.
Gambrell neutrodyne condenser.
4 Sterling "Non Pong" valve holders.
4 Ashley (or Federal) type valve holders.
3 Intervalve transformers.
Dubilier condenser, type 620, 0·0002 mfd.
Dubilier condenser, type 620, 0·001 mfd.
"Darco" grid leak, 2 megohms.
2 1 mfd. condensers.
1 2-cell grid battery.
Changeover switch movement, 2-position, 1 pole (Messrs. L. McMichael, Ltd.).
3 Burndept or Edison Bell single coil holders.
Ebonite panel, 13¾in. × 4⅞in. × 5/16in.
Ebonite panel, 13¾in. × 1½in. × 5/16in.
Cabinet to drawing and baseboard (Pickett Bros., Bexley Heath).
5 Plugs and sockets (S. A. Lamplugh Ltd., King's Road, Tyseley Birmingham).
4 Small plugs and sockets (S. Wilding Cole, 116, Snow Hill, Birmingham).
¼in. Brass rod, soldering tags, brass wood screws, 4 B.A. brass screws and nuts.
"Glazit" connecting wire (2 coils, black; 1 coil, red).
Gambrell tuning coils, A, B, and C, for broadcast wavelengths.

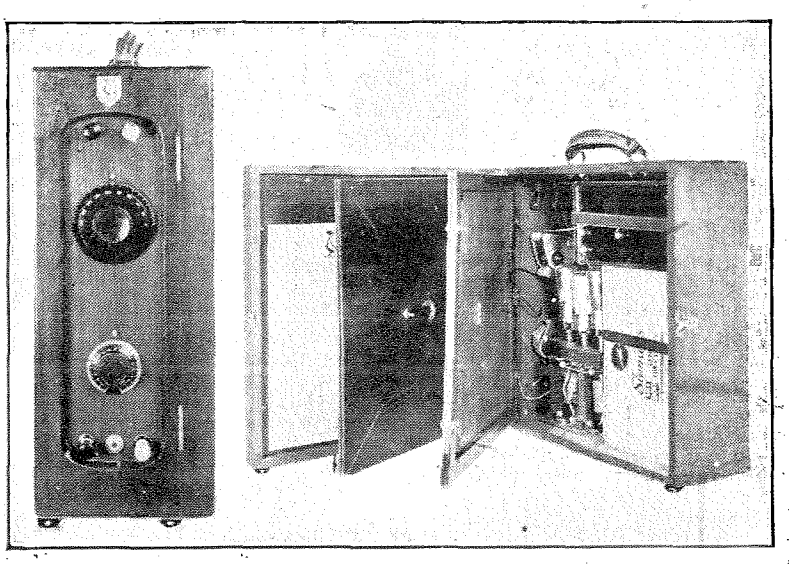
easy manner in which signals were tuned in, tests were made in by-roads with equally good results, except when passing through an avenue of trees, laden with rain. During a cessation in the 2LO transmission, attention was devoted to more distant stations, and both Bournemouth and Cardiff were tuned in, easily readable at constant signal strength; Birmingham was not transmitting at the time. During the run a frame aerial was tried with and without the earth (chassis) connection, but results were not as good as with the insulated wire and down lead from the approximate midpoint. It is interesting to note that not the slightest interference was discernible from the electrical equipment of the car or the ignition, even when coils were inserted to tune down to the ultra short wavelengths. The importance of this point need not be emphasised.

SOME COMMERCIAL PORTABLES.

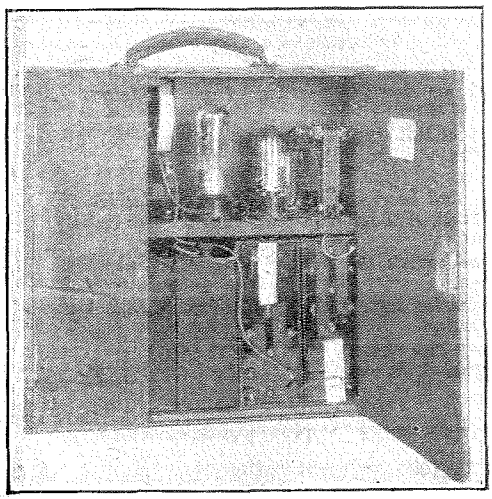
A Wide Range of Portable Receiving Sets is Already Available on the Market, and Brief Technical Descriptions are given of a Few of these Outfits.

THE SILVERTONE.

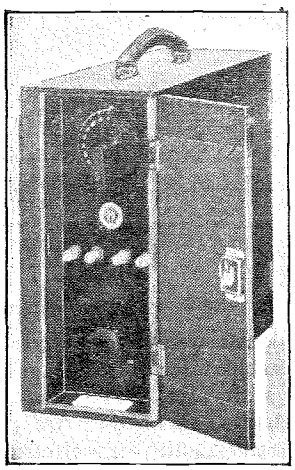
A new feature, not only in portable receiver design, but in wireless construction generally, is to be found in the portable set manufactured by The Astra Dynamo Co., of 124, Victoria Street, London, S.W.1, which is fitted with a metal top panel. The component apparatus is secured to ebonite platforms where necessary, to provide the requisite insulation, and the complete receiving set is carried in a case covered with a black, imitation leather cloth. A second similar container is used for holding the other accessories, such as batteries, telephones, valves, aerial and earth leads. The circuit is a simple one and consists of a valve detector with reaction, followed by a single stage of low-frequency amplification, built with components which give a tuning range of about 300 to 600 metres, employing both tapped inductance and variable condenser control. Reaction is brought about by a basket coil which is arranged to couple with the aerial tuning inductance. The aerial supplied is a rubber-covered wire, weighted at one end so that it can be thrown over some high

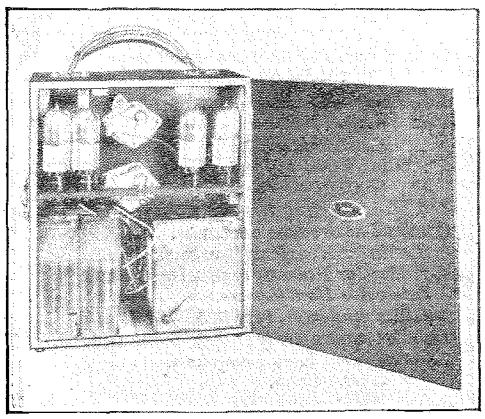


(*Left*) The "Pelican" uses a frame with oscillating detector valve and two stages of low-frequency amplification. (*Right*) Batteries and other equipment for the "Silvertone" receiver are carried in a separate case. A detector valve with variable reaction is fitted, followed by a single low-frequency stage. The instrument panel is of aluminium.



(*Left*) Interior of the "Non-Aerial" set—a three-valve receiver with frame aerial and two low-frequency stages. (*Below*) The "Non-Aerial" receiver. (*Right*) Interior of the "C.A.C." portable.





point and earth connection is made by means of an earth pin. Valves of the B.T.H. B5 type are used, operating from a 4½-volt dry battery.

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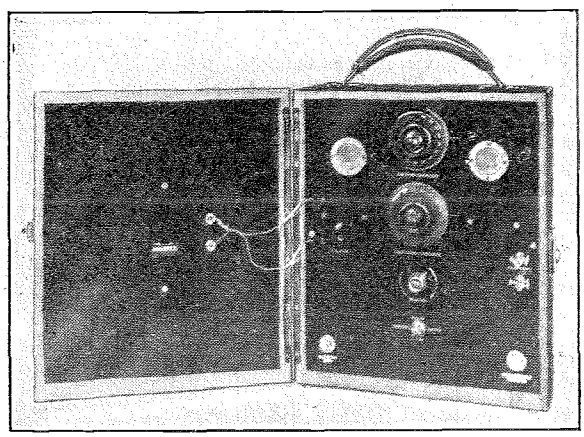
THE PELICAN.

Several novel points in design are to be noticed in this set which is a product of Messrs. Pell, Cahill & Co., Ltd., of 64, Newman Street, London, W.1. In a well-finished mahogany case is carried the entire receiving equipment, including batteries and frame aerial as well as an auxiliary frame inductance



The "C.A.C." portable receiver is a four-valve set, using valves of the ·06 type. It is complete except for loud-speaker, and carries within the cabinet both frame aerial and batteries.

for extending the tuning range. As the circuit consists of a detector valve with magnetic reaction, followed by two low-frequency amplifiers, it is possible to arrange a single dial for tuning, and this is available on the outside of the instrument, though slightly recessed to give the necessary protection.

oooo

THE "C.A.C." PORTABLE.

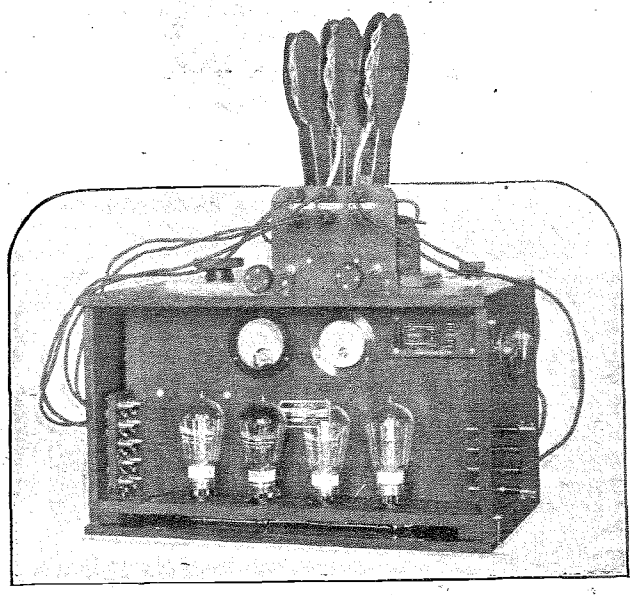
The fitting of a transformer-coupled high-frequency amplifier is a feature of the "C.A.C." receiver manufactured by C.A.C. Radio, Ltd., of 10, Rangoon Street, Crutched Friars, London, E.C.3. Four valves in all are used, the second being a detector which is followed by two low-frequency amplifiers. All valves are of the dull emitter type passing 0.06 ampere, and the filament current is supplied from a 4-volt accumulator. A self-contained frame aerial is fitted in the lid of the case, the latter, measuring when closed 7½×12×14in., being covered with cowhide, and well-finished. Hinged doors at the back and front provide access to the tuning controls and the apparatus behind the panel.

oooo

THE "NON-AERIAL."

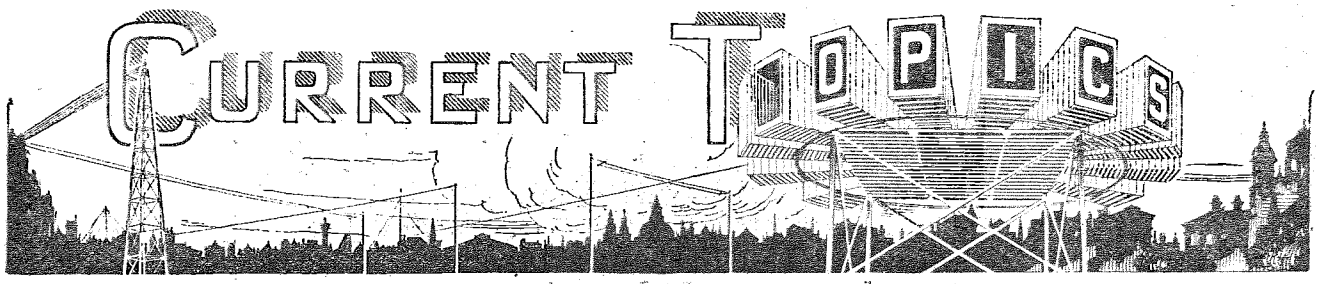
Manufacturers of portable sets usually aim at making their receivers completely self-contained, and therefore employ frame aerials enclosed within the cabinet-work. It would appear that it is considered that the fitting up of an external aerial is undesirable when the set is to be operated by a non-technical listener. With the type of circuit usually employed for portable receiver construction it must not be overlooked that this practice considerably restricts the range of reception, and except when working at exceedingly short distances from the transmitting station, the use of an elevated aerial is generally to be recommended.

The Non-Aerial Wireless Manufacturing Co., of 181, Shaftesbury Avenue, London, W.C.2, are placing on the market a compact outfit contained in a polished mahogany case, measuring 6¼in.×14in.×14in., which contains all necessary equipment, including the batteries. As in several of the sets already described, the circuit consists of detector valve with reaction followed by two low-frequency amplifying valves, which is an arrangement permitting of single knob tuning by the variable condenser connected across a self-contained frame.



[*By courtesy of Marconi's Wireless Telegraph Co., Ltd.*]

Portable 50-watt telephony transmitter. An extensive wave-length range is obtainable by the use of plug-in inductance coils of adequate dimensions.



Events of the Week in Brief Review.

BIRMINGHAM STATION'S MOVE.

A new building is being erected for the Birmingham Broadcasting Station in Broad Street. The studio will accommodate 200 persons.

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LOUD-SPEAKERS IN HOUSE OF LORDS.

The installation of loud-speakers in the House of Lords, to take place shortly, will overcome the difficulty of hearing which has so long been a cause of complaint. The microphones will be camouflaged as gilt-lined books to match the reference books, against which they will be placed on each side of the table.

The amplifiers may occupy the recesses occupied by the figures of mail-clad warriors, but experiments in this direction have not yet been concluded.

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DO YOU HEAR OSLO?

The Oslo broadcasting station is heard very strongly in the Glasgow district, and actually surpasses many of the British stations in volume, according to a correspondent of the *Glasgow Herald*. Its musical standard is, however, inferior.

The wavelength of the Oslo station is 380 metres.

oooo

A DAYLIGHT TRANSMISSION ACHIEVEMENT.

Last week we expressed the hope that it would soon be possible to report two-way working on 20 metres during daylight between England and Australia. No sooner had we gone to press than the news came through that G2OD and A2CM had succeeded.

The course of events is best described by Mr. E. J. Simmonds' log, which runs as follows:—

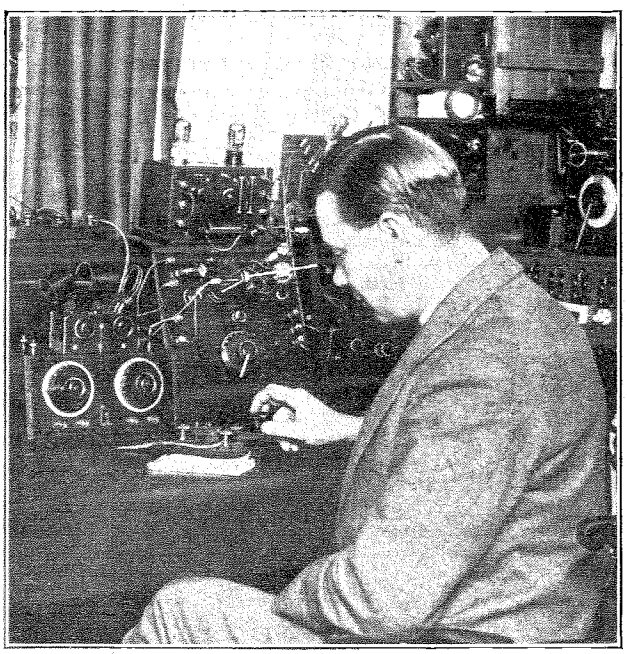
"May 2nd.—G.M.T. 0552. Two-way established between A2CM and G2OD. Exchange of signals until 0715.

"May 3rd.—G.M.T. 0520. Two-way established and following messages received and acknowledged: No. 1. 'To Prime Minister of England.—On occasion of this achievement Australia sends greetings. (Signed) Prime Minister of Australia.' No. 2. 'To Dr. Eccles.—Greetings to your Society from Wireless Institute, New South Wales Division by first 20-metre daylight working. (Signed) Maclurcan.'"

Mr. Simmonds replied with the following message: "Greetings to Wireless Institute by direct amateur 20-metre working from R.S.G.B. (Signed) Eccles."

Signals from A2CM were good, but fading was very noticeable.

An interesting feature of the test is that it was carried out by arrangement, with a view to proving the theory of Mr. J. L. Reinartz that signals on 20-metres can travel enormous distances in daylight all the way and are specially suitable for this purpose. These conditions were fulfilled in the test, Australian time being 10 hours fast of Greenwich.



DAYLIGHT WORKING WITH AUSTRALIA. Mr. E. J. Simmonds (2OD), the well-known amateur of Gerrards Cross, Bucks, whose achievement in obtaining two-way communication with Mr. C. D. Maclurcan (Australian 2CM) during daylight on 20 metres, is one of the most notable events in amateur history.

Mr. Simmonds employed a T50 transmitting valve, though differing from the standard type in having the grid and plate leads thickened. A.C. was used for the filament and rectified A.C. for the plate. The aerial at 2OD is of the "T" type, so arranged that the middle of the down lead is 50ft. from either end. A six-wire counterpoise completes the outdoor equipment. The aerial tuning condenser is of the new Igranic low loss type; whilst the condenser used in the counterpoise is a General Radio instrument with Pyrax supports.

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ENTHUSIASM IN THE ARGENTINE.

According to the latest reports, the number of licensed wireless receivers in the Argentine exceeds 300,000. The number is said to be steadily increasing.

oooo

WIRELESS *V.* COMMUNISM.

Owing to the Communist troubles in Paris, two motor lorries equipped with wireless telephony transmitters are patrolling the streets of the city in readiness to report any disturbance to the Prefect of Police.

oooo

KOENIGSWUSTERHAUSEN NEARLY READY.

The giant station at Koenigswusterhausen, Germany, is almost completed, and will probably be put into active service at the end of this month. The power of the station will be 20 kilowatts, and its wavelength will lie somewhere between 1,200 and 1,300 metres. The height of the antenna is 850 ft.

oooo

NEW FRENCH BROADCASTING STATIONS.

The patience of a vast army of potential listeners in various parts of France is shortly to be rewarded. The French are now rapidly installing a series of broadcasting stations throughout the country, including installations at Toulouse, Bordeaux, Strasbourg, and Angers.

This recognition of the needs of the public will be the cause of much rejoicing, for France has remained strangely behind most European nations in the matter of broadcasting.

Constructional work has been completed at the Toulouse station, which forms part of the General Post Office premises, and it is expected that programmes on 450 metres will commence almost immediately.

WANTED: A PATRON SAINT.

A search for a patron saint for radio is being conducted by the French magazine: "La T.S.F. pour Tous." At present there are a number of candidates for the honour, the most favoured being St. Antoine de Padoue, who is said to have projected his voice into the village church of St. Pierre des Quatre Chemins, while preaching by the roadside.

Sainte Philomene has also been nominated, for the cogent reason that the name might be construed as "Sans fil, Amen."

Claims for St. Joan of Arc are strongly supported for the reason that she heard voices.

oooo

NRRL GETTING ACTIVE.

Mr. F. H. Schnell, traffic manager of the American Radio Relay League, whose experimental trip with the U.S. Pacific Fleet was referred to recently, has lost no time in getting to work. His signals have been picked up by a Rhode Island amateur, Mr. Neal Judkins, of East Providence. This means that he has transmitted half-way across the Pacific and across America. Admiral Koontz, commander-in-chief of the U.S. Fleet, took the opportunity to transmit greetings to the A.R.R.L.

oooo

B.B.C. AND THE THEATRES.

An announcement that agreement had been reached between the B.B.C. and the theatre interests was made on May 8th.

One of the main clauses of the agreement is that plays shall not be broadcast more than once a fortnight, and first nights shall not be transmitted. It is understood that only excerpts may be broadcast, but any plays deemed suitable by the programme manager of the British Broadcasting Company will be available.

CHEAPER VALVES.

Important reductions in the price of valves were made by the leading manufacturers on May 6th. The following lists have been received:—

M.O. Valve Co., Ltd.:—

D.E.R. (general purpose), from 18s. to 14s.; D.E.6 (L.F. amplifier), from 22s. 6d. to 18s. 6d.; R. (general purpose), from 11s. to 8s.; D.E.3 (general purpose), from 21s. to 16s. 6d.; D.E.3.B. (L.F. amplifier, for resistance capacity), from 21s. to 16s. 6d.; D.E.4 (L.F. amplifier), from 26s. to 22s. 6d.; R.5.V. (general purpose), from 11s. to 8s.; D.E.5 (L.F. amplifier), from 30s. to 22s. 6d.; D.E.5B. (L.F. amplifier, for resistance capacity), from 30s. to 22s. 6d.; L.S.5 (L.F. amplifier), from 50s. to 40s.

The Ediswan range was affected as follows:—A.R., from 11s. to 8s.; R., from 11s. to 8s.; A.R.D.E., from 18s. to 14s.; A.R.06, from 21s. to 16s. 6d.; P.V.1, from 35s. to 22s. 6d.; P.V.2, from 35s. to 22s. 6d.; P.V.3 to remain at 22s. 6d.; P.V.5DE, from 30s. to 22s. 6d.; P.V.6DE, from 22s. 6d. to 18s. 6d.; and P.V.8DE, from 30s. to 22s. 6d.

The retail price of the British "Puratone" valve has been reduced to 6s. 9d.

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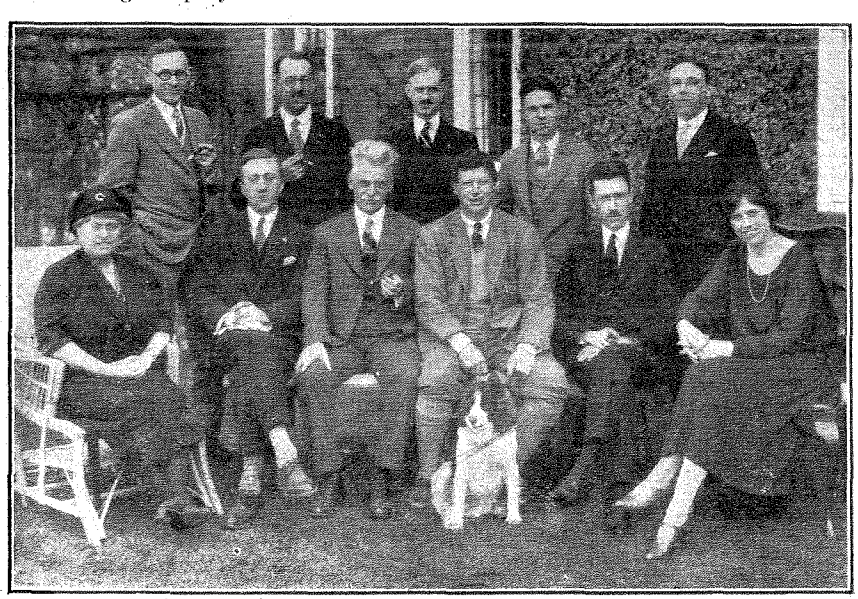
RADIO SOCIETY OF GREAT BRITAIN.

An informal meeting of the Society will be held this evening (Wednesday) at 6 o'clock, at the Institution of Electrical Engineers, Savoy Place, W.C.2. Mr. R. H. Kidd, B.A., will open a discussion on "An Attempt at Quantitative Experiments on Modulation."

At an ordinary meeting of the Society, on May 27th, Mr. F. M. Colebrooke B.Sc. will lecture on "The Rectification of Small Radio Frequency potential Differences."



AN INTERNATIONAL GROUP. An interesting photograph, taken at G2NM, shortly after the Paris Conference. Front row (left to right): Mrs. Hiram Percy Maxim, M. Mezger (France), Mr. Hiram Percy Maxim (President of the A.R.R.L.), Mr. Gerald Marcuse (2NM), Mr. K. B. Warner (Secretary A.R.R.L.), and Mrs. Gerald Marcuse. Back row (left to right): Mr. Hight (U.S.A.), Major W. C. Borrett (Nova Scotia), Mr. Reid (Newfoundland), Mr. J. Morris (U.S.A.), and Mr. Nicholls (Great Britain).

LECTURES ON THE THERMIONIC VALVE.

A course of six lectures on "The Thermionic Valve and its Uses in Wireless Circuits" is to be given on Tuesdays at the Polytechnic, Electrical Engineering Department, 309, Regent Street, London, W.1, from 6.30 to 8.30 p.m. The lecturer is Capt. W. H. Date, B.Sc., A.M.I.E.E. The commencing date is May 19th, and full particulars and a syllabus of the course can be obtained on application.

oooo

RUSSIAN AMATEUR AT WORK.

Two-way working between Russia and France was heard by Mr. L. C. Snowden, of Weybridge, on April 29th. The Russian, who was working with A.C. on 50 metres, was identified as R2BR, and he was in communication with F8JA.

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TRANSMITTING NOTES.

News from the Amazon.

2NM's achievement in working with the Rice Expedition on the Amazon is recalled by an interesting letter which Mr. Gerald Marcuse has received from Mr. J. W. Swanson, operator in charge of the wireless equipment of the expedition. In the course of the letter Mr. Swanson relates how on three occasions the canoe containing the wireless apparatus was nearly swamped in the whirlpools and rapids; twice, in fact, the transmitter was soaked, and had to be put in the sun to dry!

oooo

Only One Valve Left.

The station consists of a 25-watt VT transmitter, and ordinarily employs two 50-watt valves. A small generator delivers 500 volts to the plate instead of the rated 1,000 volts. Unfortunately, owing to the difficulties of travel and a little hard luck, the installation was reduced to one valve, making the antenna output about 13 watts. Mr. Swanson continues: "Considering I'm using a one-wire 'T' antenna (adequate counterpoise, etc.), 40ft. in length and 50ft. in height, right in dense primeval forest, this short-wave stuff is truly remarkable. Your signals come in very strong on detector alone, using counterpoise as receiving antenna."

oooo

20-Metre Working.

Undoubtedly the most notable performance of the past few days has been Mr. E. J. Simmonds' daylight working with A2CM in daylight on 20 metres. A full report of the achievement appears on another page.

oooo

Good Work on 45 Metres.

A considerable amount of work is being carried on by members of the Transmitter and Relay Section on the 45-metre wavelength, and reports go to show that this wave also travels great distances during daylight. Mosul can be worked in daylight all the way, and reports from Canada indicate daylight reception of Britishers over there.

THE THREE ELECTRODE VALVE DETECTOR.

Principles of Anode Current and Grid Leak Rectification.

By R. D. BANGAY.

THERE is an important difference between the action of a valve detector and that of a crystal detector. In the case of a crystal detector, the energy expended in the telephone receivers is actually drawn from the oscillatory circuit; with the result that the detector necessarily increases the damping of the oscillatory circuit. In the case of a valve detector, the energy which operates the telephone receivers is drawn from the local H.T. battery, and the only loading imposed on the oscillatory circuit is the small power expended in the grid circuit of the valve. Power is the quotient of the current flowing in a circuit and the voltage applied to that circuit, consequently, if the current in the grid circuit is zero, the power taken from the oscillatory circuit is also zero.

We showed in a previous article that the current in the anode circuit of a valve is controlled by the potential of the grid, and that changes in the grid potential are not necessarily accompanied by a flow of grid current. In any case, however, the grid current is extremely small as compared with the anode current, and, consequently, the expenditure of the energy in the grid circuit (which is drawn from the oscillatory circuit) is extremely small as compared with the energy liberated in the telephone circuit. Thus the extra load imposed on the oscillatory circuit by a valve detector may be practically disregarded in so far as it affects the damping of the oscillatory circuit.

Comparison with a Crystal Detector.

The characteristic curves of a crystal detector and of a three-electrode valve are plotted under steady voltage conditions assuming an unlimited supply of energy from the source of the E.M.F. In practice, however, any loading of the oscillatory circuit results in a lower voltage amplitude being attained by a given signal than would otherwise be the case. If, therefore, we are using a crystal detector, a given signal will create a substantially lower amplitude across the detector circuit than if we are using a valve detector.

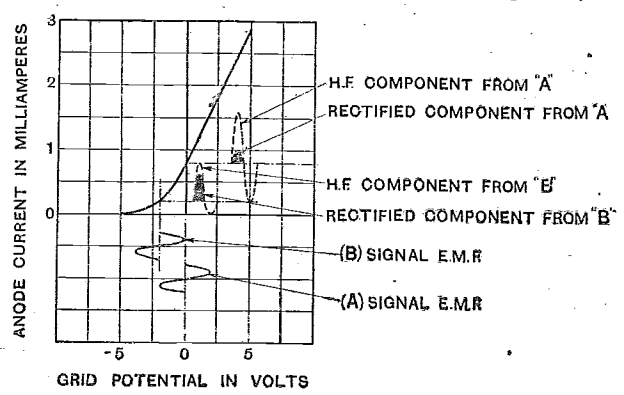


Fig. 1.—Portion of the grid volts-anode current characteristic of a valve and a diagrammatic representation of rectification.

No useful comparison can, therefore, be made between the plotted characteristic curves of a crystal, on the one hand, and of a valve, on the other, with a view to forming an estimate of their relative sensitiveness as detectors. The only way to form an idea in this respect is to compare their performance under working conditions. If this be done it will be found, generally speaking, that the sensitiveness of a good crystal detector is somewhat higher than that of a valve detector. Against this, however, we must remember that by the use of reaction a valve detector can be made many times more sensitive than a crystal detector, and also that the loading imposed by a crystal detector on the oscillatory circuit reduces the selectivity of the receiver circuits.

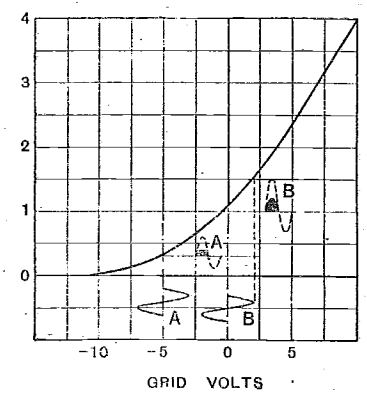


Fig. 2.—Rectification with a "general purpose" valve.

Anode Circuit Rectification.

There are two distinct methods of using the properties of a three-electrode valve for the purpose of detection. The most obvious of these two methods is known as "anode current" detection, and makes use of the bend in the characteristic "grid volts-anode current" curve in much the same way as is done in the case of the crystal detector, except, of course, that, in this case, the resulting telephone current is derived from an independent source. In order to obtain optimum detection or rectification in this way, the normal potential of the grid relatively to the filament must be adjusted to that point of the bend of the anode current where the difference between the changes in current due to any two successive half cycles of high-frequency E.M.F. applied to the grid is greatest.

This can be more easily appreciated by referring to Fig. 1, which illustrates diagrammatically the results of applying a given signal E.M.F. of 2 volts amplitude to a certain valve having a grid volts-anode current characteristic, as shown. We have illustrated in this diagram the effect of applying a signal E.M.F. to the grid in two cases:—(A) when the normal potential of the grid is zero, and (B) when the normal potential of the grid is

The Three Electrode Valve Detector.—

adjusted to negative 2 volts; the latter point comes just on the bend of the curve, whilst the former point occurs at a point approaching the straight part of the curve. The resulting current in the anode circuit is illustrated in the usual way to the right of the characteristic curve, while the rectified component of this resulting current, which is the difference between the positive and negative pulses, is indicated in black. This clearly shows that a very much greater rectified component is obtained when the normal grid voltage is adjusted to the bend of the curve, and, since the audibility of the signal in the telephone depends upon the rectified component of the current passing through it, the sensitiveness of the detector is obviously greater when adjusted to the bend of the curve.

The characteristic curve illustrated in Fig. 1 is plotted from a Type QX valve which has been specially designed for detection purposes, and for this reason has a very much sharper bend than is found in the curve of an ordinary general-purpose valve, such as the R valve.

Circuit Connections for Anode Detection

The characteristic curve of a general-purpose valve is shown in Fig. 2, where we have also indicated in the same way the result of applying an equal signal E.M.F. of 2 volts to such a valve. From this figure it will be seen that even when the normal grid voltage is adjusted to the optimum point, the rectified component of the resulting anode current is very much smaller than is obtained in the case of the Type QX valve illustrated in Fig. 1; thus, when employing this method of detection it is most desirable to procure a special valve for the purpose.

The arrangement of the circuit for this method of detection is shown in Fig. 3. The grid of the valve is connected across the points of maximum potential of the oscillatory circuit, *i.e.*, across the inductance L. The normal potential of the grid is regulated by means of a potentiometer resistance R connected across the filament working in conjunction with a small dry battery BG arranged to give the grid a negative bias potential relatively to the filament. The amount of negative bias can thus be regulated in steps by tapping from cell to cell

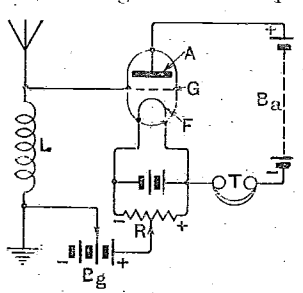


Fig. 3.—Arrangement of the circuit for anode rectification.

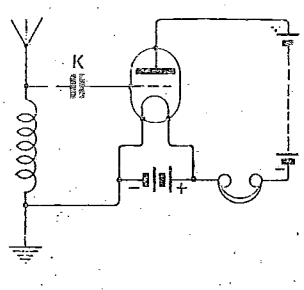


Fig. 4.—The grid condenser and leak method of rectification.

along this grid battery while intermediate potentials between these steps can be obtained by sliding the contact S along the resistance R. The most sensitive adjustment can quickly be found in practice by trial.

Grid Leak Rectification.

The other method of using the properties of the three-electrode valve for the purpose of detection is known generally as the "Grid Leak" method of detection. In the method just described, rectification is entirely independent of any flow of current in the grid circuit; in fact, the conditions of the circuit may be such that the whole of the signal oscillations take place to the left of the zero grid voltage line, as in the case of "B" in Fig. 1, in which case no grid current will flow in the circuit. In the grid leak method of detection, on the other hand, the grid current is made use of to vary the potential of the grid apart from or in addition to the potential changes given to it by the signal E.M.F., and the action of the circuit does not in any way depend upon the bend in the characteristic curve.

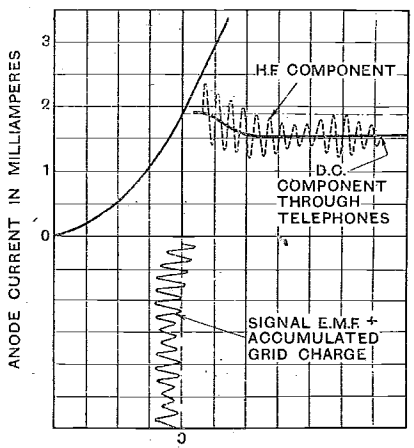


Fig. 5.—Explaining grid leak rectification.

Any current flowing through the vacuum of a valve either from the filament to the grid or from the filament to the anode is carried by electrons which, as we know, carry with them a negative charge of electricity. In the case of the circuit illustrated in Fig. 3 any flow of electrons from the filament to the grid, constituting the grid current, have a perfectly free passage through the external circuit, *i.e.*, through the inductance L back to the filament, and therefore any charge carried by these electrons to the grid is immediately dispersed and the potential of the grid is unaffected. In the grid leak method of rectification, the grid current is trapped by a small condenser connected between the external circuit and the grid, as shown at K in Fig. 4, so that any electrons arriving at the grid accumulate and charge up this condenser and the grid to a negative potential. Being unable to flow either through the external circuit by reason of the insulating properties of the condenser dielectric or through the vacuum of the valve from the cold electrode to the filament, the charge induced on the grid in this way would be a permanent one unless some path is provided through which the charge can be dissipated. If, therefore, a high-frequency potential of, say, 1 volt amplitude, is generated across the inductance L by an incoming signal, an alternating potential of 1 volt will be communicated to the grid G of the valve through the condenser K. Moreover, each time the grid becomes positive relatively to the filament, a number of electrons will pass from the filament to the grid and into the condenser, charging up both grid and condenser to a certain negative potential depending upon the capacity of the condenser and the quantity of electrons passed to it. This negative charge, whatever its value may be, must, of course, be subtracted from any future positive impulses applied to the grid by the signal, and, therefore, subsequent positive half cycles of the signal E.M.F. will produce a positive charge on the grid of 1 volt minus the negative charge accumulated during the preceding half cycles.

The Three Electrode Valve Detector.—

Taking first of all the case illustrated in Fig. 4, where there is no path through which the charge can leak away, and assuming to begin with that the grid G is at zero potential, then obviously the first positive half cycle of the signal E.M.F. will make the grid momentarily one volt positive to the filament F, causing a small current impulse to flow from F to G and thus causing the grid G and condenser K to become slightly negative to the filament. Since the grid current is an extremely small one and the period of time occupied by a half cycle is extremely short, it is possible that the quantity of electrons which are trapped at G in a single half cycle would charge the condenser to a smaller negative potential than the amplitude of the signal, but, as each successive positive half cycle of signal E.M.F. will add to this charge, the potential of the grid will be raised in the course of a few cycles to a negative value equal to the maximum amplitude of the signal E.M.F. After this point is reached the signal E.M.F. can never bring the grid to a positive potential relatively to the filament, and therefore no further increase or decrease in the negative potential of the grid can be created by signal oscillations of equal or smaller amplitude; in fact, the grid will remain set at a negative potential equal to the maximum amplitude of the signal oscillations.

This effect, as well as the resulting current variations in the anode circuit, are illustrated in Fig. 5. In this diagram the signal E.M.F. is shown as a group of H.F. oscillations with a constant amplitude of one volt. Due to the current flowing from the filament to the grid during a short period of each of the first four cycles when the grid is positive relatively to the filament, the normal potential of the grid is gradually changed during this first few cycles from zero value at the commencement to -1 volt at the end of the fourth cycle. Thereafter the voltage impressed on the grid never carries it beyond zero grid volts, and consequently no further permanent charge is added to the grid. Thus it will be seen that the effect of the signal potential is twofold; firstly, it induces a H.F. change in the voltage of the grid at all times equal to the amplitude of the signal, and secondly it gradually produces a permanent change in the potential of the grid equal to the maximum amplitude of the signal.

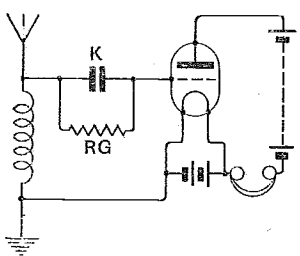


Fig. 6.—A valve connected for grid condenser and leak rectification.

The effect of these changes on the anode current is also twofold; first of all there is a high-frequency change in the current due to the H.F. changes in the grid volts, as illustrated by the dotted line curve in Fig. 5, and secondly, there is the gradual permanent change in the curve illustrated from 1.9 milliamperes to 1.5 milliamperes, due to the accumulated negative charge on the grid. If, as in the case we are considering, the anode circuit includes the highly inductive windings of a telephone receiver or transformer, the only change in current passing through these coils due to the signal will be the gradual change from 1.9 milliamperes to 1.5 milliamperes, because the inductance of these windings offers an enormously high impedance to any high-frequency fluctuations.

Rectification of Modulated Waves.

It now remains to be seen how this gradual change, due to the accumulated charge on the grid, can be made to respond always in proportion to the amplitude of the signal oscillations. In the circuit which we have been considering, and which was illustrated in Fig. 4, this change only adjusts itself once and for all to the maximum amplitude of the signal, at which value it remains permanently set owing to the persistance of the charge on the grid. Suppose, however, we partially destroy the permanence of this charge accumulated on the grid by providing a leakage path across the condenser K, as shown by RG in Fig. 6, through which that charge can gradually leak away. It is not difficult to see that the maintenance of the charge on the grid will depend upon a continuation of the signal oscillations which at each positive half cycle will have to make good the leakage occurring during the negative half-cycle. Moreover, that as the amplitude of the signal oscillations becomes less, so also will the accumulated charge on the grid leak away until it adjusts itself automatically to the new value equal to the signal oscillations. In this way the variation of the normal grid potential and also of the anode current flowing through the telephones will fluctuate in sympathy with the sound modulations impressed on the carrier wave. This effect is illustrated in Fig. 7.

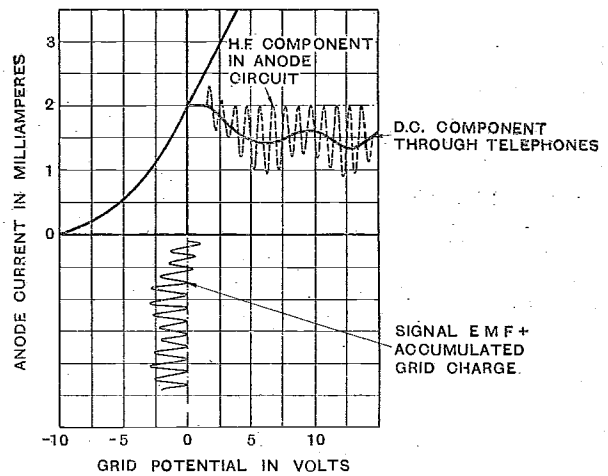
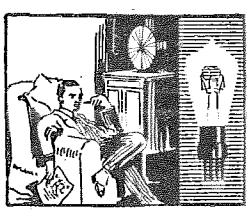
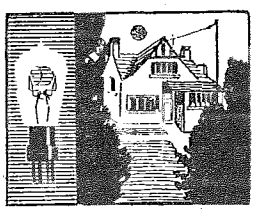


Fig. 7.—Rectification of a modulated wave.

To obtain the best result it is, of course, necessary that the leakage path across the condenser be of a suitable value. If the leakage takes place too rapidly, obviously there will be very little or no accumulation of negative charge built up by the signal. On the other hand, if the leakage is too slow, the grid potential will not adapt itself quickly enough to a smaller amplitude of oscillations, and therefore a suitable intermediate value of leakage resistance must be chosen to meet both these conflicting requirements. In practice it will be found that the capacity of the condenser K, which must also be taken into account, will be approximately .0003 mfds., and the resistance of the leak across it about 1 to 2 megohms, depending upon the type of valve used.



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.*

Radio Society of Highgate.

An entertaining report of the Paris International Amateur Conference was given by Mr. H. Andrewes, B.Sc., on Thursday, April 30th. He described in great detail the work carried out at the various meetings and gave a humorous account of the many incidents which took place "not according to schedule," owing to the language difficulty.

Visits to the Eiffel Tower, Malmaison and Ste. Assise appear to have afforded a great amount of interest. The transmitting apparatus at Ste. Assise evoked particular attention, and the party were much impressed by the enormous counterpoise which extends over several hundreds of acres.

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

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Selfridge Club Radio Society.

A Radio Society has been formed composed entirely of members of the staff of Messrs. Selfridge and Co., Ltd. It has already been affiliated to the Radio Society of Great Britain. The society's experimental room and workshop is situated at No. 32, Orchard Street, W.1, where debates and informal meetings will be held weekly.

A series of lectures is being arranged for the coming month, and it is confidently hoped that the new organisation will soon rank amongst the most active societies in the country.

The Hon. Secretary is Mr. J. O. Edley-Edwards.

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Northern Radio Association (Ireland).

At a recent meeting in the association's rooms the programme for next winter session was outlined. Lectures by well-known scientists and radio workers in Northern Ireland are being arranged, and will be delivered on the first and third Thursdays in each month from October to April. A dance is also arranged for the end of next October.

The work of the past winter was reviewed, and 19 new members were elected.

Intending members from any part of Ulster should write to the Hon. Secretary, Mr. John A. Sang, Northern Radio Association (Ireland), 47, Chichester Street, Belfast.

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Streatham Radio Society.

Owing to the largely increasing membership, the society has had to remove to larger headquarters at the Hyde Farm Social Club, Radbourne Road. Their first meeting was held there on April 30th, when an interesting lecture was given by Mr. E. H. Shaughnessy, O.B.E., Assistant Engineer-in-Chief at the General Post Office. Mr. Shaughnessy dealt with the wireless work of the G.P.O. since the early days of radio, and proceeded to describe the work carried on at the Leafield, Northolt and other Post Office stations. The lecture was illustrated by lantern slides.

The annual general meeting of the society will be held on May 14th.

Hon. Secretary: Mr. N. J. H. Clarke, 26, Salford Road, S.W.2.

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Bristol and District Radio Society.

An enjoyable visit to the Cardiff Broadcasting Station was paid by 100 members and friends of the Bristol and District Radio Society on Saturday, April 25th. They were met at the studio by the Assistant Director, Mr. Norman Settle, and Miss L. King, in the absence of the Station Director, Mr. E. R. Appleton. The party first inspected the studio and the control room, and then proceeded to the transmitting station. A collection made at the studio resulted in £5 5s. being handed over to the fund for providing the Bristol Royal Infirmary with artificial sunlight apparatus.

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Ilford and District Radio Society.

A most interesting lecture and demonstration on "Loud Speakers" was given by a representative of Messrs. Alfred Graham and Co. on Tuesday, April 28th. The speaker, who illustrated his remarks with lantern slides, dealt with both the manufacture and use of loud speakers. He also outlined the causes of distortion in loud speaker operation, and mentioned that in the majority of cases the set was responsible. Slides were shown of the various processes in the manufacture of the famous "Amplion" loud speaker.

The Hon. Secretary of the society is Mr. F. W. Gedge, 157, High Road, Ilford.

FORTHCOMING EVENTS.

WEDNESDAY, MAY 13th.

Radio Society of Great Britain.—Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Discussion to be opened by Mr. R. H. Kidd, B.A., "An Attempt at Quantitative Experiments on Modulation."

THURSDAY, MAY 14th.

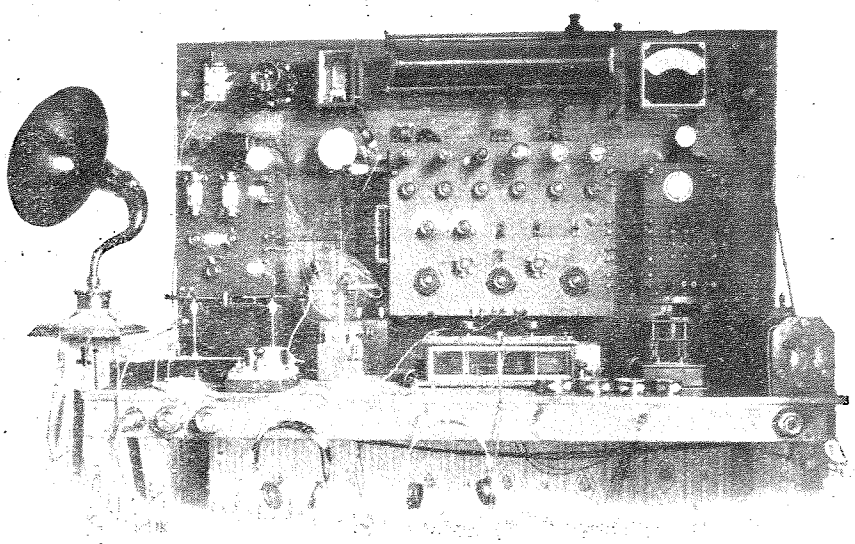
Streatham Radio Society.—At the Hyde Farm Social Club, Radbourne Road. Annual General Meeting.

MONDAY, MAY 18th.

Eastern Metropolitan Group Radio Lecture Association (R.S.G.B.).—At 7.30 p.m. (Tea at 7). At St. Bride's Institute, Bride Lane, Ludgate Circus, E.C.4. Lecture: "Short Wave Transmission." By Mr. F. H. Haynes.

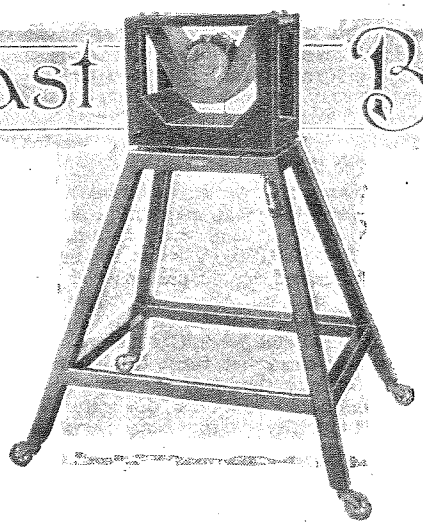
WEDNESDAY, MAY 20th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Mast and Aerial Equipment." By Mr. W. J. Turberville-Crewe.



An imposing amateur layout. This photograph shows the equipment at the experimental station of Mr. H. W. Heppel, of Wimbledon.

Broadcast Brevities



TOPICALITIES FROM SAVOY HILL.

"No Admittance Except on Business."

Visitors to the Oxford Street transmitter are not to be admitted during the hours of transmission. In response to numerous requests the B.B.C. has already arranged a number of afternoon visits, and these will be permitted probably until the end of May, the number of persons admitted at one time being limited to five. The B.B.C. explains, by way of apology, that visits cannot but distract the attention of the staff from the more serious work of tending the new station and getting the best that they can out of it, a duty indubitably necessary in these days when listeners in certain districts complain so bitterly about the change over from Marconi House to Oxford Street; a change, in the opinion of many, from good to bad.

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Reports Required.

The engineers, by the way, ask me to invite listeners to keep a careful note of the effects during the next week or two, as reports will presently be required and will be extremely valuable if they come from listeners themselves.

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Brighter Talks.

I learn that the B.B.C. are trying to discover means of brightening the Talk items in the programmes, while enhancing their educational value. The Talks by Professor Peers from the Nottingham Station recently wound up with a discussion of the points raised by the lecturer. The idea will be extended in the near future, and various Talks will take the form of discussion and debate. Early in June, for example, Mr. John Strachey and Mr. C. E. M. Joad will have as their subject: "Is Shakespeare better than Garvice?"

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Delay at Daventry.

Since last week's Brevities appeared, I have been informed that the high-power station at Daventry will not be ready in June, as originally planned, and that August is the earliest month during which it can be brought into service. The two masts, which will be 500 feet in height, have been built up to 80 feet, but the manufacture of some of the electrical apparatus for the station has been unavoidably delayed.

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Alternative Programmes.

London listeners are more relieved at this delay than might generally be supposed. The Metropolis is poorly served with alternative programmes, but Chelmsford, for what its programmes are worth, fulfils a certain purpose and caters for a fairly large clientele, and although the city lies within the high-power crystal area, the distance is certainly great for the vast and straggling metropolitan area, where the larger proportion of listeners is to be found.

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Wavelengths.

Which station is working on 326 metres—Edinburgh or Nottingham? Curiously enough, both have been doing so, apparently without heterodyning. Edinburgh has had a somewhat adventurous career in wavelengths. She has worked on 325, 328, 465 and 326 metres. It is singular that no listener seems to have spotted the parallelism, or at any rate, to have raised any sort of protest.

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Wireless Affected by Railways.

Reports have been received that owing to the electrification of a section of a certain railway near London, receiving sets are being affected as far away as a mile from the line. A curious feature is that in some cases aerials sloping in different directions from the railway are affected in different ways. Telephones also are suffering. It is singular that elsewhere railways seem to have litttle effect on broadcast reception.

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York Minster.

For the recent broadcast of the Military Service from York Minster, microphones were placed in several positions and preliminary experiments made so that the transmission could be arranged artistically, i.e., by the manipulation of the controls perfect acoustical results were obtained and echo either introduced or subdued at will. This engineering feat produced extremely satisfying results. In many churches throughout the country the Minster Service was broadcast by means of loud-speakers; in private houses in York it was picked up from Chelmsford. Within the Minster the congregation seated some distance away from the pulpit were able to catch only a word here and there of the preacher's discourse, whereas two hundred miles away every word was heard distinctly.

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An Official Listening Post.

An official listening post is, I am told, to be established by the B.B.C. near Bromley, Kent, with a receiver which can get all stations, so that in the event of any wavelength variations, the earliest possible information may be available. D.F. apparatus will be installed and efforts made at this centre to check jamming and other interference. The listening post will be used as a medium for linking up with KDKA and the Continent.

FUTURE FEATURES.

Sunday, May 17th.

LONDON.—9 p.m., Music of Italy.

BIRMINGHAM.—9 p.m., Bach programme.

MANCHESTER.—3.30 p.m., The Opera, "La Traviata" (Verdi).

Monday, May 18th.

ALL STATIONS.—10.5 p.m., Act III. of the Opera, "Der Rosenkavalier" (Strauss). Relayed from the Royal Opera House, Covent Garden.

Tuesday, May 19th.

SCOTTISH STATIONS.—11 a.m.-12 Opening Ceremony of the General Assembly of the United Free Church of Scotland.

SCOTTISH STATIONS.—1 p.m., Speeches by the Earl of Elgin and Kincardine, and the Moderator, at the Opening of the General Assembly of the Church of Scotland.

Wednesday, May 20th.

LONDON.—8 p.m., Historical Pictures in Music.

LONDON.—10.40 p.m., Milton Hayes, the Laughmaker with a Philosophy.

BELFAST.—7.30 p.m., Symphony Concert.

Thursday, May 21st.

LONDON.—8 p.m., Band of H.M. Coldstream Guards.

ALL STATIONS.—10.20 p.m., Act. III. of the Opera, "The Valkyries," relayed from the Royal Opera House, Covent Garden.

CARDIFF.—8 p.m., Beauty in Music.

Friday, May 22nd.

LONDON.—9 p.m., Ballad Programme.

MANCHESTER.—7.30 p.m., Concert in aid of the Salford Royal Hospital, relayed from the Palace Theatre, Salford.

LEEDS-BRADFORD.—8 p.m., Memories of Old Yorkshire.

To Overcome Interference.

The royal road to the overcoming of interference, however, will be by the raising of the power of Continental services, the elimination of many of the spark systems on 450 metres, and a mutual arrangement between the various European countries through the International Bureau.

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An Uphill Task.

Mr. Arthur Burrows, late of the B.B.C., is finding his task at Geneva, in connection with the Bureau, anything but a bed of roses. At present he has only one general assistant and a typist, and his time is pretty fully occupied in dealing with the thousands of letters and telegrams which reach his office daily. He is shortly making arrangements to transfer as much as possible of the routine work to other hands in order to leave himself free to tackle some of the bigger questions, such as the re-distribution of wavelengths and the prevention of interference, which he has always recognised as calling for early solution. He will not at present concern himself with the interchange of programmes. The fact is that the relaying of Continental stations is not regarded seriously by the B.B.C. "It may be all right as a noise," say the B.B.C. engineers, "but it is absolutely hopeless as a programme."

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A Plea for Individuality.

It is a subject for consideration whether the high-power station with its audience composed mainly of country residents should be used for alternative programmes. Rather, should it not cater for the parsonage, the hall and the residences of retired business or service men with a distinctive programme, leaving London, the centre of diversity, to supply the needs of the metropolitan area from 2LO solely and from another station or stations as may be found expedient in the course of time?

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Remember the Crystal User.

At present it is estimated that main stations serve a crystal population of ten million listeners, and the high-power station about 750,000. The former figure can be increased by 50 per cent. if the plans now in hand materialise, while the Daventry station will double the crystal facilities provided from Chelmsford. It is, however, somewhat futile to dismantle the Chelmsford station if it means that more than half a million of the potential crystal population in the south is to be left without wireless facilities *via* the crystal detector.

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Irish Listeners.

The suggestion has been made that as many thousands of people in the Irish Free State listen nightly to the programmes of the B.B.C., but do not contribute directly towards the expense of providing them, the Free State listeners should provide, at their own expense, one complete night's entertainment from the high-power station, the night to be an "Irish Night" with artists from Ireland. A section of Irish listeners, however, on patriotic grounds, have put forward a counter-proposal for establishing a broadcasting service in the Free State, to avoid as far as possible relying upon the British broadcasting service for the entertainment of listeners. The Free State Government are drawing £1 per annum on each licensed receiving set, and are keeping the money in their own coffers. If a broadcasting service is established in the Free State, the Government may be generous enough to hand over some part of their profits to start the service on its way.

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What Becomes of it All?

Does the ether contain records of speech and music from the beginning of time? Mr. Fielder, engineer at the Nottingham station of the B.B.C., is rather cautious. He does not think that, even given sufficiently sensitive apparatus, it would be possible to pick up the conversations of Antony and Cleopatra, the speeches of Disraeli or Pitt, or even the tones of Queen Victoria's voice; but he does think it possible that anything broadcast to-day could be picked up at any time within a month. He declares that he has himself picked up news a week after it had been broadcast.

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After Chelmsford Closes Down.

What is going to happen in the south-east corner of England when 5XX moves to Daventry in August next? Hundreds of listeners at Folkestone and adjacent towns are now only able to get Chelmsford on crystal and do not receive 2LO at all. Presently, when Chelmsford closes down altogether, they will be shut off from the B.B.C. unless in the meantime different counsels prevail at the Post Office and new wavelengths and more power are released for broadcasting. A new high-power station for London, preferably on the south-eastern boundary, offers the solution which, I understand, the broadcasting officials have placed before the P.M.G.

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Broadcasting Parliament.

A listener writes protesting against the proposal put forward to broadcast Parliamentary speeches. "I always understood," he says, "that broadcasting was for instruction, amusement, and the encouragement of good taste in music and literature. I cannot see how any of these will be served by the new suggestion. On the first occasion that the new idea is brought into operation I shall dismantle my aerial, get rid of my set, and demand the unexpired portion of my licence fee from the Post Office."

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No Cause for Anxiety.

The correspondent shows needless alarm. Is it not generally agreed that broadcasting suffers a drawback in that the listener either takes the one programme provided, say, from 2LO, or gets nothing at all? It has also been suggested that the best way of surmounting this difficulty is to have a new high-power station working in the vicinity of London on a greater wavelength than 2LO, from which Parliament and other items which probably would appeal to the minority of listeners would be transmitted. The normal programme from the existing station would not then suffer any interference.

MUSIC ON THE CANAL. Broadcast programmes meet with as much approval on the barge as on the houseboat. This photograph was taken near a London wharf.

A LONG DISTANCE SINGLE VALVE RECEIVER.

Details of a Popular American Set.

By A. J. WOODWARD.

IN these days, when the aim of every amateur is to receive all B.B.C. and most Continental stations with consistent and reliable regularity, the general trend is towards a multiplicity of valves, and receivers of the super-heterodyne and neutrodyne types are coming more and more into popular favour in order to achieve this purpose. Whilst these receivers are superlative in their excellence, they suffer from one serious drawback, which deters the ordinary man from proceeding any further with them, and that is the large number of valves which it is necessary to employ. Although, of course, many excellent types of dull emitter are now available, thus solving the question of filament current supply, it must be admitted that the initial cost of these instruments is high, and the question of the cost of valve renewal always looms large in the mind of every potential owner of a multivalve set. The only solution which has hitherto suggested itself has been the employment of a single valve super-regenerative receiver, but although astonishing results are obtainable with a set of this description, it has not been found possible to produce a really reliable instrument employing the super-regenerative principle, their vagaries from the point of view of consistency being well known to anybody who has experimented with them.

A Sensitive Single Valve Set.

It has been found possible to produce an easily controlled one or two valve set for short wavelengths, which will bring in "KDKA" and the American short wave amateurs with considerable consistency, but no set has yet made its appearance which will perform the same office for stations working on what has come to be known as the "broadcast" band of wavelengths. True, much can be done with the ordinary one-valve regenerative set followed by one stage of low-frequency amplification, but there still seems to be something lacking from the point of view of "easy-reception-with-something-in-hand" which has hitherto only been attainable with high-frequency amplification.

The circuit of a receiver which has a considerable vogue in America is given in Fig. 1, and is an attempt to fill this long-felt want. It was carefully evolved after a considerable amount of experimental work, the purpose of which was to produce a single-valve receiver which would be superior to the ordinary single-valve regenerative receiver from the point of view of sensitivity, and yet would be consistent in its action and not offer the insuperable operating difficulties of a super-regenerative set. The result of these experiments was this circuit, which, although leaving much to be desired, will be found productive of a remarkable degree of sensitivity and selectivity over a band of wavelengths extending from 200 to 700 metres.

An examination of the diagram will show that the construction of this instrument is simple in the extreme, the only component which need be constructed being the vario-coupler, which is of a special type, and, as will be seen from the diagram, is not used for its customary purpose of obtaining loose coupling. The other components which are needed are a 0.0005 mfd. variable condenser, four fixed condensers having the capacities indicated in the diagram, one filament rheostat having a resistance according to the type of valve used, three switch arms, 13 contact studs, and two variable grid leaks, and also a fixed grid leak complete with clips. The latter component is not shown in the diagram, but its purpose will be indicated later. The usual H.T. and L.T. batteries, together with terminals and wire for connecting up, will, of course, be needed.

Details of Components.

It is first necessary to construct the vario-coupler. The stator should be wound on an ebonite former having a diameter of 3in. Commencing at one end of the

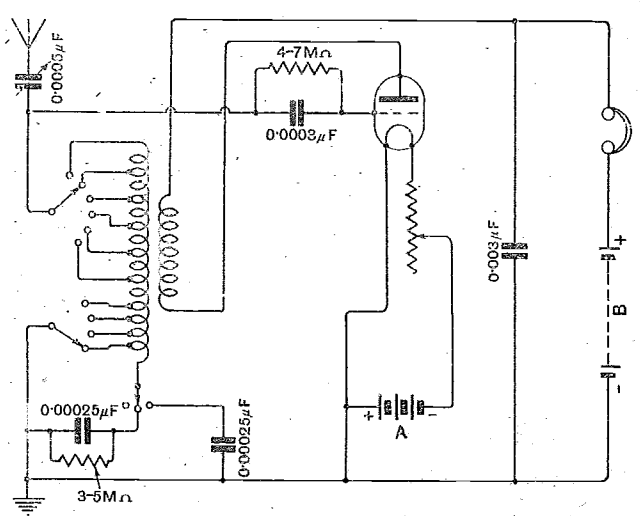


Fig. 1.—Connections of the receiver. A is the filament battery and B the adjustable plate battery. The large coil has a total of 83 turns, and the smaller coil has 38 turns.

former, fifty turns of No. 28 D.C.C., tapped at every tenth turn, including the first, are wound on. The winding is then continued for a further twenty-one turns, which are untapped, after which nine more turns tapped at every third turn are wound on, the winding being finished off with a further three turns. The rotor of this component consists of a ball having a diameter slightly smaller than that of the stator, on which are wound 38 turns of a similar gauge of wire, 19 turns being wound on

A Long Distance Single Valve Receiver.—

each side of the spindle. The rotor is mounted inside the stator in the conventional manner.

The mounting of the components should present no difficulty. With regard to the variable leaks, it will be noticed that it is necessary for one to be variable between four and seven megohms, and since these are not altogether easy to obtain, it will be necessary to use an ordinary variable grid leak of reliable make having the customary range of 0.5 to 5 megohms, and to insert clips in series with it, into which an ordinary 2 megohms grid leak is inserted. This will then enable the variable grid leak to cover the desired range. It will be better if a fixed leak of 3 megohms is used, since then it will enable the range of the combined fixed and variable leaks to be carried well over 7 megohms. It will probably be better also to use a fixed leak having a value of one or two megohms in series with the 3-5 megohm variable leak.

This circuit will be found to be better than the ordinary single valve detector circuit, whilst at the same time it is not subject to the instability and vagaries of the super-regenerative receiver. It will be found that when using this circuit a comparatively low anode potential is desirable, and the correct adjustment of the wander plug in the H.T. battery will make a considerable difference to the sensitivity of the instrument. Once the idiosyncrasies of this circuit have been mastered, it will be found possible to tune in distant stations with delightful smoothness, since a very delicate control over regeneration can be obtained. For loud-speaker work, of course, the usual type of valve amplifier will be necessary. Connections for a two-valve note magnifier are given in Fig. 2. This circuit is one which can be recommended to the experimenter who wishes to construct a set for receiving distant broadcasting stations, but who at the same time has not the inclination to embark upon the construction of a multivalve set having several stages of high-frequency amplification.

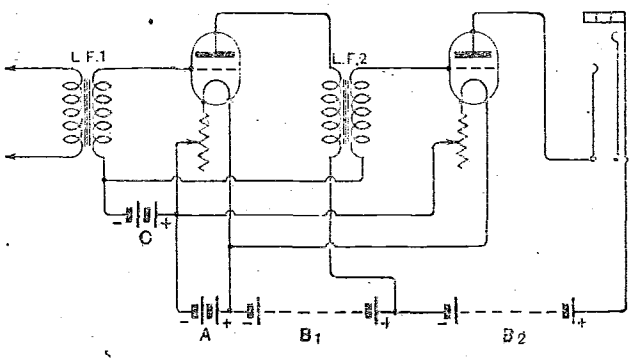


Fig. 2.—A two valve note magnifier. A is the filament battery, B_1 and B_2 the plate batteries, and C the grid battery. The coupling transformers are L.F.1 and L.F.2.

HIGH FREQUENCY RESISTANCE.

A Method of Calculation from Resonance Curves.

By A. P. CASTELLAIN, B.Sc., D.I.C.

IT is perhaps quite generally known that the sharper or peakier a resonance curve, the lower is the resistance of the circuit, and, conversely, that a flat resonance curve denotes a high resistance circuit, but it is probable that not many readers know how to calculate the actual circuit resistance from the resonance curve. These notes have been written with the idea of giving a simple method, together with a justification of it.

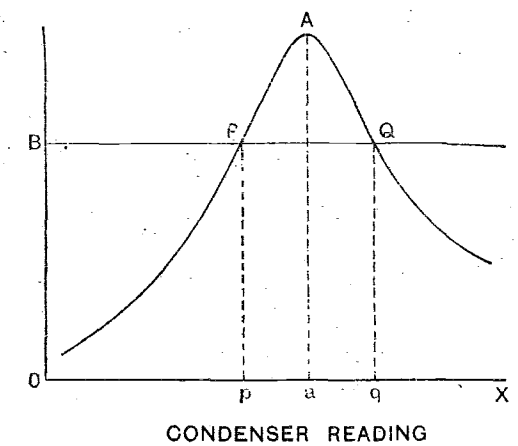


Fig. 1.—A typical resonance curve used to illustrate the method for finding the resistance of the circuit.

Method.

Draw a horizontal line BQ such that its distance from the base line OX = 0.707 times the maximum height (at A) of the curve, and let it cut the curve at P and Q (see Fig. 1). Let the condenser readings corresponding to the points A, P, and Q be a, p, and q respectively.

Then the resistance R of the circuit is given by

$$R = 942 \frac{L}{\lambda}\left(\frac{q-p}{a}\right) \text{ ohms,}$$

where L is the coil inductance in microhenries and λ is the resonant wavelength in metres.

Justification of Method.

Consider the simple resonant circuit shown in Fig. 2 and suppose there is an alternating current of frequency $f = \frac{\omega}{2\pi}$ flowing round it. The voltage across the resistance will be iR, and will be in phase with i; the voltage across the inductance will be ωLi, 90° ahead of i, and across the condenser $\frac{i}{\omega C}$, 90° behind i.

The total impedance Z of the circuit is

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}.$$

High Frequency Resistance.—

For resonance the voltages across the inductance and condenser are equal, hence $\omega L i = \frac{i}{\omega C}$ or $\omega L = \frac{1}{\omega C}$; thus at resonance the total impedance is $\sqrt{R^2}$, *i.e.* R, so that the maximum current is only limited by the resistance of the circuit.

In all cases the current is inversely proportional to the impedance—*i.e.* $i \propto \frac{I}{Z}$ or $i = \frac{E}{Z}$, where E is a constant.

To return to the resonance curve (Fig. 3), let C be the capacity to give resonance at wavelength λ with inductance L.

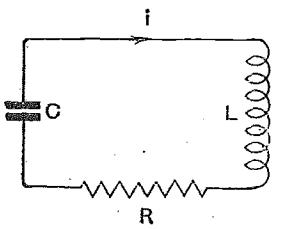


Fig. 2.—A circuit containing capacity (C), inductance (L), and resistance (R).

Let the maximum current (*i.e.*, at resonance) be I, and let I_1 be such that $I_1^2 = \frac{1}{2}I^2$.

Let the two values of capacity which give the current I_1 be C_1 and C_2. Then, for capacity C at resonance,

$$I = \frac{E}{R}.$$

$$\text{For } C_2,\ I_1 = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C_2}\right)^2}} = \frac{I}{\sqrt{2}} = \frac{E}{\sqrt{2}.R}$$

$$\text{Hence } \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C_2}\right)} = R\sqrt{2}$$

$$\text{or } \left(\omega L - \frac{1}{\omega C_2}\right) = R$$

$$\text{Similarly for } C_1,\ \left(\frac{1}{\omega C_1} - \omega L\right) = R$$

(The reversal of sign is due to the impedance of the condenser being in this case greater than that of the inductance as $C_1 < C$.)

$$\text{Hence } \frac{1}{\omega C_1} - \frac{1}{\omega C_2} = 2R$$

$$\text{or } R = \frac{1}{2\omega}\left(\frac{1}{C_1} - \frac{1}{C_2}\right) = \frac{1}{2\omega}\left(\frac{C_2 - C_1}{C_1 . C_2}\right) \text{ ohms.}$$

The first assumption is that $C_1 . C_2 = C^2$, and this is approximately true for the average resonance curve for radio circuits. Of course, the sharper the curve, the more nearly is this assumption true.

Thus

$$R = \frac{1}{2\omega} . \frac{C_2 - C_1}{C^2} = \frac{1}{2\omega C} . \left(\frac{C_2 - C_1}{C}\right) \text{ ohms.}$$

It has already been shown that at resonance $\omega L = \frac{1}{\omega C}$ (where L is in henries and C in farads)

so that $$R = \frac{\omega L}{2}\left(\frac{C_2 - C_1}{C}\right).$$

Also $\omega = 2\pi f$ and $f = \frac{3 \times 10^8}{\lambda}$, where λ is wavelength in metres.

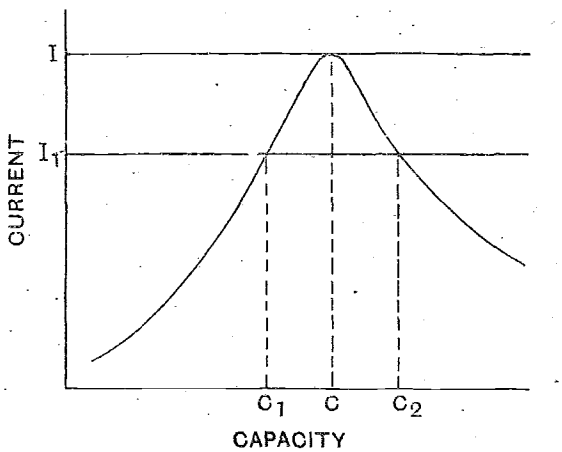


Fig. 3.—A Resonance Curve.

Hence

$$R = \frac{2\pi \times 3 \times 10^8}{2 \times \lambda} \times L \times 10^{-6} \left(\frac{C_2 - C_1}{C}\right) \text{ ohms,}$$

where L is in microhenries, and

$$R = \frac{942L}{\lambda}\left(\frac{C_2 - C_1}{C}\right) \text{ ohms,}$$

which is the same as the formula given if the capacity of the condenser is assumed directly proportional to its scale reading.

Calls Heard.

Extracts from Readers' Logs.

Tenterden, Kent.

French.—8AB, 8BA, 8BF, 8BO, 8BV, 8CT, 8DA, 8DE, 8EE, 8EN, 8EP, 8FC, 8FN, 8GI, 8GK, 8GM, 8GO, 8GP, 8II, 8IP, 8LM, 8MT, 8NK, 8PA, 8UU, 8XF, 8WK, 8ZY, 8ZM, 8ALG, 8BRG, 8HSD, 8HSG, 8GUR, 8GVR, 8JUX, 8LLO, 8LPR, 8RBR, 8SSU, 8WAL. *Belgian.*—B7, B4AU (telephony), 4AS, 4TU. *Dutch.*—0BQ, 0AA, 0MR, 0NL, 0II, 0ZN, 0RE, 0PV. *Danish.*—7ZM, 7OK, 7EC. *Swiss.*—9 BR, 9AD, 9LA. *Finnish.*—2NM, 2NCB *Swedish.*—SMYY, SMZV, SMXV, SMZE (telephony). *Italian.*—1MT, 1KX, 1AM, ACD, 3MB, 3AM. *Rhineland.*—1CF, 1RB, 1AF.

E. S. Tait.

Cambridge. (Feb. 13th to Feb. 22nd.)

American.—1AAC, 1AFN, 1AVF, 1AF, 1APC, 1ER, 1AR, 1BWX, 1BZ, 1BSC, 1BH, 1BEP, 1CAK, 1PL, 2BLM, 2BY, 2AAY, 2CNS, 2CLA, 2CPK, 2EB, 3AVK, 3HG, 3HJ, 3LW, 3OT, 3CJN, 3CHG, 3MB, 3HH, 3KNS, 4VC, 8OQ, 8PK, 1QAK, WIZ. Finnish.—2NM. *Swiss.*—9AD, IRAQ, GHH1. *Dutch.*—0NTZ, 0PV.

(0-v-1.) W. K. Islip

Sherborne, Dorset. (Feb. 11th to Feb. 24th.)

German:—1RB. *Swedish:*—SMGB, SMPL, SMXV, SMYV, SMZV, SMZZ. *Finnish:*—2NCB, 2NM, 3NB. *Italian:*—1AF, 1CO, 1MT, 1NO, 1KX, 1RT, 1WB, 3AM, 3MB, MFB. *Swiss:*—9BR, 9LA. *Canadian:*—1AR, 1DD. *U.S.A.:*—1GA, 1GS, 1RD, 1PL, 1PY, 1SW, 1XU, 1XZ, 1YB, 1WL, 1BCC, 1BKR, 1BWX, 1CKP, 1CRE, 2EB, 2GK, 2PD, 2TP, 2CEE, 2CGI, 2CXW, 2CXY, 2BQU, 2CJB, 3CU, 3IR, 3OQ, 3ADB, 3BSB, 3CVF, 4SA, 4TJ.

(0-v-0.) A. V. D. Hort.

LOUD-SPEAKERS TO AID TRAIN PASSENGERS.

Experiments at St. Pancras.

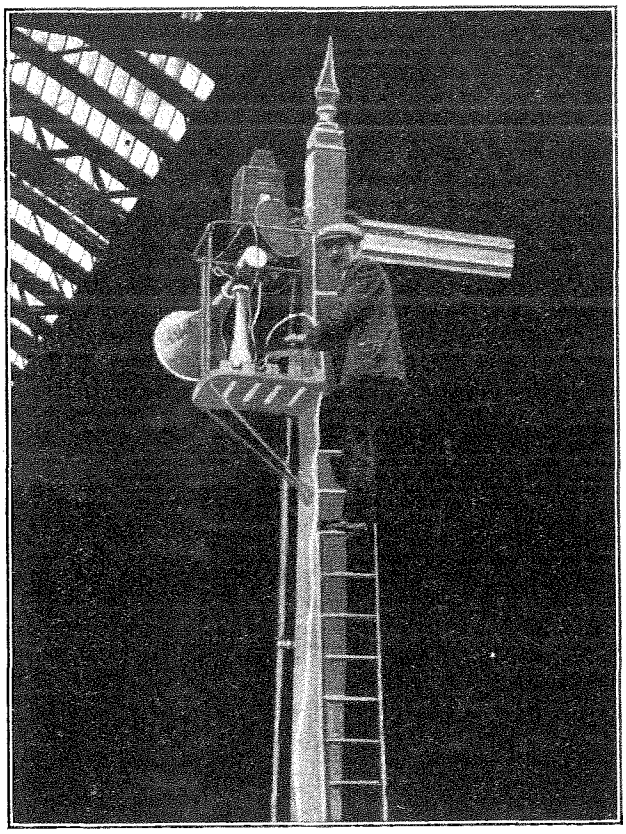
THE latest experiment with Marconiphone loud-speakers, which was carried out at St. Pancras Station on April 30th, holds promise of happier days for the railway traveller.

The object of the test was to decide upon the efficacy of loud-speakers for announcing the departure of trains and other matters of importance to prospective travellers.

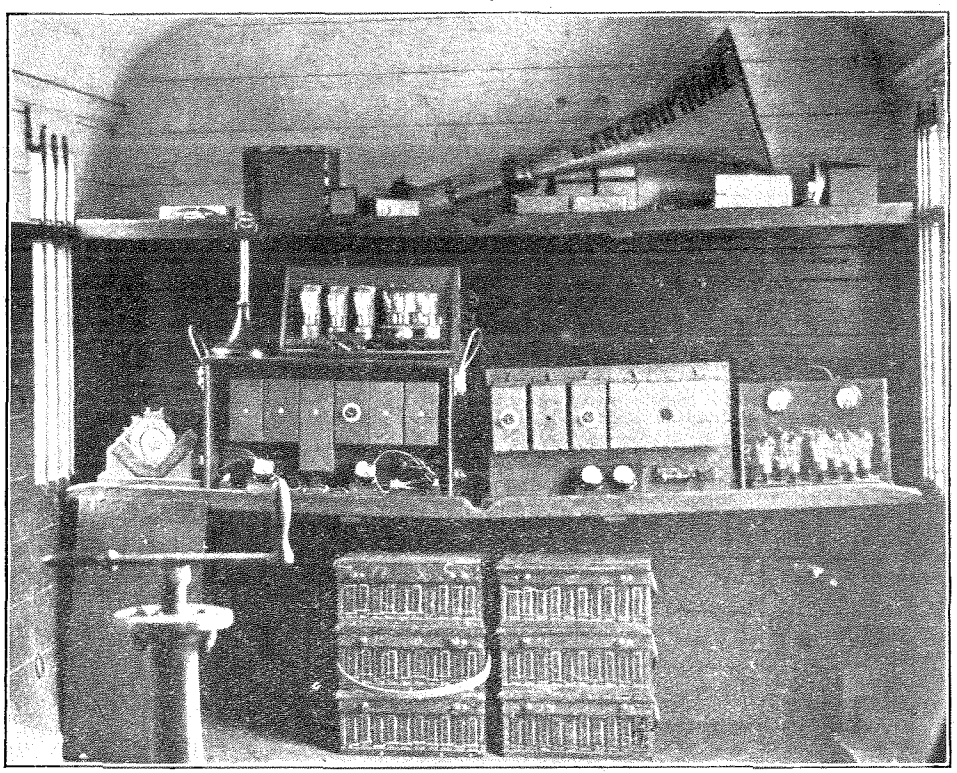
The apparatus employed consisted of the standard broadcasting equipment, comprising a Round-Sykes microphone and "A" and "B" amplifiers, in conjunction with Marconiphone loud-speakers. In addition, a "C" amplifier was used, consisting of eight valves in parallel.

Five loud-speakers were placed at the outer end of one of the platforms, and were directed into the station, whilst an additional loud-speaker was placed on a signal gantry just outside the station.

Some interesting comparative tests were carried out with an alternative equipment comprising one of the new Marconiphone carbon microphones and an "E" amplifier, of which the first three stages are resistance capacity coupled. This amplifier was connected to the "C" amplifier. When the two equipments were employed alternately it was found that they gave practically equal volume and quality.



The loud-speaker seen in this photograph was used for giving instructions to shunters in the open air, and proved very effective.



The entire equipment of microphones, amplifiers and batteries was contained in a passenger guard's van in the manner shown. An earth connection was obtained through the hand-brake.

The entire equipment of microphones, amplifiers, and batteries was housed in a passenger guard's van standing at the end of No. 1 platform. The power developed by the loud-speakers was enormous, and it was estimated that under reasonably silent conditions the speaker was audible in the open air up to a distance of three-quarters of a mile.

Great credit is due to the directors of the L.M.S. for the progressive spirit in which they have taken up the present innovation, and the success achieved suggests interesting developments in the near future.

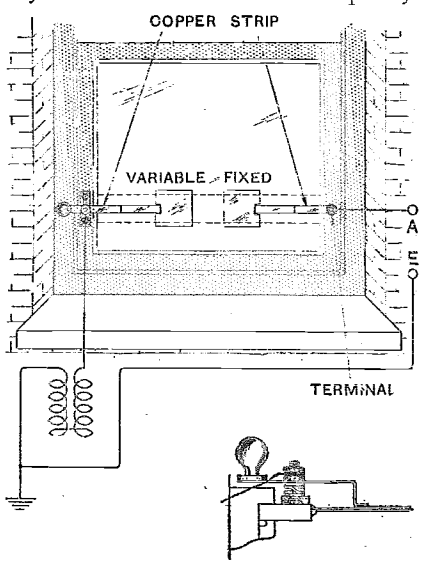
NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

A CAPACITY LEAD-IN AND FILTER CIRCUIT.

A capacity lead-in has previously been described in this section of the journal, but readers may be interested in a modification which includes a "rejecter" circuit for minimising interference from unwanted signals.

The aerial is connected to a plate extending across the window on the outside. On the inside, two plates are fitted, one fixed for the aerial lead to the set, and the other variable. The variable electrode is connected through an inductance (a variometer, if possible) to earth. By a careful adjustment of the variable capacity



A novel rejecter arrangement in which the window pane constitutes the dielectric of the tuning condensers.

and inductance, it is possible to divert jamming signals through this alternative path to earth.—R. A. K.

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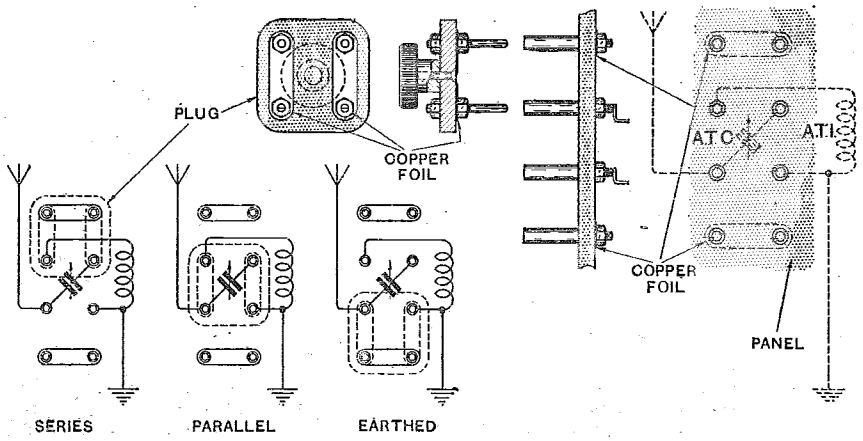
SERIES-PARALLEL AND EARTHING SWITCH.

A convenient switching arrangement for earthing the aerial when the set is not in use and connecting the tuning condenser in series or parallel can be constructed with valve legs and sockets. The circuit connections are made to eight sockets arranged in two rows of four as in the diagram. A short-circuiting plug fitted with two pairs of valve pins is used to effect the circuit changes, and may be fitted, if desired, with a knob to facilitate handling.—J. A. S.



Series and parallel switching of the aerial tuning condenser by means of plug and socket connecters.

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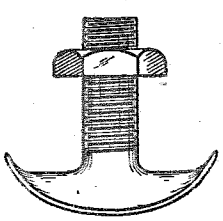
BUSH FOR "ONE-HOLE" FIXING.

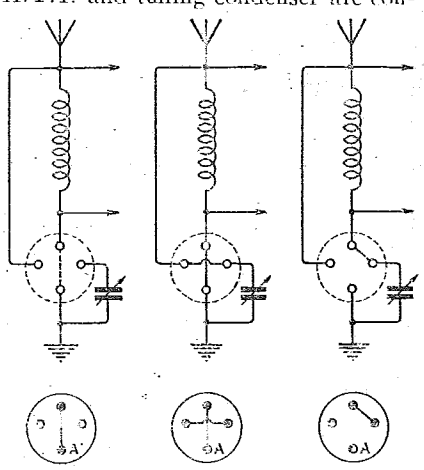
The valve of a disused bicycle inner tube makes an excellent bush for condenser or variometer spindles which pass through an ebonite panel. The valve is taken from the tube, and the oval securing washers are then removed, leaving the threaded stem with a shoulder at one end. The stem may be cut down to any required length and fitted to the panel with the securing nut. It is advisable, however, to leave the stem as long as possible to obtain a satisfactory bearing. The hole in the stem will just take a 2 B.A. screwed rod, which is a size often used for the spindles of tuning components.—B. W. B.



A cycle tyre valve can be used as a bush for "one-hole" fixing.

A USE FOR OLD VALVE BASES.

A very convenient series-parallel switching arrangement can be made for the aerial tuning condenser with the aid of three valve bases. The A.T.I. and tuning condenser are con-



Switching the aerial tuning condenser with a valve holder and socket.

nected to a valve holder, the scheme of connections being indicated in the diagram. The connections of the short-circuiting plugs are such that the tuning condenser may be eliminated entirely or may be connected in series or parallel with the aerial in the ordinary way.—D. M. T.

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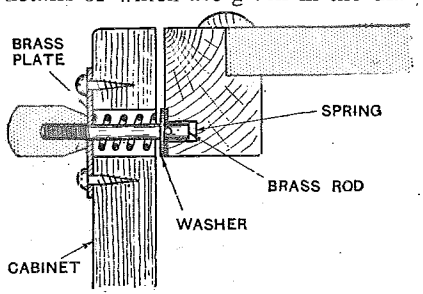
A HINGED PANEL MOUNTING.

It is frequently necessary to obtain access to the underside of a receiver panel in order to rectify a fault or make some change in the circuit. This becomes a tedious process when the panel is screwed into a cabinet or container in the ordinary way, and the hinge mounting described below will be found a great convenience when frequent examinations of the wiring have to be made.

The panel is cut a little smaller than the size normally required by the cabinet, and is mounted in a rebated frame which is itself an easy fit in the cabinet. Spring pivots, details of which are given in the diagram, are fitted at the centre of each side of the frame so that it can be turned completely over with the components uppermost. The frame and panel may be removed from the cabinet by withdrawing the pivots against the pressure of the coiled springs.



Stop pin held in position by a spring for retaining the instrument panel in the containing cabinet.

It may be mentioned as a supplement to this idea that contact springs can be quite easily arranged to switch off the H.T. and L.T. batteries when the panel is reversed. In this case the battery supply terminals would be fitted to the outside of the cabinet and connected through the contacts to the terminals on the panel. —G. A. C.

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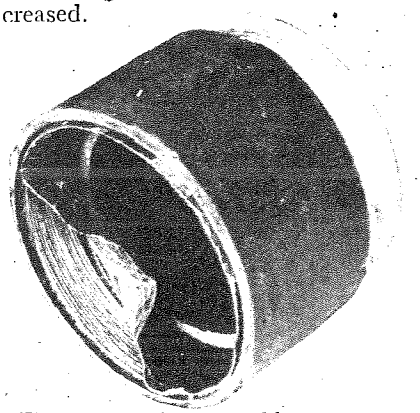
INTERNAL VARIOMETER WINDINGS.

It is an advantage to secure the stator winding of a variometer to the inside of the former. The distance between the rotor and stator windings is thereby reduced, with the result that the mutual coupling and inductance range of the variometer is increased.



The use of a string-covered former to give support to an internal winding.

If the stator coil is cylindrical in form, it is quite an easy matter to fix the coil to the inside of the former. A small tube of suitable diameter is chosen and wound with a layer of string. The string is then covered with a layer of waxed paper over which the true coil is wound. Double cotton covered wire is recommended, and the turns should be treated with shellac varnish or paraffin wax and allowed to set. The string may then be withdrawn, leaving a self-supporting coil, which can be fixed to the inside of the former with adhesive tape or string.—J. C. M.

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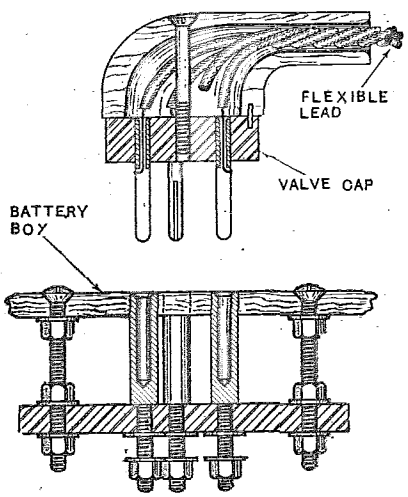
A BATTERY SUPPLY PLUG.

The diagram shows the construction of a non-reversible plug for battery connections. The use of such a plug obviates the confusion of loose battery wires and provides also a convenient method of switching off the batteries when the receiver is not in use.



An easily constructed four-pin plug and socket for the battery connections.

The plug consists of a valve base screwed or pegged to an old pipe bowl which acts as a covering for the wires at the back of the valve pegs. The plug fits into valve sockets mounted below the lid of the battery box on a small ebonite panel.

If several H.T. tappings are used in the receiver, all four connections may be reserved for the H.T. supply, but if not more than two tappings are required the plug can be arranged to carry the L.T. supply in addition.—W. H. S.

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MARKING-OFF EBONITE.

A scriber is usually employed when transferring dimensions to an ebonite panel. Lines made with the scriber in this way are sometimes difficult to follow, particularly when sawing or filing along them. Scratch lines can be rendered visible by filling with chalk, and in order that sufficient of the chalk may be held in the groove, a deep scratch line is necessary. This is a useful tip and well worth the attention of the amateur instrument maker.—A. B. C.

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MULTI-LAYER INDUCTANCES.

When a winding is needed of considerable inductance value and it is not considered necessary to employ any of the special methods of construction such as honeycomb or pile winding, the coil is often constructed by running wire more or less anyhow, on to the former. When end cheeks are not provided it may be found that with the winding higher in the middle than at the sides, the centre turns fall out of position and become loose. This can be prevented by completing the final layer in zig-zag fashion, resembling in appearance the form of winding adopted in a ball of string. Having made a winding which is high in the middle, the outside layer is put on by zig-zagging the wire across the turns.

Long-wave loading coils of reasonable efficiency can be constructed in this way and occupy very little space. The wire used may be No. 28 D.C.C. —D. L. B.

LAW, LANDLORDS AND WIRELESS.

The Rights of Tenants with Regard to Aerials.—The Significance of Fixtures.—What is Waste.

By CHARLES GREENWOOD.

SO stupendous and unprecedented has been the growth of broadcasting during the past few months that it is hardly surprising that various and important legal problems have presented themselves for solution in connection with the world of wireless.

Some of these questions are dealt with in that hotly debated Bill that is intended to confer on the Postmaster-General certain very wide powers that will enable him to keep a tight, and, it is suggested irksome, hand on the broadcasting movement.

This article, however, is designed to discuss and explain the rights and duties of tenants with regard to the erection of aerials on their landlord's property. The Bill does not pretend to deal with these matters, and, therefore, we need have no fear that our statements of law will have to be reconsidered in the near future.

When one considers that the vastness of the number of people who now own wireless receiving sets is only equalled by the vastness of their ignorance of matters legal, one cannot wonder that credence has been given to some very disquieting rumours as to the powers of landlords to prohibit the erection of aerials. Please do not think that this ignorance of the general public is a matter for reproach, or even regret—"Where ignorance is bliss . . ."—and anyway universal legal knowledge would only lengthen the dole queue by the addition of numerous members of a certain learned profession.

Landlords' Limitations.

I would take this opportunity of stating most emphatically that in the vast majority of cases landlords have no power to place a ban on the erection of aerials by their tenants.

For this comforting assurance we are indebted largely to the effect of the various Rent (Restrictions) Acts, and, generally speaking, it is only when a house falls outside the provisions of those Acts that we are called on to face the possibility of a landlord's prohibition taking effect.

It is perfectly obvious that when a landlord is not estopped from turning out a tenant at his (the landlord's) own sweet will, he simply comes along and tells the tenant that he has a rooted objection to wireless in all its branches. In such circumstances, the tenant, willy-nilly, must take down the aerial if he wishes to keep the house. Of course, he immediately erects an indoor aerial in the spare bedroom, and continues in his nefarious practice until the landlord, unexpectedly making a tour of inspection of his property, stumbles across the offending instrument, and gives the tenant notice to quit forthwith. The latter immediately retaliates by suing the landlord for damages on the ground of trespass, and they subsequently exchange greetings in the County Court.

It should not be forgotten that landlords have no right to wander over premises in the occupation of their tenants, unless power has been reserved for them to do so. Which brings us to

Tenancy Agreements.

It may well be that an anti-wireless landlord will in future insist on a clause being inserted in all his tenancy agreements designed to prohibit the tenant from erecting an aerial of any sort, size, shape, or description. In addition, most well-drawn tenancy agreements contain a clause that gives a landlord power to inspect the property at certain stated and reasonable times. Under such an agreement, and with a strict landlord, the tenant would have no option but to obey—or forfeit his tenancy.

I have not yet encountered an agreement of this description, but landlords are sometimes cantankerous individuals, and I should not be at all surprised to see some such clause inserted in agreements that have been entered into just lately.

It is well known that one cannot erect an aerial without attaching either the aerial itself or at least the lead-in to the fabric of the house in which the receiving set is situated, and it has been suggested that the knocking in of large nails or bolts might give landlords an opportunity of complaining of waste. Now, waste, as far as houses are concerned, consists of some "spoil or destruction" to the fabric, which inflicts on it any lasting damage.

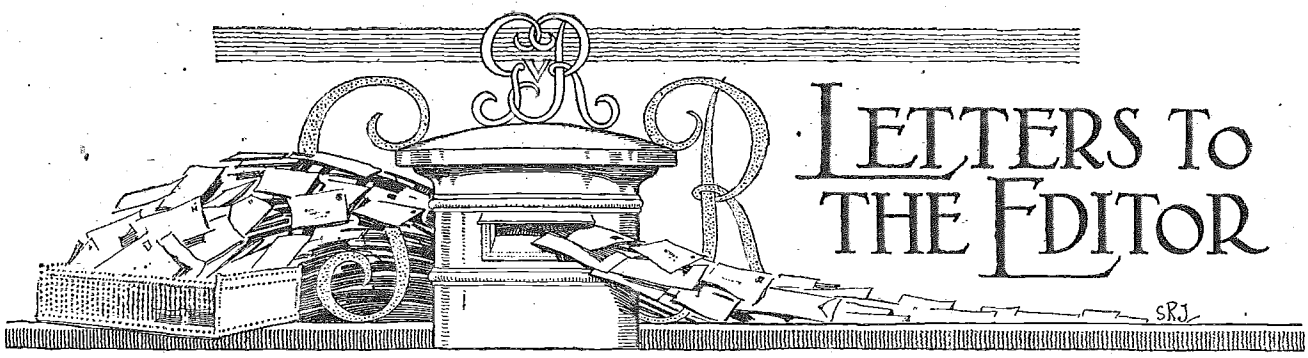
They will not be liable for waste so long as they use the property in a "reasonable and proper manner," and at the present day I am confident that no court would hold that the erection of an ordinary aerial was an unreasonable use to make of a dwelling-house.

What is a Fixture?

There seems, just lately, to have been a tendency towards the erection of much more elaborate, substantial, and expensive aerials than has been the case in the past, and the query has been raised as to whether these aerials might not become a "fixture" that could be claimed by the landlord at the conclusion of the tenancy.

A fixture, it should be explained, consists in this case of a movable article that has become actually attached, in the eyes of the law, to the house in question. As a general rule, these fixtures become the property of the landlord, but exceptions are made in favour of the tenant with respect to fixtures made for the purposes of "domestic use or ornament," and I think there is little doubt that a modern interpretation of those words would include a wireless aerial. Anyway, if the aerial is capable of easy removal without damage to the fabric of the house, and was only attached temporarily or for its "more complete use and enjoyment," it is not a legal fixture at all.

Under the circumstances, however, tenants would do well to walk warily in the erection of some of those complicated constructions of timber lattice work that are sometimes to be seen in use as aerial masts.



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.

PORTABLE SETS AND THE LAW.

Sir,—I am by nature a law-abiding citizen, but both in motoring and in wireless I am often induced to break the law—as regards motoring in respect of the 20-mile limit, and as regards wireless by using a portable set away from my home.

As the law relating to wireless is now under revision I am surprised that no one appears to have raised any question in regard to this point. If I have a portable set and take this away from home I understand that, strictly speaking, I require to apply for a fresh licence if I intend using the set more than ten miles distant from my registered address for my home set. If this is correct, then thousands of "innocent" citizens are daily breaking the law. Surely this point could easily be rectified in the new law. It is a bad thing to have laws which are constantly broken, and moreover, it is a distinct discouragement to trade.

A. H. M. WARD.

EFFICACY OF H.F. AMPLIFICATION.

Sir,—In the "Readers' Problems" section of the April 1st issue of *The Wireless World* there is an interesting paragraph headed "Efficacy of H.F. Amplification." The point seems to be that this is highly beneficial if the H.F. stage is really efficient.

While not wishing to contradict the opinions expressed in this paragraph, I do think they are a little unconvincing in view of the experience of many experimenters; my own will perhaps serve as an illustration.

The H.F. stage in my receiving set I believe to be reasonably efficient. I will leave this, however, for you to judge in the light of the following results. Manchester, about seventy miles away, can be received clearly, but very faintly, on detector valve alone, with reaction coil removed and a short-circuiting plug in its place. When the H.F. stage is switched in, still using no reaction, reception comes up to good headphone strength when using a direct-coupled circuit. With loose coupling it is still louder, quite as loud as is comfortable on headphones. The amplification, indeed, appears to be greater than can be due to the effect of the H.F. stage alone, and is apparently to some extent due also to the increased efficiency obtained from the detector working with increased input. As another test example, Brussels comes in at good headphone strength on H.F. and detector using direct-coupling and no reaction, but not a whisper can be heard without the H.F. stage.

In spite of these facts, I find that by cutting out the H.F. stage, using detector and one stage of L.F. amplification with reaction on to A.T.I., any station that I have ever heard when using H.F. amplification can be tuned in at rather greater volume than on H.F. and detector. Admittedly, quality is not good in cases where reaction has to be pushed close up to the limit, but such faint stations can only be heard badly by the alternative method. On the score of selectivity there does not seem to be much difference. I may say that my log of stations heard includes every B.B.C. station, both main and relay, more than twenty Continental, and about half a dozen American, broadcast telephony only being concerned as I cannot read Morse.

Of course, volume is undoubtedly greater on a 1-v-1 combination than an 0-v-1, but then it is much stronger still on 0-v-2. So the question naturally arises, assuming that one is strictly limited as to the number of valves employed, for all-round results is the H.F. stage worth while?

J. H. S. FILDES.

Llandudno Junction, S.O., North Wales.

EXTRAORDINARY RECEPTION IN KENYA COLONY.

Sir,—I have no doubt the following will prove of interest to your readers.

Nairobi is situated 6,000 feet above sea level, and is almost directly on the Equator, which fact would give an idea of the atmospheric conditions prevalent here. Further, the whole of Kenya Colony is mountainous country, and the soil is particularly hard. Nevertheless, all these difficulties have proved no hindrance to the progress of wireless.

I have built my own five-valve set on a local wood panel, unvarnished, and without any soldered connections, and the results I have obtained are surprising. Pittsburg (KDKA) can be received any day with *absolute certainty*. Some time ago I listened in through this station to speeches given at a meeting of the American Legion, and I distinctly heard the shouts of "Hear, hear," the clapping of the hands, and the laughter of the audience. On some days this station relays time signals from Arlington, and I can set my watch according to these signals. On several occasions KDKA has been received absolutely without any aerial or earth, although, of course, in such an event the concerts are necessarily weak. Does this not constitute a record? America is at least nine to ten thousand miles distant.

Other stations received without any aerial whatsoever are WGH, WIR, NKF, and 8GB.

When the American broadcasting is received, it is almost daybreak here, from 4.30 a.m. to 5.30 a.m., although then in Pittsburg it would be only 8.45 p.m. to 9.45 p.m.

Wishing *Wireless World* the best of luck.

ABDUL RASHID.

Kenya Colony.

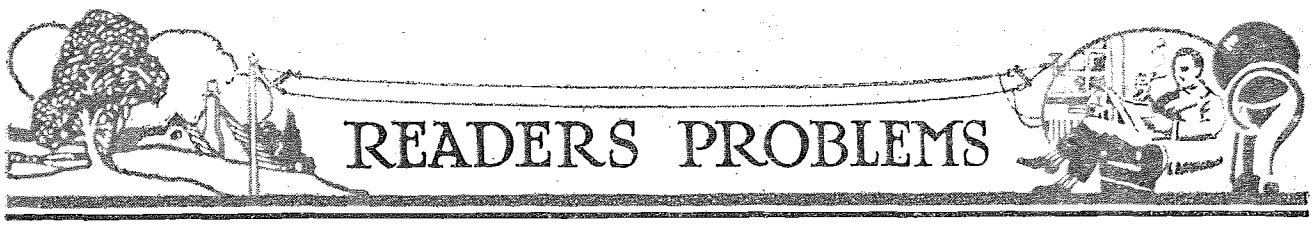
AN EXPERIMENTER IN INDIA.

Sir,—Would you be kind enough to publish this letter in your valuable journal to inform your readers that I relinquished my transmitting licence (call sign 2OY) when I sailed for India on February 27th, 1925. Since I arrived in this country I have received a number of reports on 2OY's transmissions during March and they all indicate that the new owner of that call sign (if it has already been reallotted) resides in the north of England.

I should also like to take this opportunity of thanking all those experimenters with whom I carried out experiments in England for their co-operation and assistance. When I return to England I hope I shall be able to renew my acquaintance with all. In the meantime I shall listen for signals from England and when conditions permit (I have no electric power in my bungalow at present) I hope to get in radio touch with those at home on a short wavelength. Details of call sign and wavelength will be sent in due course.

E. J. HOBBS (Captain),
Royal Tank Corps.

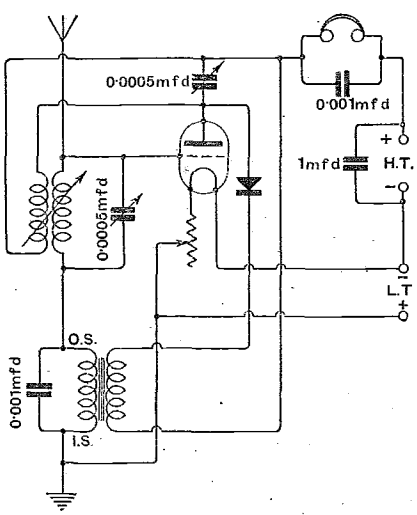
Secunderabad, India.



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

Methods of Employing a Single Valve.

MANY readers frequently desire to know what is the utmost that may be done with one valve with regard to range and volume. There are, of course, innumerable single-valve circuits, all of which have their special merits, and when considering the design of a single-valve set it is necessary first of all to consider briefly the purpose for which the receiver is to be used. Undoubtedly, the circuits which do get the utmost out of a single valve are those of the super-regenerative type, but these are usually so unstable and difficult to control that the amateur is compelled to abandon them in favour of a circuit which is more consistent in its action. The straightforward single-valve circuit in which magnetic reaction is carried on to the aerial tuning coil is undoubtedly the best when sheer distance-getting is the primary consideration. If, however, we add a crystal detector and a low-frequency transformer to the circuit, we shall find that we have greatly enhanced our volume, and at the same time have not sacrificed the sensitivity brought about by using reaction, since this can be obtained by coupling the tuned plate coil to the aerial coil. A suitable circuit is illustrated below. It is necessary to experiment very carefully with the connections of the L.F. transformer, since it will be found that in any reflex set there is one particular method of connection, concerning which no rule can be laid down, which gives best results. The wrong method of connection will considerably reduce efficiency. The connection of a fixed condenser of approximately 0.001 mfd. across the secondary windings is also important in this circuit. By using coils of the plug-in type the circuit is adaptable to any wavelength.



A single valve and crystal reflex receiver. The tuned anode coil is coupled to the aerial coil.

o o o o

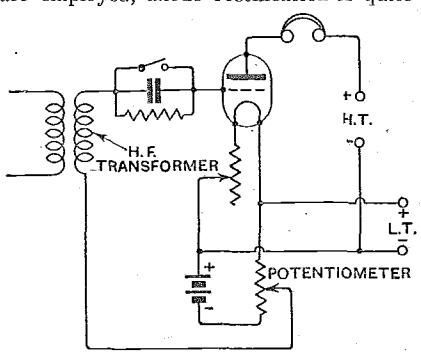
Determining Valve Characteristics.

A READER wishes to know what is the determining factor which causes a valve to possess a high amplification factor and a high anode impedance, or *vice versa*. All other things being equal, this is determined solely by the relative disposition of the valve electrodes. Thus, given two valves possessing electrodes of the same shape and with similar filament characteristics, the ultimate character of the valve depends on the disposition of the electrodes with respect to each other. This is strongly exemplified in many modern valves of the "dull-emitting power type," some of which possess a high amplification factor, a high plate impedance, and a comparatively short straight line portion of grid volts-plate current characteristic, whilst others possess reverse characteristics. The former type will be found very efficient when placed in an amplification circuit where the initial input to them is small, and they are also suitable for anode rectification purposes. The other type are more suitable for handling a large amount of power, and should always be placed in those positions in a circuit where a large input to their grids is to be expected. They are also very suitable as rectifiers, using the conventional grid condenser and leak method.

o o o o

Methods of Obtaining Rectification.

IT is well known that when signals of considerable amplitude are delivered to a detector valve making use of the conventional grid leak and detector method of rectification a certain amount of distortion is produced. This distortion can be circumvented by abandoning the use of the leaky grid condenser and applying a negative bias to the grid of the valve, thus causing it to rectify on the lower bend of its grid volts-plate current characteristic. This is usually known as anode rectification. Unfortunately, however, it will be found that when using an ordinary valve, this method of rectification is rather inefficient unless very strong signals are applied to it. It is possible to obtain valves for this purpose having a very sharply defined "lower bend." In receivers of the neutrodyne or superheterodyne type, where several stages of H.F. amplification are employed, anode rectification is quite



A scheme for giving grid condenser and leak or anode detection.

efficient, and assists greatly in preventing distortion, but even in these instances it will be found that louder signals are obtainable from the more conventional method of rectification, and it seems desirable when building a receiver of this type to embody a simple switching arrangement, whereby a rapid change may be made from one method to the other. A suitable circuit is illustrated in the diagram. By moving the potentiometer slider to the top position and opening the switch short-circuiting the grid condenser, it will be seen that we have the conventional method, whilst in order to change over to anode rectification it is only necessary to close this switch and move the potentiometer down. When embodying this arrangement on the second detector of a superheterodyne, it is well to use different values of grid leak and condenser from those customarily employed on the broadcast wavelengths. Values of 0.0003 mfd. and 0.5 megohm may be tried. In receivers of other types, where the currents to be rectified have a higher frequency, the conventional sizes may be employed.

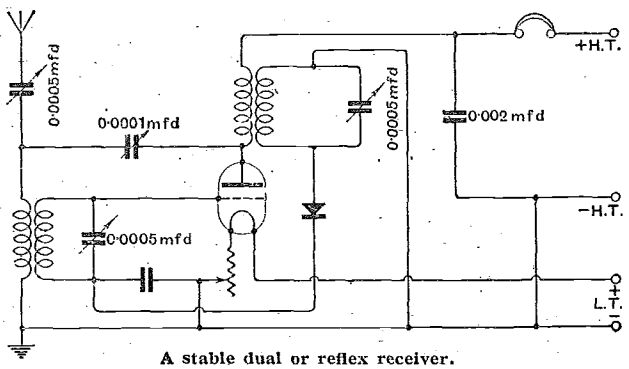
o o o o

Stability in Dual Amplification Circuits.

IT is usually found that one of the chief causes of the annoying low frequency "buzzing" to which many circuits of the dual amplification type are prone is the presence of the low frequency transformer. Many attempts have been made to eliminate this by placing

capacities, and sometimes non-inductive resistances across one or other of the windings, but it cannot be said that these devices are altogether successful, and at the best they are but palliatives. It is well to experiment further with these types of circuit to see if something more efficient can be produced.

One of the most stable forms of reflex sets, and one which is too little known, is illustrated in the diagram below. It will be noticed that no low frequency transformer is included in the circuit, the rectified signals being transferred directly back into the grid circuit of the valve. In this manner it will be found that a marked increase in the stability is brought about, and at the same time the apparatus is more sensitive to distant signals, since the valve functions more efficiently in its capacity as a high frequency amplifier than is the case where a transformer is employed. The only drawback, of course, is that this circuit will not be productive of so great a signal strength from the local station as in the more conventional type of circuit, and is therefore not suitable for operating a loud-speaker. The aerial circuit is not directly coupled to the grid circuit of the valve. However, it is not recommended that the ordinary variable loose-coupling be used, as it would tend to make the circuit rather prone to oscillate at radio frequency. The degree of coupling may be fixed. If preferred, of course, the coupling may be made very tight, and the aerial tuning condenser omitted, thus enabling the so-called aperiodic coupling to be used. The high frequency transformer in the anode circuit of the valve may be of the conventional type, or may be made aperiodic for the band of wavelengths over which it is desired to tune. In this manner "searching" will be made much easier, since one variable condenser will be eliminated. Regenerative effects are obtainable by means of the small variable condenser connected between the anode of the valve and the high potential end of the aerial tuning circuit.



A stable dual or reflex receiver.

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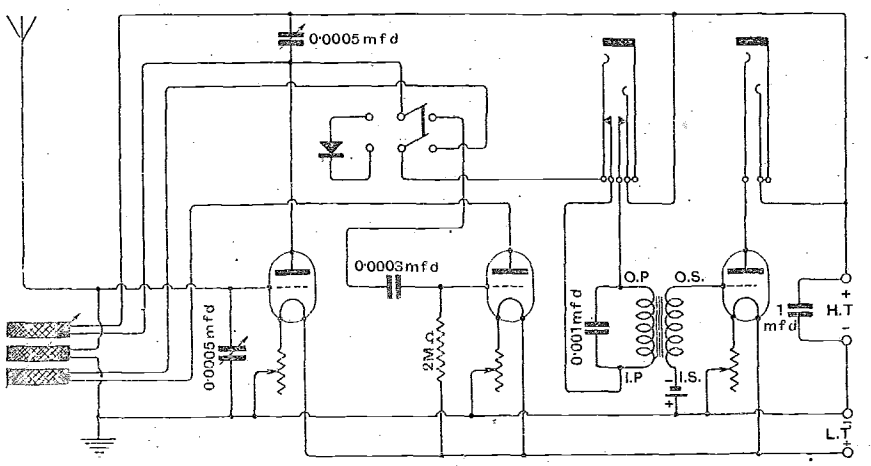
An Efficient Switching Arrangement.

WE receive frequent requests from readers in which diagrams are required involving elaborate and complicated switching arrangements on the H.F. side of the set, in order that a large number of combinations may be had, such as crystal or valve rectification with or without an H.F. stage preceding this rectifier. As the serious experimenter will appreciate, this usually involves a number of switching arrangements, which leads to serious losses in the instrument due to stray capacity effects, and in many cases leads to absolute instability. An attempt has therefore been made in the circuit illustrated in the diagram below to provide switching arrangements in which most of these combinations can be brought about with as little switching as possible. As will be observed from the diagram, only one switch is employed on the H.F. side of the circuit, the purpose of this switch being to change from valve to crystal rectification, the H.F. valve being eliminated by merely turning out the filament of this valve. With this circuit the following four combinations are obtainable, exclusive of the elimination of the low-frequency stage which is accomplished by plugs and jacks:—crystal detector only, valve detector only, H.F. and crystal, and H.F. and valve detector.

As will be seen from the diagram, by means of using a three-way coil holder, the turning off of the filament of the H.F. valve causes the set to be automatically converted to a loosely coupled receiver employing either valve or crystal rectification, whilst turning on the filament causes this set to revert to a direct coupled set employing an H.F. valve preceding either detector as desired. In this manner complicated switching arrangements with their attendant disadvantages are avoided.

If good quality is aimed at together with absolute freedom from oscillation, attention should be paid to the avoidance of unnecessarily long leads in the L.F. portions of the circuit, and this can often be best brought about by the use of plugs and jacks rather than switches. It is often found that in the case of a set which is normally thought to be stable on the L.F side, the addition of long leads to the telephone terminals in order to enable a loud-speaker to be operated in a distant part of the house, will cause a continuous audible note to be emitted. In a properly designed amplifier this should not occur, and the remedy lies in carefully rewiring the L.F. portion of the circuit, using jacks if possible, rather than in such palliatives as the placing of fixed resistances across the intervalve transformer windings.

To obviate the necessity of readers writing us to say that no provision is made to connect O.P. of the transformer to earth instead of to H.T.+ when the crystal is being used, we would point out that the crystal detector is always connected in shunt with the anode coil, and thus does not form a path for the H.T. current which would, of course, paralyse its action.



A three-valve receiver with an effective switching arrangement for connecting a crystal or valve detector. The first (H.F.) valve can be cut in or out by turning its filament resistance on or off.

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Use of Condensers Across Anode Resistances.

A READER wishes to know whether it is necessary to shunt each anode resistance of a resistance-coupled low frequency amplifier with a fixed condenser of 0.0002 mfd. capacity or whether this component is only required to be fitted in shunt with the first resistance in the circuit.

A condenser across each resistance is quite unnecessary and, in fact, inadvisable, as such a condenser would tend to reduce the potential set up across the resistance especially at the higher musical frequencies. Its purpose when shunted across the initial anode resistance which, it must be remembered, is in the anode circuit of the detector valve, is to by-pass the high frequency component of the current flowing in the anode circuit and so enable reaction effects to be obtained and to increase the efficiency of the detector.

The Wireless World AND RADIO REVIEW

No. 301. WEDNESDAY, MAY 20TH, 1925. VOL. XVI. No. 15.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4. - Telephone: City 2847 (13 lines).

Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 10 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries abroad, £1 3s. 10d. per annum.

D.F. AND THE OSCILLATION TROUBLE.

THE war against the oscillator is still being waged, though perhaps not with the same intensity as was evidenced some time ago, because little by little new users of wireless sets are beginning to understand how to handle them cautiously, whilst their own experiences of reception interfered with by the activities of neighbouring oscillators have brought home to them the seriousness of the offence from the listener's point of view.

We believe that by degrees this trouble will be overcome entirely by means of education, whilst reduction in the price of wireless apparatus and components will enable the single-valve receiver to be replaced by apparatus rather more elaborate and, therefore, capable of giving satisfactory results without the necessity for straining the "ears" of the receiver to the point of oscillation. We are sorry to see, according to Press reports, that one of the wireless amateur organisations talks of fitting motor cars with direction-finding sets to travel about and locate sources of oscillation with a view to bringing test prosecutions against the offenders. We cannot imagine that gratuitous interference of this kind, even if the prosecutions should prove to be successful, will do anything to overcome the nuisance. Very few listeners, we feel sure, are ever responsible for deliberate interference by oscillation, and it is both unreasonable and futile to attempt to improve upon the present state of affairs by such means. Interference by oscillation is almost invariably caused through ignorance on the part of the user of the apparatus, and can be remedied only by education. We feel sure that every user of wireless to-day very soon learns that his set is capable of causing interference, and that as soon as possible he acquires sufficient knowledge to take the necessary precautions.

From a technical point of view, the idea of being able to locate occasional oscillation by means of roaming D.F. stations seems in itself absurd, because unless the oscillation is continuous and in some way distinctive, it is impossible for two or more D.F. stations to take bearings on the momentary oscillation produced during the "swishing" of a condenser when search is being made for a weak station. There may be many such momentary productions of oscillation in a given area and none of them distinctive except, perhaps, in so far as the wavelength is concerned, and even then the probability is that several stations may be searching on the same wave.

If oscillation is conducted maliciously, then the presence of "spying" D.F. stations is more likely to lead to an organised game on the part of the offenders than to effect a remedy, and we foresee the possibility of a very disconcerted D.F. organisation if one or two hardened criminals of the oscillating profession care to put their heads together to frustrate the D.F. efforts. It is rumoured that the Post Office is devoting attention to the problem of locating unauthorised transmitting stations as well as to devising some means of checking oscillation.

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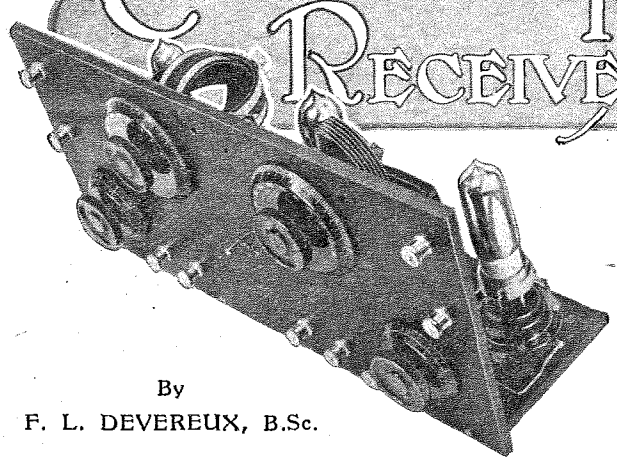
Compact Three Valve Receiver for Long Waves



A Set Specially Designed on Compact Lines to Enable Easy Adaptation for Use as a Portable Receiver.

By
F. L. DEVEREUX, B.Sc.

ONE of the principal factors governing the design of a portable receiver is the magnitude of the E.M.F. induced in the aerial circuit by the transmitter. As a frame or short elevated aerial is generally used as a collector, this E.M.F. is very small and is frequently insufficient to operate a rectifier. The success of a portable set depends, therefore, upon two factors :—

(1) The choice of a transmitting station that will induce a large E.M.F. in the aerial.

(2) The use of high-frequency amplification, supplemented by reaction, in order that a working potential may be applied to the detector.

In the South of England and in the Midlands, strongest signals are received from the high-powered station at Chelmsford, unless the receiver happens to be situated near to one of the local stations. We will assume, then, that Chelmsford is chosen, from the point of view of signal strength, as the transmitter. Another very good reason for the choice of the Chelmsford station is that high-frequency amplification is practicable with resistance-capacity coupling on the wavelength of 1,600 metres used by this station. This is by far the simplest method of coupling high-frequency valves, and is capable of giving excellent results on wavelengths above 1,600 metres. The system is aperiodic, and no tuned circuits are associated with the valve couplings.

The Circuit.

The practical circuit evolved from the foregoing considerations is illustrated in Fig. 1.

Three valves are employed, the first two operating as high-frequency amplifiers, and the third as a detector. Valves of the 0.06 type are recommended, since their small demands in the matter of filament current make possible the use of moderate size dry cells for the filament heating battery.

For the H.F. stages, valves having a high-amplification factor should be chosen. The voltage amplification per stage can never exceed the amplification factor of the valve when resistance-capacity coupling is employed, and is often little more than 50 per cent. of this value in actual practice. The D.E.3B. and A.R.0.06 types of valve with amplification factors of 16 and 11 respectively are recommended. One of these types may be used for the detector, but a valve of lower impedance, such as the D.E.3, will give better results if several pairs of telephones are to be used.

The values of the anode resistances have been fixed on the assumption that a H.T. battery of 100 volts is to be used. A higher degree of amplification could be obtained with 150,000-ohm resistances and 150 volts, but it is thought that a battery of this size would be inconsistent with the idea of portability.

The coupling condenser and leak between the first two valves have been given values of 0.0005 mfd. and 1 megohm respectively. It is necessary to prevent rectification in the second valve, and the grid leak has therefore been connected to −L.T. The grid of the second valve will receive a negative potential equal to the voltage drop across the first filament resistance. The filament end of the A.T.I. is connected to −L.T., and the first valve will also receive this grid bias. If a 4½-volt dry battery is used to supply the filament current, the grid bias will be

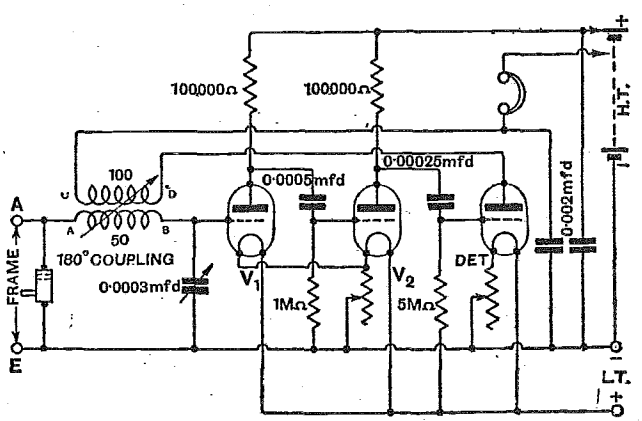


Fig. 1.—The theoretical connections of the receiver.

Three Valve Receiver.—

about $-1\frac{1}{2}$ volts, assuming that the filament is rated at 3 volts.

To obtain efficient rectification, the value of the grid condenser between the second H.F. valve and the detector has been made less, and the resistance of the grid leak greater than in the case of the previous valve. For the same reason, the grid leak is connected to +L.T., since a slight positive grid potential gives best results with most dull emitter valves.

Since the valve couplings are aperiodic, the tuned circuits in the receiver are connected to the grid circuit of the first valve. A coupling coil in series with a fixed coil holder is connected between grid and filament, the whole of the inductance being tuned by a variable condenser. With a plug-in coil of suitable size inserted in the coil holder, a short aerial slung from a tree may be connected to the terminal A, and an improvised earth connection to terminal E. The use of a short elevated aerial is recommended in preference to a frame, unless the set is to be used in motion. The elevated aerial gives greater signal strength and better stability in tuning. A frame aerial when used should be connected across the terminals A and E. In this case no tuning coil will be required, and the coil holder should be left open.

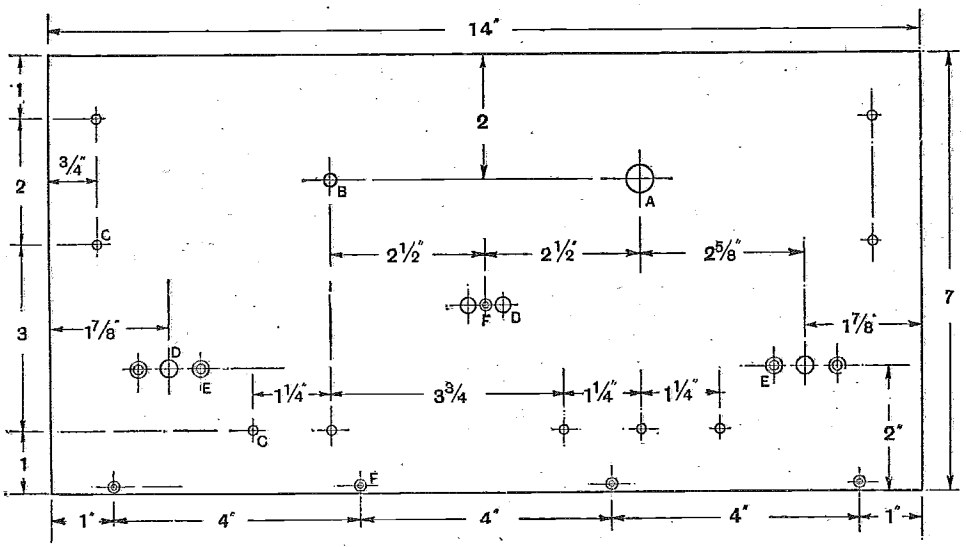
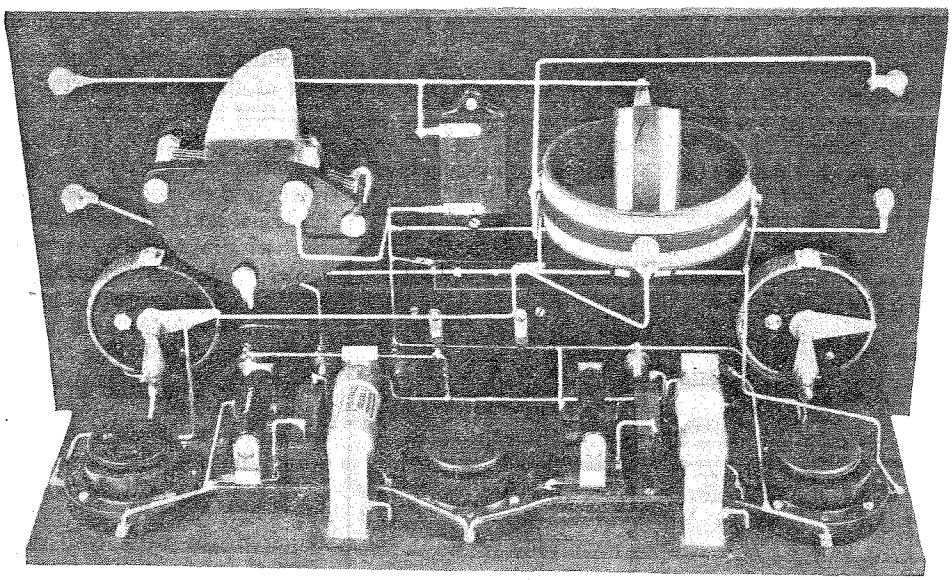


Fig. 2.—Details of the front ebonite panel. The holes have the following sizes: A, $\frac{1}{4}$in.; B, $\frac{5}{16}$in.; C, $\frac{3}{16}$in. for No. 4 B.A. terminals; D, $\frac{5}{16}$in.; E, $\frac{1}{4}$in. and countersunk for No. 4 B.A. screws; F, $\frac{1}{4}$in. and countersunk for No. 6 B.A. screws.



Rear view of the set. Notice how compactly the components are arranged, and the neat, straightforward wiring.

Reaction is controlled by a small vario-coupler provided with a 180° movement. Thus positive reaction may be applied to increase the sensitivity of the receiver, and negative reaction to stop self-oscillation which may be caused by stray capacities in the valve holders and wiring. The stator or outer fixed coil AB is connected in the grid circuit, and the rotor CD is connected in the anode circuit of the detector valve in series with the telephones. A high-frequency by-pass condenser of 0.002 mfd. is connected between the telephone end of the reaction coil and −L.T., and

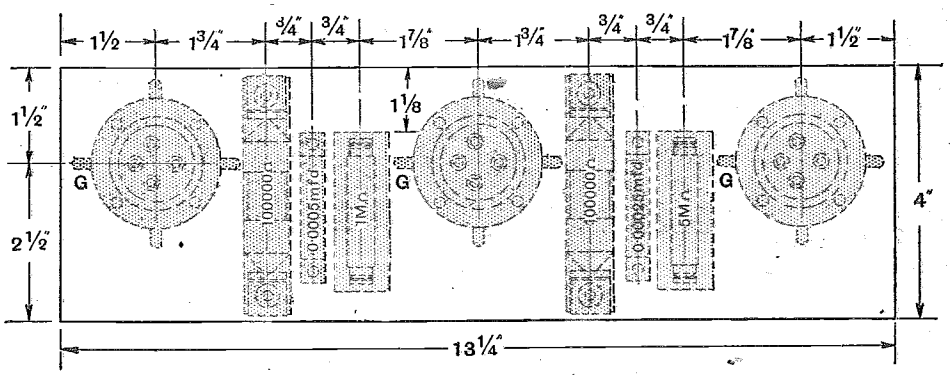


Fig. 3.—Arrangement of components on the ebonite base.

Compact Three Valve Receiver for Long Waves.—

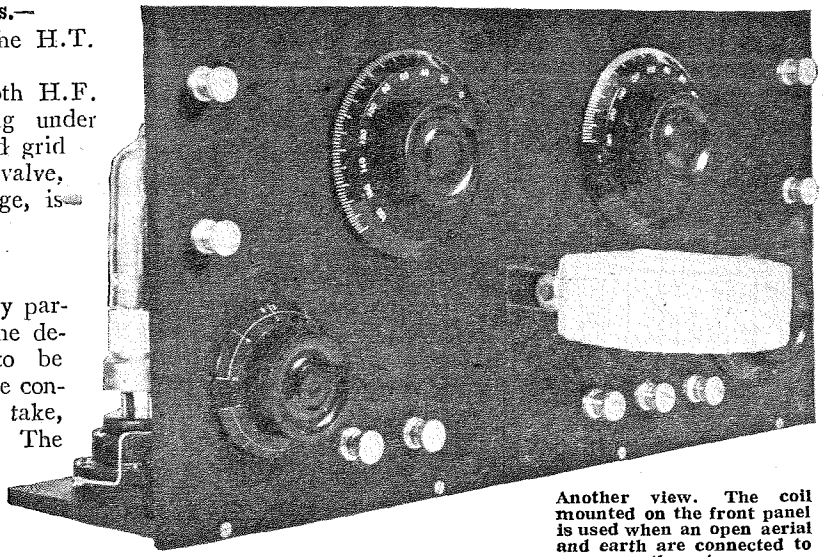
a similar condenser is connected across the H.T. supply to the high-frequency valves.

A single filament resistance controls both H.F. valves, since these valves are operating under similar conditions as far as the H.T. and grid voltages are concerned. The detector valve, which operates with a lower anode voltage, is provided with a separate filament control.

Constructional Details.

The receiver has not been built to fit any particular size or type of carrying case. The decision as to whether the batteries are to be carried in the receiver case or in a separate container, and the forms which these are to take, must be left to the taste of the individual. The essential components have been built into a unit, the dimensions of which are related to the components themselves, and not to the probable size of the case.

The dimensions of the larger of the two panels are given in Fig. 2. This panel carries the terminals for the batteries and other external connections, together with the reaction coupling, the tuning condenser, the filament resistances, the coil holder, and the two by-pass condensers. The small panel in Fig. 3 carries the valve holders and the coupling resistances and condensers.



Another view. The coil mounted on the front panel is used when an open aerial and earth are connected to the set.

The arrangement of the components on this panel is such that wiring is reduced to an absolute minimum. Indeed, wires are not required for some of the grid connections, which are made by soldering together adjacent connecting lugs.

For the reaction coupler, it is convenient to buy a variometer and to modify the connections and, if necessary, the windings. The variometer need not necessarily be of the type illustrated in the photographs. A ball type variometer would do quite well, or a vario-coupler could be constructed by mounting a basket coil to rotate inside or at one end of a plain cylindrical winding. The number of turns required for each coil will depend upon the type of former adopted, but 50 for the outer coil AB, and 100 for the reaction coil CD, may be taken as an indication of the number required.

It will probably be found best to assemble the components on the panels before screwing these together. With the components assembled, the wiring should present no difficulty if carried out with the aid of the wiring diagram in Fig. 4.

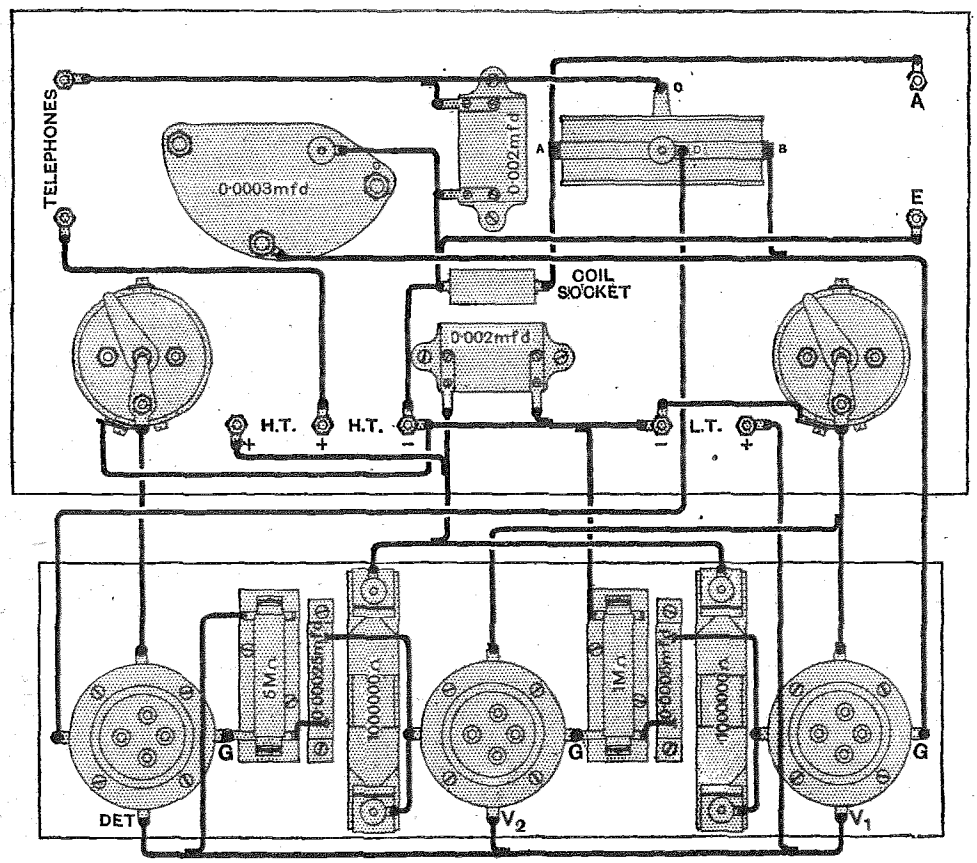


Fig. 4.—The wiring diagram. Terminals A B are the ends of the stator winding of the variometer and C D the ends of the rotor winding.

Operation.

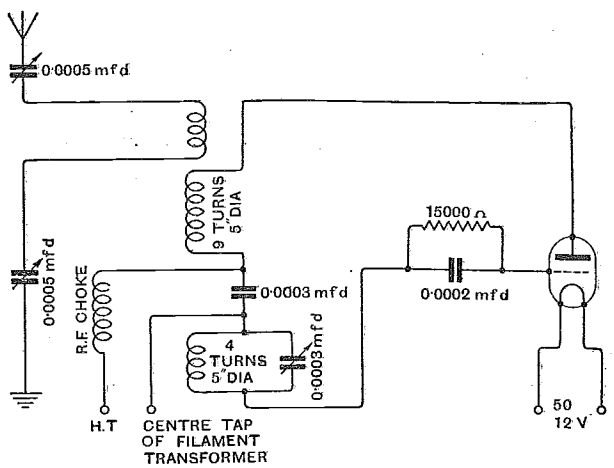
The preliminary trial of the finished receiver should be made with a high-tension voltage of 100 volts for the

COMPONENTS REQUIRED.

1 Ebonite panel, 14in. × 7in. × ¼in.
1 Ebonite panel, 13¼in. × 4in. × ¼in.
1 Variable condenser, 0·0003 mfd., maximum.
1 Vario-coupler (180° movement).
2 Variable filament resistances (McMichael).
2 Fixed condensers, 0·002 mfd. (Dubilier type 600).
1 Fixed condenser, 0·0005 mfd. (Dubilier type 600A).
1 Fixed condenser, 0·00025 mfd. (Dubilier type 600A).
2 Anode resistances, 100,000 ohms (Dubilier).
1 grid leak, 1 megohm (Marconiphone).
1 grid leak, 5 megohms (Marconiphone).
3 Anti-phonic valve holders (Burndept).
Terminals, wire, etc.

H.F. valves, and about 45 volts for the detector. An earth connection and a short aerial should be used with a tuning coil of suitable size in the coil holder. A Gambrell E coil was used in the actual tests of this set, but an Igranic No. 200 or 250 coil would do equally well. The valves should then be turned on until further increase of the filament temperature does not produce any appreciable increase in signal strength. The tuning adjustments involve the simultaneous manipulation of the reaction coupling and tuning condenser, and are not more difficult than those of a single-valve set.

If the set is working normally, it should be possible to receive clear signals from Chelmsford on a 10ft. indoor aerial at a distance of thirty-five miles. Incidentally, it is interesting to note that quite good results can be obtained from local stations on the 300-500 metre waveband, showing that a certain amount of H.F. amplification takes place on these wavelengths.

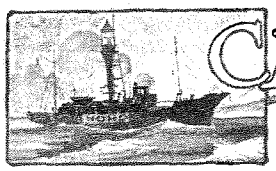


The circuit arrangement with details of component values.

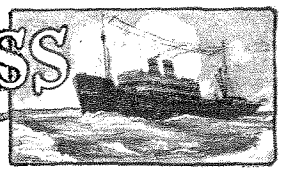
22-METRE TRANSMITTER.

The Equipment at 2OD, Successful in Communicating with Australia in Daylight.

The valve is an adapted M.O. type T.250, and choke coils are inserted in all power supply leads. It will be seen from the circuit that Mr. Simmonds does not employ the master oscillator arrangement used in his previous successful experiments with longer waves. The aerial system has a fundamental wavelength of 66 metres, and is operated at the third harmonic.

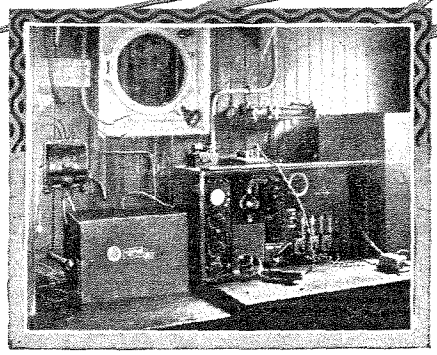


CALLING UP BY WIRELESS



Wireless Call-bell Devices.

By N. ASHBRIDGE.



A description of Commercial Systems which the interested amateur can modify to meet his own requirements.

THE advantage of one station being able to attract the attention of the station with which it is intended to communicate, without the operators at both ends keeping a continuous watch with headphones, will be readily appreciated. Large high power stations, which usually deal with a more or less continuous stream of commercial traffic, would not normally require calling-up apparatus, and this would also apply to stations which call up as a matter of routine at regular, and fairly frequent, intervals. However, there is a large number of installations, chiefly employing powers up to about half a kilowatt, which require to communicate at unknown times, and at infrequent intervals. If these stations can be provided with apparatus which will ring a bell in the distant station when communication is required, the operators can be employed on other work, not necessarily in the same building as the wireless station.

The requirements of such apparatus are fairly straightforward, but are not very easily met in all respects. The more important points to be considered are the following:—

(1) The apparatus must not respond to signals of any kind, other than those from the station making the call.

(2) The apparatus must be sufficiently sensitive to operate with certainty, even when the conditions are not entirely favourable.

(3) The consumption of filament and anode current must be kept as low as possible, because normally the valves may be switched on almost continuously.

(4) The cost of the calling apparatus itself must be reasonable, as compared with that of the wireless station of which it forms a part.

Considering first of all very briefly the special problem of calling-up between ships, we find that the conditions are extremely exacting. The jamming on the ship wave will usually be acute, especially near any large port, while in the tropics atmospherics will be troublesome. Again, a failure to respond to a call might be very serious, because the call will occasionally be one of distress. However, the requirements (3) and (4) are not so important, in the case of ships, as (1) and (2). Several designs have been tested at various times, and at least one has given excellent results. In this case the call is made by sending out a series of dashes of definite duration at carefully timed intervals. These signals are sent by hand on the spark transmitter, and are timed by observation using an ordinary watch, this method giving sufficient accuracy. The receiving apparatus comprises an ordinary wireless receiver with sufficient amplification to operate a relay connected in the anode circuit of the last valve. This relay operates a mechanical device, which closes the circuit of an electric bell only when the definite series of timed current impulses are received. Such apparatus is not in general use at the present time, but eventually it may become universal.

Principles of Operation.

In this article it is intended, as far as space permits, to describe in detail two devices, which have been used for calling between two or more stations of moderate power. In both cases the call signal is in the form of continuous waves modulated by a definite sonic note. In order to make a call one very long dash is sent out lasting between fifteen and thirty seconds. This long dash is received at the distant station on the ordinary radio receiver, and is then applied to a fairly selective note filter. In the first of the two schemes to be described the last valve of the filter is arranged to give rectification. The result of the rectified note frequency oscillations is a change in the value of the direct current flowing in the anode circuit of this valve. This change of current actuates a suitably wound P.O. type relay, which could be made to close an electric bell circuit direct. However, the note filter in itself is not a sufficient protection against rough spark signals and atmospherics, even when used in conjunction with a selective radio receiver. Cost and other practical considerations limit the degree of selectivity used on the radio receiver of a small station. In order, therefore, to prevent the bell being rung by Morse jamming and atmospherics, the anode circuit relay is arranged to operate a further relay with a delayed action. The contacts of this relay do not close, unless the current has been applied to it for the specified time, say, twenty seconds. Strong Morse signals do not have an accumulative effect, because if the curernt is interrupted for even a fraction of a second, the armature resets itself, and a further twenty seconds of uninterrupted current are re-

Calling Up by Wireless.—

quired before the secondary contacts are closed, actually ringing the bell.

The Call Transmitter.

Fig. 1 shows the theoretical diagram of the call transmitter connected to a radio transmitter, employing grid control for telephony. The portion to the right of the dotted line is the call transmitter itself, and that to the left of the line is the radio transmitter. It will be seen that the former consists essentially of a straightforward oscillating circuit arranged to give a note frequency of the order of 1,500 periods per second. An iron core is not used for the inductance, as this would tend to cause fluctuations in the frequency of the note produced. The condenser B has a fixed value, and different notes are obtained by varying the inductance A, which includes the variometer K. This becomes necessary when it is required to call different stations working on the same wavelength. Parts G and D are the grid leak and condenser respectively, and E is the reaction coil; F is a coupling coil which serves to transfer some of the energy generated in the circuit A B to the microphone transformer J.

The Calling Apparatus.

This method of connection has the advantage that no internal connections in the radio transmitter need be disturbed, when it is desired to make a call. The degree of coupling of the coils F, A, and E is fixed, and resistance L serves to regulate the amount of control applied to the radio transmitter. The valve C can be of the same size and type as the high-frequency oscillator M; this is actually highly desirable, because it is then possible to run it at considerably less than full power, which assists in obtaining an accurate and steady note. At the same time the high tension supply can conveniently be taken from the same generator for both valves. In order to simplify the diagram, the switching arrangements, for changing from "call" to "speech," have been omitted.

The Call Receiver.

Fig. 2 shows the theoretical diagram of the call receiver in its simplest form. T_1 and T_2 are the telephone terminals of the radio receiver, and A is a coupling coil having the same order of impedance as a pair of telephones. This coil is variably coupled to the circuit EC,

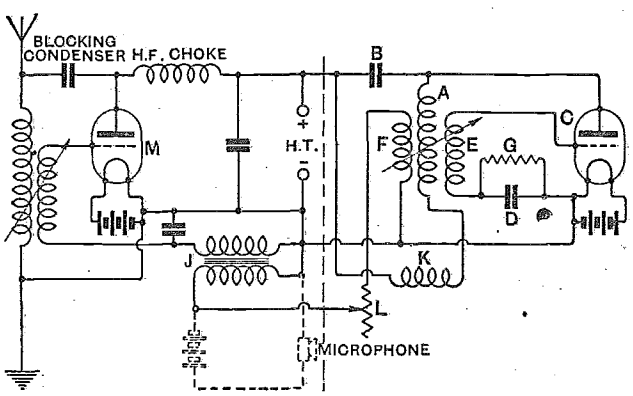


Fig. 1.—Connections of a call transmitter equipped with grid control for telephony. The portion to the right of the dotted line is the calling apparatus.

the latter being tuned to the frequency of the incoming note by the variable condenser E. The cell F maintains the grid of the valve V_1 at a negative potential to prevent an increase in the damping of the circuit EC by grid current. The circuit HL is exactly similar to EC, but the coupling between P and H has a fixed value. Parts J and K are the grid leak and grid condenser respectively,

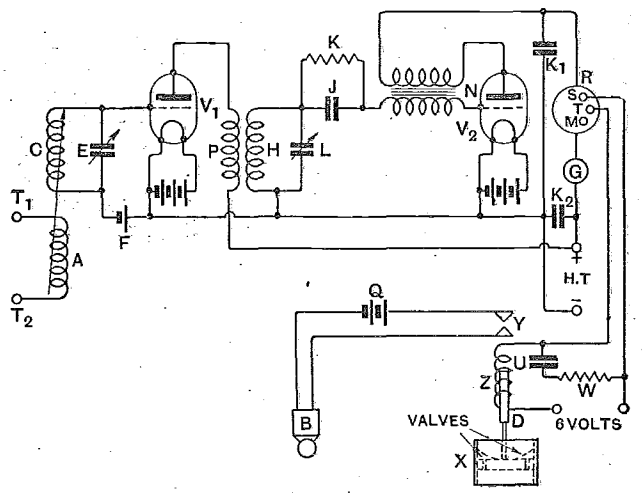


Fig. 2.—Arrangement of a call receiver. When the relay is actuated a bell rings.

producing rectification in the valve V_2, or, in other words, a change of direct current through the relay R. Reaction is applied by means of the transformer N, the windings of which have to be very carefully chosen to suit the remainder of the circuit. The condensers K_1 and K_2 provide an easy path for the alternating component of the plate current.

The object of using this somewhat unusual method of reaction lies in the fact that it will give the required effect over a considerable band of frequencies without readjustment, and is generally very stable. The increase of sensitivity given by the reaction transformer is represented by an increase of 100 per cent. in the change of plate current for a given signal input.

Operation of the Relay.

The relay R is of the P.O. type, wound with a large number of turns of fine wire, so that it is operated with certainty by a very small current change. The safe value of the required current is approximately 0.3 milliampere. It will be realised that when no signal is coming in, there will be a steady plate current, which will hold the tongue of the relay over to "mark." Since "grid leak" rectification is used, the effect of a signal is to reduce the plate current so that the relay goes over to "space." The delayed action relay is therefore connected up across the tongue and spacing contacts, as shown on the diagram. Condenser U and resistance W serve to minimise the sparking at the P.O. relay contacts. This secondary relay consists of a solenoid, Z, with an armature, D, which is attached to a piston working somewhat loosely in a paraffin oil dashpot, X. The upward movement of D is retarded by the paraffin in the dashpot, while its downward movement is rapid, owing to the valves located

Calling Up by Wireless.—

in the piston itself, which allow the oil to flow freely through them in an upward direction only. This relay is usually adjusted so that an uninterrupted current has to flow in the solenoid coil for about twenty seconds before the contacts at Y are closed by the upward movement of the armature. Morse signals, however strong, merely cause the armature to move up and down through very short distances. The contacts at Y actuate an ordinary electric bell, which may be fixed at any point convenient to the operator.

Calling-up apparatus of this description has been used successfully on lightships and lighthouses.

A Second Arrangement.

Fig. 3 shows the theoretical diagram of the second scheme, which differs from the above in two important respects.

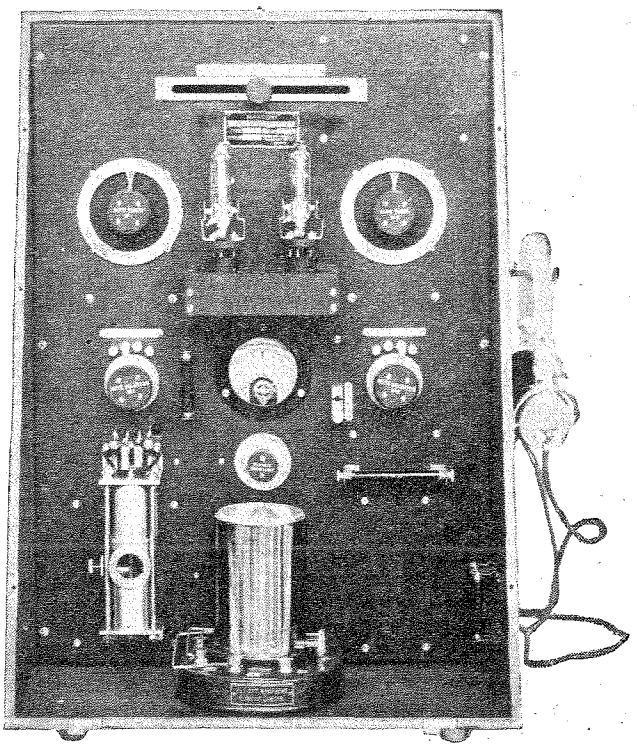
(1) The call is in the form of a loud-speaker signal, instead of the ring of an ordinary electric bell.

(2) The same piece of apparatus is used both to modulate the transmitter, when sending out a call, and to receive a similar call from the distant station.

The method of working is briefly as follows: When receiving a call signal, the valve V_1 acts as a note filter, while the valve V_2 amplifies aperiodically. This produces a strong sonic note in the loud-speaker, similar to that sent out by 2LO as a warning for the time signal. When it is desired to transmit a call, the filter valve V_1 is made to oscillate at the same audio frequency as that on which is receives when acting as a filter. The oscillations produced are further magnified by the valve V_2, and a very powerful note is given out by the loud-speaker. In order to modulate the radio transmitter, it is only necessary to hold the microphone in the trumpet.

Connections of the Receiver.

Referring to the diagram, T_1 and T_2 are the telephone terminals of the radio receiver, A is a coil variably coupled to the audio frequency oscillatory circuit BE. DC is a reaction coil wound in two sections; the portion C is in action during reception to reduce the damping of the circuit BE, increasing the sensitivity as well as the selectivity. When transmitting a call, the second portion of the reaction coil is unshorted, causing the circuit BE to generate oscillations, which are passed on to the valve V_2 *via* the transformer G. When this extra portion of the reaction coil is unshorted, it is necessary to connect a condenser, F, in series with the tuning condenser E, in order that the transmitted note may be maintained at exactly the same frequency as that to which the circuit tunes when receiving. The required amount of compensation is very small, so that F will be large compared with E, but it will be easily realised that the received and transmitted frequencies must be practically identical, or the two stations will attempt to chase each other when tuning their note frequency circuits. However, it has been found that it is sufficient to make the condenser F variable in steps.



[*By courtesy of Marconi's Wireless Telegraph Co., Ltd.*]
The Marconi Wireless Call Bell Receiver.

With regard to the question of valves, almost any good receiving type is suitable, but normally dull emitters are used, since the apparatus is working continuously, and economy in filament consumption is of real importance.

This type of call-up has the advantage that it is very simple and free from moving parts. However, the emitted signal is usually not so penetrating as an electric bell, and although the note filter greatly reduces the jamming signals, a strong spark station with a "rough" note will come through as a kind of blurred mush in the loud-speaker. There are, however, a number of stations on which a simple device of this description can be employed very conveniently and with considerable economy from the point of view of operators' time.

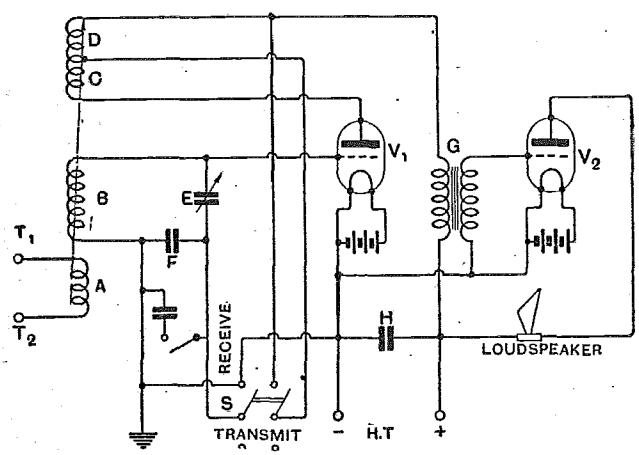
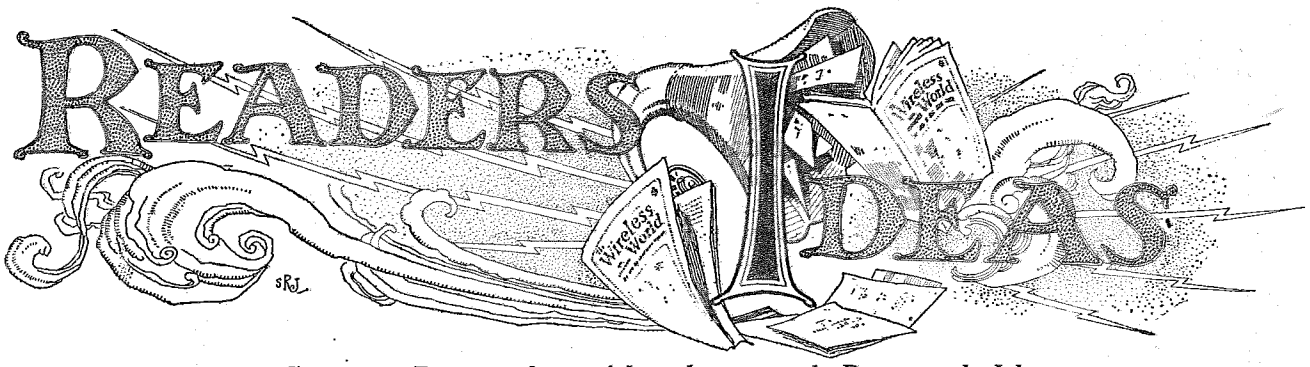


Fig. 3.—Another scheme. The operator's attention is attracted by a note emitted from the loud-speaker.

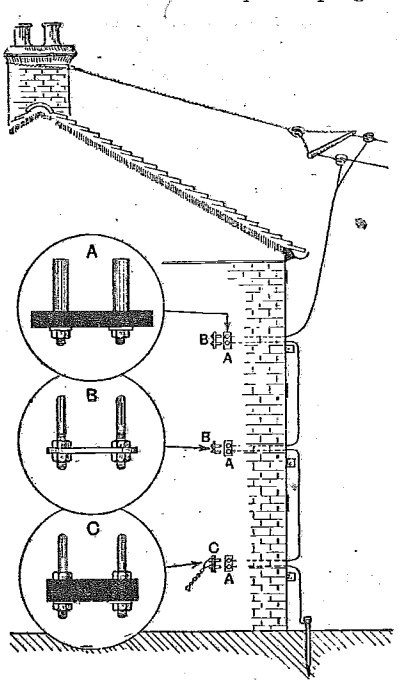


A Section Devoted to Novelties and Practical Ideas.

AERIAL LEAD-IN CONNECTIONS.

When a receiver is to be used on different floors of the same building the system of wiring illustrated in the diagram will be found very convenient.

The aerial lead-in is connected on each floor to small terminal panels carrying two terminal sockets. From these sockets the aerial and earth connections are taken, the sockets on other floors being at the same time short circuited with a special plug.

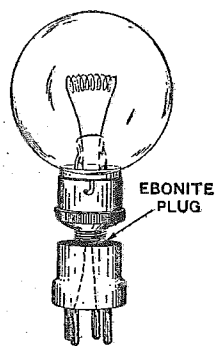


How the aerial lead-in may be arranged when the receiving apparatus is to be transferred from room to room.

The terminal panels must be mounted near to the windows on each floor and the sections of the lead-in should be spaced away from the wall to avoid losses and capacity effects. —G. E. M.

A TEST LAMP FOR FILAMENT CIRCUITS.

In the absence of a voltmeter, a test lamp is useful for ascertaining whether the correct voltage is being applied to the filament sockets of a newly wired set. If the H.T. voltage has been applied to the filament circuit through some fault in the wiring it will only result at the worst in the burning-out of the comparatively cheap test lamp.



A small lamp with bayonet fitting connected to the filament pins of a valve holder, provides a ready test of the filament circuits of a receiver.

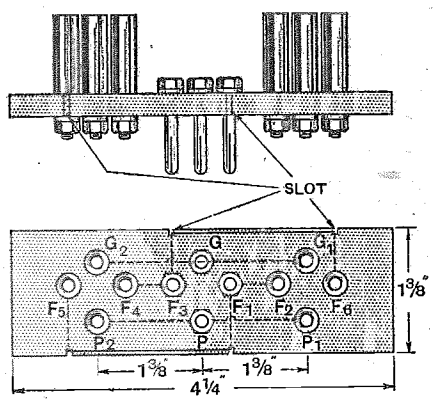
It is convenient to mount the lamp on an old valve base which can then be rapidly inserted in each valve-holder in turn. The connections from the test lamp are jointed to the two filament legs and the lamp holder may be screwed into an ebonite disc made to fit the top of the valve base. A simpler, though perhaps not quite such a satisfactory method, would be to fill the valve base with molten pitch.—L. M.

oooo

PARALLEL CONNECTIONS FOR L.F. VALVES.

Low-frequency amplifying valves of similar characteristics can be connected in parallel in the last stage of an amplifier to increase the volume from a loud-speaker. In this way an experimenter who has a number of general-purpose valves would be able to obtain good loud-speaker results without incurring the expense of a special power valve.

An adaptor by means of which two valves may be connected in parallel in the last stage of an existing amplifier is illustrated in the accompanying diagram. The valve pins on the lower side of the panel are connected to the valve-holders on the upper side, the corresponding sockets of which are connected across in parallel.

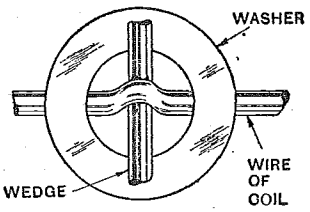


A simple adaptor for connecting valves in parallel.

Valves in parallel are not capable of dealing with greater input amplitudes than each valve taken individually would be capable of amplifying without distortion. It is useless, therefore, to attempt to cure distortion which is caused by excessive input amplitudes by connecting valves of the same type in parallel. Distortion of this kind can be cured only by using a valve in which the length of the part of the characteristic available for amplification is greater.—E. J. S.

MAKING TAPPING POINTS.

In winding a tapped cylindrical coil it is generally best to wind the coil straight through from end to end and then to make the tappings by prising up turns with a sharp tool at the approximate points.



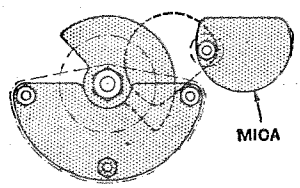
A simple method of making tapping points on inductance windings.

The operation will be greatly facilitated if a 4B.A. washer is first placed over the position and the wire lifted up through the central hole. A short piece of No. 18 S.W.G. bare copper wire inserted between the loop so formed and the washer, will prevent further movement, and will greatly assist the removal of the insulating covering from the wire prior to soldering.—H. N.

oooo

A VERNIER CONDENSER ADJUSTMENT.

Of the three factors governing the capacity of a condenser, the area of overlap of the plates and the distance between them are frequently made adjustable in order to bring about variations of capacity. A very neat vernier adjustment for a variable air dielectric condenser can be obtained by varying the third factor —the dielectric constant.



A critical vernier condenser control may be arranged by mounting a plate of mica so that it can be inserted between the fixed and moving plates.

A mica or celluloid vane is mounted on a spindle passing through a bearing in the panel in such a way that it may be inserted between one of the fixed and one of the moving vanes of the condenser. Since the dielectric constant of the vane is greater than that of air, the capacity of the condenser will be increased as the vane is inserted between the plates.

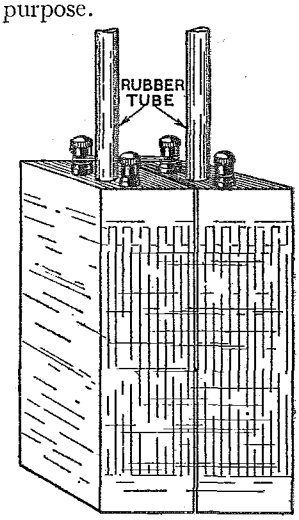
An extremely fine adjustment of capacity can be obtained with this method, which involves no structural alterations to the condenser.—T. B.

oooo

PREVENTING CORROSION OF ACCUMULATOR TERMINALS.

The corrosion of accumulator terminals is in nearly all cases due to the acid spray which escapes from the vents during the process of charging.

The spray may be prevented from spreading over the top of the accumulator by fitting lengths of rubber tubing to the vent flanges after removing the vents. The tubes should be from 12in. to 18in. in length and of fairly stiff texture. The rubber tubing reinforced with canvas which is used for hose piping is excellent for this purpose.



Extension tubes fitted to the vents of an accumulator prevent the acid from spraying on to the metal parts of the terminals and causing corrosion.

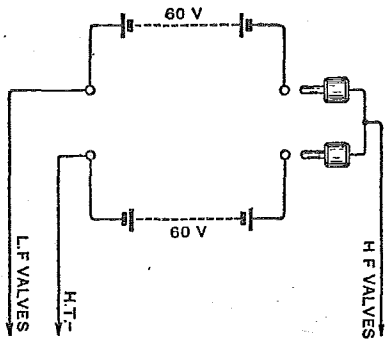
The true gases—oxygen and hydrogen—produced during the charge escape freely through the top of the tube, but the globules of acid thrown up by the bubbles of gas are confined to the tube and fall back into the accumulator.—F. W.

oooo

H.T. BATTERY CONNECTIONS.

When several tappings are taken from a high-tension battery, the cells between the lowest tapping and —H.T. are called upon to deliver a larger current than cells nearer the positive end of the battery. The result is that the cells at the negative end of the battery become exhausted first, and are a source of great inconvenience when the whole of the battery is built in one block.

In receivers employing modern valves 60 volts is generally required for the H.F. and detector valves, and 120 volts for the low-frequency amplifiers. To meet these requirements it is best to purchase two separate 60-volt units and to connect them according to the diagram. Periodically the connecting link from which



Connections of the H.T. battery to provide for even discharge by interchanging the sections which are subjected to a heavier load.

the tapping to the H.F. valves is taken is changed from the bottom to the top of the battery, so that the distribution of current in the two halves may be reversed. In this way the batteries will be discharged evenly and become exhausted at the same time.—R. E. A.

oooo

FIXING AN AERIAL TO A HIGH TREE.

When it is desired to attach an aerial to an unclimbable tree the following method, which has proved successful on many previous occasions may be tried.

A length of thread greater than twice the height of the tree is attached to a suitable missile, such as a ½in. hexagon nut, and projected over the top of the tree from a catapult. The thread, which should be of good quality, is then used to pull a strong, light cord, by means of which the aerial may be raised. If the aerial is heavy the cord may be used to pull over rope of greater strength.

The catapult should be of large size, ¼in. square rubber being necessary for a tree 80ft. in height. It is advisable to lay the thread in the form of a zig-zag on the ground about 50ft. from the base of the tree in order that it may be quite free to rise when the missile is released.—R. H. B.

ACCUMULATORS FOR PLATE CURRENT.

How to Make an H.T. Battery.

By S. J. MATHEWS.

THE dry cell battery is not by any means the ideal method of supplying the necessary anode current for multivalve receivers. This specially applies to receivers using the modern small power valves which take a current in excess of that which the small cells of the dry battery can efficiently supply.

Where the experimenter has electric light mains available, different methods of using the high voltage supply can be adopted, but even with the best of them a slight hum is noticed in the telephones. This hum is swamped by loud signals, but is very annoying when trying to receive distant telephony.

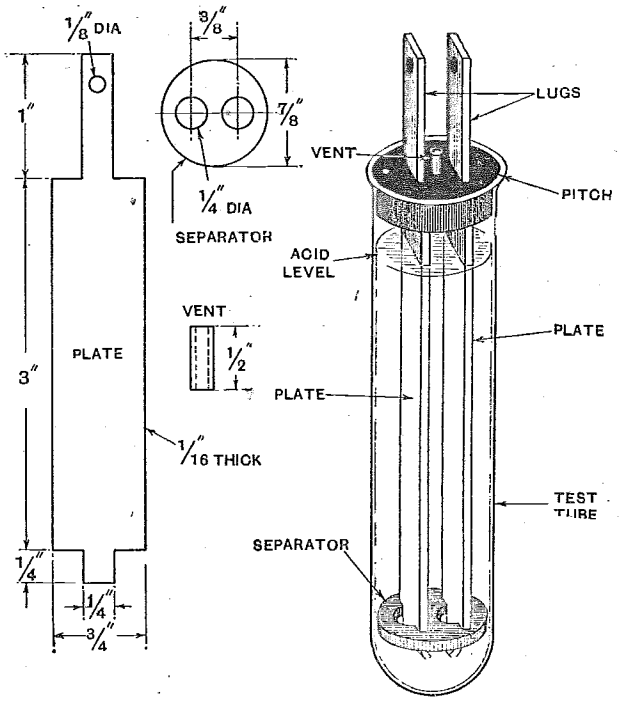


Fig. 1.—Sketch of a completed cell, and the dimensions of the parts.

Undoubtedly the best method of supplying H.T. to a receiver is by means of a battery of accumulators, and contrary to the general impression these can be easily constructed at home. Such a battery is also very cheap to construct; the 60-cell battery shown in the photographs cost the author about 25s., complete with wooden stand.

Materials Required.

Each cell of the battery consists of the following parts:—

One 4in. glass test tube.
Two lead plates.
One ebonite separator.
One glass vent.

These parts, and the complete cell are shown in Fig. 1.

The plates are cut to the size and shape shown in Fig. 1 from sheet lead $\frac{1}{16}$in. thick. The number of plates will, of course, depend on the number of cells the reader wishes to make, and it should be remembered that two plates will be required for each cell. The battery shown in the photograph is nominally 120 volts, and consists of 60 cells. Thus 120 plates had to be cut. The lead should be cut up into strips and shaped afterwards. The cutting can be done with a large pair of scissors or tin-snips.

Making the Parts.

The separators should next be made, and for this purpose a lathe is required. If such a tool is not available the work can be put out very cheaply. The separators are parted off a rod of ebonite $\frac{7}{8}$in. diameter, and the two holes, $\frac{1}{4}$in. diameter, drilled afterwards; one is required for each cell.

A length of glass tubing, such as is used in chemical laboratories, should now be obtained, and at the same time the test tubes can be purchased. The latter are quite cheap, and the author obtained a very good quality article from Messrs. Townson and Mercer, Ltd., Camomile Street, E.C. They are about 1in. diameter and 4in. long. The glass tube is cut up into short lengths as shown in the figure to form the vents. One each of the test tubes and vents are required for every cell of the battery.

Assembling the Cells.

The cells can now be assembled. First of all take two plates and push the short tangs into the two holes in an ebonite separator. The tangs, which will project through the ebonite, should be bent over slightly so as to hold the plates and the separator together. The whole is now carefully placed into a test tube, and this process should be repeated with all the cells it is desired to make.

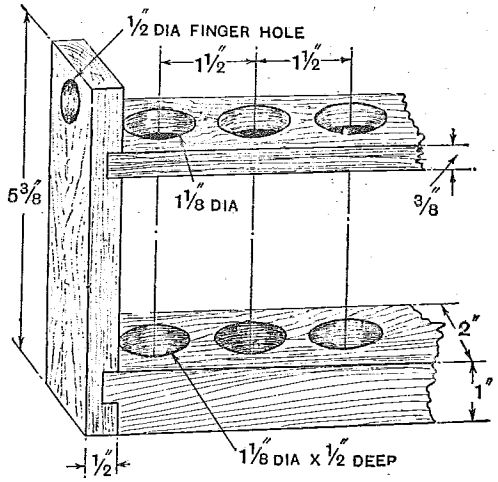


Fig. 2.—Arrangement of the battery rack.

Accumulators for Plate Current.—

Our next operation is that of sealing the cells, and for this purpose some pitch should be obtained. A word of warning is perhaps necessary here, as pitch is a dangerous material if not handled carefully. It should be melted in small quantities in an old saucepan, and on no account should a naked flame be allowed to get near it.

The cells are first filled to within ¼in. of the top with silver sand, care being taken to see that it is perfectly dry. A glass vent tube is now placed in the centre of each cell by pushing it a short distance into the sand. Then the molten pitch is poured in on top of the sand, filling the cell to the top. After the pitch has set it will be found quite easy to remove the silver sand by simply turning the cell upside down and letting it pour through the vent. The last few grains can be shaken out, but if a slight quantity of sand refuses to come out, leave it in, for it will do no harm. With the aid of a hot hat pin a small air hole should be made through the pitch. This is necessary when pouring acid through the vent.

Arranging the Cells.

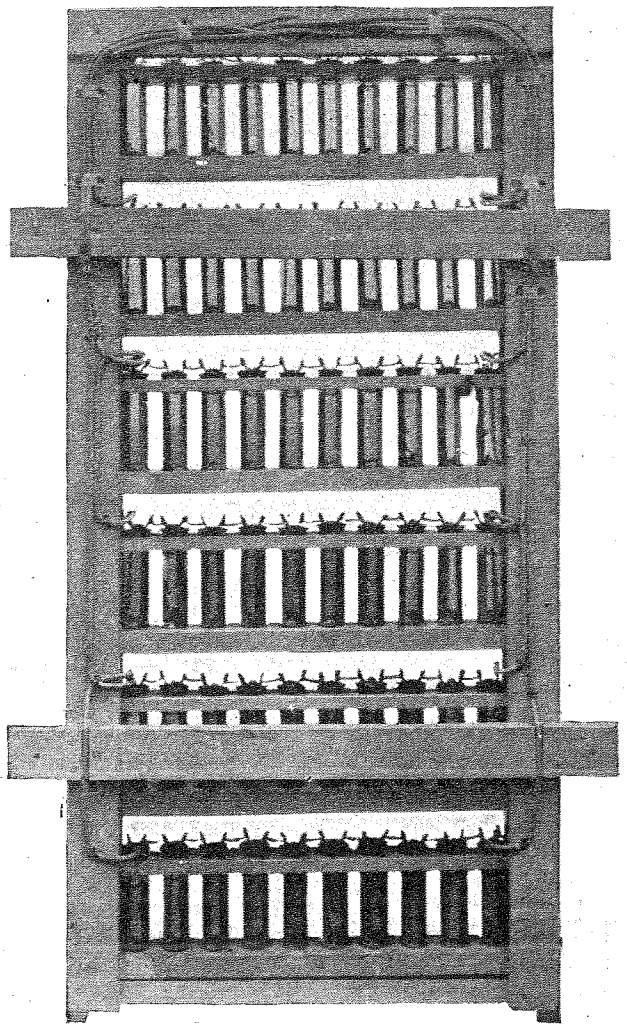
The best plan for storing the cells is in racks of ten constructed as shown in Fig. 2, which is self-explanatory. These racks can be put side by side into a box or stored one on top of another in another rack as shown in the photographs. The former method is more convenient if the battery has to be taken away for recharging, but in the author's case electric light mains were available for charging, so that the method shown was adopted and the battery fixed to a wall, so taking very little floor space. Whatever method is adopted all woodwork should be given a coat of anti-sulphuric enamel. The cells in each rack can now be connected up in series. A short length of lead wire is used for this purpose, the joint with the plates being soldered. When the racks have been housed in their stand or box, these should also be connected up in series and suitable tappings made. The author made a tapping to each of the six racks, thus providing voltages of 20, 40, 60, 80, 100, and 120. These tappings are taken to suitable terminals, a further terminal connecting to the plate intended for the common negative. Each cell should now be filled with best sulphuric acid, having a specific gravity of 1,200.

Forming the Plates.

Everything is now ready for the forming process, which is the chief part in the manufacture, and an electric light installation is absolutely necessary. About one-fifth of an ampere is required for forming the plates, and a suitable lamp or resistance must be connected in the circuit to pass this current when the cells are in series with it.

The negative lead should be connected to the proposed negative terminal, and the positive to the highest positive tap, the current being switched on for half an hour. Now leave the battery for twelve hours, and then reverse the connections, *i.e.*, positive main to negative terminal and negative main to highest positive tap, and switch on the current for another half hour. This is done seven times, reversing the direction of the current on each occasion.

The battery should now be connected the right way round and charged for one hour each evening for a week, it being left untouched between the periods of charging. After this it should be quite ready for use, and if tested with a voltmeter should show a voltage of 2.5 volts per cell. It can now be discharged until each cell shows 1.8 volts on a voltmeter, when it should be recharged in the ordinary manner.

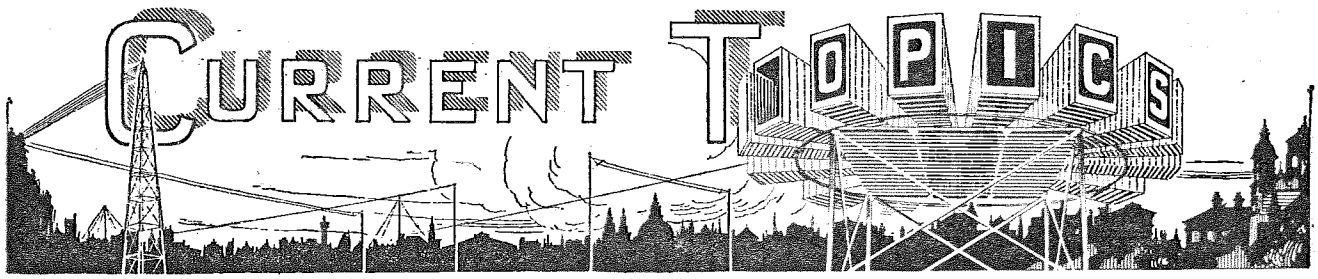


View of the rear of the 60 cell battery, showing the cables connected to provide a suitable range of voltages.

LOUD SPEAKER SERVICE IN CRYPT.

So great was the attendance at the Church of St. Martin's-in-the-Fields, London, on the occasion of the broadcasting of the service on Sunday, May 9th, that part of the congregation had to be accommodated in the crypt. Through the medium of Marconiphone loud-speakers they were able to participate in the entire service, which was reproduced with perfect clarity.

The equipment consisted of two microphones placed opposite the pulpit and one on the choir stalls, these being connected to two "A" amplifiers followed by an "E" amplifier. The "E" amplifier embodies three stages of resistance capacity coupling.



Events of the Week in Brief Review.

NIPPED IN THE BUD.

According to *The Times*, seven secret wireless transmitting stations have been seized by the police at Lisbon.

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ESPERANTO FOLLOWS ENGLISH.

The course of English lessons from the Vienna broadcasting station was completed on May 15th, and is being followed by lessons in Esperanto.

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AMERICA'S BROADCASTING PROBLEMS.

An attempt to clear up the present chaos in the American broadcasting system will probably be made in September, when, it is understood, a national radio conference will be called.

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CHINA AND WIRELESS BAN.

The Central Chinese Government is arranging to lift the embargo on radio material and supplies, according to the American Radio Relay League.

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BROADCAST INTERFERENCE ON THE COAST.

Hastings, Worthing, and Yarmouth all report interference with broadcast reception from various sources. As might be expected, ship transmissions are held to be partly responsible, but Worthing listeners complain of "jamming" from a French station which interferes badly with Bournemouth's transmissions. The principal cause of complaint on the East Coast is stated to be the Government station at Caister.

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NRRL HEARD IN BRITAIN.

Mr. J. Ridley (5NN), of South Norwood, London, S.E., has been successful in picking up short-wave signals from NRRL, the experimental station with the American Pacific Fleet, at present operated by Mr. F. H. Schnell, of the American Amateur Relay League. The transmission note was absolutely pure D.C., reports Mr. Ridley, and signals were received at approximately R7.

Mr. Ridley is himself transmitting on 45 and 25 metres every week-end.

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NOVEL TRANSMITTING REGULATIONS IN SWITZERLAND.

A plan whereby amateur transmitters supervise their own activities and enforce their own rules is meeting with acceptance in Switzerland, according to a Continental correspondent.

This scheme, suggested by M. Nussbaum, Chief of the Government Radio Bureau, at a recent amateur conference, requires every transmitting amateur to join a society of transmitters with an approved set of rules which it is empowered to enforce. Transgression of the rules will involve the cancellation of the transmitting permit.

The number of licensed receiving stations in Switzerland now exceeds 25,000.

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GERMAN SHORT WAVE TESTS.

A series of experimental transmissions during this month on a wavelength of 54 metres is announced by the Telegraphen-technische Reichsamt in Berlin. The signals, which will be in Morse, will be sent out thrice daily, during the periods from 2 p.m. to 2.20 p.m., 6 to 6.20 p.m., and 10 p.m. to 10.20 p.m. (B.S.T.). They will be composed of a group of six Morse letters followed by an interval of eight seconds, continuing in this manner throughout each test.

THE MACMILLAN EXPEDITION. A special 20-metre transmitter, employing the Reinartz-Zenith circuit, has been designed for the use of the MacMillan Arctic Expedition this summer. Our photograph shows the three designers of the instrument. (Left to right) Mr. H. C. Forbes, Lieut. John Reinartz and Dr. Karl E. Hassel.

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SHIP TO SHORE TELEPHONY.

The experiments in ship to shore wireless telephony which have recently been conducted at Southampton by the Marconi Company in conjunction with the Post Office have not been entirely successful, according to the *Morning Post*. The principal difficulty encountered has been "jamming," and to obviate the trouble another site will probably be chosen for the land station.

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NEW SOCIETY AT WORTHING.

The inaugural meeting of the Worthing Wireless Society, to be held on May 26th, will be the occasion of a lecture by Captain P. P. Eckersley, Chief Engineer of the B.B.C., whose subject will be "The History of Broadcasting in Britain."

His Worship the Mayor will preside, and it is hoped that the meeting will provide an excellent "send off" for the new venture.

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AUSTRIAN AMATEUR ACTIVITY.

From the Technical Editor of the "Radio Woche," Vienna, we learn that the principal *amateur* wireless organisation in Austria is known as the "Verband der österreichischen Radio Klubs," and embraces some eight or nine amateur societies. The "Freier Radiobund," mentioned in a previous issue, is founded on a political basis.

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A SPANISH PROBLEM

"To license or not to license" is the problem which is now exerting the minds of the Spanish authorities in relation to private wireless stations. Discussing the question, the "Heraldo de Madrid" supports the Madrid Wireless Committee, which urges the suppression of the licence system, on the ground that it is unreasonable to tax waves that come through the air. Such a tax, it is explained, is very difficult to collect, particularly as there is nothing easier than the concealment of apparatus. The journal advocates customs dues on apparatus imported into the country, believing that the State will obtain far more revenue in this manner than in endeavouring to trace the clandestine receivers which undoubtedly exist.

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NEWARK HEARD IN INDIA.

Signals from G2NB (Mr. N. G. Baguley, Newark, Notts) have been picked up on several recent occasions by the No. 5 Squadron R.A.F. Wireless Section at Kohat, India. The receiver consisted of a detector valve only.

FINNISH AMATEURS' INTERNATIONAL PREFIX.

The Secretary of the Finnish Radio Amateur League advises us that, from April 1st, the nationality prefix for Finnish amateur transmissions is "S," and not SZ, as stated in an earlier issue.

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A TRANSMITTER FOR EXPLORERS.

A transmitter and receiver for the express purpose of communicating with Arctic and tropical explorers is being erected at the offices of *Radio Broadcast*, New York City. Such an installation would appear superfluous in this country, but in America, where exploration almost amounts to a pastime, the new plant should fulfil a useful function. It will work on short waves, and efforts will be made to maintain touch with explorers during both night and day.

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2KF HEARD IN PAPUA.

An interesting QSL has reached Mr. J. A. Partridge (2KF), of Merton Park, from the wireless station at Port Moresby, Papua, where he was heard working with Australia on February 9th and 15th.

The operator at Port Moresby remarks that it is strange that the greatest difficulty is experienced in working with Australia after 4 p.m. owing to heavy atmospherics, but British and American amateur stations are readable at any time.

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RELAY CHAIN FOR CZECHO-SLOVAKIA.

A chain of relay broadcasting stations is to be erected across Czecho-Slovakia. The sites chosen are Boheme, Moravia, and Slovakia. They will relay the programmes from Prague.

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THE SHIP'S ORCHESTRA REPEATER.

On recent trips of the Canadian Pacific liner *Montclare*, the White Star liner *Cedric* and the R.M.S. *Arlanza*, the success has been demonstrated of a new form of equipment known as the ship's orchestra repeater. By means of this installation music played in the saloon can be perfectly reproduced in other parts of the ship, thus permitting dancing on deck and allowing concerts to be enjoyed by many people who could not actually hear them at first hand. The largest installation, which was used on the *Montclare*, comprised two Marconi magnetophones, three amplifiers and Marconiphone loud-speakers.

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WIRELESS *VERSUS* PIRATES.

In order to cope with piratical attacks on vessels sailing between Hong Kong and adjacent Chinese ports, the Colonial Office suggests that local steamers be fitted with wireless and carry skilled operators.

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BROADCASTING IN SPAIN AND SWEDEN.

Two new broadcasting stations are being erected by the Marconi Company in Stockholm and Madrid respectively. They will consist of the standard Marconi 6 kw. "Q" type installations as used in the main stations of the British Broadcasting Company.

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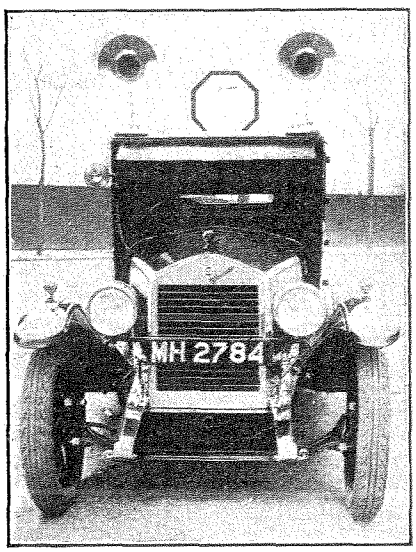
WIRELESS IN PORT.

In cases of emergency merchant ships may now use their wireless transmitting apparatus in certain specified harbours. These include the naval harbours of Portsmouth, Plymouth, Chatham, Sheerness, and Rosyth, and also the Port of London above Cross Ness. It is understood that only urgent ships' service messages are permitted, and the circumstances must be such that the vessels are unable to communicate with the shore by other means owing to stress of weather or other causes. Broadcast listeners need not, therefore, fear any encroachment on their preserves.



WIRELESS ON THE CAR. An Essex coach fitted with a General Radio eight-valve set and M.A.P. loud-speakers. It will be used for demonstration purposes during the coming summer. Good reception is obtainable without aerial or earth.

MISUSE OF CALL SIGN.

The call sign 2JG is apparently being misused by an illicit transmitter. The owner of the call sign is Mr. W. A. Seed, of Crigglestone, Wakefield, and he would be glad of any information leading to the detection of the culprit.

BROADCASTING IN OTHER LANDS.

The issue of "The Wireless World," to be dated May 27th, will be specially devoted to an account of the development of broadcasting outside the United Kingdom, and distinctive types of apparatus designed abroad will be reviewed.

COMPULSORY WIRELESS FOR JAPANESE SHIPS.

In view of recent disasters, a bill is to be presented before the Japanese Parliament enacting that all ships carrying more than fifty persons must install adequate wireless apparatus. A recent enquiry has shown that most vessels of 3,000 tons and over carry wireless, but the new bill involves an enormous number of smaller craft.

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REPORTS FROM 5QK.

Mr. F. Waller, Hon. Secretary of the Southend and District Radio Society, would welcome evidence which would lead to the detection of an unknown transmitter who is using the Society's call sign 5QK. The Society's apparatus is not at present in use, but reports of 5QK have been received from various localities, including Sutton, Surrey.

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WRITTEN REPORTS, PLEASE.

Mr. A. Turner (2XO), of 13, Elgin Avenue, London, W., is conducting a regular series of telephony experiments on Sunday evenings in connection with experiments with a new microphone. Whilst welcoming reports and criticisms on the transmissions, Mr. Turner would be glad if these were confined to written communications, as recently he has had a great number of interested callers at his house.

The transmissions are on 195 metres, between 6.40 and 8 p.m. on Sundays.

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BROADCASTING FROM TOULOUSE.

The new French broadcasting station at Toulouse, operating on 450 metres, is reported to be giving great satisfaction. According to our Paris correspondent, the transmissions have been heard at good strength in Brussels, Geneva, Zurich, Milan, Turin, Fiume, Madrid and Barcelona.

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AMATEUR TRANSMISSION IN HOLLAND.

The proposed regulations for amateur transmitters in Holland are very far from acceptable, according to a Continental correspondent. Under the suggested arrangement, amateur transmission is restricted to the period between 7 and 9 p.m., the wavelength not to exceed 200 metres. The proposals include a transmitters' tax of 50 gulden per annum, and one of the clauses enjoins that every transmitter must possess a receiver permanently tuned to 600 metres, for the purpose of intercepting distress calls at sea.

Considering the total ban on amateur transmission which has hitherto existed in Holland, we feel that Dutch amateurs should be glad to avail themselves of any concession which the Government may be prepared to grant.

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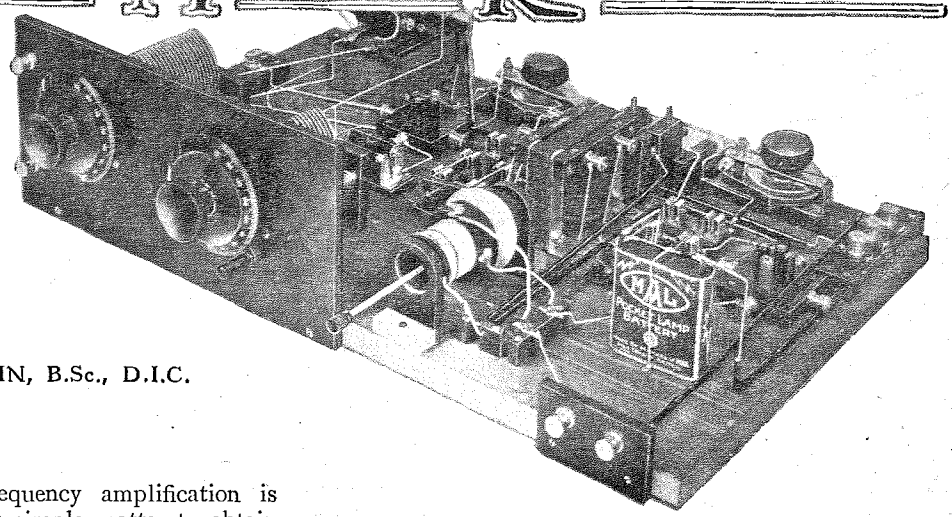
FIRST "S.B." IN FRANCE.

The inaugural ceremony of the recent French Exposition of the Decorative Arts was simultaneously broadcast by all the French stations. This is the first occasion of simultaneous broadcasting on a large scale in France.

Selective Morse Receiver.

Detector = L.F. Set with a Tuned Air-Core Low-frequency Filter Transformer.



By A. P. CASTELLAIN, B.Sc., D.I.C.

WHEN stable high-frequency amplification is possible, it is quite a simple matter to obtain very selective reception. On short waves—below 100 metres—however, it appears none too easy to obtain direct high-frequency amplification, so that some other method of selective reception must be looked for.

One obvious and widely used method is the supersonic heterodyne, which can be made exceedingly selective while being very simple to operate. However, the great drawback to this method is the number of valves required, which entails quite a large first cost in the matter of batteries as well.

There is another method which can be made to give even more selectivity than the super-heterodyne with only two, or, at most, three valves. This method may briefly be described as follows :—

An ordinary oscillating detector valve is used, Fig. 1, followed by a special low-frequency amplifier which is sharply tuned to (say) 1,300 cycles per second, and is, therefore, practically insensitive to all other frequencies.

The low-frequency amplifier contains a loose coupled transformer, with both primary and secondary windings tuned by means of fixed condensers to 1,300 cycles. In this way the transformer is made to have a very low impedance primary for all frequencies, except the 1,300 cycles, and hence behaves like a short-circuited normal type of transformer for all frequencies except the one to which it is tuned.

A typical amplification/frequency curve for such a transformer is given in Fig. 2.

The method of operation, then, is as follows :—

The station required is heterodyned to give a 1,300-cycle note in 'phones placed in the plate circuit of the oscillating detector. Let us suppose that there is another station very nearly on the same wavelength—so nearly that it is heterodyned to give a 1,000-cycle note in the 'phones. It will, therefore, be extremely difficult to read the station required owing to the jamming of the other one.

If the special L.F. amplifier now be put in circuit the signals of the station which is heterodyned to 1,300 cycles will be amplified about sixteen times, while the unwanted station will come through at about its original strength.

In practice it is found better to have an ordinary L.F. transformer in circuit for normal use, and a switch to put the special transformer in circuit instead when the required signal is jammed.

The special transformer may be made to amplify even more than sixteen times (with a valve, of course) at 1,300 cycles by the use of L.F. reaction. The circuits and apparatus used by the author are given in Figs. 1 and 3, while the illustrations, and Figs. 4 and 5 show the practical arrangement. The apparatus was mounted

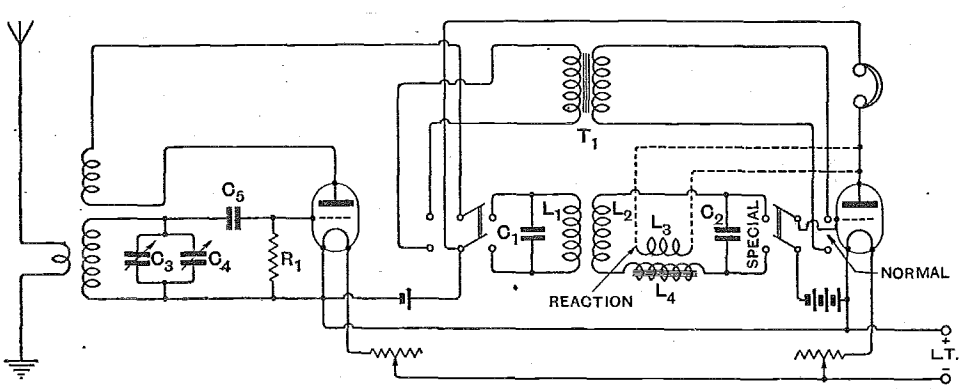


Fig. 1.—An explanatory diagram of connections. Tuning condensers C_3 and C_4 may have capacities of about 0·0005 and 0·00005 mfd. T_1 is an ordinary intervalve transformer.

Selective Morse Receiver.—

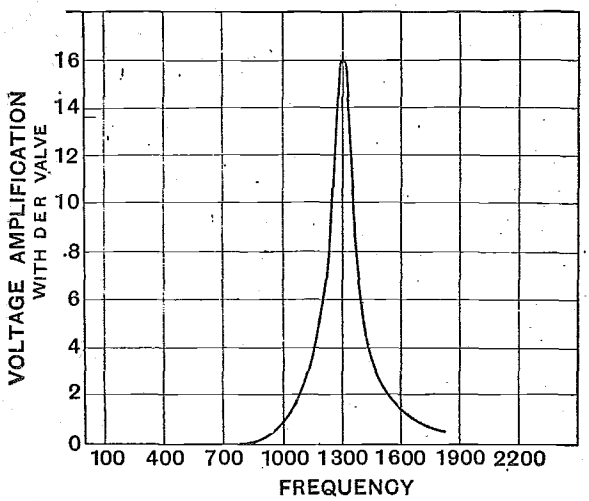


Fig. 2.—Typical resonance curve for the special transformer.

on a board, and in the practical set comprises a loose coupled tuner with reaction from the first valve, and a pair of switches to put an ordinary inter-valve transformer or the special circuit between the detector and note magnifier. The special circuit comprises two plug-in coils, L_1 and L_2, a variable iron-cored coil, L_4, and a low-frequency reaction coil, L_3. Condensers C_1 and C_2 are for tuning the circuit, and have values of 0.1 mfd. and 0.0015 mfd. respectively; coils L_1 and L_2 are ordinary plug-in coils, being Igranic Nos. 1,500 and 1,250.

The variable iron-cored coil L_4 and the reaction coil L_3 are home made, and are sketched in Fig. 5.

A piece of ebonite tube, 1in. in diameter by $3\frac{3}{4}$in. long, is provided with two cheeks, slightly less than $1\frac{1}{2}$in. outside diameter, cut from sheet ebonite and stuck in position. The cheeks are $1\frac{1}{2}$in. apart, and the space is wound with 3,500 turns of No. 40 D.S.C. copper wire. A core is constructed of soft iron wire, by forming a bundle of the wires $1\frac{1}{2}$in. long and $\frac{11}{16}$in. diameter. Through the centre of the core is put a piece of brass rod which acts as an adjusting handle, and the ends of the core are bound with tinned copper wire which is then soldered. This component is easily made, and is sketched in Fig. 5. Over the cheeks is placed a piece of ebonite tube $1\frac{3}{4}$in. outside diameter and $1\frac{1}{2}$in. long, and this tube slides smoothly over the cheeks, as its internal diameter ($1\frac{1}{2}$in.) is just a fraction larger than the diameter of the cheeks. This movable tube is the former for the reaction coil, and on it is wound 1,500 turns of No. 40 D.S.C. copper wire. If the reader has the means for cutting a wide groove in the $1\frac{3}{4}$in. tube, so much the better, as then winding is an easy matter; but, if not, the wire should be wound on carefully, and the turns run from side to side to prevent

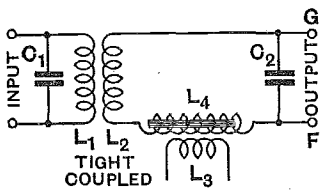
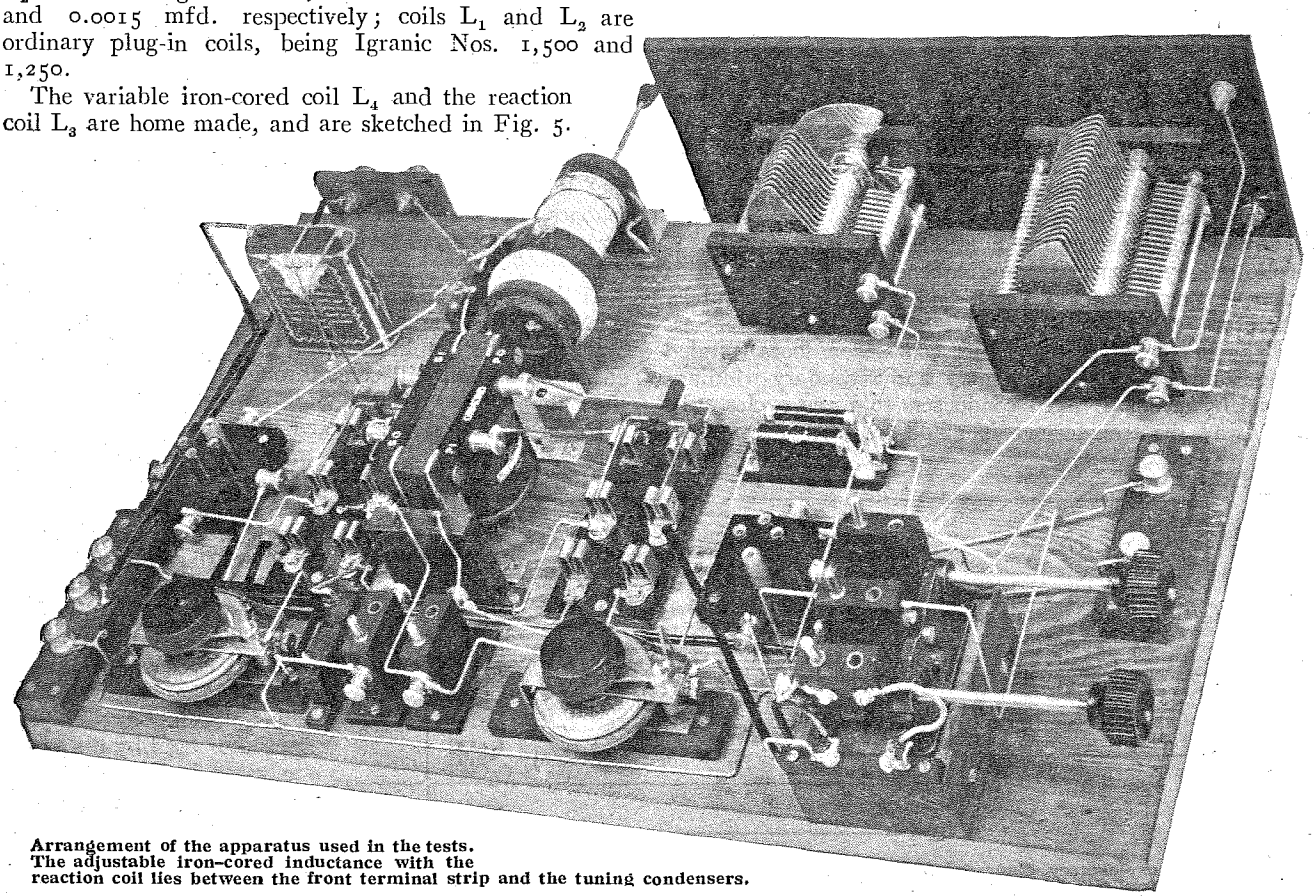


Fig. 3.—The special transformer. C_1 and C_2 have capacities of 0·1 and 0·0015 mfd. respectively; L_1 and L_2 are Igranic plug-in coils, Nos. 1,500 and 1,250. Coils L_3 and L_4 are constructed as indicated in Fig. 5.



Arrangement of the apparatus used in the tests. The adjustable iron-cored inductance with the reaction coil lies between the front terminal strip and the tuning condensers.

Selective Morse Receiver.—

slipping. The whole unit may be mounted on two supports as indicated.

It will be seen that the two variable condensers are mounted on a piece of ebonite. The larger of these, 0.001 mfd., is in parallel with the aerial tuning coil, while the smaller one, 0.0005 mfd., with vernier, tunes the closed circuit. By the side of the aerial coil is the aerial and earth terminals. The other terminals, for the batteries and telephones, are also mounted on small pieces of ebonite, which are then screwed to the base.

The remaining components can easily be identified; thus there is the three-coil holder, mounted on a block of wood for convenience, the two filament rheostats, two double-pole change-over switches, and two valve holders; also a grid condenser and leak, both being of the tubular type.

Some of the wiring is run through sleeving, to prevent the possibility of accidental contacts and short circuits; these wires are laid near the surface of the board. Wires carrying H.F. currents are made as short as practicable, and reasonably well spaced.

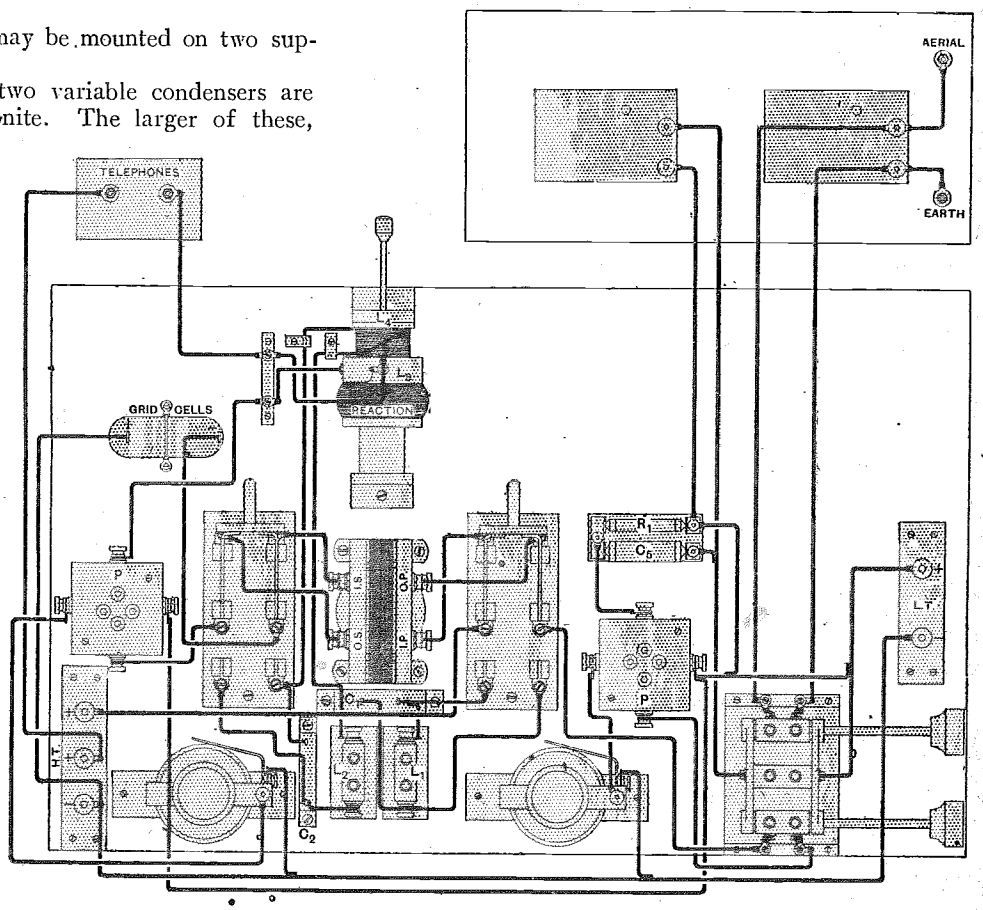


Fig. 4.—Wiring diagram. R_1, grid leak of 2 megohms; C_5, grid condenser of 0·0003 mfd.; L_1, L_2, coil holders for No. 1,500 and 1,250 turn coils; L_3, adjustable iron-cored coil with reaction coil L_3; C_1, fixed condenser 0·1 mfd., and C_2, 0·0015 mfd.

The apparatus was found to work quite well without L.F. reaction, and use of the latter, although it certainly increased selectivity and signal strength, tended to run the dots and dashes of the signal together at higher speeds.

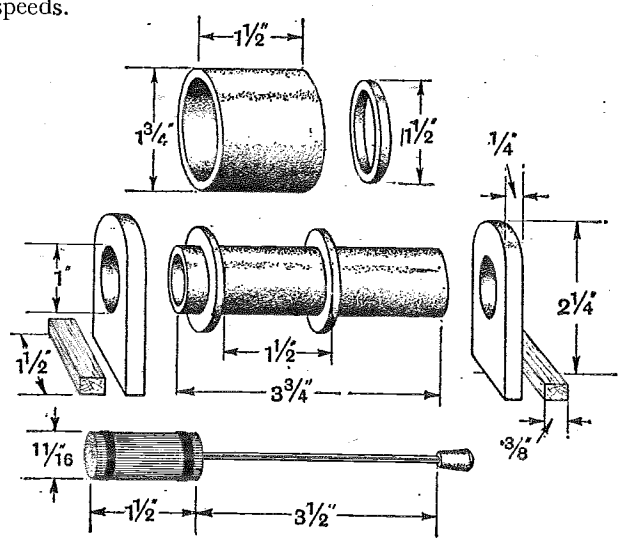


Fig. 5.—Constructional details of the adjustable iron-cored coil and the reaction coil.

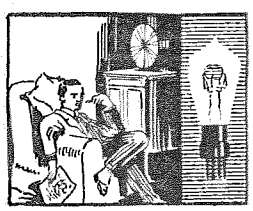
Of course, the great drawback to this method is that the transmitter wavelength must be quite constant, and also the receiving aerial must be fairly rigid, or the heterodyne note will wander. However, if much jamming is experienced, it is well worth while making up an amplifier as described here, and it would be interesting to have the results obtained by those who use it.

21-METRE TRANSMISSION FEAT.

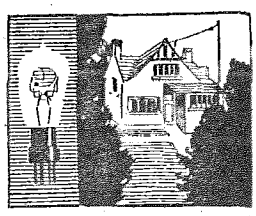
THE Metropolitan-Vickers Electrical Company, Ltd., have just succeeded in encompassing the globe with a radio transmission on 21 metres. The transmissions were made from the experimental station G2AC at the Metropolitan-Vickers Research Department, Trafford Park, and the signals were picked up by Mr. Ralph Slade (Z4AG) of Dunedin, New Zealand. An interesting point is that the signals were received at noon, New Zealand time, so that by whatever route they travelled, they must have covered half the distance in daylight.

It is proposed to continue the experiments with increased power and with the use of reflector aerials.

Reports on reception would be welcomed by Mr. A. D. H. Fleming, Manager, Research Department, Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, England.



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.

Norwich and District Radio Society.

On Tuesday, May 5th, a most interesting lecture was delivered by Mr. Davies, representing the Marconi Osram Co. The subject was, of course, "Valves," and the lecturer's remarks were supplemented by a generous display of lantern slides and a very comprehensive array of valves of all sorts and sizes.

Mr. Davies dealt very exhaustively with his subject, and the intricate processes of manufacture were made clear by the various pictures thrown upon the screen.

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Woolwich Radio Society.

An extremely efficent short wave set was recently demonstrated by Mr. Houghton. Special attention had been paid to the elimination of losses in coil holders, wiring connections and other vital parts, and a feature of the receiver was the smooth control over reaction.

A very instructive visit was paid to the Burndept works at Blackheath on April 11th, when Mr. F. Phillips, the chief engineer, explained with meticulous care, the many processes carried out in the manufacture of Burndept apparatus.

Another interesting event was Mr. Beeson's description, on April 15th, of a modified Reinartz receiver of his own construction, having a range from 100 to 3,000 metres.

As the result of an address by Mr. Lewis, on April 22nd, the Society has decided to support the Wireless League and to help in the formation of a Woolwich branch.

The society now rejoices in the possession of a transmitting licence with the call sign 5WS, and it is hoped to begin transmitting work very shortly.

Membership of the Society is open to all wireless enthusiasts in Woolwich and its neighbourhood. Enquiries will be warmly welcomed by the Hon. Secretary: Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

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North Middlesex Wireless Club.

An interesting scheme of short wave reception was explained by Mr. W. Gartland on April 29th.

In broad outline the receiver described was of the constant aerial type, for wave lengths up to 80 or 100 metres, only three turns of wire being used in the aerial circuit, while closed circuit coils varied from six to fifteen turns. An interesting feature of Mr. Gartland's arrangement was the fact that the lower end of what is really the closed circuit was connected to the earth side of the aerial inductance.

At the close of Mr. Gartland's paper Mr. J. Bray described his experiments on these low wavelengths. Although mainly on the same lines as the previous circuit, Mr. Bray's arrangement differed in detail and gave plenty of scope to his listeners to experiment on similar lines.

Hon. Secretary: Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

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Wimbledon Radio Society.

The Headquarters of the Society were crowded to overflowing on April 23rd, when a mock "trial by jury" of an oscillating fiend was held.

Mr. R. J. Tolton took the part of the prisoner, Hector O. Dyne, his defence being undertaken by Sir Ed. Burne-Toute K.C. (played by Mr. P. G. West), Sir A. Wanderplugge, K.C., H.T. (played by Mr. H. G. Oliver) prosecuting on behalf of the Wimbledon Radio Society. The prisoner denied the charge of oscillating, submitting that his accumulator was being recharged, his aerial had been commandeered for the weekly wash, and the cat having been put out for the night, he was unable to obtain a whisker to operate his set. Cross-examination revealed that he had borrowed an accumulator from Mr. L. T. Downe (C. P. Frost) and that the clothes hung on his aerial were not his own. Prosecuting counsel called Mr. I. Sawyer (C. E. P. Jones), an expert witness, to prove the charge, and he produced one wave of the prisoner's oscillation, which he had cut off with the edge of his sharp tuning.

Counsel for the defence submitted that if the prisoner was guilty, then he was justified in his action in endeavouring to overcome the nuisance and annoyance caused to him by 2LO who were transmitting their usual programme on the night in question.

The prosecuting counsel contended that the burly monster (the prisoner) was a ruthless radiating ruffian, a horrid hamhanded heterodyner and an offensive originator of oscillating undulations. "Little he wracks," said counsel, "of the rocks on which he wrecks our rheostats."

Mr. Justice P. O. Tenshul, in summing-up, said that he had never before met a set of more unreliable witnesses.

The jury found the prisoner guilty, but recommended that the mercy of the court be shown to him, so that the judge, in passing sentence, remitted the maximum penalty of £100 to a fine of £99 19s. 11¾d, and ordered that his set should be confiscated and divided amongst the jury and himself.

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Golders Green and Hendon Radio Society.

A novel type of informal meeting was held on May 6th, when Mr. Frost brought his three-valve receiver and invited any member to wire up and test out various circuits with a view to finding which gave the best results.

The Society's Field Day has now been definitely postponed from Whit Sunday to Sunday, June 7th, when experiments on a number of wavelengths will be tried out. It is hoped that on this occasion a few American amateurs will be worked in daylight.

Particulars of the membership may be obtained from the hon. secretary, Mr. Crewe, 111, Prince's Park Av., N.W.11.

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Northampton and District Amateur Radio Society.

At the last meeting of the winter session Mr. C. T. Atkinson, of Leicester, lectured on "Audio Frequency Amplification."

After dealing with some earlier methods of L.F. amplification, Mr. Atkinson gave a careful explanation of the work of the amplifying valve, and devoted the major portion of his remarks to the problem of overcoming distortion. The respective merits of transformer, choke and resistance capacity coupling were discussed, and many obscure points which had puzzled the members were satisfactorily explained.

Mr. Atkinson concluded with some useful hints on the general upkeep and improvement of wireless apparatus.

FORTHCOMING EVENTS.

WEDNESDAY, MAY 20th.

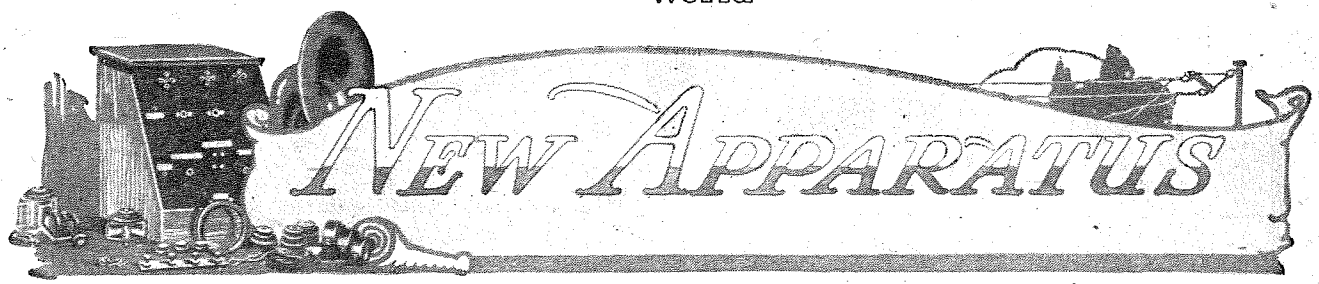
Golders Green and Hendon Radio Society.—At 7.30 p.m. At the Club House, Willifield Way. Lecture: "Mast and Aerial Equipment." By Mr. W. J. Turberville-Crewe.

WEDNESDAY, MAY 27th.

Radio Society of Great Britain.—At 6 p.m. (Tea at 5.30.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "The Rectification of Small Radio Frequency Potential Differences." By Mr. F. M. Colebrooke, B.Sc.

WEDNESDAY, JUNE 3rd.

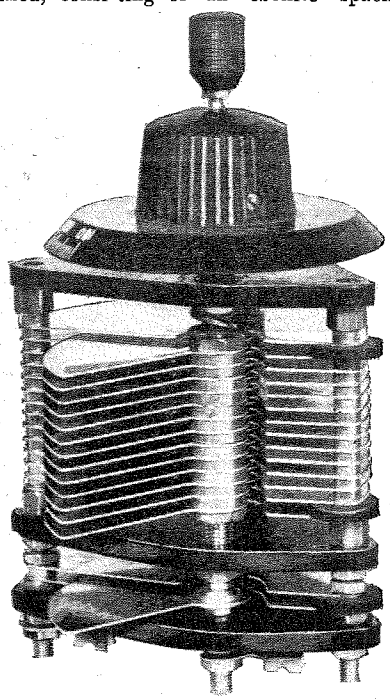
Institution of Electrical Engineers (Wireless Section).—At 6 p.m. (Light refreshments at 5.30.) At the Institution, Savoy Place, W.C.2. Lecture: "The Effect of Wave Damping in Radio Signal Measurements." By Dr. R. L. Smith-Rose, M.Sc.



A Review of the Latest Products of the Manufacturers.

H. & B. VARIABLE CONDENSERS.

The variable condensers supplied by Messrs. Hall & Brenard, Ltd., London Terminal Aerodrome, Croydon, Surrey, are very reasonable in price, and the standard of workmanship is quite equal to other condensers of this type. An ingenious stop for the moving vanes is used, consisting of an ebonite spacing



H. and B. variable condenser.

washer of such a diameter that it provides a stop for both the minimum and maximum positions. The condensers are available with semi-circular and "square-law" vanes, and also with a three-plate vernier, actuated by an auxiliary spindle passing through the main spindle, which is drilled through from end to end.

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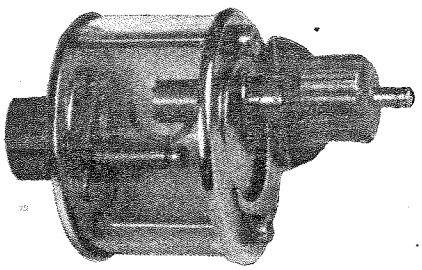
DORWOOD CRYSTAL DETECTOR.

The crystal holder and contact operating mechanism are attached to the end plates of a frame which supports a cylindrical glass cover whitened on the underside. A claw is arranged to grip the crystal, forcing it down into firm contact with an irregular surface to ensure good connection. The tension spring is released by a small plunger, so that the crystal can be rotated to make use of every available part of its surface, and a movement is provided so that the crystal holder can be rotated. The mechanism which



In the Dorwood detector provision is made for searching out points over the entire crystal face.

operates the catwhisker contact is ingenious, and consists of a sliding pillar held on to the face of a cam by a small tension spring. The cam is revolved by a knob which protrudes from the end of the detector, and its contour gives small movements to the pillar for a relatively large movement of the operating knob.

The detector is a well-finished and durable instrument, but it is doubtful whether the many devices with which it is fitted, and which add to its complication, render it suitable for the crystal user who is disinterested in technicalities.

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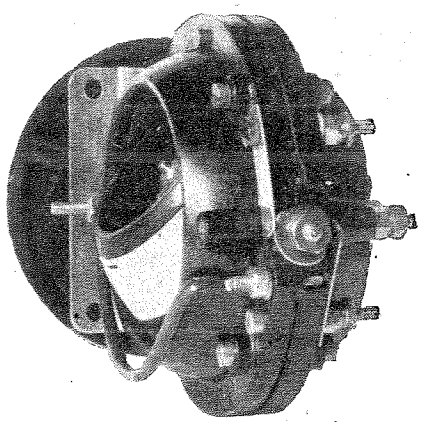
THE MARCONIPHONE VARIOMETER.

Users of variometers frequently extend the tuning range by fitting a switch to connect the windings either in series or parallel. The inclusion of such a switch, however, not only takes panel space which



The Marconiphone variometer is fitted with an automatic series parallel switch.

may be needed for other components in a small set, but also necessitates somewhat difficult wiring. This new variometer brings about the changes for a series and parallel connection of rotor and stator while rotating the spindle. Having completed 180° of the dial with the windings series connected, a cam and spring mechanism fitted to the end of the rotor shaft connects the windings in parallel for the further rotation of the dial between 180° and 360°.

The switch mechanism consists of two blades which make contact with one end of the rotor winding; one of them, when not in contact with the face of the cam, resting on a contact screw. This component should prove exceedingly useful for the construction of simple or compact receiving sets.

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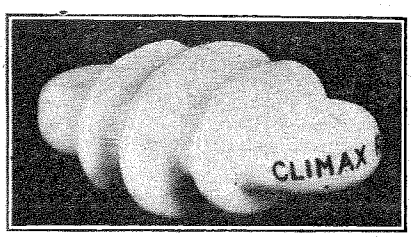
CLIMAX AERIAL INSULATOR.

Among the several accessories marketed by Climax Patents, Ltd., 182, Church Street, London, W.8, is a useful aerial



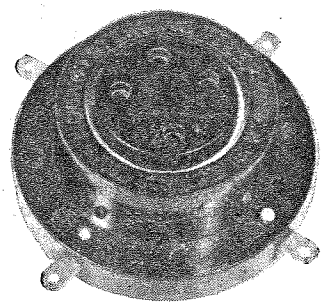
Climax porcelain insulator (actual size).

insulator. Made of white porcelain, it measures about 2in. overall, is light in weight, and its glazed surface maintains a high degree of insulation. The three rings considerably increase the surface of leakage, whilst the distance between the holes to which aerial and halyard wires are attached presents an exceedingly low capacity. For use even on the shortest wavelengths the single insulator at each end of the wire will probably be found sufficient, whilst for an aerial for broadcast reception purposes the insulator will be found particularly suitable, as it will cause only a slight sag in the aerial wire.

There is little doubt that a special grade of porcelain of high tensile strength is employed for the manufacture of this insulator, judging by the considerable pull that must be exerted upon it before it will fracture, and for the supporting of even the heaviest amateur aerials it can be relied upon to be of adequate strength.

THE STERLING "NON PONG" VALVE HOLDER.

There has long been a need for a rubber-supported valve holder which is non-microphonic in its action. The Sterling Telephone and Electric Co., in recognising this want, have for some while been supplying a valve holder in which "Sorbo" india rubber is used to render the supported valve non-microphonic. Although perfectly achieving this object, no provision was made when the valve was withdrawn to prevent the tearing apart of the valve holder plate from its rubber support. In the new pattern, however, a valve can be forced into the holder and again withdrawn without dislodging the valve holder proper from the moulded piece used for attaching to an instrument baseboard. Another feature in the design is the bringing out of the filament, plate

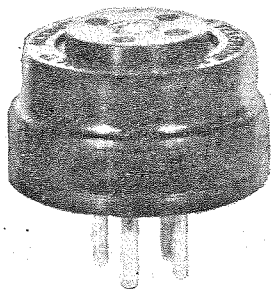


Sterling "Non Pong" valve holder for baseboard mounting.

and grid connections to tags for soldering, the two filament connections adjoining one another to simplify the wiring layout. Another model is also available in which four prongs projecting from the base of the holder are used for making connection to the anti-microphone centre piece. In keeping with all other Sterling products, this component is of high grade and well finished

PAPIER MACHÉ HORNS.

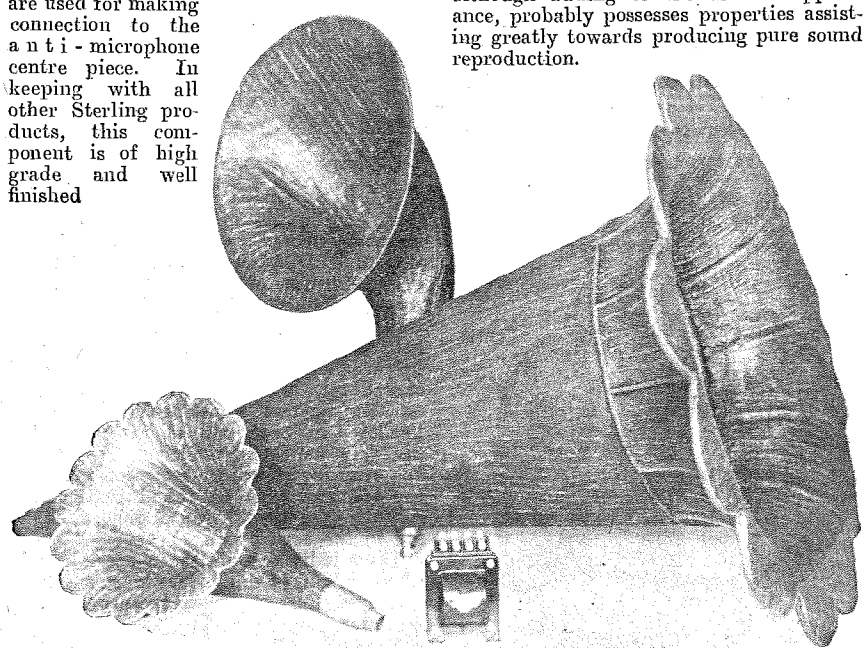
Those readers who pay careful attention to the musical quality obtainable from their receiving apparatus will welcome the introduction by the Scientific Supply Stores, 80, Newington Causeway,



Another type of Sterling antimicrophonic valve holder.

London, S.E.1, of a range of loud-speaker horns of new design and constructed in papier maché.

It is generally agreed that when the whole of the loud-speaker is entirely constructed from metal that distortion occurs owing to the resonant effects which are produced by the metallic parts themselves possessing well-defined periods of oscillation giving rise to undue magnification at certain and critical note frequencies. This action, which is sometimes referred to as a "metallic effect," is certainly avoided by constructing the horn from non-resonant materials, wood and ebonite sometimes being employed, and in this instance papier maché, which can, of course, be relied upon to have entirely uniform response at all frequencies. The surface, too, which is finished in a decorative old gold style, is rough, which, although adding to the artistic appearance, probably possesses properties assisting greatly towards producing pure sound reproduction.



Specimens of the new papier maché loud speaker horns manufactured by the Scientific Supply Stores.

The several types are supplied with metal adapters, but owing to the varying sizes of tube with which loud-speakers are fitted it may be necessary to attach an additional connecting piece to obtain a good fit on the metal mount of the diaphragm.

Much has been written concerning the correct design of loud-speaker horns, and it is probable that the large model closely follows in shape the latest practice which experience shows to be correct. Some idea of its approximate dimensions can be obtained by comparison with the Igranic intervalve transformer standing in the foreground in an accompanying illustration.

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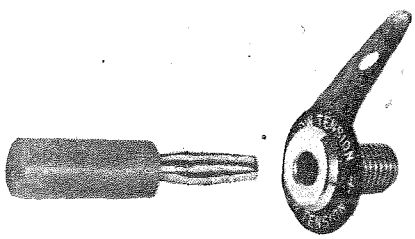
USEFUL PIN AND SOCKET CONNECTOR.

An improved form of pin and socket connector can now be obtained from Messrs. S. A. Lamplugh, Ltd., of Kings Road, Tyldesley, Birmingham.

It is probably much more reliable in its action than the usual split pin type, making smooth and reliable contact. The



Reliable plug and socket connector.

socket is obtainable with labels denoting the usual terminals of a receiving set both in red and black.

The use of plug and socket connectors in wireless receiver design is to be recommended, and will be found to greatly facilitate the making of the many connections necessary when bringing a receiver into operation.

ITEMS FROM THE TRADE.

In a recent issue mention was made of "Crystic" solder, which has been placed on the market by Messrs. Geo. Mallins, of 448, Bordesley Green, Birmingham. This solder is excellent for wiring purposes, and we regret that the impression was given that it is intended for fixing crystals in their holders.

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In connection with the successful exchange of signals on 20 metres between this country and Australia, it is interesting to note that Mr. E. J. Simmonds (2OD) made use of Marconi Osram valves, types T.250 and D.E.Q.

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Owing to the number of wireless firms in Watford, some confusion has arisen as to the correct address of Messrs. Darco, Limited, radio engineers. The registered address of the company is 77-79, High Street, Watford, and the works, situated in another part of the town, are entirely devoted to the production of Darco grid leaks and other Darco proprietary lines.

THE IMPORTANCE OF EXPERIMENTING.

A Talk Broadcast from 2LO by Mr. A. A. Campbell-Swinton, F.R.S., Past President of the Radio Society of Great Britain, on Saturday, May 16th.

IT is an interesting question what manner of men they were who made our great discoveries and inventions, and what were their vocations or professions in ordinary life. It might appear a reasonable suggestion, at first sight, that they would be found to be persons engaged in the professions to which their discoveries and inventions applied, but enquiry shows that quite frequently this is by no means the case.

Mr. A. A. Campbell-Swinton, F.R.S.

Discoveries Made by Amateurs.

For instance, take the subject of radio-telegraphy, and think who were the persons who originated it. Not one of them was a professional telegraphist, though by the time wireless came into being, telegraphy was quite an old-established and large business, and telegraphists were quite numerous.

Wireless telegraphy in its origin owes its existence chiefly to University Professors of Physics: Clerk Maxwell, of Cambridge, who predicted from his mathematics the principle of electro-magnetic radiation; Hertz, a German, who proved Maxwell's theory experimentally; the Frenchman, Branly, who showed how the radiations could be detected by the coherer; the Italian, Righi, who, with his oscillator, gave improved facilities for the transmission of radio waves; and Oliver Lodge, who independently invented the coherer and first showed how it was possible, by means of that instrument and with Hertzian waves, to transmit telegraphic signals over quite considerable distances without wires.

Maxwell, Hertz, Branly, Righi, and Lodge were all University professors of physics, with no telegraphic experience or connection. Then came Marconi with his practical and commercial views, and his laborious and prolonged experiments, which first made wireless telegraphy into a thing of practical utility and started it on its present marvellous career. Whatever he may be today, Marconi was certainly not a telegraphist when he first started in wireless. Indeed, he was then a very young man who had only just completed his scholastic education.

Early Contributions to Wireless.

Nor is wireless telegraphy an exception, inasmuch that in its inception, at any rate, it owes but little to professionalism. History abounds with such cases. To go fully into this is beyond the time at my disposal, but the following information with regard to the authors of a few of our most famous discoveries is instructive, especially in view of present-day educational controversies. An outstanding feature is that many of them had no professional connection with science at all, but were amateurs pure and simple. Among these may be mentioned Robert Boyle, the famous discoverer of the law of the expansion of gases, who was a landed proprietor educated at Eton, and has been described as "the father of chemistry and brother of the Earl of Cork." Henry Cavendish, also, who discovered hydrogen and the composition of water, and did much original work in electricity, besides devising the celebrated Cavendish experiment for ascertaining the weight of the earth, was a pure amateur, being the grandson of the second Duke of Devonshire. He was very eccentric and very rich. Sir William Herschell, the famous astronomer, was by profession an organist and a teacher of music. Priestley, who discovered oxygen, was a Presbyterian minister. Dalton, the distinguished chemist, who elaborated the atomic theory, was an assistant schoolmaster. Benjamin Franklin, who, with a kite, drew electricity from the clouds and thus established the identity between electricity and lightning, was a self-educated printer. Benjamin Thomson, afterwards Count Rumford, who contributed considerably to the theory of heat, began life as an assistant in a store. Franklin became United States Ambassador to England, while Rumford reorganised the Kingdom of Bavaria, and the pair are, perhaps, the only politicians—or, perhaps in their case, one ought rather to say statesmen—who ever contributed anything of value to science. James Prescott Joule, who was the experimental founder of the great theory of the conservation of energy, and who first determined the mechanical equivalent of heat, was likewise an amateur, being by profession a brewer.

Others were of the medical profession, as the famous Dr. Gilbert, of Colchester, physician to Queen Elizabeth, whose works on electricity and whose book, "De Magnete," are a monument to his industry and discernment. Thomas Young, the great protagonist of the luminiferous ether and of the undulatory theory of light, also was a doctor. Sir Isaac Newton, on the other hand, was a student, and afterwards a professor of Cambridge University, and finally Master of the Mint. Sir Humphry Davy and Faraday both made their great names at the Royal Institution, where they enjoyed facilities for experiment, which one would like to see greatly multiplied elsewhere. Both were of humble origin, Davy

The Importance of Experimenting.—

being the son of a wood-carver, who became assistant to a surgeon; and Faraday the son of a blacksmith, and a bookbinder's apprentice, who had the good fortune to attract Davy's attention and to become his assistant, and afterwards his successor. It is noteworthy that but few of these great men had the advantage of early scientific training.

The case of some of the world's greatest inventors is also interesting. James Watt began life as a mathematical instrument maker. George Stephenson was a colliery fireman who only learnt reading, writing, and arithmetic after he was grown up. Arkwright, the great inventor of cotton-spinning machinery, was a barber. Daguerre, one of the principal inventors of photography, was a scene painter. Sturgeon, the inventor of the electro-magnet, was a private soldier, and carried out his earlier experiments within barrack walls. Morse, of telegraphic instrument and code fame, was a painter and sculptor. Alexander Graham Bell, the inventor of the telephone, a teacher of the deaf and dumb. David Hughes, the inventor of the type-printing telegraph and of the microphone, a professor of music. Edison, a railway newsboy, practically self-taught. Williams, afterwards Lord Armstrong, the inventor of hydraulic power distribution, and celebrated for his gun, a practising solicitor till he was thirty-five years of age.

Genius Needs No Teaching.

All this goes to show that inventors are born and not made, and that, at any rate in numerous cases, genius can dispense with teachings from outside.

How a great scientific discovery can be made practically by accident is evidenced by that of the X-rays. As Sir Oliver Lodge has recently very happily expressed it, Röntgen was simply messing about with a Crookes tube and happened to notice that a neighbouring screen covered with some fluorescent material lighted up. He could not have been looking for what he found, as the rays were quite unknown and entirely unexpected. It is surprising that Crookes, in working all his careful experiments with his tubes in many of which he used fluorescent material, had not noticed the same phenomenon. There is a story that he actually found that a box of photographic plates that lay on his laboratory table had become mysteriously fogged, no doubt by the rays from his tubes, but the cause did not occur to him, and he never followed it up.

We see, therefore, how any person of intelligence who makes scientific experiments may possibly make an important discovery, as did Röntgen. It is often much more a question of acute powers of observation than of any special amount of knowledge; indeed, too much knowledge, of what has been done in the past may interfere with originality, and even put off an experimenter from trying things which in the light of past experience may not seem likely to come off.

Here, then, we see the reason for the importance of cultivating scientific research of every description, not only by professional persons but also by amateurs. The more experimenters there are the more likely it is that we shall have new discoveries and new inventions.

The New Wireless Bill an Obstruction to Invention.

The Radio Society of Great Britain, as also the Institution of Electrical Engineers and the Royal Society, are taking considerable interest in the new Bill before Parliament dealing with wireless telegraphy and signalling, and especially with those clauses in the Bill which regulate wireless experimenting. Regulations there have, of course, to be, so as to avoid interference with other transmissions, but it is hoped that these regulations may be of such a nature as to give the experimenter as much freedom as can be safely allowed.

As we have seen, wireless telegraphy was originated not by professional telegraphists but by persons who, so far as telegraphy is concerned, were really amateurs; while it is also a fact that many of its later developments, such as the invention of the valve by Dr. Fleming, the addition of the third electrode which converted the valve into an amplifier, by de Forrest, have also been due not to telegraphists but to physicists. Again, quite recently such remarkable work in the way of the use of short waves for very long-distance transmission has been carried out by persons who were amateurs pure and simple. Thus, if we wish the science of wireless to progress in the future as it has done in the past, experimenters of all descriptions should be given every scope and encouragement.

Calls Heard.

Extracts from Readers' Logs.

Norwich.

British:—2AUC, 2CC, 2DX, 2FN, 2KW, 2KZ, 2LZ, 2MC, 2MQ, 2NB, 2RB, 5ID, 5LF, 5MO, 5NN, 5PU, 5PZ, 5QV, 5SZ, 5UQ, 6GH, 6LJ, 6OK, 6RY, 6TD.

(Low loss, 0-v-1.)

CAPT. H. J. B. HAMPSON (6JV).

Cachar, India. (350 miles N.E. of Calcutta.)

British:—2FM, 2KF, 2KT, 2KW, 2NM, 2OD, 2SZ, 2VS, 2WJ, 2YT, 5NN, 5PU, 6NF, 6RD. *American*:—1AAC, 1ANA, 1BD, 1CMP, 2AX, 2BRB, 2RK, 2XI, 2YI, 3ADB, 3AEC, 3BGI, 3CKL, 3JO, 4OA, 5CN, 5LS, 5MI, 6AAO, 6AC, 6AHP, 6AWK, 6AME, 6AKW, 6AWP, 6AWT, 6BUR, 6BVE, 6BVW, 6CGO, 6CHL, 6CIX, 6CMP, 6CMU, 6CTO, 6CQE, 6CY, 6EW, 6OI, 6PL, 6RN, 6UA, 9BHX, 9CXX, 9DMJ. *Australian*:—2BK, 2DS, 2YG, 2YI, 3BM, 3BQ, 3BD, 3JU. *New Zealand*:—1AO, 2AC, 2AP, 4AA, 4AG, 4AK. *French*:—8BF, 8QL. *Dutch*:—0GC, 0LL, 0NL, 3CN. *Swedish*:—SMZI, SMZY. *Finnish*:—2NM. *Italian*:—1MT. *Canadian*:—5BA. *Iraq*:—GHH. *Argentine*:—CB8. *Java*:—ANE. *Russian*:—RDW. *Unknown*:—8BO.

(2-v-1). G. W. G. BENZIE (2BG).

Moen i Maalselv, near Tromsoe, Norway.

British:—2DR, 2FM, 2KZ, 2NM, 2WY, GHH5, 5HS, 5PZ, 6FG, 6GB, 6GH, 6NF, 6RM. *French*:—4SR, 8CT, 8SM, 8SSC, UFP. *Argentine*:—LPX. *Italian*:—1AA, 1CO, 1NO, 1WB, 3AM, IDO. *Dutch*:—0BA. *Belgian*:—4C2. *German*:—1CF. *Swedish*:—SMZZ, S1AZ (SAZ Sveagrufvan Spitsbergen). *Russian*:—RL. *Unknown*:—1RB, RISK.

(0-v-1, Reinartz.) J. DIESEN.

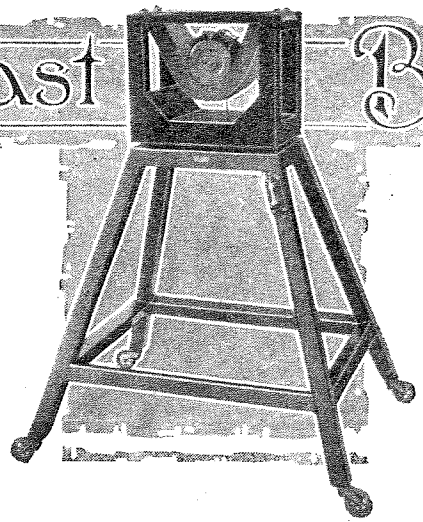
Norwich.

American:—1AAJ, 1AID, 1ALK, 1ARY, 1AYI, 1BDX, 1BGQ, 1CKP, 1HN, 1OW, 1PL, 1YD, 2ABD, 2ABT, 2BRC, 2CNS, 3AB, 3ADQ, 3HS, 3MF, 4SA, 4TJ, 4TV.

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

CLEMENT J. HARCOURT.

Broadcast Brevities



TOPICALITIES FROM SAVOY HILL.

The Derby.

In official circles there has been a good deal of dubiety over the proposal to broadcast the Derby. It was felt that if sanction were obtained it might be regarded as giving official recognition to horse-racing. In Press circles it was feared that it would mean the introduction of the thin end of the wedge in that the shouts of the crowd would reveal to listeners throughout the country the name of the winning horse, and so impinge on the interests of the evening newspapers.

oooo

Solving the Problem.

The difficulty was surmounted by the undertaking of the B.B.C. to instal the microphone at Tattenham Corner only; to provide a land line from that spot to the nearest existing land line, half a mile distant, and transmit only the sounds from Tattenham Corner, which will include the shouts of the bookmakers, the thud of the horses' hoofs as they flash past on their way up the "straight" to the winning post, and the noises of the crowd.

oooo

The Third Attempt.

The B.B.C. tried to carry through a similar plan last year and the year before. The third attempt has been successful.

oooo

A Live Wireless Society.

Some time ago listeners in the neighbourhood of the East Coast from Sheringham in Norfolk to as far south as Hastings, Sussex, suffered from interference in 5XX from a Post Office station. After a period of quiescence the station was recently restarted for experimental purposes. The Yarmouth Radio Society reported that the station was working on 1,400 metres C.W., entirely blocking out reception over a large area of Norfolk. As a result of representations to the Post Office through the Yarmouth Radio Society the interference has been practically eliminated, which shows that a live Radio Society is of considerable value to listeners, who should, therefore, support their local societies in every way possible.

oooo

French Stations.

It is said that some of the French stations have become the disturbers of the wireless peace of Europe. *Petit Parisien* station has been interfering with several other continental stations, and with the best intentions in the world *Petit Parisien* has been trying to avoid interference; but the effect has not been altogether satisfactory from Britain's point of view, as several of the B.B.C. stations have been heterodyned by *Petit Parisien's* attempts to find a distinctive wavelength of its own. It is singular that Toulouse on 360 metres (London's wavelength) is not clashing with 2LO, whereas Cadiz on a similar wavelength has been causing a good deal of trouble.

oooo

Good-bye to the Straight Talk?

The question of the broadcasting of Talks will presently be reviewed. There is certainly a big demand for the abolition of the "straight talk"—that is the Talk unrelieved by comment or other interruption. While in the meantime experiments are being made to ascertain whether the "debate" style of Talk will prove more popular, it is felt that something more needs to be done to hold the interest of a large body of listeners. This is a point which the officials have under consideration.

oooo

"Inside" Broadcasts.

As regards Talks delivered from the studios, I am assured that the B.B.C. is always provided with a copy of the Talk in advance, although anything in the nature of a censorship is seldom called for. Anyhow, the result of the miniature storm which was created by Miss West's recent speech will be a tightening up of the procedure, and all people concerned in outside broadcasts will be warned to keep off politics.

oooo

A Mohawk Singer for 2LO.

Os-ke-non-ton, a Canadian Indian, whose name interpreted means "Running Deer," and who has broadcast a good deal in America, will be included in the programme from 2LO on June 5th, when a programme entitled "From the New World" is to be given.

He is a Mohawk singer who is said to be the best exponent of Indian music on the American Continent. His interpretation of Indian songs is based on the experiences of a childhood spent in paddling his canoe on the Mississippi, in friendship with the creatures of the forest, and in catching the wary inhabitants of the pools and lakes of the Far West. His engagement by the B.B.C. was arranged after much difficulty, and is an achievement of special importance.

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The B.B.C. and the Theatres.

As an example of the harmful effects of premature publicity, the disclosure concerning a projected agreement between the theatre managers and the B.B.C. for the broadcasting of plays would be hard to beat. Many papers announced that an

FUTURE FEATURES.

Sunday, May 24th.

LONDON.—2.30 p.m., Empire Day Thanksgiving Service. Relayed from the Stadium, Wembley. S.B. to all Stations.

LONDON.—9 p.m., De Groot and the Piccadilly Orchestra.

Monday, May 25th.

LONDON.—8 p.m., "Back to 1913."

BIRMINGHAM.—8 p.m., Music—Humour—Drama.

BOURNEMOUTH.—8.15 p.m., The Bournemouth Municipal Orchestra: Conductor, Sir Dan Godfrey.

Tuesday, May 26th.

LONDON.—8 p.m., Russian Programme: Conducted by Eugene Goossens.

Wednesday, May 27th.

BIRMINGHAM.—8—10 p.m., Chamber Music Programme.

GLASGOW.—8—10 p.m., Symphony Concert.

Thursday, May 28th.

LONDON.—8 p.m., Chamber Music Evening.

BIRMINGHAM.—8 p.m., Musical Comedy: "Cupid and the Ogre."

BELFAST.—7.30 p.m., Instrumental Music and Musical Comedy.

Friday, May 29th.

LONDON.—8 p.m., The Wireless Symphony Orchestra: Conducted by Percy Pitt.

"WINNERS."

A REVUSICAL EXTRAVAGANZA IN THREE ACTS.

BOURNEMOUTH.—8 p.m., "Bournemouth calling Poland."

MANCHESTER.—8 p.m., "Musicians make Merry."

GLASGOW.—8 p.m., Popular Portraits.

agreement had been concluded, and proceeded to give details which to a large extent accurately reflected what was in the minds of both parties; but owing to the unauthorised publicity the clock has been put back, and I am told that it would not be surprising if a satisfactory settlement were postponed.

oooo

Famous Artists to Broadcast.

On each Wednesday in future, from 10.40 to 11 p.m., it is hoped that a special feature will be included in the broadcast programme from 2LO and other stations. Arrangements have already been made for Wednesdays in May and June, and the artists will include Madame Kirkby Lunn, the famous contralto, The Fisk Jubilee Singers, a party of five coloured Americans with a considerable reputation, and Mr. Bransby Williams, the well-known impressionist.

oooo

The Nightingale to Broadcast.

The song of the nightingale may be broadcast from Miss Beatrice Harrison's residence at Oxted, Surrey, on May 30-31, between 11.30 p.m. and 12.30 a.m. It is not expected that it will be possible to get the microphone nearer to the birds than a distance of about thirty yards, and precautions, therefore, will have to be taken to cut down extraneous sounds, such as the sound of rustling leaves and other noises of nature which can so easily be heard on quiet nights in the woods.

Difficulties.

The difficulties of broadcasting from an open spot are accentuated by many minor interferences. The buzzing of flies, for instance, must be eliminated as far as possible; even the midges cause a good deal of inconvenience, as they are attracted to the microphone by the heating up of the magnetising coil when using heavy current to make it ultra-sensitive. Then suitable corrections have to be applied in the amplifiers on the spot to make the song of the nightingale predominant, and to reduce all other sounds.

oooo

Land Line Troubles.

Noises are also apt to be noticeable on the land lines used between the Surrey woods and 2LO. To overcome these, the largest amount of amplification must be used at the country end instead of the usual method of amplification at the distant end. Extensive amplification at 2LO must also be introduced before the birds' song is transferred to the transmitter. And, above all, is the possibility that when all arrangements have been made the birds may not sing. But Miss Harrison will, of course, play her 'cello in the woods, and it is seldom that the birds do not respond.

oooo

The Sea that Wouldn't Respond!

Which reminds an official of the B.B.C. with whom I was discussing the difficulties of outside broadcasting that on one occasion elaborate plans were made for broadcasting the sound of the sea; the item was published in the programme, but when the great night arrived the sea was as calm as a mill-pond.

oooo

Radio Revue.

Radio revue is taking the place of radio drama during the summer months at Manchester. No one will be so unwise as to try to define "revue," which, in the studio, at any rate, is just an excuse for providing a cheerful and varied evening—songs, musical entr'acte, and sketches being strung together in a happy-go-lucky sort of way.

oooo

An Advantage.

Revue has a great advantage over radio drama in that whenever the inevitable shower puts a temporary stop to tennis, or the garden, one can cut in anywhere. June 1st will see "The 7.30 Revue" running into yet a 3rd edition, with the same company in entirely new songs and sketches.

oooo

Morse.

Considerable Morse interference is occurring, and French trawlers are said to be among the worst offenders. A listener the other day declared his belief that every time a French trawler caught a fish a wireless message on one or other of the British wavelengths was sent to the trawler's home port announcing the gladsome news.

oooo

Wavelengths.

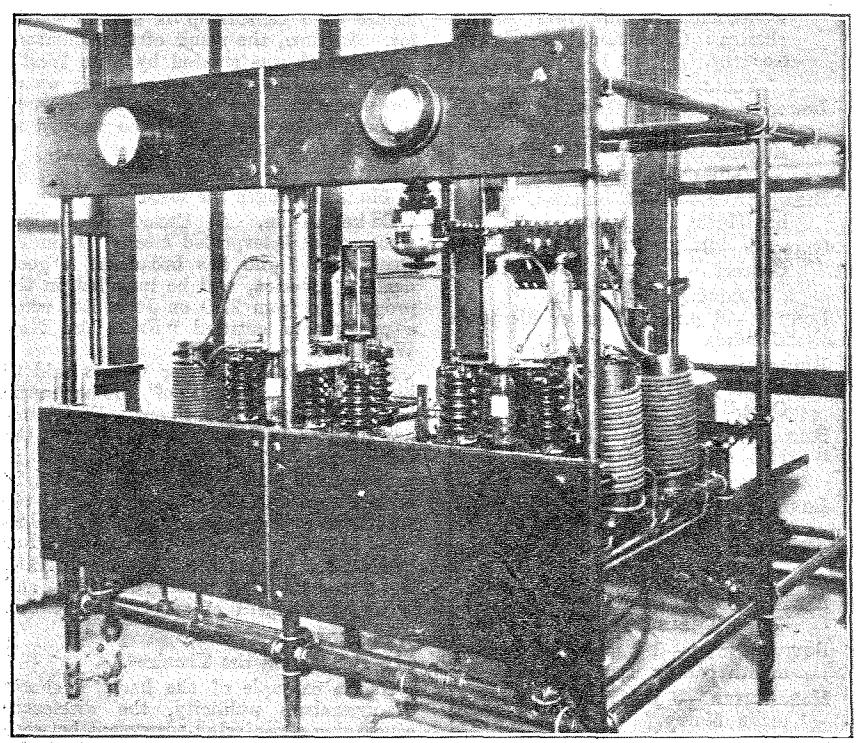
Details were published in a certain newspaper the other day of changes in the wavelengths of British broadcasting stations. Generally the variations were not more than one or two metres, except in the case of 2LO's wavelength—given as 360 metres. It is not necessary to attach any significence to the published alterations. Always an error of plus 1 or minus 1 is allowed in fixing wavelengths, and the average set is not sufficiently selective to secure the perfect adjustment which will fine a difference down to one or two metres.

oooo

A Studio Audience?

Broadcast artists have sometimes been heard to declare that they feel that they could do a good deal better before the microphone if they were in touch with an audience, be it small or large, for the sake of the inspiration which they would derive from an almost unconscious recognition of the effect which they were creating.

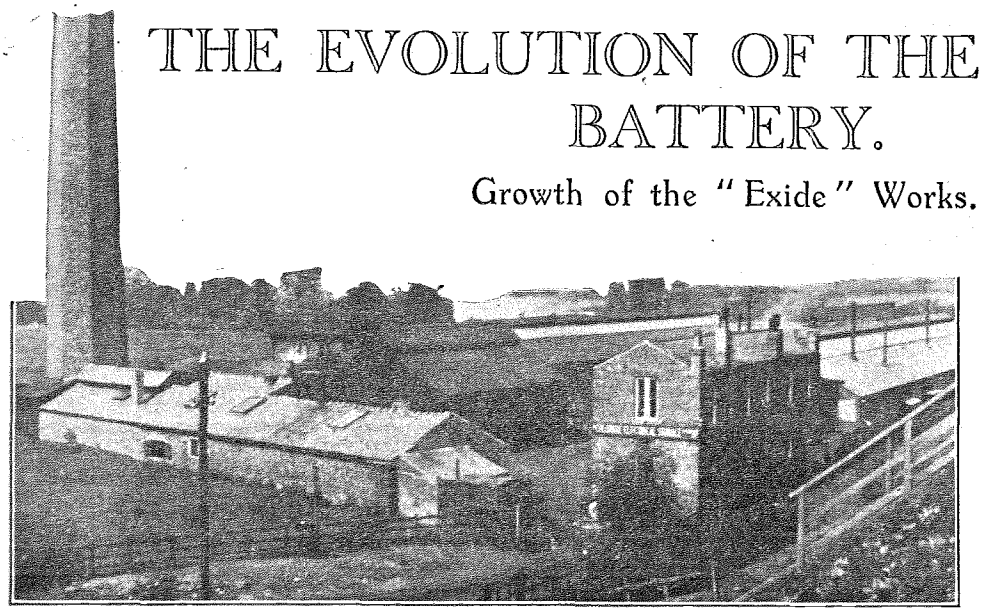
The question whether radio plays should not be given with a visible audience who would applaud or otherwise express their feelings has been under consideration. Facilities for accommodating an audience are none too easy, other than in a public hall or theatre. If this difficulty could be overcome, it is generally agreed that it would be to the benefit of broadcasting to have an audience at the transmitting end, which would add a good deal to the reality of broadcasting.



EXPERIMENTS AT KDKA. The oscillating unit which forms part of the new experimental equipment at KDKA, East Pittsburg, U.S.A.

THE EVOLUTION OF THE STORAGE BATTERY.

Growth of the "Exide" Works.



The development of the accumulator battery has coincided very closely with the growth of The Chloride Electrical Storage Company, Ltd., from whose works at Clifton Junction, near Manchester, electrical accumulators have been produced for more than thirty years.

AN idea of the changes which have taken place in the last thirty years in the manufacture and application of the accumulator battery was afforded during a recent Press visit to the works of the Chloride Electrical Storage Co., Ltd., at Clifton Junction, near Manchester.

In the accompanying photographs an interesting comparison is provided by the appearance of the Exide Works at the end of the last century and their appearance to-day. In 1893 the works at Clifton were more or less experimental. They had no claims to pretension, and consisted of one low shed and one tall chimney. To appreciate their subsequent growth and development, it is only necessary to glance at the photograph below.

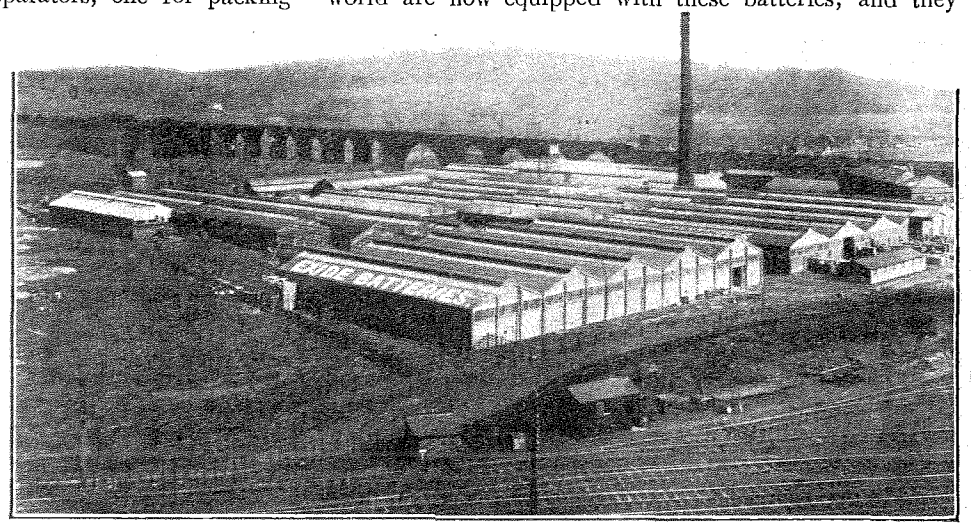
The insistent demand for more batteries requires continual extensions, the latest additions to the works being six new sheds—two to house the joiners' machine shops, two for dealing with wood separators, one for packing car starting batteries, and one for forming plates. Another shed is being erected for batteries in celluloid boxes.

In the early days the batteries were made chiefly, if not solely, for stationary purposes, providing a standby in cases of emergency, such as the failure of generators. The working staff was comparatively small, and the plant, up-to-date at that time, was soon found to be inadequate. Continuous improvements and expansions have taken place ever since.

One of the most interesting features of the accumulator battery is its adaptability for a variety of purposes. It is employed to light country houses far away from electric mains, and its use is increasing as a valuable emergency plant in hospitals, schools, asylums, and workhouses. It finds a place in electrically driven works as a means of smoothing the supply from the mains, and is an indispensable adjunct in electrical sub-stations on railways.

On board ship the storage battery has proved invaluable, and during the war chloride batteries rendered yeoman service on submarines. Their use in connection with the starting, lighting, and ignition of motor cars is, of course, well known.

But the greatest development in storage battery manufacture came with the demands imposed upon it by wireless, and it is interesting to note that the first wireless message from a ship was sent out with the aid of an "Exide" battery. Wireless stations throughout the world are now equipped with these batteries, and they



The "Exide" works at Clifton Junction, as they appear to-day. Compare this with the photograph above, taken near the same spot thirty years ago.

Storage Batteries.—

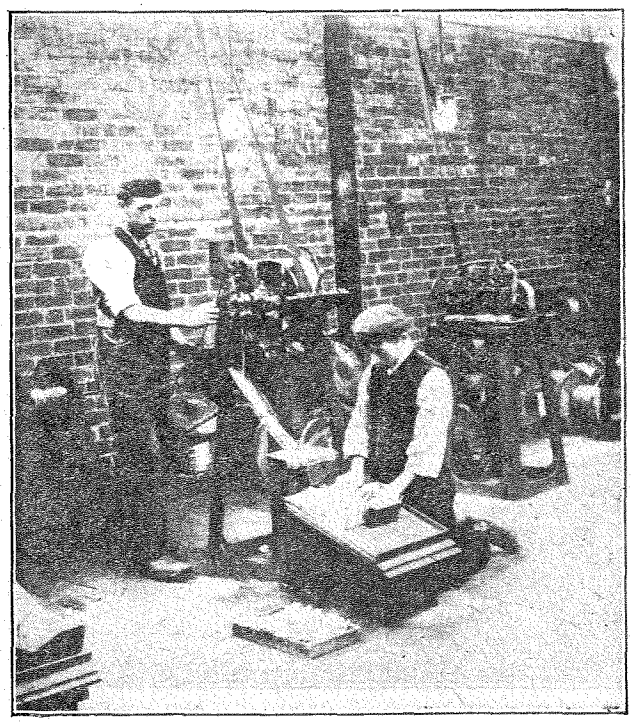
form an integral part of the plant in such installations as the Poldhu station and the stations of the British Broadcasting Co.

Wireless demanded a range of batteries hitherto uncalled for. Very careful experiments were necessary to determine exactly what type of battery was required. Research work was therefore begun at Clifton in a small corrugated iron shed. To-day the weekly output runs to many thousands of cells in celluloid alone, in addition to large quantities in glass boxes.

The Chloride Co. have not lost sight of the important fact that employees appreciate what is done for them. The works at Clifton Junction, consequently, have all the amenities that make life pleasant. Clean, well-cooked food is provided at moderate prices in spacious rooms. Playing fields, tennis courts, and bowling greens are close to the premises, and a number of helpful societies form part of the social structure of the staff. Recently the company inaugurated a pension scheme.

Making Chloride rosettes to-day.

Much of the company's success has been due to its organisation of service agents. A new scheme has been inaugurated whereby each local service station has power to appoint in its own area "Exide Battery Dealers," comprising garages, electrical contractors, wireless dealers and the trade generally. These dealers—exhibiting a special sign—draw all supplies from the local service station, and act as receiving stations for them. Dealers are thus able to give all battery users maximum service.



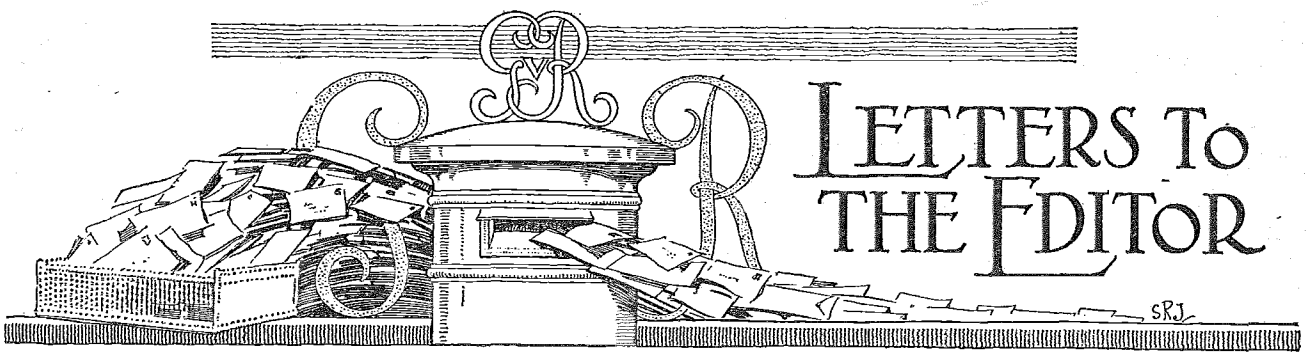
The same process as it was carried out in 1895.

INTERNATIONAL RADIO MANUAL.

THE cosmopolitan nature of broadcasting and international communication between experimental stations necessitates a universal language, and at the International Amateur Radio Conference in Paris the study and use of Esperanto as an auxiliary language for radio-telegraphic and telephonic communications was recommended.

The British Esperanto Association have recently published a useful little manual for the use of wireless amateurs and others, comprising a short chapter on the pronunciation, construction and grammatical rules of the language; two vocabularies of technical terms; a list of the principal broadcasting stations of the world, indicating the stations which make use of Esperanto as part of their regular programmes; and other data. The Manual has been written and compiled by H. A. Epton, F.B.E.A., a member of the R.S.G.B., and honorary secretary of the International Radio Association, and is published at the nominal price of 6d.

"The International Radio Manual," published by the British Esperanto Association, Inc., 17, Hart Street, W.C.1., pp. 80.



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.

AN OSCILLOGRAPH MIRROR.

Sir,—I have constructed an oscillograph as described by Mr. Castellain in your issue of March 28th, and I decided to make a revolving mirror for visually observing the waves.

I think that your readers may be interested in my method because of its cheapness.

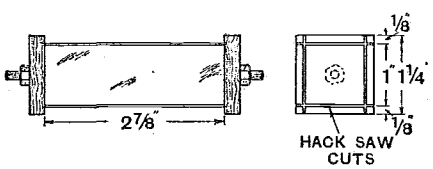
For the mirrors (of which there are four, mounted as shown in the figure) I used 3in. × 1in. microscope slides which were silvered by means of the following method :—

Silvering Solution.

Solution A : Dissolve 2.5 grams silver nitrate in 100 c.c. distilled water and add ammonia to it till the precipitate almost redissolves and then make up to 250 c.c.

Solution B : Dissolve 0.5 grams silver nitrate in 250 c.c. boiling distilled water, then add 0.4 grams Rochelle salt and continue boiling until the precipitate becomes grey.

Filter and keep in well-stoppered bottles in the dark. Just before use mix equal volumes of A and B and pour the mixture over the surface to be silvered and allow to remain one hour.



Construction of simple revolving mirror.

The surface to be silvered is best cleaned with caustic soda solution, then with dilute nitric acid and washed with distilled water, afterwards being dipped in stannous chloride solution, rinsed in tap water and then placed in the silvering bath, which may conveniently consist of a paraffin-waxed cardboard box.

This method is also useful for making galvanometer mirrors, etc.

When dry, clean the mirrors on some surface, mount in the saw cuts in the vulcanite end pieces as shown.

Pass the threaded rod through the centre of the end pieces, and by means of nuts clamp the apparatus together. The rod also acts as an axle. Fasten a pulley on this axle, and then mount in bearings. J. MASSEY PRESTON, B.Sc., A.I.C.

Euxton, nr. Chorley.

PRICES OF COMPONENTS.

Sir,—In the papers there has appeared the announcement of a further reduction in the prices of valves.

The problem which is worrying experimenters and home constructors is the consistent manner in which other components, *e.g.*, audiofrequency transformers, retain their high price.

Surely with all their up-to-date machinery the big firms are able to produce components more cheaply now than they were a year ago. Most of the better components have not altered one iota in price since last year.

Wishing the new *Wireless World* a long and prosperous voyage.

Blackpool. L. B. MYLECHREEST.

NIGHT TRANSMISSION ON 20 METRES.

Sir,—Perhaps the following results may be of interest to you and your readers. On Sunday, April 26th, I listened on the 20 metre wave band from 8.15 p.m. (B.S.T.) onwards. At this time the sun was just about to set. I found American signals quite strong and numerous. When the sun set signals became slightly stronger. Fading was only slight, and interference from other stations, mush or static practically nil. From then onwards I logged American stations until 10.50 p.m. and found no decrease in strength as darkness came on. At 10.50 U9XAX, in Minneapolis, was very strong indeed and very steady. Altogether in two hours and a half I logged twenty American stations, all being very good strength. I should be interested to know whether any of your readers have noticed any fading out of 20 metre signals at sunset, or if they can tell when they do fade out. I do not think these results are freak ones, as I have since heard stations (American) at 10.30 p.m. on several occasions. H. ANDREWES (G2TA).

Highgate, London, N.6.

Sir,—It seems to be a general opinion amongst amateurs that signals on 20 metres will not travel far after dark. During the past three weeks I have often listened on this wave, at various times, and have received the following stations.

From 17.00 *to* 19.00 *G.M.T.:* U8GZ, U1PL, U1CI, NKF, U2ANM, U2MU, U1CMX, U1CKP, U1CCX, U1OW, U4TV, U1CMP, A2CM.

From 19.00 *to* 21.00 *G.M.T.:* Only U4SA, U1CMP.

From 21.00 *to* 02.00 *G.M.T.:* U9XAX, U1BOQ, U1CKP, U1SF, U2BHN, U8GZ, U1CMX, U1ER, U6AGK, U4SA, U4TV, U1HN, U1ALW, U1XU, U4XE, U1ASF.

In general, before darkness here signals are of moderate strength and fading is very bad. At, or just after, sunset here signals are in general faint and fading is extremely bad; after sunset conditions seem better and signals are *very* strong and fading moderate.

You will note that the list of calls includes a 6; this signal must have travelled half way in daylight and the remainder in darkness.

In *The Times* a report of 2OD's communication on 20 metres with Australia stated that the signals travelled all the way in daylight. Surely this is not justifiable unless the direction taken by the signals is measured, as they may obviously take any path in daylight or in darkness—they may, in fact, take many! W. A. S. BUTEMENT (G6TM).

West Hampstead, N.W.6.

Sir,—I should be glad if you could find room for a few details on 20-metre work.

On Sunday, April 26th, between 20.40 and 21.10 G.M.T. I received on 20 metres the following American stations :—3ZW (R6); 9ZT (R3); 1CMP (R7); 1CKP (R7); 1ASF (R6); 1BOQ (R5). It is obvious, by the code, that these were all strong, and it speaks worlds for 20 metre work prospects when Britishers get going.

On Monday, April 27th, I also received : 1CMX (R5); 4SA (R4); 1CKP (R7)—between 21.15 and 21.18 G.M.T. During this

same evening, from 20.00 G.M.T. and over a period of two hours, NKF was working tests on 20.8 metres. His strength was R7 to commence with, and as the evening advanced this strength steadily decreased to R4. Other experimenters are apparently noticing that 20 metres working is more difficult during the dark period than in daylight.

While NKF was on I earthed my aerial and found a slight *increase* in signal strength. The earthing is done by a plug and socket on a 3 ft. heavy flexible copper cable, and there was a distance of 3 ft. between the earthed aerial and the nearest point of the aerial lead to the receiver. This effect is only to be expected in the light of experience on 100 metres.

The receiver I use is detector and one L.F., with Hartley circuit.

For 20 metres I use the following: Aerial series condenser, .00005 mfd. air dielectric; aerial inductance, 2 turns on 4in. diameter; secondary inductance, 4 turns on 4in. diameter; secondary variable condenser, .0002 mfd.; reaction variable condenser, .0002 mfd. These variable condensers are arranged to have very low minimum capacity, which on measurement is .00001 mfd. Both inductances are "air" supported, and the turns are spaced $\frac{3}{16}$in.

E. J. PEARCEY (2JU).

Fulham, London, S.W.6.

Sir,—On Sunday, April 26th, between 15.50 and 00.45 (27th April), I logged no fewer than 25 American amateurs on 20-23 metres, including all but the 5th, 6th, and 7th districts. Fading was much more noticeable from the more distant stations (*e.g.* 9th dist.) than the nearer ones. Strength increased from an average of R5 to R7 at 10 p.m., then gradually receded. The loudest, 1CMP, was heard all over the house on loud-speaker, the receiver being 0-v-1 Reinartz. Stations were still being heard on 20 metres at 1 a.m. (B.S.T.) when I closed down. It would appear that it is not necessary for daylight to cover more than the starting point of the 20-metre signals for them to be heard at great distances. An extraordinary piece of intelligence learned was that UICCX was in communication with UIASF at 8.50 p.m. B.S.T., despite the fact that these two stations are situated in the State of Massachusetts, the greatest width of which is less than 200 miles. Although I am 400 miles from London not a single British amateur was heard on 20 metres that day. That several were working is evident from a remark of UICCX that he had worked "five British boys" during the afternoon. I have no doubt that these stations were actually on around 20 metres, as many of them called "CQ20," and, further, the 40-metre stations did not come on until about midnight.

J. GORDON RITCHIE.

Glasgow.

HETERODYNE TRANSMISSION.

Sir,—Your recent editorial on "Overcrowding the Ether" is a very useful reminder of the limitations of wireless telephony.

Any two stations that one can hear produce beats, but the beats are inaudible unless the carrier wave frequencies differ by less than about 10,000. Perhaps the difference in frequency might be less, as one could become accustomed to, and ignore, the shrill faint whistle of about 6,000.

If 10,000 were the limit, only 100 stations of wavelengths of 300 metres and over could exist in any area without interference. Even that small number must be reduced on account of almost unavoidable harmonics. If wavelengths down to 150 metres are included the number of allowable stations is doubled: it becomes 200. If wavelengths down to 75 metres are included, the number becomes 400.

The area in which these numbers of stations may exist increases with the power of the stations, and it increases with the sensitivity of the receivers.

It becomes obvious that it is very easy to overcrowd an area, and I can think of only two possible remedies. The first is to reduce the power of most of the transmitting stations, the second is to diminish the sensitivity of receiving sets. The effect in either case is to diminish the area in which a given number of transmitting stations may be put.

So far I have assumed that nothing but wireless telephony is transmitted. This is far from true. It is very much to the interest of amateur experimenters to show that every wavelength not used for telephony can be used by a great number of Morse or other mechanical signal stations without the slightest interference with each other. If the amateur does not show how this can be done he may be quite certain that the business transmitters will soon rob him of all or very nearly all, his wavelengths.

The first thing to do is to abolish heterodyne reception and substitute heterodyne transmission. Imagine that a number of stations on 300 metres want to transmit. One of them heterodynes its own signals so as to transmit the note A. To do so it must produce 440 beats a second by sending every signal on two frequencies, 1,000,000 and 1,000,440, corresponding to wavelengths of 300 and 299,868. Another station heterodynes its own signals so as to transmit A♯. It must send every signal on two frequencies, 1,000,000 and 1,000,466.2, corresponding to wavelengths of 300 and 299.860.

The first station can check, and must check, its transmission by comparing its note with a standard tuning fork or a resonator answering to its proper note, and every other transmitting station does something of the same sort.

As an ordinary receiver could not distinguish A from A♯ with certainty, he must use a resonator between his telephone receivers and his ears. Resonators can be made adjustable to different tones as easily as coils and condensers can be adjusted to different high frequencies. As a compensation for the added complication of an acoustical resonator the complication of something to heterodyne CW is abolished.

If some arrangement of this sort were in use 50 or more stations could transmit at the same time on the same wavelength in the same area, and anyone could pick out any one of them by using the proper resonator. A station's name would appear in a list as transmitting on, say, 300 metres E♭, and it could be listened to and every signal clearly heard by anyone who used an E♭ resonator on a simple non-heterodyning set, if the set were sufficiently selective to tune out stations transmitting E♭ on 303 metres or on 297 metres.

In any area a given wavelength will serve more than 50 Morse transmitting stations. In the same area a given wavelength will serve only one telephony transmitting station. At the risk of undue repetition I repeat that it is the urgent business of amateur experimenters to show how many Morse transmitting stations can be put on each Morse wavelength unless they wish new stations to rob them of their wavelengths.

R. E.

CURRENT AMERICAN PRACTICE.

Sir,—Your reader John Kennedy states in his letter in your issue of April 1st that the Americans use house lighting current for "A and B" batteries (H.T. and L.T.).

There is on the market an arrangement for H.T., but it is not very satisfactory in most cases, but we have no arrangement for using house lighting current (110 volts A.C.) for lighting filaments of receiving tubes.

He also states that there is a tube with external filament that uses 110 volts, but I am sorry to say this is not fully developed for public use.

Most American radio fans use type 201-A. tubes. This tube uses 5 volts and consumes $\frac{1}{4}$ of an ampère an hour.

The neutrodyne is very popular here, but the regenerative set with two stages of audiofrequency amplification ranks first in the land for the money. Some "DX hounds" claim 1,500 miles (on 'phone) for this type of set.

The honeycomb coil (and other types) used so much in Great Britain, are not employed at all in manufactured sets in this country.

I should like to hear from some of your English readers.

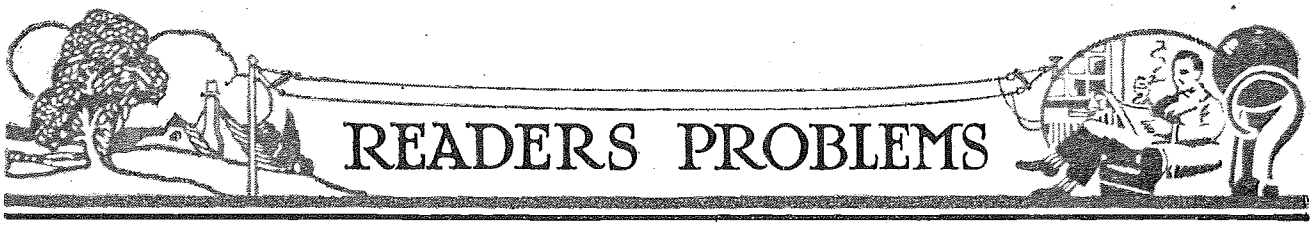
FRANCIS DALY.

8, Linwood Road, Boston, Mass., U.S.A.

THE "POLAR BLOK" EQUIPMENT.

Sir,—*The Wireless World*, No. 298, Vol. XVI., No. 12 of April 29th, 1925, page 396. With regard to the recent article on "Polar Blok" equipment, I think, as an enthusiastic devotee of the Polar Blok System, it is only fair to the Radio Communication Company, Ltd., to point out that they have all along marketed "blank panels" for amateurs to mount their own components upon. I, personally, make considerable use of these blank panels.

G. C. G.



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

Causes of "Crackling" Noises in a Valve Receiver.

A READER who is troubled by crackling noises in his receiver, together with poor volume and quality, wishes to know what is likely to be the cause of this. His receiver is of the conventional four-valve type, but is not fitted with switching arrangements for varying the number of valves, consequently, he finds it difficult to locate in what portion of the circuit the trouble lies.

The number of possible causes which may contribute to the trouble complained of are so multitudinous that it is impossible to definitely locate the fault without a very careful examination and testing of the receiver. It may in the first place be due to atmospherics. This may be quickly determined by temporarily disconnecting the aerial and noticing whether the noises cease or otherwise. Trouble may be experienced from local electric mains, the only real test of this being to temporarily connect up another receiver. A badly soldered joint, excessive flux on the panel, and the use of poor quality ebonite are other causes which may contribute to the noises complained of. Other possible causes are a faulty grid leak or filament rheostat, this remark applying specially to rheostats of the carbon compression type.

The H.T. and L.T. batteries should not be overlooked when seeking for faults of this nature. Attention is frequently paid to the H.T. battery, but it must not be forgotten that a faulty accumulator will also cause noises of this nature to be set up due to a variation in the filament current. Cases have been brought to our notice in which the fault was due to a defective connection in the "pinch" of a valve, although this is more often the case with foreign valves than with those of British manufacture. Probably one of the most frequent causes of the trouble is a breakdown in the insulation of the windings of either the telephones or of either one of the intervalves or of the output transformer. In either case it is almost invariably the winding which carries a steady current from the H.T. battery, which fails in this respect. If a pair of telephones and a flashlight battery are connected in series with the primary of a suspected transformer, a click should be heard on making and breaking the circuit. If the insulation is defective, a continuous sizzling noise will be heard in the telephones all the time that current is passing through the circuit instead of the silence which should follow the initial click on forming the circuit. Before carrying out this test, care must be taken, of course, to see that the telephones and the testing battery are beyond reproach.

Another frequent cause of this trouble is an intermittent connection in the leads of the telephones or loud speaker.

oooo

A Reliable Three-valve Set.

IN spite of the present popularity of multivalve sets employing the supersonic heterodyne principle of reception, there still remains a demand for a reliable and easily constructed set, which is at the same time sufficiently sensitive to receive many stations at good strength on the telephones without resort to a large number of valves.

Difficulties of Tuning Two H.F. Circuits.

MANY correspondents who have undertaken the construction of receivers of the neutrodyne type employing two stages of H.F. amplification have experienced difficulty owing to the fact that they have attempted to use condensers of the double circuit type in which two sets of plates are operated from the same shaft, but with indifferent results. It must not be forgotten that when two stages of high frequency amplification are used tuning will tend to be exceedingly sharp, and if the products of inductance and capacity are not equal in each circuit, very poor efficiency will result. It will thus be seen that however great the care exercised by manufacturers in matching the two halves of these condensers, it will be rendered quite abortive if the transformers which they tune are not also equally well matched. If, therefore, the transformers are not matched, the perfect matching of the two halves of the condenser will be a disadvantage rather than otherwise, since what we really require is that the capacities of the two halves of the condenser be adjusted to counteract the discrepancy between the two transformers. Of course it is possible by dint of careful construction to make the two transformers equal in value, but even then there are various stray capacity effects in the connecting wires of the set which upset the balance. It is possible, however, to get over the difficulty in a very simple manner by affixing a single-plate vernier to one of the double condensers. It will then be possible to counteract any discrepancy in a simple and efficient manner.

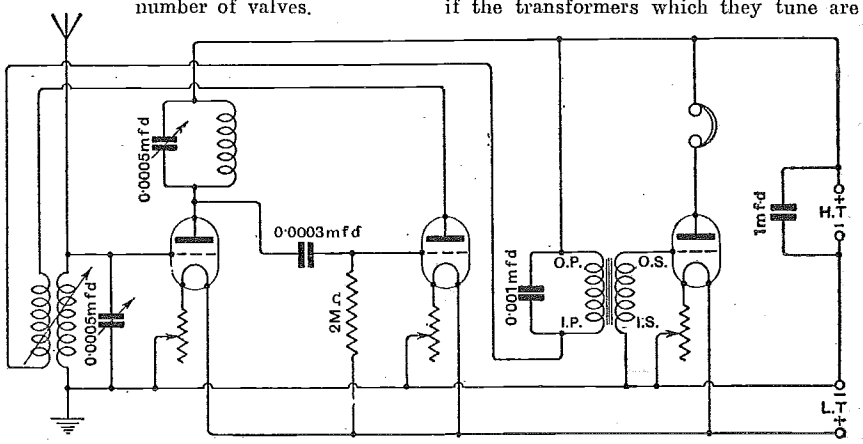


Fig. 1.—Connections of a three-valve receiver, H.F. detector and L.F., with reaction on the aerial.

The receiver connected as in fig 1, which has stood the test of time and experience, is probably one of the most reliable that can be used under ordinary conditions of reception. If care is taken in its construction, no difficulty should be experienced in tuning-in most of the main B.B.C. stations under normal conditions. The success or otherwise of a receiver of this type depends on the care which has been taken to use good quality components, and to avoid losses on the high frequency portion of the circuit. On a normal aerial and earth no difficulty should be experienced in operating a loudspeaker of good strength and quality on the nearest broadcast station.

Coils of the plug-in type may be used, thus making the receiver equally adaptable to all wavelengths.

A One-valve Set for the Local Station.

IT frequently happens that the amateur desires to construct a set designed for the purpose of being placed in the hands of inexperienced people, so that they may be capable of switching on the local station at will. A crystal set is unsatisfactory, because it usually happens that it requires resetting at every period of listening-in. Consequently resort has been had to the simple valve detector

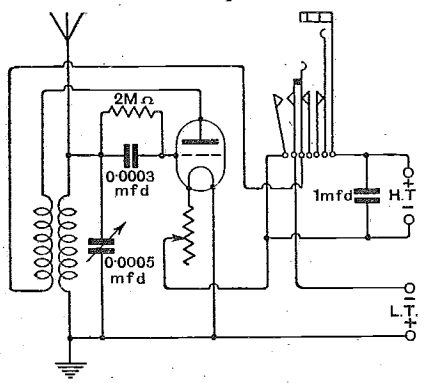


Fig. 2.—A simple single-valve receiver.

without reaction, since the elimination of reaction greatly simplifies matters and renders the apparatus "foolproof." When the receiver is to be used outside a thirty-miles radius of a broadcasting station, however, some form of reaction becomes imperative. This can be incorporated into the set without rendering the instrument any the less constant or easy to manage by following the circuit of fig. 2. The aerial and reaction coils can be mounted in two fixed coil holders side by side, so that their relative positions cannot be changed. Various sizes of reaction coil may be plugged-in until one is found of sufficient size to provide a generous amount of reaction without causing the set to oscillate at any setting of the aerial tuning condenser. This set will be found absolutely constant in its tuning, the local station always coming in at the same setting of the aerial condenser. The set may be still further simplified by substituting the variable filament rheostat by a fixed resistance of definite value, according to the type of valve and source of L.T. supply used. Upon inserting the telephone plug, the valve filament is automatically switched on, the withdrawal of the plug at the conclusion of the programme switching off all batteries.

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Correct Design of an Amplifier.

IT frequently happens that in order to secure high quality of reproduction, and at the same time not to sacrifice volume unduly, amateurs effect a compromise between transformer and resistance coupling by employing a transformer in the first stage of audio frequency amplification, the final stage being resistance-coupled. Although it cannot be denied that this method is productive of better quality than that obtainable with two transformer-coupled stages, it must be admitted that this arrangement is fundamentally unsound when we come to look closely into it. It is probable that the increase in quality due to its use is the direct outcome of the reduction in the voltage swing applied to the grid of the last valve causing both this valve and the loud-speaker to be worked well within their limits rather than to the obtaining of a correct balance between the high and low musical frequencies which is the main purpose for which resistance coupling is employed. After rectification the high and low musical frequencies are more or less correctly balanced, but their amplitude is small. Now, if we apply this output to a low frequency amplifier consisting of two or three resistance-coupled stages in cascade, this balance is fairly well maintained. If, however, in order to obtain an increase in volume, we make the first stage transformer-coupled, the lower frequencies will not be amplified to such an extent as the higher frequencies, and if we now pass this to one or two stages of resistance coupling, they can do nothing to restore the correct balance; their only point of advantage over employing an additional transformer coupled stage being that they do not of themselves still further accentuate the predominance of the upper musical notes.

Now it must not be thought that a transformer entirely suppresses the lower musical frequencies. It merely amplifies the higher frequencies to a greater degree than the lower frequencies, and if two stages of resistance coupling are added, of course this discrepancy appears in the loud speaker in a greatly magnified form. Hence, if we insert the transformer in the final stage of the amplifier, the first stages being resistance coupled, it is obvious that the correct balance of amplification will have been maintained up to the input terminals of the transformer, and then although the transformer will slightly upset this balance, it will not matter nearly so much as formerly, when the transformer was in the first stage. A circuit illustrative of the above-mentioned principles is shown in fig. 3.

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An Unusual Cause of Low Frequency "Howling."

MANY letters have been received from readers in which they have stated that on substituting dull emitters of the 60 mA. class for bright emitters in their receivers, they have been troubled by persistent howling from the loud-speaker.

This phenomenon is mainly due to the delicate nature of the electrodes in these types of valves. The sound waves from the loud-speaker cause the electrodes to be set into mechanical vibration. This electrode vibration naturally causes a variation in the plate current, which is, of course, passed along to the loud-speaker and again repeated back to the valves by the consequent modulation of the loud-speaker output. The result is that an initial scarcely audible howl gradually builds up into a roar.

In the case of a receiver where the valves are enclosed, a cure can usually be effected by closing the lid of the instrument, but in cases where the valves are mounted on the panel it becomes necessary to shield the valves from the direct influence of the loud-speaker.

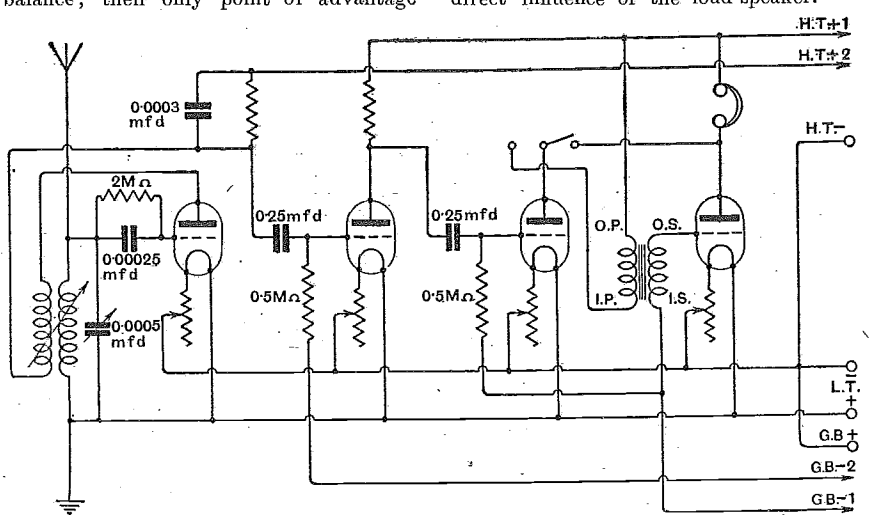

Fig. 3.—A four-valve receiver designed to give high quality results.

The Wireless World AND RADIO REVIEW

No. 302. WEDNESDAY, MAY 27TH, 1925. VOL. XVI. No. 16.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - - - - - Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4. - Telephone: City 2847 (13 lines).

Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 10 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries abroad, £1 3s. 10d. per annum.

BROADCASTING IN OTHER LANDS.

IN whatever country one lives, the tendency is always to become engrossed in the developments taking place in that country at the risk of overlooking the progress which is being made abroad. Perhaps in no other direction is this attitude more characterised than in wireless development, particularly in its relation to broadcasting. It is, however, a mistake to adopt the attitude that progress in other countries can be of little interest to ourselves, more especially when broadcasting is in many other parts of the world developing on lines almost parallel with our own. Rather than ignore what other countries are doing, we should from time to time make a definite effort to acquaint ourselves with the steps which other nations have taken towards the achievement of ideal broadcasting conditions, which is naturally the goal aimed at in every system set up to make the most of this new service to civilisation.

Conditions Differ in Every Country.

To record the steps taken towards the development of broadcasting in other countries is not to advocate the systems adopted as being preferable to our own, nor is a review of apparatus devised in foreign countries for broadcast reception to be taken as a recommendation that such apparatus is applicable for use in this country. We feel sure that our readers recognise the fact that in no two countries are conditions for broadcast reception identical, and, therefore, it is only natural that the types of sets and components produced should differ to a considerable extent. If one takes as an example the sets manufactured in the United States of America, we find at once that manufacturers there are in the happy position that they are only required to design sets having a limited wavelength range, which makes that part of their production of receivers a very much easier problem than the one which confronts the British designer who is expected to produce receivers applicable for reception with equal satisfaction on the normal broadcast band as well as on longer waves for the 1,600 metre station.

In France one of the principal reasons for the slow progress which has been made in popularising broadcasting is the fact that there stations are operating with widely different wavelengths, making the design of receivers an uneconomical proposition unless they are to be sold at almost prohibitive prices.

Direct Comparisons Impossible.

The reason for presenting to our readers a special issue of *The Wireless World* devoted principally to a record of wireless development abroad, is that so little attention has been paid in the past to progress made outside our own country. It has naturally been impossible to review comprehensively development in all parts of the world, and it has, therefore, been necessary to confine our attention to a limited number of countries where broadcasting organisations have been brought to a fair standard of development. We have found it impossible to make any true comparison between broadcasting in this country

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and the organisations employed by any other nation, on account of the diversity of attendant circumstances. Many attempts have, we know, been made to draw comparisons between manufacturing conditions here and in the United States. Our own opinion is that no comparison of this kind can be made in fairness to the industries of either of the countries. The production of wireless receiving sets in America is carried out to a much more ambitious programme than it would be possible to support here, whilst, as our correspondent writing in this issue on "Radio in the United States" points out, the development of wireless receivers there has been largely governed by the circumstances of the patent situation.

Mass Production Methods.

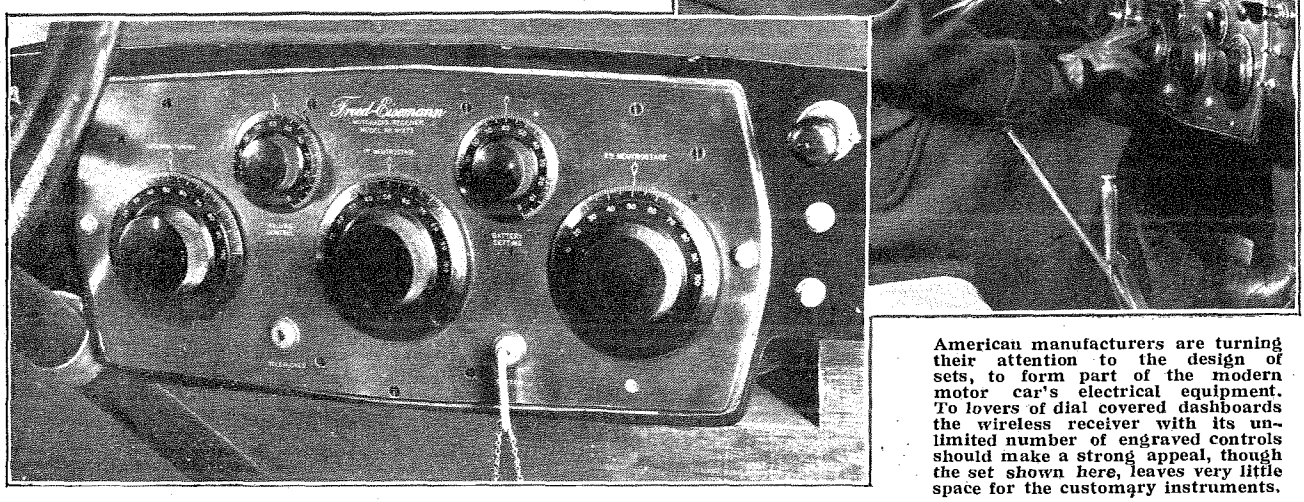
On the question of quantity alone, the mass-production methods, which it is possible to adopt in America, certainly tend towards meeting the demand for cheaper sets than are produced in this country, but, although the sets sold here are admittedly high priced, yet the margin of profit to the manufacturer is far below that which obtains in the United States. Mass production, too, always seems to tend towards a reduction in the quality of the product.

It seems difficult to understand exactly why this should be so, but, nevertheless, the truth is borne out by a comparison of the products of some of the best manufacturers selected in this country and the United States. There are, of course, marked exceptions, and the discriminating amateur can quickly pick out those products of foreign origin which have not their counterpart on the British market, and which, perhaps for this reason alone, make a special appeal. But, taken altogether, we find that the standard of quality is higher here than abroad, and the buyer to obtain can expect better value for money.

These remarks apply, of course, only in the case of articles manufactured in this country where competition maintains a high standard, and does not hold good in cases where "price rings" exist to maintain the price of articles irrespective of the cost of production, as has been seen in some sections of the industry.

The B.B.C. Copied by Other Countries.

In reviewing the systems set up to control broadcasting in the various countries, it is interesting to note how many governments have adopted organisations modelled on the lines of the British Broadcasting Company. Those European governments which have, up to the present, left broadcasting development to chance and have taken no positive steps towards organisation, have been left far behind, and changes of government have further helped to retard progress.



American manufacturers are turning their attention to the design of sets, to form part of the modern motor car's electrical equipment. To lovers of dial covered dashboards the wireless receiver with its unlimited number of engraved controls should make a strong appeal, though the set shown here, leaves very little space for the customary instruments.

Competition with the British Manufacturers.

At the moment there seems little risk that the British producers of broadcast apparatus and the organisation set up in this country have any serious rivalry to meet from other countries, yet it would be foolish to lose sight of the fact that unless British enterprise, especially on the manufacturing side, is stimulated in time, competition from abroad will prove a serious menace to the prosperity of the industry; more especially so if the foreign producer once obtains a firm foothold and finds that it is worth his while to produce apparatus specially applicable to meet the conditions existing here.

RADIO in the UNITED STATES

Our Correspondent, who has recently visited the United States, gives his views on the present position there, with special reference to the conditions which have governed the development of Receivers.

THE present position of radio development in the United States is the product of a set of circumstances differing in most respects from anything which is met with in this country. Of these the most far-reaching in importance are three, namely, the size of the country and the nature of the broadcasting service, the patent position, and the general plentifulness of money coupled with a readiness to spend it on any novelty.

Spending Capacity of the Public.

The last of these causes needs very little explanation. As a result of the war and the whole attitude of the country on the subject of trade, money is undoubtedly very plentiful and the public has little hesitation in spending it freely on any device which adds to the interest in life. From this it follows that radio sets sell in very large quantities, and there is little or no demand for cheap and simple types. Crystal sets are exceedingly scarce, and when met with are little more than toys. Again, one-valve sets are not common, although there are a few at prices of the order of £2. There are a certain number of two-valve sets at prices of about £6 or £7, but by far the greater number of sets seen employ four or more valves. Although there is unquestionably a good deal of experimental construction of sets done, there is very little doubt that the ratio of manufactured to home-made sets in use is much greater in the States than in this country.

How the Patent Position has Influenced Design.

The effect of the patent position in America is quite as important a factor as the readiness to buy. In this country any *bona fide* manufacturer of sets can obtain a licence which enables him to employ practically every patent of value, and this being the case design is not interfered with in the least by any fear of infringement. On the other hand, in the United States a large number of basic patents are held by one large organisation which does not licence outside manufacturers upon any terms, and in general the holders of any patent of value use it themselves, or at most only licence a few other firms to do so.

This line of action puts a very severe handicap in the way of any new firm wishing to take up the business of wireless manufacture, and in actual fact the bulk of the manufacture falls into the hands of two groups operating two sets of patents, and with designs which are to a very large extent the result of the patent position in which the firms find themselves.

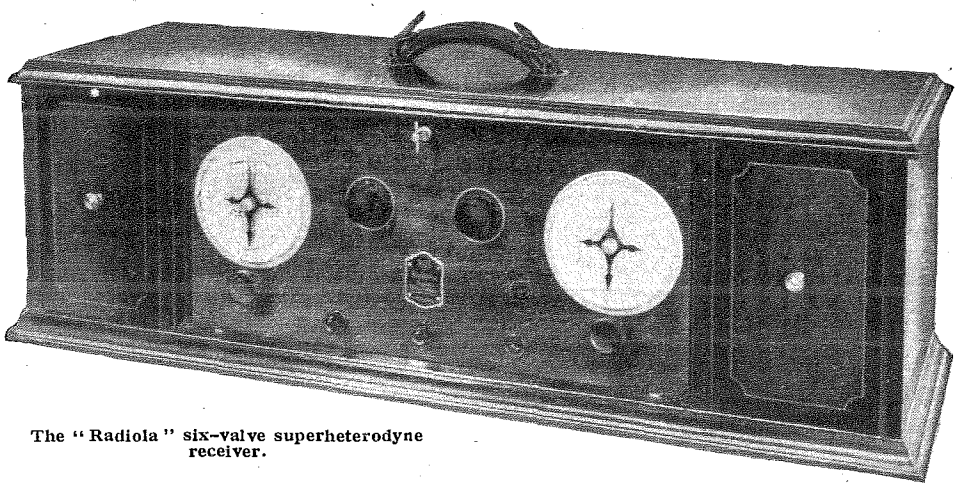
Effect of Geographical Conditions.

The remaining cause, namely, the nature of the country and the broadcasting service, has perhaps a still more far-reaching effect. In a country comparable in size with Europe there are about 600 fairly high power transmitting stations, but there exists no organisation such as the British Broadcasting Company, whose direct business is the supply of first-class broadcasting matter. The bulk of the American broadcasting programmes is provided for indirect advertising purposes, and it can readily be understood that the amount of money which it is economical to spend in this way is not sufficient to enable first-class artistes to be engaged with any frequency. As a matter of fact, it is by no means unknown for artistes to pay for "the use of the ether," that is to say, for an opportunity to broadcast.

Radio in the United States.—

The Programmes.

As a result of all this the quality of the programmes is poor in comparison with the technical excellence of the stations themselves, and it further follows that public interest is diverted in the direction of the picking up of distant stations rather than in the actual musical results obtained from any one station. This leads to a selective type of design enabling great ranges to be obtained, but not paying any very great attention to the actual quality of reception, particularly on loud-speakers. Together with the desire for range lies the need for very great selectivity, as all the larger cities have at least one, and often several, broadcasting stations, and as an example the city of New York has more than a dozen different stations.



The "Radiola" six-valve superheterodyne receiver.

Very fortunately either of the two main methods of attacking the problem of range need very little modification in order to obtain high selectivity. The difficulty in regard to selectivity may be emphasised by pointing out that nearly all the 600 stations in the country operate between 250 and 600 metres. This limitation of wave has, of course, one advantage, in that it leads to a good deal of simplification and cheapening of design, because the ordinary receivers on the market are arranged almost without exception to cover this band only.

Types of Receiver.

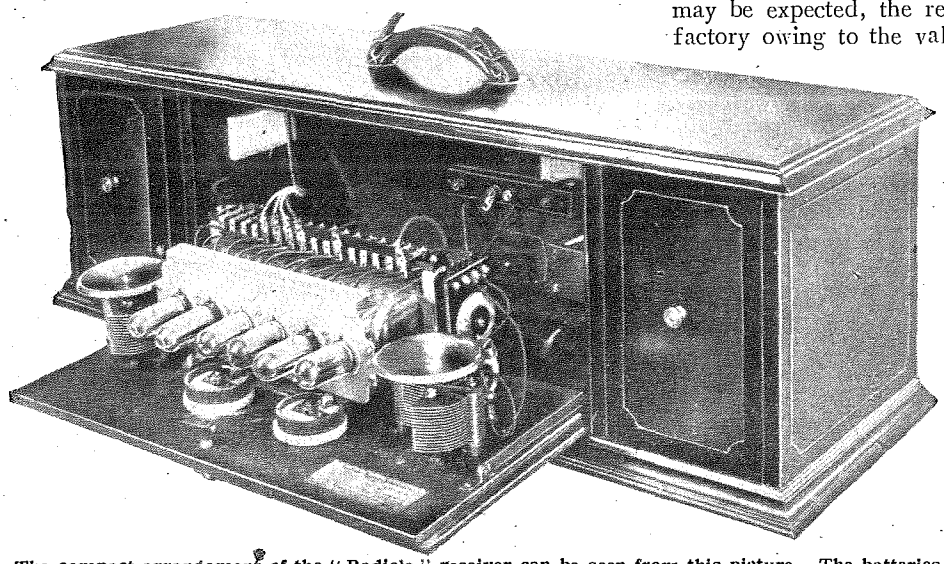
The two main types of successful receiver evolved to meet these special circumstances are the neutrodyne and superheterodyne. The performance of these types is very similar, but the superheterodyne obtains its results from a frame aerial, whereas the neutrodyne requires an open one. As an instance of the degree of selectivity obtained, an American superheterodyne receiver gave quite satisfactory reception of other stations without interference at a distance of about 500 yards from the New York stations WGY and WJZ.

Limited Range of Valves.

Another feature of interest in the American market is the small number of types of valve employed. Types commonly met with do not exceed half a dozen in number, and are very closely comparable to types of general purpose valves on the English market. The bright filament valve is obsolete, and there is little or no tendency to produce valves with special characteristics to meet special requirements. As an example, the American market does not include a range of valves with a high magnification factor for resistance capacity amplification, or with low internal impedance for power handling purposes, although there exist one or two exceptions to the latter rule.

It is customary to operate loud-speakers with general purpose valves with characteristics similar to the British D.E.5 or even the D.E.3 or the Weconomy valve. As may be expected, the results are not always very satisfactory owing to the valves being unable to meet heavy demands for power handling without distortion. The resistance capacity method of low-frequency amplification is a field practically unexplored. Reflex circuits do not appear to be in any great demand.

There are no regulations in the United States to prohibit the use of reaction coupled back to the aerial in such a way as to make it possible to produce oscillation, but there appears to exist a strong feeling in the trade that it is undesirable that sets of this type should be put into the hands of a public who are not always capable of using them without annoying their neighbours. As a result only



The compact arrangement of the "Radiola" receiver can be seen from this picture. The batteries are housed in separate compartments at each end of the cabinet.

Radio in the United States.—

one or two types of instrument on the market are designed on these lines. It should, however, be pointed out that these types, though numerically small, enjoy great popularity, and this is in all probability due to the extended range which this type of construction makes possible with even a few valves used on a poor aerial system.

A point which may occasion some surprise is that short-wave stations such as KDKA attract comparatively little interest in the United States. They are used almost entirely for wireless relaying, and as their programmes are being put out simultaneously from other stations on a longer wavelength it has not been thought necessary so far to provide commercially receivers suitable for taking them direct.

The Price of Receivers.

There are very large quantities of radio sets manufactured in the States at prices which at first sight seem low in comparison with those ruling on this side of the Atlantic. Further investigation, however, shows that this cheapness is more apparent than real, as the finish of such items as cabinet work is in general inferior to the higher grades of article on sale in this country. It is probable that the cost of an American radio set is more equal to that of a comparable set on the home market than is that of an American automobile to the corresponding English car.

In spite of the existence of low consumption valves, there does not appear to be any universal tendency to the adoption of dry batteries for filament lighting. In the generality of firms the accumulator still retains its old popularity. Dry cells are, however, used almost exclusively for high tension purposes in spite of the fact that many sets operate with a number of valves without grid bias, and therefore with high consumption of high tension current.

Summing up, the demand of the American public is not so much for good quality, but almost entirely for a highly selective long range radio receiver which may require a good deal of expert handling to give its best results. A highly finished article of furniture is usually desired, capable of first-class artistic reproduction, and this demand has been excellent catered for by the radio trade of the country.

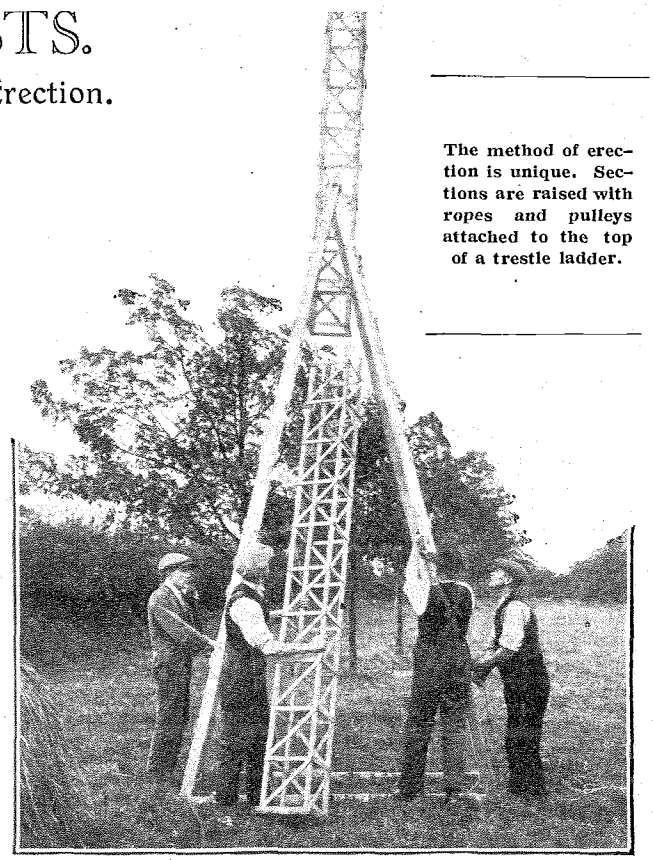
LATTICE MASTS.

Simplified Method of Mast Erection.

THERE is inevitably a superfluity of component instruments made for the amateur, though it is seldom that we hear of anything being done to provide him with a reasonably cheap mast which can easily be erected. For some time past Messrs. Hobbies, Ltd., have been experimenting at their Dereham Works in an endeavour to design a mast to meet amateur requirements and which can be erected in confined space.

Of lattice box construction, the mast possesses great rigidity, and with ordinary care will not bend or sway when the guy wires are only temporarily terminated to the anchorages. The vertical timbers are of square section, and a minimum of wood is used, so that the complete mast is as light as possible. Each section is easy to lift and turn, and weighs very little for its bulk. The bottom section is naturally the largest, and each tapers gradually to the top.

For a 70ft. mast seven sections are employed, and the process of construction consists of bodily raising the mast by means of ropes and pulleys carried by a trestle ladder and inserting the sections in turn from the base. The latter is placed over the spot where it is proposed to erect the mast, and two raising cords are run over the pulleys, terminating at the foot of the section. By hauling on the ropes the mast is raised sufficiently to permit the insertion of the next section, each section being allowed to rest on the ground whilst the joining pieces are being screwed together. As the height increases it is necessary to steady the mast, and the guy wires are, of course, uncoiled as the sections go up, each wire being held by an assistant, who pays it out slowly as required. By this means the mast is raised simply and comparatively quickly, the guy wires being finally adjusted when the entire mast has been fitted up. The guy wires are best terminated on anchors of wood treated with creosote and buried in the ground.



The method of erection is unique. Sections are raised with ropes and pulleys attached to the top of a trestle ladder.

A PAGE OF COMPARISONS.

Broadcasting in Other Countries.

By W. H. MERRIMAN, A.I.E.E.

CRITICISM of the methods adopted in our own country is a national characteristic, and probably the British Broadcasting Company, its methods and monopoly, earn more than their fair share of destructive and a very meagre portion of constructive criticism. It may be of interest, therefore, to contrast the different regulations obtaining in other countries for the control of broadcasting, and to consider whether they can show any marked superiority over those in force in Great Britain and Northern Ireland.

In some countries the revenue for the maintenance of broadcasting stations and the programmes transmitted is dependent almost entirely upon a system of advertising. This is the case in the United States, where the stations are in the hands of individuals or companies, and are grouped into three categories:—Class A, limited to stations with an output of less than 500 watts and using wavelengths between 222 and 300 metres; Class B, which does most of the public broadcasting, is allowed an output of 500 to 1,000 watts, or in certain cases greater power, and uses wavelengths of 300 to 345, 375 and 545 metres; Class C, which is now obsolescent, comprises stations at present licensed to use a wavelength of 360 metres, but these are gradually being absorbed into Class A, and no new Class C licences are being issued.

Divers Regulations.

In South Africa, also, licences are issued to individuals who thereby obtain the exclusive right to broadcast over a certain specified area. They may transmit advertising matter for a limited time daily, not exceeding 10 per cent. of the total programme, and may also contract with listeners within their prescribed area on terms ranging from £2 per annum for private residences, to £6 for fully licensed hotels. Listeners, in addition, must take out an annual licence, for which the fee is 5s.

In Australia the experiment of employing receiving sets with fixed wavelengths, which could only be used for the particular transmitting station, proved ineffective, and the old regulations have given way to others under which the broadcasting stations are divided into two classes, one of which receives revenue from licence fees and advertisements, and the other receives no revenue but may advertise. Stations of the first class are strictly limited in number, and collect licence fees from receivers, which vary, according to the distance away, from 30s. to 20s. for ordinary licences, and from £10 to £7 10s. for hotels and places of entertainment.

In Canada licences are issued for private commercial broadcasting stations, but no tolls, fees, or other considerations may be collected without the consent of the Department of Marine and Fisheries. Amateur broadcasting licences for short distances are also granted to recognised radio associations.

In Belgium the regulations affecting broadcasting are believed to be still under discussion, and receiving sets are subject to a tax varying with the number of valves used.

In Germany the transmission of broadcast news, etc., is conducted by the State authorities and receivers, which must be approved and stamped by the Post Office, are subject to taxes varying with the number of valves used and the degree of amplification.

In Italy a concession for broadcasting has been granted to the Unione Radiofonica Italiana, who receive a tax on each receiver sold of 50 lire plus an additional tax according to the number of valves used.

Japan has adopted the plan, tried unsuccessfully in Australia, of having receivers tuned only to prescribed wavelengths.

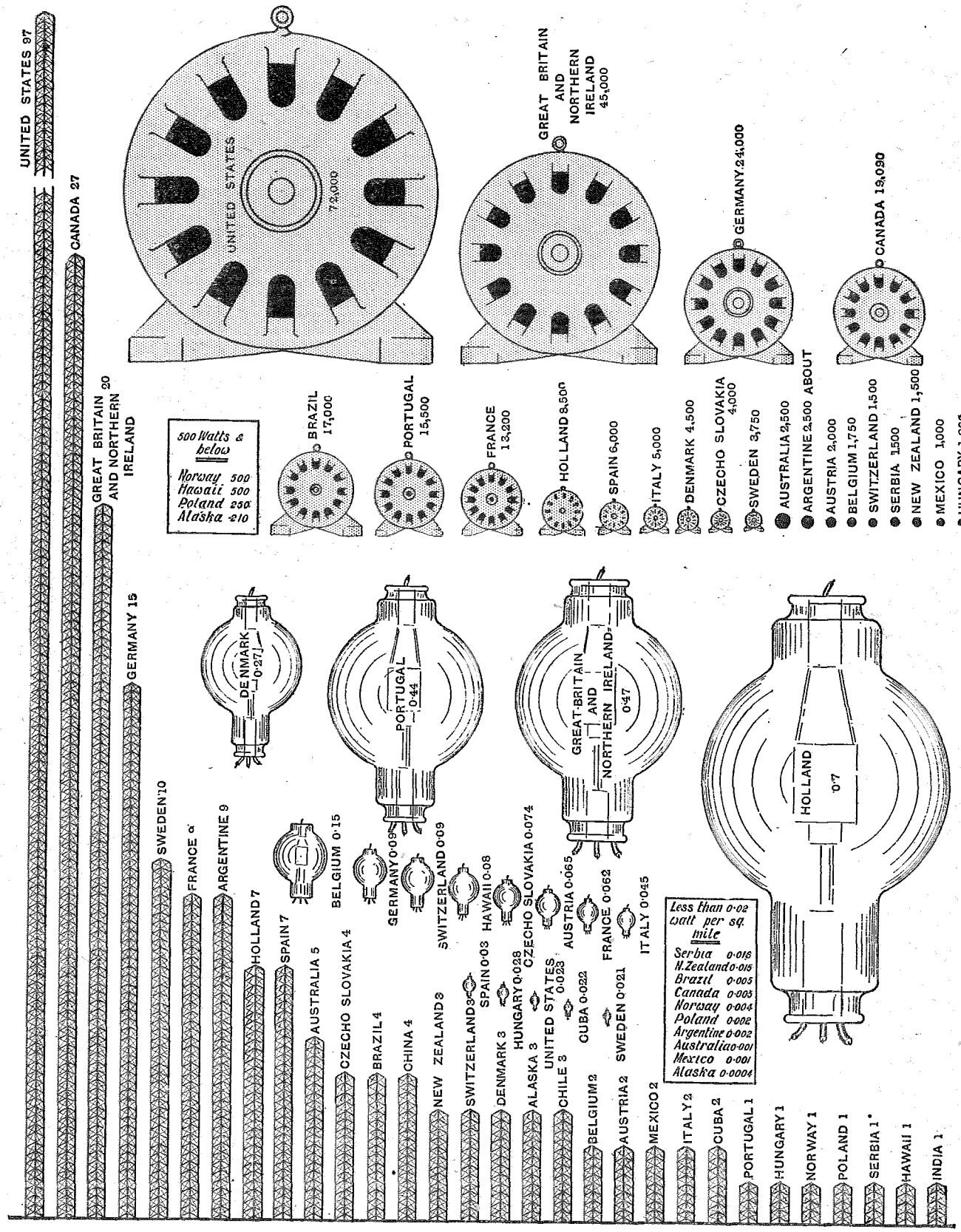
Spain is erecting official broadcasting stations which may use sufficient power for the range desired and wavelengths between 1,550 and 1,650 metres. Licences are also granted for private stations limited to an output of 8 kw., and using wavelengths from 300 to 440 metres and from 460 to 500 metres. The licence fees vary according to the power and number of hours service.

In Switzerland, broadcasting is under Government control. Receiving stations are divided into eight different classes according to whether they are intended for public or private use and the type of aerial employed. The fees range from 10 francs for private receiving sets to 120 francs for commercial receiving stations.

It is apparent from the foregoing remarks that the methods and regulations for controlling broadcasting are many and varied, and to those who carp at our own methods, we can only say, in the words of Capt. Bruce Bairnsfather, "If you knows of a better 'ole, go to it"!

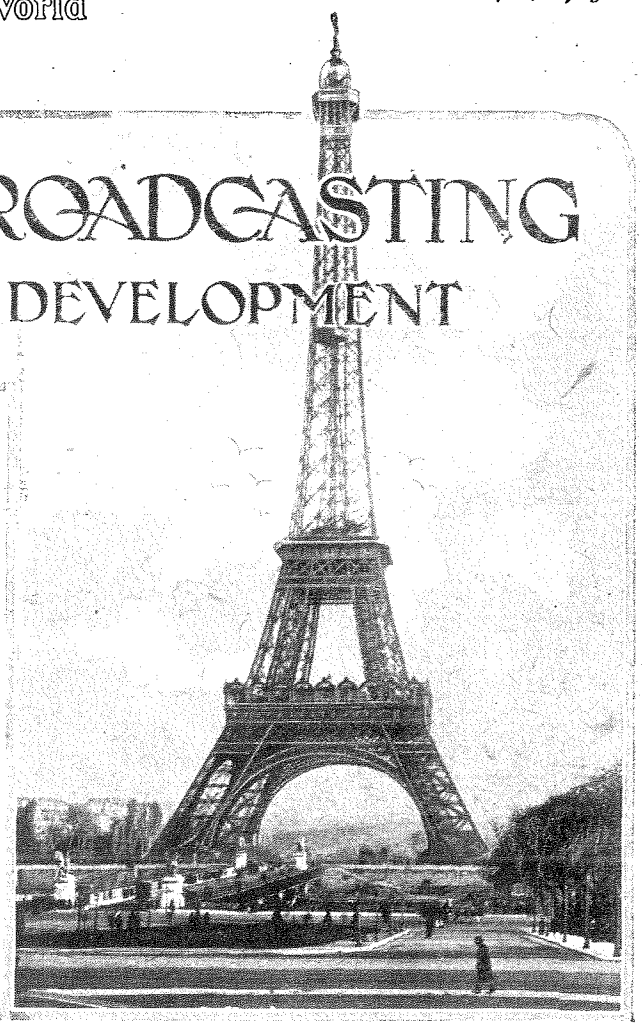
A Comparative Chart.

On the next page is an interesting chart giving a comparison of the number of public broadcasting stations in different countries of the world, their aggregate nominal power, and the average distribution in watts per square mile of territory. This latter comparison is perhaps somewhat misleading for such countries as the United States and South America, where there are vast expanses of territory unserved by broadcasting stations, and others where these stations are almost too numerous. In computing the aggregate power, we have included relay stations, but have only taken into consideration the "Class B" stations of the United States, as it is understood that those of Classes A and C are mainly used for instructional or private purposes. The comparative height of the masts indicates the number of stations, the size of the generators the aggregate power, and that of the valves the average distribution per square mile of territory.



Height of masts = number of stations; size of generators = output; size of valves = watts per square mile.

FRENCH BROADCASTING AND ITS DEVELOPMENT

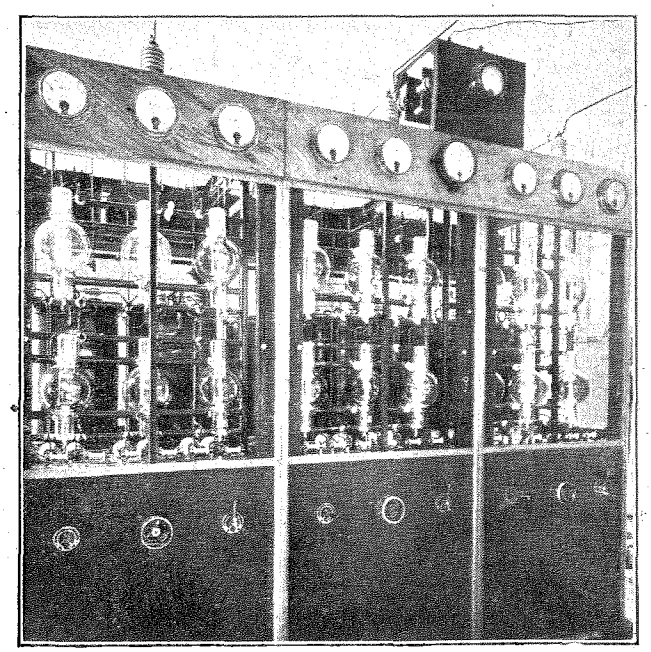


The comparatively slow progress made in France in the development of broadcasting is no doubt due to the attitude of the French Government. Only two privately owned stations are at present in operation, whilst the transmissions from the official stations are essentially of an experimental nature.

By Our Paris Correspondent.

THE broadcasting situation in France to-day is such that extensive changes in the organisation may take place at any time. As the broadcast listeners in nearly all countries have learned, to their sorrow, radio is becoming more and more a political football. In France, where Government monopolies of all the most necessary forms of communication exist, broadcasting is face to face with many difficulties.

For the moment, however, it is not a Government monopoly, and for the time being there is still some doubt as to whether it ever will become so, in view of the violent opposition shown by the Press and the public as well as most of the wireless manufacturers. On the other hand, the new Government is inclined to take a strong view, and, in any case, new legislation of a somewhat lasting character is anticipated. If radio broadcasting can be shown to be an income-bearing investment for the Government, then in that case it seems almost certain that it will ultimately be taken over as a State monopoly.



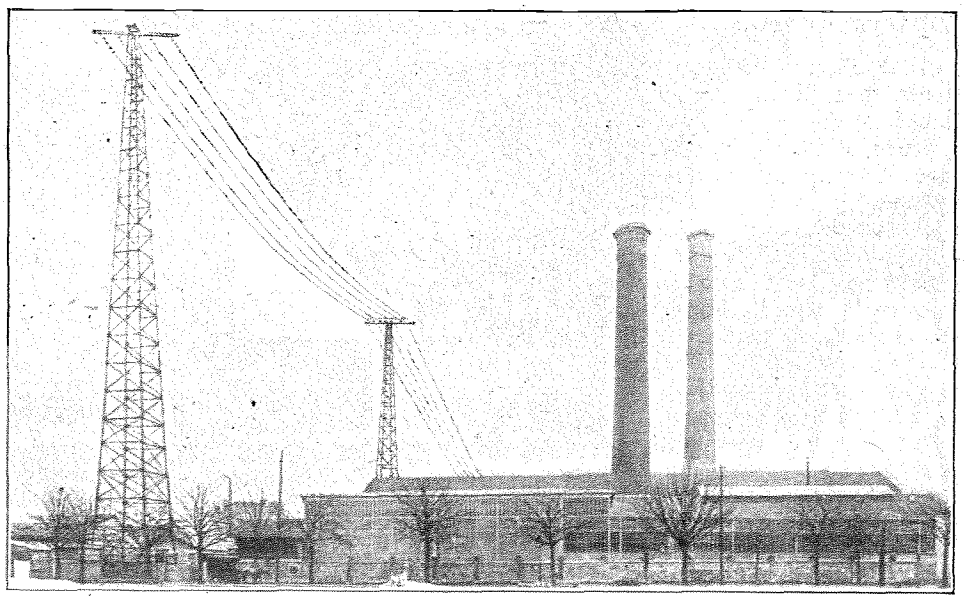
The rectifying valves at the Radio Paris station.

Regulations Hamper Progress.

The present regulations governing private broadcasting are somewhat vague. The original conditions necessitated permission being obtained from the Government before a broadcasting station could be erected and the payment of taxes bearing a certain ratio to the power of the station. These taxes naturally had a considerable effect in preventing any private enterprise in broadcasting. In fact, during the summer of 1923 there was a discussion of an increase of taxes, which would have amounted to a charge of something like Frs.10,000 per annum per kilowatt, and this produced an almost complete cessation of amateur broadcasting, whilst private manufacturers were on the point of giving up in despair. But later in the year a new Decree was passed which liberated all amateur broadcasting stations and broadcast listeners from taxes and also from Government supervision except for certain minor regulations. This change of attitude of the Government brought the amateurs out of hiding and also

French Broadcasting.—

prompted a large number of applications for broadcasting privileges. The positive effect of the Decree was that the right was extended for receiving sets to be established in any place by anyone of French nationality after the registration of the station at the nearest Post Office and on payment of a tax of 1 franc. Any receiving set which was used to entertain the public—as, for instance, in restaurants, music halls, etc.—was subject to a minimum tax of 200 francs per annum, and any receiving station if used for any other commercial purpose without special authority was liable to be instantly closed and the apparatus confiscated

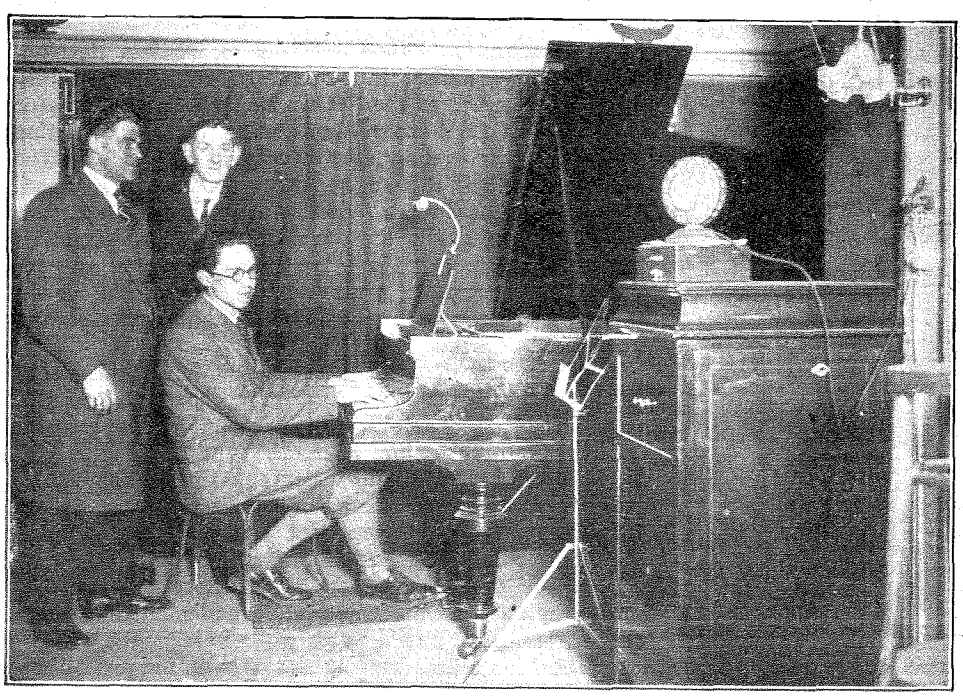


Aerial system of Radio Paris.

The Official Attitude.

Transmitting stations were divided under five separate categories. Broadcasting stations came under the direct supervision of the Under-Secretary of State, and also, from the technical aspect, under the Department of Posts and Telegraphs. All applications for permission to establish broadcasting stations, as well as for amateur transmitting stations, had to be made to these departments, and were subject to be made use of at any time by the state should necessity arise in the interests of the public or the safety of the state. A complete specification of the station had to be submitted to the Department of Posts and Telegraphs, and taxes varying with the input power could be imposed. This Decree, however, although it was passed, has never yet been put into effect, and at present if application is made for a broadcasting station it has to be submitted to the Minister of Posts and Telegraphs, where the application is very likely to be held up indefinitely, as the Department reserves to itself the right to grant or refuse licences as it sees fit.

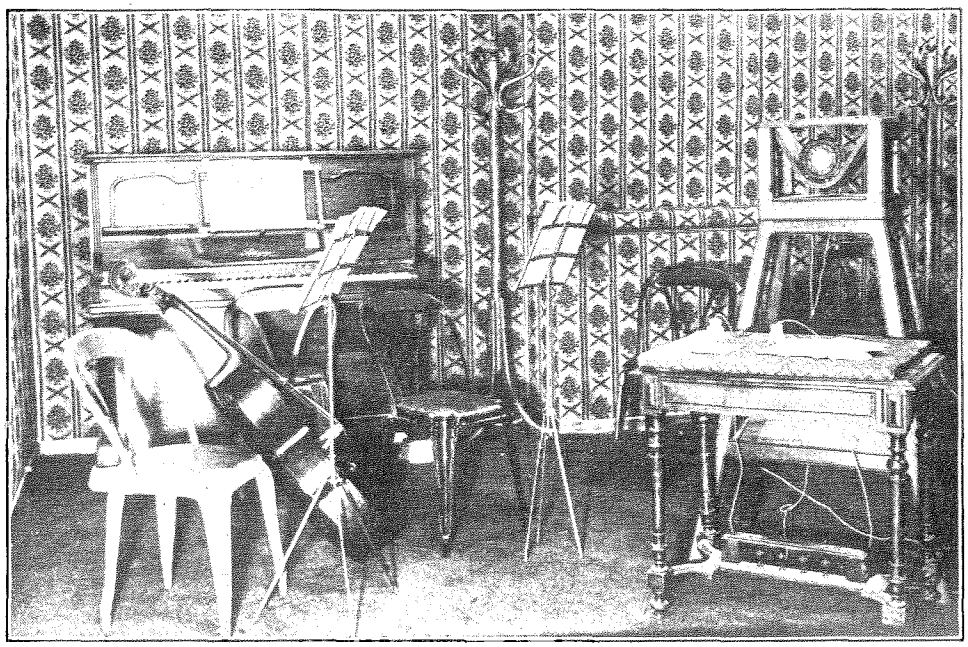
The net result of this situation is that there are at present only two private broadcasting stations in existence in France. These are Radio Paris, owned and operated by the Société Française Radio-Eléctrique, and the Petit Parisien, owned by the newspaper of that name. Radio Paris has been in operation since 1922, and commenced activities a few months after the first telephony transmissions were conducted in France by the Eiffel Tower station. According to estimates which have been supplied, there have actually been over thirty applications made for permission to establish broadcasting stations, but, as the officials themselves say, "One must be a little careful to whom one grants such licences." The officials certainly have been careful!



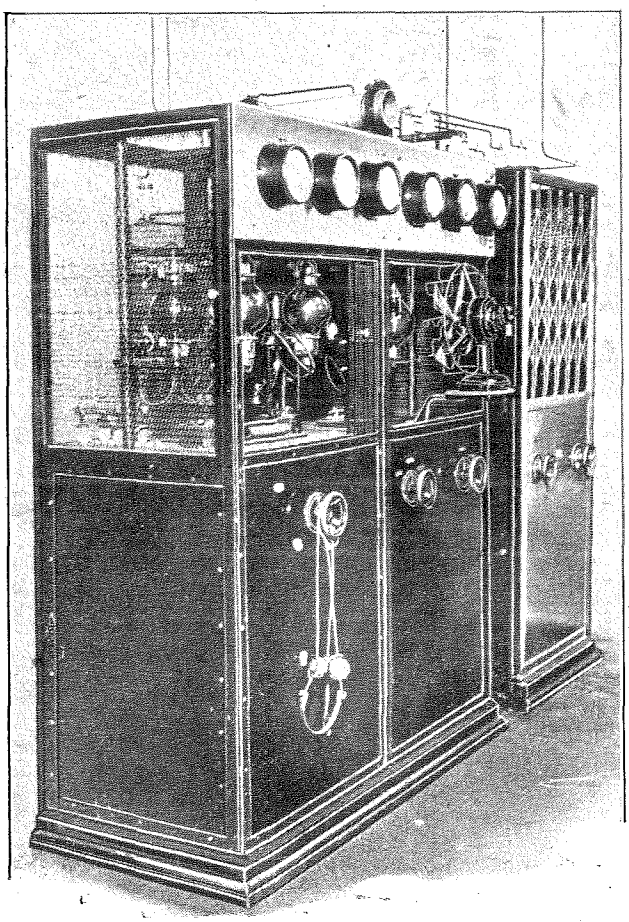
The Eiffel Tower studio.

In one direction this caution in granting licences has.

French Broadcasting.—no doubt, had a directly beneficial effect, because if licences had been freely granted in the early days, the extent of interference in France between one station and another would have made broadcast reception almost impossible. Interest in reception in France is mainly confined to the shorter wave stations, as long-wave ones, such as the Eiffel Tower, are not very popular, no doubt partly on account of the fact that, as the Eiffel Tower is an experimental station rather than a broadcasting service station, the quality of transmission varies according to the nature of the experiments being carried out, and very often the quality is so poor that the public derive no entertainment from listening to it, whilst, in addition, frequent variation in wavelength is very disconcerting both to the manufacturer and to the public using receiving apparatus. Just as in England, the fact that there are short-wave and long-wave stations to listen to has increased the cost of manufacturers' receivers, and consequently the price to the public, apart from the fact that the technical difficulties encountered in designing selective receivers which will tune to both wavelengths are by no means easy to solve.



Studio of the Radio Lyon station operated by the French Government.



The transmitter panels at the Radio Lyon station. Other government controlled stations are under construction at Toulouse and Marseilles.

State Monopoly Proposal.

But perhaps the worst set-back to wireless development in France came in November, 1924, when proposals were made to the Government by the Ministry of Posts and Telegraphs recommending that broadcasting should be taken over by the Government monopoly. The reasons given for this suggestion were that, in a limited territory such as France, wireless might become a menace rather than an aid in the event of war. The proposals further suggested that a chain of Government stations should be erected on somewhat the same lines as the B.B.C.'s stations in Great Britain, and that a central office should be established in Paris.

The effect on the Press and the public of these proposals was much the same as when the new Wireless Bill was introduced in England. A storm of protest was raised on both sides, and it seemed that the proposals of the Ministry of Posts and Telegraphs might have to be dropped and, in fact, there has been no attempt up till now to interest the Government further in the scheme. In spite of this, the French manufacturer still has always the fear of Government action and Government monopoly hanging over his head, and, under these circumstances, regards it as not worth while to incur the expense of establishing a broadcasting station with the probability that after a while it will be closed down.

RADIO IN HOLLAND.

A Pioneer in European Broadcasting.

By W. PEETERS

(Our Correspondent in Holland).

NOW that Holland has taken part in the first International Broadcasting Conference recently held in London at the instigation of the British Broadcasting Co., and is also represented on the Committee which will take up its abode in Geneva, the occasion is favourable for reviewing the progress of radio in Holland.

Holland a Pioneer in Broadcasting.

Long before broadcasting stations were erected in England, radio-telephony stations operated in Holland and regularly gave gramophone concerts, the best known being that of the Netherland Radio Industry at The Hague (PCGG), which for some months transmitted concerts, later organised by *The Daily Mail*, which were heard well in England.

Amateur progress was also well advanced, and hundreds of experimenters keenly followed the wireless events. On account of the nearness to Germany, the apparatus used came chiefly from that country, and, after the war, component parts from German military sets were brought wholesale across the frontier.

For many years this stock could readily be drawn upon and every amateur could provide himself with a complete receiver. Now, however, this is no longer the case, and our own products, supplemented by parts imported from America, England, and France, are almost exclusively used.

Amateur Transmitting Licences.

The oldest and largest amateur radio organisation is the Netherland Association for Radio-Telegraphy, which has branches throughout the country, and is authorised by the Government to transmit from its various centres. The Government only grants transmitting licences to amateur associations, and not to individuals. The maximum energy permitted is 100 watts, and the wavelength must not exceed 200 metres.

Notwithstanding this prohibition, there are numerous amateurs secretly transmitting and using call-signs beginning with the letter O or P. Many have worked with America, while they are reported daily as having been heard in all European countries.

The number of listeners is daily increasing, and there are now about 45,000, the majority being in Amsterdam, Rotterdam, and The Hague.

To be independent of foreign cables during the war, a powerful radio-telegraphic station was built at Kootwyk, near Apeldoorn, which maintains a regular service with India (Bandoeng). The aerial is suspended on six masts 212 metres in height. The receiving station is at Meyendell, and both stations are controlled from the telegraph offices in Amsterdam.

A powerful transmitting plant has been installed in the Amsterdam Stock Exchange, which, at stated times, broadcasts financial news for the benefit of provincial bankers, while the well-known Press office of Vas Díaz in Amsterdam also uses this transmitter for the dissemination of the Press messages, which are received by the provincial papers, who are thus able to publish the latest news.

Most of the banking houses in Amsterdam are equipped with receiving apparatus enabling them to pick up several wireless services, *e.g.*, the traffic between London and Paris, Berlin and Hamburg, etc. Communication with Paris and Hamburg is also expedited by this means through the intermediary of Amsterdam, as it is found that radiograms are quicker than cablegrams, and, in consequence, Amsterdam is in receipt of financial news from the London and Berlin exchanges within five minutes, greatly to the advantage of the banks.

The Broadcasting Stations.

With regard to broadcasting, Holland has no official stations, but there are radio-telephony stations belonging to wireless companies operated at their own expense. The Nederlandsche Seintoestellen Fabrick is an exception. In the early part of 1924 a syndicate of Dutch listeners was formed to collect the money necessary to defray the expense of the programmes, and obtained the use of the transmitter at Hílversum free of charge. Listeners send in voluntary contributions, and, thanks to their help, the periods of transmission have steadily increased. Concerts are transmitted almost daily, and have become well known abroad. The Philips Factory at Eindhoven has lately presented two masts 60 metres in height, so that the range of the station is now greatly increased.

No Receiving Licences required.

No licences are required in Holland. Receiving is free, and there is no tax on the apparatus. The most popular foreign reception is from the Chelmsford station, and its excellent programmes are greatly appreciated by all Dutch listeners.

We have no national radio industry. The apparatus made here is constructed of imported parts, and coils of the honeycomb type are generally used. Complete sets are imported mainly from France, with built-in coils designed for wavelengths of 200 to 3,500 metres. Telephones and loud-speakers come mainly from England. Four radio journals are published catering for the requirements of both listener and experimenter.

In September the Second International Radio Exhibition will be held in Amsterdam, at which English firms will be represented. This promises to be as successful as that held last year.

From May 29th to June 7th there will be a radio demonstration at the Kurhaus in Schevenigen organised by the Nederlandsche Vereenigingvoor Radio Telegrafie.

WILLIAM STURGEON.

Centenary of the Invention of the Electromagnet.

Abstract of a Lecture Delivered at the Royal Society of Arts on May 20th

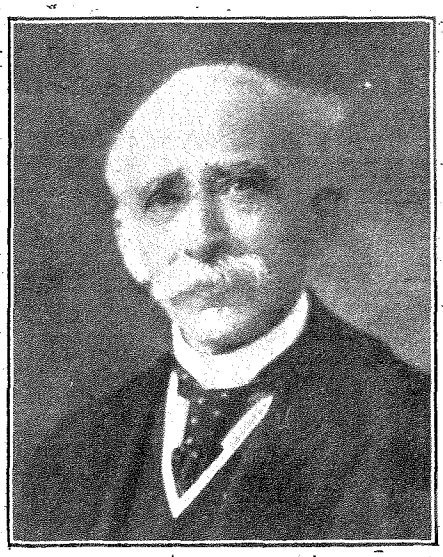
By Dr. J. A. FLEMING, F.R.S.

ONE of the most important inventions ever made in connection with electrical science was the electromagnet, which was given to us just a hundred years ago by William Sturgeon, a poor shoemaker, and some time private in the 2nd Battalion of the Royal Artillery.

An electromagnet consists of a bar or iron, straight, or of horseshoe form, which is wound over with many turns of copper wire.

When an electric current is sent through this wire, the iron becomes a powerful magnet, but that magnetism disappears when the current is stopped.

This appliance is the basis of nearly all the technical applications of electricity. The electromagnet also provides one of the most important tools of the physicist, and some of Faraday's greatest discoveries were made by its aid. Sturgeon made the first electromagnet with a rod of iron half an inch in diameter and a foot long, which was bent into the form of a horseshoe and was wound over, spiral fashion, with 18 turns of bare copper wire. When the current from a single voltaic cell was sent through this wire the iron became a strong magnet and could sustain a weight of 9 lb.



Dr. J A. FLEMING, F.R.S

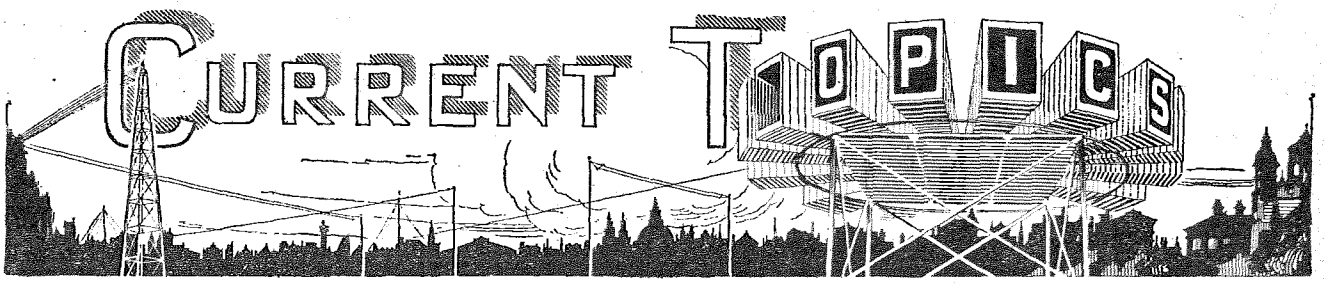
Sturgeon presented his first electromagnet, with other apparatus for explaining the facts of electromagnetism, to the Royal Society of Arts of London in May, 1825, and the Society gave him in return a silver medal and a premium of thirty guineas. That original electromagnet has, in the course of the century, been lost, but the inventions of Sturgeon and some of the problems of electromagnetism were expounded to the Royal Society of Arts on May 20th in a lecture given by Dr. J. A. Fleming, F.R.S., Professor of Electrical Engineering in the University of London. Dr. Fleming exhibited a model or replica which he had made of Sturgeon's original electromagnet, and explained the improvements subsequently effected in it by Joseph Henry in the United States and James Prescot Joule in England.

Large electromagnets are now much used as workshop appliances for lifting up masses of iron and also masses of iron turnings, scrap, and filings, which can thus be lifted and transported without handling.

The second part of the lecture was devoted to the consideration of some of the scientific problems involved in this remarkable property of the common metal iron, of being magnetised. Metallurgists have long recognised that iron can exist in several allotropic forms, just as can phosphorus or selenium, in which the physical properties are quite different, though, chemically speaking, they are the same substance. At temperatures above 900° C. the iron is in the form called *Gamma-iron*, and is non-magnetic and possesses considerable power of dissolving carbon. At ordinary temperatures it is in the state called *Alpha-iron*, and is highly magnetisable. Its crystalline form and specific heat in the two states are quite different, and the atoms are packed closer together in the Gamma than in the Alpha iron. An experiment was shown by Dr. Fleming with a red-hot iron wire allowed to cool slowly to illustrate the passage back of the iron from the Gamma to Alpha form, and the expansion and recovery of magnetic power at a certain temperature. Some metals, such as manganese, when alloyed with iron have the power of keeping it in the non-magnetic, or Gamma, state even at ordinary temperatures. Samples of the 12 per cent. manganese-steel, discovered by Sir Robert Hadfield in 1882, which is non-magnetic, and the non-magnetic cast-iron of Dawson and Ferranti, were shown.

A very remarkable nickel-iron alloy, called Permalloy, containing 78.5 per cent. of nickel and 21.5 per cent. of iron, was produced a little time back in the United States by the research engineers of the Western Electric Company. This material has 100 times the magnetic permeability of pure iron for very small magnetising forces. It has been used for the "loading" or overwinding of submarine telegraph cables on the principle first made known by the late Mr. Oliver Heaviside, and the result has been to increase the speed of signalling two or three times when compared with a similar cable loaded only with pure iron.

Scientific questions connected with the cause of the special magnetic property of iron, nickel, and cobalt were discussed by Dr. Fleming, and the lecture concluded with a further reference to Sturgeon's work. He was the first to introduce the amalgamation with mercury of the zinc plates in a voltaic cell, thus effecting a great saving in zinc waste when the cell was not in use. He was the first to produce an electric motor rotating by an electric current, and many other smaller inventions. Unfortunately, scientific research was not a remunerative pursuit in Sturgeon's day, and the last years of his life were spent in great penury. But he was one of those who helped to lay the foundations for modern electrical engineering, and his name and work deserve to be remembered even a century after that work was done.



Events of the Week in Brief Review.

FRENCH GOVERNMENT AND ESPERANTO.

Esperanto has been accepted by the French Government as an authorised language for postal, telegraphic, and radio-telephonic messages.

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HAVE YOU HEARD MILAN ?

Transmissions have begun from the new broadcasting station at Milan, which operates on 545 metres, with the call sign SITI. The evening concerts commence at 6 p.m. (B.S.T.), though news bulletins are transmitted during the day at 1.30, 2.0, 3.30, and 5.30.

oooo

BROADCASTING THE NIGHTINGALE.

Saturday, May 30th, at 11.30 p.m., is the day chosen for a repetition of last year's experiment in broadcasting the song of the nightingale. If possible, a conversation between two birds will be transmitted, and for this purpose two microphones will be installed in the garden of Miss Beatrice Harrison's house at Oxted, Surrey. Miss Harrison will lure the birds with soft strains on the 'cello.

oooo

WIRELESS AND BACCHUS.

"Customers move to the room where the loud-speaker is, but they do not drink more," say the Liverpool police in answer to suggestions that wireless in licensed houses encourages heavy drinking.

Since last November broadcast receivers have been permitted in several public-houses, and permission has just been renewed.

oooo

THE CQ NUISANCE.

An appeal to European amateurs is made by a Norwegian reader, Mr. J. Diesen, who asks transmitters who send out CQ calls to state on what wavelength they intend to listen. The ordinary general call is answered by transmitters on every conceivable wavelength, with the result that considerable interference is caused over a very wide band.

oooo

LONGER AERIALS ?

Sir W. Mitchell-Thomson (Postmaster-General), in answer to a question by Colonel Day in the House of Commons, stated that the question of increasing the standard size of wireless aerials had recently been considered, but the conclusion reached had been that such an increase would not be in the general interest. Where, however, there are special reasons for requiring the use of a larger aerial permission is given on application.

20-METRE WORKING WITH NEW ZEALAND.

Mr. E. J. Simmonds (G2OD), of Gerrards Cross, has added to his long list of achievements by being the first British amateur to effect two-way communication with New Zealand during daylight on 20 metres. This occurred at 5.30 on the morning of Sunday, May 17th. At that time Mr. Simmonds was in communication with Mr. C. D. Maclurcan (A2CM), of Strathfield, N.S.W., when he picked up a call on a slightly lower wavelength from Mr. Ralph Slade (Z4AG), of Dunedin. He immediately replied with congratulations, and a schedule of working was arranged for the following morning.

Working was resumed at the stipulated time on Monday, and Mr. Simmonds sent the following message: "To the Radio Society of New Zealand,—Greeting by first daylight 20-metre communication between New Zealand and Great Britain from the Radio Society of Great Britain."

The tests between the two stations were carried on until 6.20 a.m., when fading set in.

In connection with this achievement it should be borne in mind that at the time of transmission New Zealand and Great Britain were both in daylight, the time in Dunedin being approximately 5 p.m.

Mr. Simmonds has met with further success in his daylight transmissions to Australia. While working with A2CM on Sunday, May 17th, his signals were reported as "ten times stronger" than in the previous week. At 6 a.m. A2CM requested him to listen for A2DS, and five minutes later this station, owned by Mr. R. R. Davis, of Vaucluse, N.S.W., was heard. Signals were weak, however, owing to the approach of darkness in Australia.

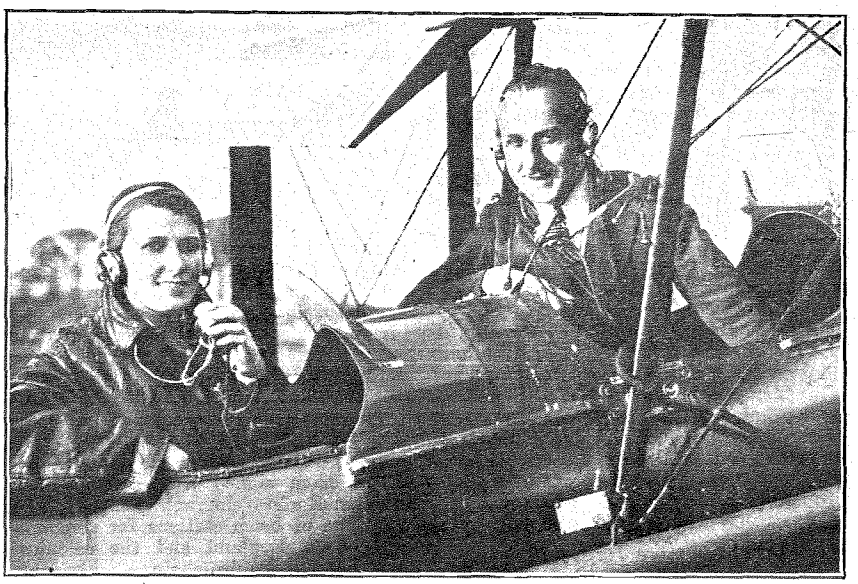
During these experiments the power at G2OD was 125 watts.

oooo

VIENNA RELAYS 5XX.

A compliment is being paid to British broadcasting by the Viennese broadcasting authorities, who have made arrangements for the retransmission of Chelmsford's programmes from the Vienna station.

A nine-valve receiver has been installed on the outskirts of the city and this picks up the programmes from 5XX several times a week. The receiver is connected to the broadcasting station by landline.



FLYING LESSON BROADCAST. Thousands of listeners recently enjoyed the novelty of hearing an actual flying lesson broadcast from 2LO. The tutor was Mr. Alan Cobham, who is seen in the photograph with his pupil, Miss Heather Thatcher, the well-known actress.

THE DERBY.

Eleven fixed wireless stations are being employed by the police to direct traffic on the roads to Epsom. Each station maintains touch with the office of the Assistant Commissioner of Police, which is situated at a point north of the Epsom grand stand.

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A CORRECTION.

We regret a small omission in Fig. 2 of the article entitled "The Crystal as an H.F. Amplifier," by L. L. Barnes, in our issue of May 6th. The figure in question omitted to show the resistance connected in the lead between the earth side of the crystal and the sliding contact of the potentiometer.

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CALLS HEARD IN GERMANY.

We print below the first list to reach this office of British calls heard in Germany. The sender is Herr Rolf Formis, of Stuttgart.

2NE, 2DX, 2NB, 2BZ, 5GS, and 6RM.

A three-valve receiver (0-v-2) was used.

oooo

ITALIAN TRANSMITTING CONTEST.

A prize contest for Italian transmitting amateurs is being arranged by *Il Radiogiornale* under the auspices of the National Radio Club of Italy, to take place from June 1st until March 31st, 1926.

The prizes will take the form of gold, silver, and bronze medals, and also wireless apparatus presented by leading manufacturers. The awards will be made for the following achievements :—

(1) The greatest distance traversed, duly confirmed by QSL, with a power of less than 200 watts (minimum 10,000 kilometres).

(2) The greatest number of two-way communications, duly confirmed by QSL, with a minimum distance of 5,000 kilometres.

(3) The most interesting report, having reference to the hour, season, etc.

In view of this competition the National Radio Club of Italy earnestly requests amateurs throughout the world to be good enough to send reports of reception to their Italian comrades, to give them every opportunity of competing successfully.

oooo

OWNERSHIP OF 2OY.

With reference to the letter from Captain E. J. Hobbs in a recent issue regarding his late call sign, 2OY, we have been advised by Mr. Charles A. Harnwell, of Traveller's Inn, Denby Dale, Huddersfield, that this call sign has now been allotted to his station. He would be glad to hear from the many correspondents who have recently sent reports to Captain Hobbs.

oooo

IDENTITY OF 2VX.

The call sign 2VX no longer belongs to a transmitter in the Coventry area, but has been assigned to Mr. W. R. Clark, Roselyn, 3, Caroline Place, Aberdeen. All QSL cards are promptly acknowledged

ICELAND AGAIN.

Another amateur to work with 1BG of Iceland is Mr. P. H. Dorté (G6DO), of Weybridge. Communication was effected on May 13th, when 1BG's signals were received at fair strength on a two-valve set. He was transmitting on 98 metres, and fading was hardly noticeable.

oooo

WIRELESS BUSINESS IN MOSCOW.

In Moscow the public interest in wireless has resulted in a shortage of apparatus. Several establishments are busy, says a Moscow journal, but are unable to keep pace with the popular demand. The quality of the available goods leaves something to be desired, and particularly

FIELD DAYS. The opening of the Field Day season was observed by the Wimbledon Radio Society, on Sunday, May 10th, when experiments were conducted on Bookham Common. The photograph shows the mobile transmitter 2CA, operated by Mr. C. P. Jones.

is this the case with crystals, which are stated to be very insensitive. Provincial buyers hail from the Ural, Siberia and the Caucasus, and a considerable mail-order business is already in existence. It is understood that a Russian radio exhibit will be a feature at the coming Scandinavian-Baltic Fair.

oooo

INDIAN BEAM STATIONS.

It is announced that the Indian Government have signed a contract with the Indian Radio Telegraph Company for the erection of beam stations for communication with England and the colonies as part of the Empire chain.

The first station, which is to be completed this year, will be erected at Kirkee, Poona. Under the terms of the contract the company must employ Indian labour as far as possible.

COLOUR IN THE STUDIO.

The unresponsive microphone and the chill "atmosphere" of the studio have long been regarded as a handicap to temperamental artistes. To infuse warmth and colour into the studio is the object of a new American scheme which is being adopted at WJAZ, Chicago. Dr. M. Luckiesh, Director of the Lighting Research Laboratory, has been called in, and he will superintend the installation of apparatus which will provide "soft gradations of light and bold illuminative effects to fit in with the mood of the selection being given by the artist."

We should imagine that many items in the typical broadcast programme would impose a considerable strain on such an equipment.

oooo

A SPANISH TRANSMITTER.

Reports on his transmissions are welcomed by Señor Miguel Moya (EARI), of Concordia 4, Madrid. He transmits on 40 to 115 metres.

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AMATEUR TELEPHONY FROM SWEDEN.

Probably one of the first occasions on which good telephony below 40 metres from a European amateur has been heard in this country occurred on May 13th, when Mr. G. L. Morrow (G6UV), of Berkhamsted, Herts, was in communication with Swedish SMYV. At 10.50 p.m. they were working with Morse, 6UV being on 45 metres and SMYV on 38 metres, but a few minutes later SMYV attempted telephony on the same wavelength.

To the surprise of Mr. Morrow, speech came through in excellent quality and at good strength, and communication was maintained in this manner for half an hour, 6UV replying in Morse.

It is understood that the Swedish transmitter was employing a power of less than 30 watts, and, considering the distance of 950 miles and the fact that 6UV was using a standard low-loss two-valve receiver (0-v-1) not designed for telephony, the performance reflects great credit on SMYV. The station is owned by Mr. Carlsson, c/o Graham Brothers, Stockholm.

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WIRELESS LESSONS IN MEXICO.

A national system of educational broadcasting is being instituted in Mexico.

oooo

TELEPHONY BETWEEN AEROPLANES.

"It was recently found feasible for pilots in aeroplanes to converse with each other when they were in full flight and as far as five miles apart," writes Mr. J. H. Morecroft in the June number of "Radio Broadcast," New York. "This feat was accomplished during preliminary tests in equipping army aeroplanes for summer manœuvres. Five miles seems a very short distance to us who nightly hear concerts a thousand miles away, but it is to be remembered that the power output of the aeroplane transmitter is necessarily low, and there is the difficulty of receiving—enormous because of the excessive noise caused by the powerful motors and the hurricane rush of the wind."

Broadcast Brevities

SAVOY HILL

2LO's New Studios.

Plans are in hand at Savoy Hill for adding to the studio accommodation. At present there is the main studio on the first floor, whence all the big items are broadcast, and the "old" studio, as it is called, on the third floor. The latter is used for talks, the Children's Corner, rehearsals, etc. It may presently be scrapped and a new studio as large as the main studio constructed, with two smaller studios, one of which will be used for talks and the other for specialised work, such as auditions and rehearsals.

oooo

Control of Sound Effects.

Special methods will be introduced of increasing or lessening the draping materials, so as to control the sound effects. Improved methods of ventilation will also be introduced to exclude extraneous sounds. Microphones, amplifiers, telephones, and other adjuncts of transmission will be practically identical with the apparatus in the existing main studio.

oooo

The Oxford Street Station.

An idea is abroad that the Oxford Street Station is proving exceedingly troublesome. Reports have stated that two breakdowns have occurred there. That is not the case. The breakdown on May 4th, on the occasion of the American Ambassador's speech at the Hotel Victoria, was at the hotel end and not at 2LO. The station itself has had only one breakdown, viz., on May 13th, when no transmission was possible for an hour and a half.

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Induction from 2LO.

Extraordinary reports are made by listeners as to the induction from 2LO. In a street abutting on the transmitting station it is said that the broadcast may be obtained off the water pipes at any time desired.

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Relay Station for Bristol.

Is a relay station necessary for Bristol? Some Bristolians are privately pressing the claims of the city to this development; others state that crystal reception is possible, with a good aerial, from Birmingham, Cardiff, 5XX and Bournemouth. "No immediate prospect of a relay station for Bristol or any other locality" I am told at the B.B.C. headquarters. But I believe that much depends on the passing of the Wireless Bill as to the provision of additional stations, both main and relay, in certain towns. Meanwhile it must be remembered that ninety per cent. of the population is within crystal range of a broadcast service. The other ten per cent. of the population is interesting the wireless engineers and their needs are fully recognised.

oooo

Such is Fame!

A gentleman in France has been recently representing himself as "The British Broadcasting Company of London," and has been transmitting gramophone records, songs and talks in a language with a pronounced Gallic flavour, after which he has again labelled himself "The British Broadcasting Company of London now closing down."

Aware of the enquiries which were being made about him, he changed his title to "The British Idea Station of London." He has been received at various places on the South Coast and inland towns in the South of England, and it is hoped from information in the possession of the British officials that he will be presently tracked down, as he is causing considerable interference among listeners in this country.

oooo

Secret Wireless.

Wireless engineers, both at Savoy Hill and elsewhere, would like to know more about any new discoveries which indicate a desire to provide an improved public service, for only in the event of new movements starting that are destructive of the ideals of the public service which the B.B.C. support is opposition likely to arise from that company. The B.B.C., of course, claims no monopoly in broadcasting. To the Government alone belongs the right to decide whether any new and genuine rival service shall be set up, whether for the broadcasting of theatrical productions alone or for other purposes.

oooo

Telepathy.

Mr. Edward Isaacs, the pianist, who recently broadcast from 2LO, told me that on one of his tours he received a sort of telepathic message to the effect that certain artists who were to appear with him in Chamber works had met with a railway accident. The message reached Mr. Isaacs some two hours before the concert and impressed him so strongly that he made emergency arrangements to fill the programme in other ways. His decision was justified: for a telegram arrived just before the concert began reporting that an accident had befallen the party and although the mishap was not serious the artists were considerably delayed.

FUTURE FEATURES

Sunday, May 31st.

LONDON.—4 p.m., The Capetown Orchestra.

CARDIFF.—9 p.m., "Spring," "The Redemption" and "The Pentecost."

MANCHESTER.—4 p.m., Choral Favourites.

Monday, June 1st.

LONDON.—8 p.m., Bank Holiday Programme.

BELFAST.—7.30 p.m., "Black and White."

Tuesday, June 2nd.

LONDON.—9 p.m., Song Recital by John Coates.

BELFAST.—4 p.m., Elgar's Birthday.

Wednesday, June 3rd.

LONDON.—8 p.m., An Hour from H.M.S President.

BOURNEMOUTH.—8 p.m., "The Rose of Araby."

CARDIFF.—8 p.m., "The Spirit of Adventure in Wales."

DUNDEE.—12 p.m., Presentation of the Freedom of the City of Dundee to the Prime Minister, Mr. Stanley Baldwin.

Thursday, June 4th.

LONDON.—8.45 p.m. "The Beggar's Opera." (A Shortened Version.)

BIRMINGHAM.—8 p.m., Dramatic Episodes from Great Plays.

ABERDEEN.—9 p.m., "Coronation Ode."

Friday, June 5th.

LONDON.—8 p.m., "From the New World."

MANCHESTER.—8 p.m., Band—Songs—Humour.

GLASGOW.—8 p.m., A Varied Night.

Saturday, June 6th.

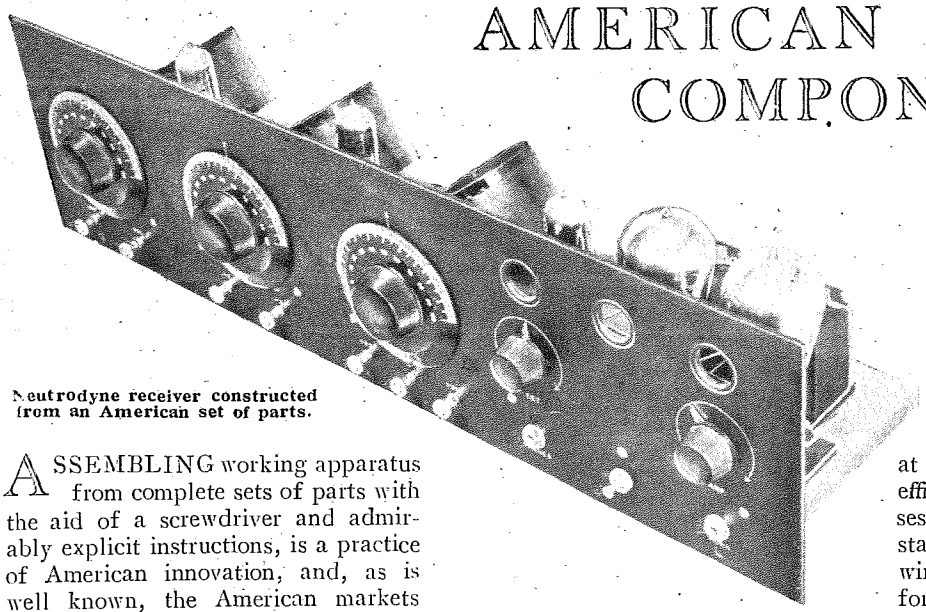
LONDON.—8 p.m., Humour and Novelties.

BIRMINGHAM AND 5XX.—8 p.m., Popular Orchestral Programme.

TOPICALITIES

AMERICAN SETS AND COMPONENTS.

A Review of Some Selected Instruments which have Recently made their Appearance on the British Market.



Neutrodyne receiver constructed from an American set of parts.

ASSEMBLING working apparatus from complete sets of parts with the aid of a screwdriver and admirably explicit instructions, is a practice of American innovation, and, as is well known, the American markets supply sets of parts (kits) for the home constructor, from an alarm clock to a miniature power-driven motor car, and in keeping with this practice is the production of sets of wireless receiver parts which require only assembling and wiring.

The extent to which the components have been prepared for assembly and the work needed to complete the outfit depend not only upon the design, but also upon the amount of detail and finish undertaken by the manufacturer. In America, the outfits, it can be assumed, are in the same condition as if the parts of the receiver had been completely put together, given their commercial finish, and then dismantled to the point where the main components become separated.

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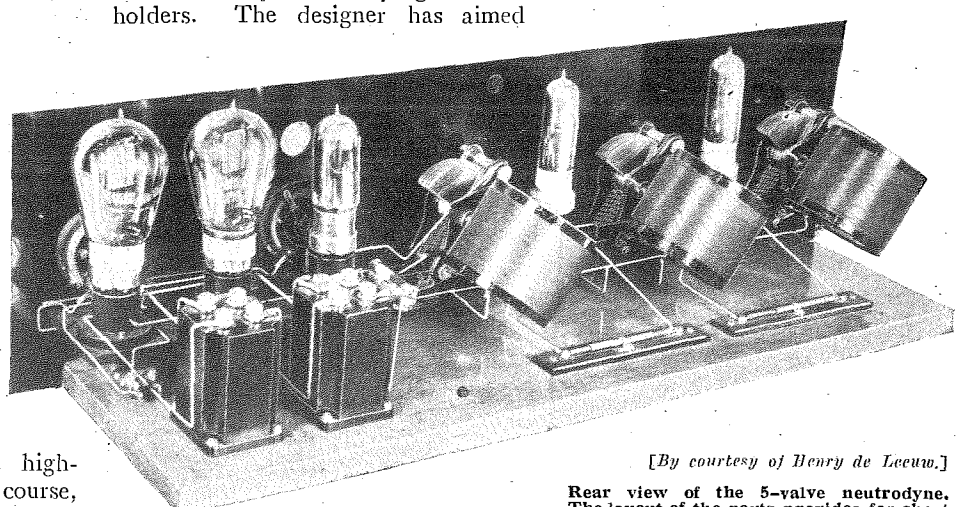
NEUTRODYNE KIT.

The Neutrodyne receiver, in keeping with American home construction practice, is supplied by the F. A. D. Andrea Co. (Fada). It is marketed with all component instruments completely finished, and is packed in a sectioned cardboard box, and includes everything to the last screw. The baseboard is of polished mahogany and the front panel is Radion ebonite, drilled and engraved. The high-frequency transformers are, of course, completely wound, and already attached by means of short metal brackets to their respective condensers. Each high-frequency unit is mounted on the panel by means of three screws, and the dials held in position with grub screws. The receiver begins to resemble its finished form after the work of only a few minutes. The circuit is the well-known neutrodyne arrangement, with secondary tappings for the feed back potentials, and includes two stages of high-frequency amplification, valve detector, and two transformer-coupled low-frequency stages. A set of valve holders is supplied, mounted on supporting brackets, though as far as the user in this country is concerned, these will have to be substituted by an ebonite panel carrying British holders. The designer has aimed at producing a receiver of high efficiency and, at the same time, possessing an attractive layout. For instance, it will be seen that inspection windows are provided on the panel for three of the valves, whilst windows for the remaining two would need to be made at positions on the panel that would detract from the good appearance obtained by evenly distributing the equipment. The designer, therefore, abandons the inspection windows for the high frequency amplifiers, though he considers it desirable for the remaining valves.

In criticising the design from a practical standpoint, many experimenters will think it undesirable to arrange all terminals along the lower front edge of the instrument. This means that the receiver must stand above its batteries, with the aerial and earth leads, particularly the former, trailing across the front of the aerial tuning dial. The



[*By courtesy of Henry de Leeuw.*]

Rear view of the 5-valve neutrodyne. The layout of the parts provides for short and direct wiring.

American Sets and Components.—

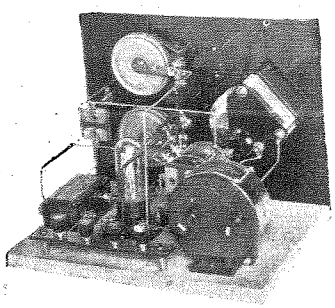
layout adopted lends itself to simple wiring, and particularly in the high-frequency stages, where the use of short leads is a necessity if efficiency has to be maintained. The low frequency amplifying circuit involves break-jack switches for completing the filament circuits and disconnecting the low frequency amplifying stages. Here again the wiring is compact, and no lead probably exceeds 7in. in length between any two points, many of them being only an inch or two.

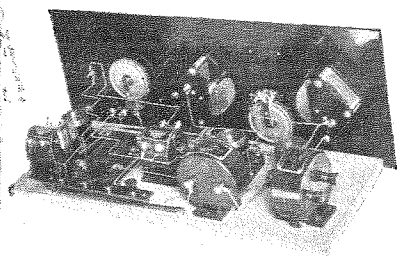
It is surprising to find that, although an additional terminal appears on the panel so that both of the low-frequency valves can be operated at high plate potentials, no provision is made for grid bias. Filament control for both high and low frequency valves is obtained by a single rheostat, whilst a separate control is provided for the detector valve by a cleverly constructed filament resistance which, by means of a single knob, gives both fine and coarse adjustment. All fixed capacity condensers are clamped with Prespahn or similar material, and are sufficiently light in construction to be supported on the wiring. The neutrodyne condensers consist of two short pieces of wire fitting into glass tubing of about ⅛in. diameter. Over this slides a metal sleeve, partly overlapping the wires inserted from the ends of the tube, thus providing a suitable condenser to balance valve capacity. A grid leak of the clip-in type is supplied of overall dimensions similar to the British high-resistance leak, though it is of somewhat different construction. The body of the leak consists of a glass tube, and the high-resistance material is a black substance deposited on the interior.

Referring to the booklet of instructions which accompanies the outfit, one finds that the use of wire covered with sleeving is advised, and the completeness of these instructions can be gauged when one is told to check off with an ink line on the wiring diagram each lead as it is fitted. The instructions for adjusting the neutrodyne circuit are extremely explicit, and the use of a buzzer wavemeter, made up from parts marketed by the same company, is recommended, though with the large number of broadcasting stations in America, it would appear that the adjustment could be equally well accomplished with incoming signals.

Little purpose would be served here in advising the British reader who has procured one of these American outfits as to the best method of fitting it together, for the booklet leaves nothing to chance.

The accompanying photographs show one of these American receivers built up to suit British valves, and whilst the performance of the instrument is very creditable, one wonders why it would not be better to purchase the completed set, which there is little doubt could be marketed for the same price as the kit. Probably, the process of putting the set together appeals to the American, though the amount of work involved does not compare with the effort expended by the average Britisher on his home-constructed receiver.





[*By courtesy of Gaston E. Marbaix.*]

One- and three-valve Reflex Sets, supplied in a semi-finished condition. Finished receiving sets, constructed from the parts supplied, are also shown.

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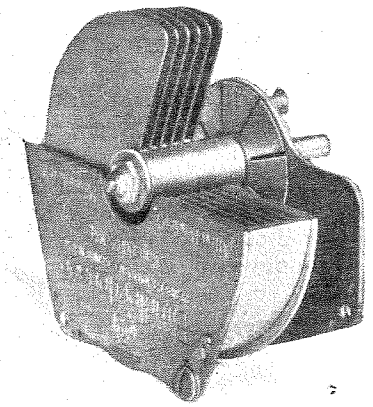
SEMI-FINISHED RECEIVING SETS.

It is perhaps more correct to refer to certain of the American outfits as "semi-finished" receivers, and it is hard to see why they cannot be marketed as finished sets when offered in a condition so near completion. There is nothing instructive and no mark of ability is shown when converting one of these outfits into a working set, for not only are all the components in position on the panel and the baseboard, but, in addition, most of the wiring is supplied, so that it is only necessary to lay it in position and connect up.

For the wiring of the low-frequency amplifying stages of a three-valve receiver, all leads are cut to length and laced together in the form of a cable, each being of a distinctive colour, so that if necessary it can be traced. Leads are soldered to the tags of the jacks, and the spare ends, which are connected to the filament and transformer circuits, are terminated with tags, and so adjusted as to length that when the cable is laid in position no error is likely to arise by way of a wrong connection. A practical wiring diagram facilitates the work of connecting up. The tuned circuits are, of course, wired with rigid conductors, but it would seem that in the design attention has not only been devoted to an efficient and well-balanced layout, but the com-

American Sets and Components.—ponents are so arranged that their relative positions permit of the preparation of a practical wiring layout which can be shown on a printed diagram and closely resembles the paths taken by the leads in the set.



[*By courtesy of R. A. Rothermel.*]
Bradley condenser. The spindle is supported by a tubular bearing.

Represented actual size, the leads in the set are almost equal in length to the lines in the diagram.

The "All Amax" junior and senior outfits are of the semi-finished class. They are simple reflex receivers embodying high grade components.

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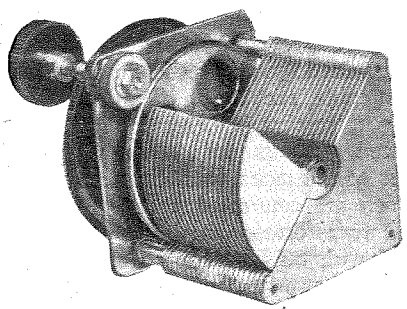
KING NEUTRODYNE KIT.

Classed with the receiving sets supplied in a partly finished condition is the King five-valve Neutrodyne outfit.

The tuning condensers and intermediate transformers are mounted to-



[*By courtesy of R. A. Rothermel.*]
The Cota condenser is another form of one-bearing condenser design.

gether, the panel is drilled, the valve holders are set up in position on their brackets, and the low-frequency wiring is supplied in the form of a laced cable already referred to. It is left to the constructor to fit the apparatus to the panel and baseboard with the aid of a screwdriver and the screws and nuts supplied, to wire up the high-frequency circuit with short and direct leads, as indicated in the practical wiring diagram, and to connect up the cable.

However small the experience of the constructor, there is little doubt that the completed set will function correctly, and it is difficult to see how any possible error can arise in putting such a receiver together.

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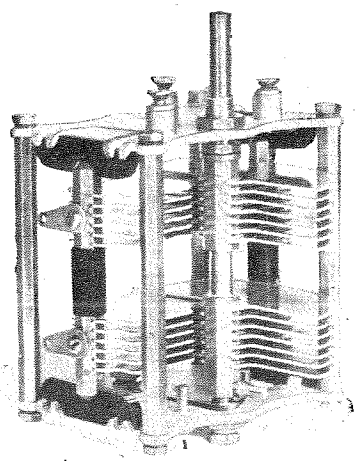
BRADLEY VARIABLE CONDENSER.

The outstanding feature of the Bradley condenser is the unusual one-end plate construction. The moving



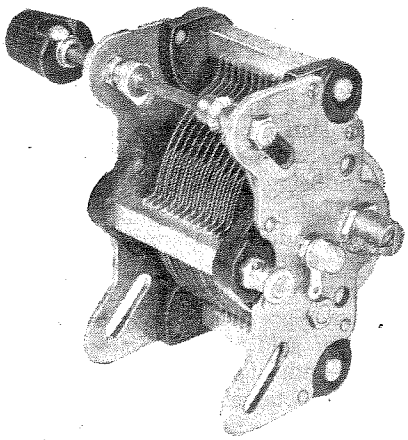
[*By courtesy of R. A. Rothermel.*]
Double Amsco condenser.

plates revolve on a rigid bearing which is secured to the front end plate, and to hold the moving plates securely in position a tubular brass sleeve is attached to the end plate embracing the moving spindle to almost its entire length. By this means the one-end fixing arrangement is rendered perfectly reliable. The plates are of brass, which permits of soldering, so that good connection can be made, while the stationary plates are secured to the end mounting plate by two ebonite pillars, an arrangement which in the experience of the designers produces an absolute minimum of dielectric loss.

oooo

THE COTA COIL COMPANY'S CONDENSER.

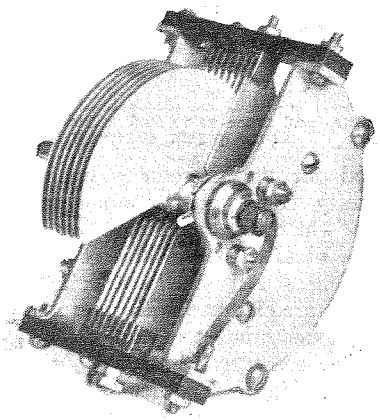
This, again, is of the one-bearing type, and, in addition, is fitted with a wheel and pinion control for providing critical adjustment. Fixed and moving plates are spaced apart by means of washers, and the spindles to which the stationary plates are attached are insulated from the mounting plate by ebonite bushes.



[*By courtesy of C. G. Vokes and Company.*]
In the Brand condenser the moving plates are driven through a set of bevel and worm pinions, giving a critical control without backlash.

THE AMSCO CONDENSER.

As is typical with all modern variable condensers, extreme care has been taken in the method of setting up the fixed plates so that the electrostatic strain through the insulating material may be uniformly distributed and give rise to the least possible loss. The moving plates are carried on a plain spindle which

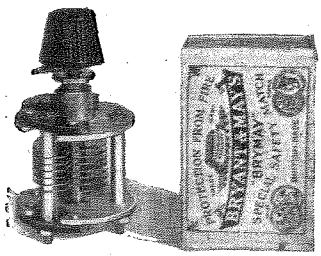


[*By courtesy of R. A. Rothermel.*]
Gardner and Hepburn condenser.

passes through a bronze bearing of liberal length provided with a slot and adjusting nut to compensate for wear. The lower bearing is also of bronze and in the form of a cup, and carries a small steel ball to control the thrust of the spindle. A flexible

American Sets and Components.—

connection between the spindle and end plates ensures reliable contact. For panel mounting, the top end plate carries three screws in preference to the one-hole attachment now so generally adopted. Stator and



[*By courtesy of R. A. Rothermel.*]
The "Midget," intended for use in the neutrodyne circuit.

rotor plates are wedged into milled slots in the supporting spindles.

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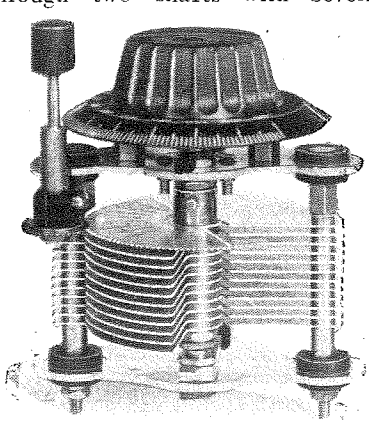
BRAND CONDENSER.

An unusually fine piece of work is the condenser of the American Brand Corporation. Following the most recent developments in condenser design, the moving plates are in electrical contact with the end mounting, while the fixed plates are supported by means of pieces of insulated material arranged in a manner which is considered to minimise dielectric loss.

A critical control is obtained through a pinion drive which operates through two shafts with bevelled



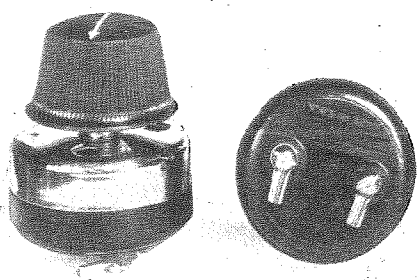
[*By courtesy of R. A. Rothermel.*]
The Heath geared condenser.

gears giving 100 to 1 reduction. This condenser is of the square-law type, though many American instruments employ the ordinary semicircular-shaped plate, certain models being supplied in both patterns. Not only is the method of supporting the plates particularly robust, but the manner in which they are bonded together can be considered to be most reliable. All the metal work is of brass, the end plates being of liberal thickness making a really heavy job.

oooo

GARDNER AND HEPBURN CONDENSER.

The novelty of design is to be found essentially in the method of supporting the plates and the way in which they are held together. The process of construction consists apparently of casting supporting pieces on to the plates and subsequently drilling through. Fewer parts are probably employed in the construction of this condenser than in those already referred to, and it is more simple in its assembly. It is,



[*By courtesy of R. A. Rothermel.*]
The "soft-tread" totally enclosed variable resistances.

nevertheless, reliable, and is offered at a price somewhat lower than the majority of the American variable condensers.

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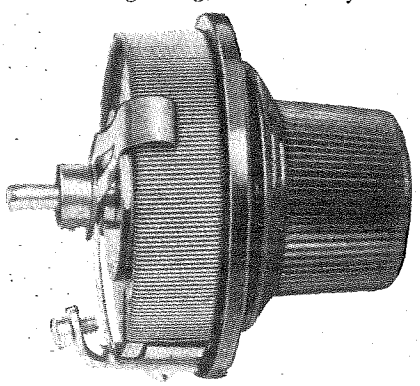
CHELTON CONDENSER.

Marketed under the name of the "Midget" is the variable condenser shown in an illustration on this page and contrasted in size with a box of matches. It has a maximum capacity of 0.00005 mfd., and special attention has been paid to producing a low minimum. It is intended for use as a balancing condenser, and has been specified in several American circuits embodying the neutrodyne principle.

oooo

HEATH CONDENSER.

Critical adjustment is arranged by means of gearing, and a very thin



[*By courtesy of C. G. Yokes and Company.*]
Kelfort resistance.

pinion wheel, stamped from sheet metal, engages on a quadrant a little larger in size than the moving plates. In accordance with modern practice, the fixed plates are insulated from the metal end pieces, but in this instance ebonite bushings are employed larger in size than those frequently met with on British condensers.

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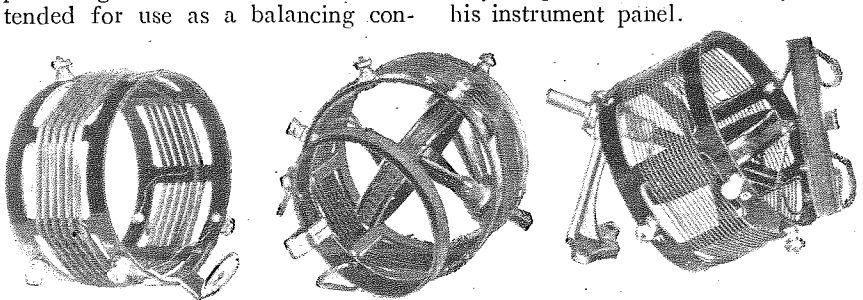
SOFT TREAD RESISTANCES.

The variable resistances used for filament control and as potentiometers of American manufacture are in general principle similar to the British types, and a few of the more expensive models represent a very high grade in instrument construction by mass production methods.

This resistance operates by the usual moving arm, but on examination one at once observes that the movement is particularly smooth. The operating knob is of good, clean moulding, and its smart appearance may tempt the amateur to adopt it on his instrument panel.



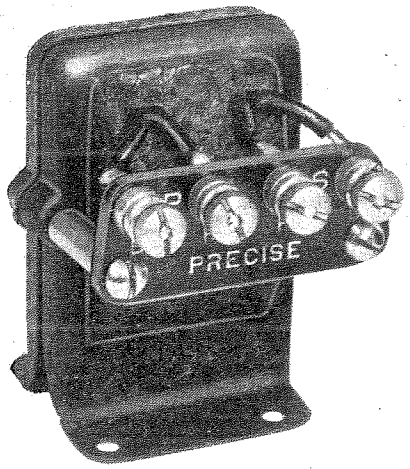
[*By courtesy of R. A. Rothermel.*]
Specimens of the Bremer-Tully inductances.

American Sets and Components.—

KELFORD RESISTANCE.

It is probably due to the extensive use of Bakelite mouldings that some of the smaller American components have such a clean and attractive finish. The body of this rheostat is a hollow Bakelite former, and the resistance winding is carried on a fibre strip in accordance with usual practice.

Here, again, the operating knob has a particularly beautiful finish.



[By courtesy of C. G. Yokes and Company.]
The Precise low-frequency transformer.

In addition to being sharply milled, it has a knurled flange which can be gripped for obtaining critical control.

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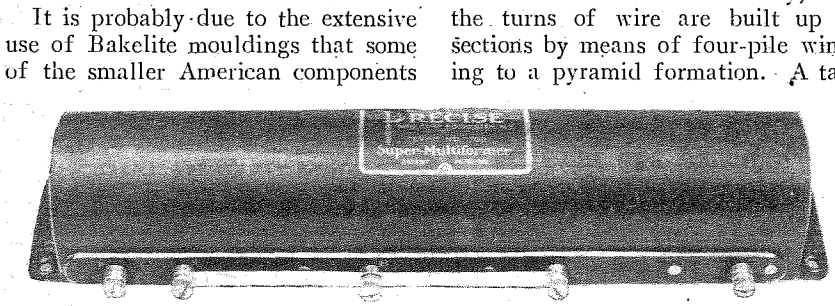
BREMER-TULLY TUNING INDUCTANCES.

It is interesting to note that the three-coil holder so universally adopted in this country, with its geared control, is practically non-existent on the American market. Tuning inductances are invariably wound to cylindrical or basket formation, and coupling is obtained by rotation. Referring to the illustration of the three mounted inductances, that on the left is a high-frequency transformer suitable for broadcast wavelengths. Primary and secondary sections are run on alternately, and the turns of wire are built up in sections by means of four-pile winding to a pyramid formation. A tapping point is arranged on the secondary for bridging off a suitable potential for capacity neutralisation. The other two inductances are fitted with coupling coils, one of which changes from minimum to maximum coupling by means of 180° movement, and is intended for providing reaction, whilst another winding is hinged to the former for use as an aerial circuit. The metal parts used for supports are small and few in number, whilst the insulating material is cut away for the purpose of reducing dielectric losses. One model has a wavelength range from 50 to 150 metres, and the other for the broadcast band covers from 200 to 565 metres when the secondary winding is bridged with a 0.0005 mfd. variable condenser.



[By courtesy of C. G. Yokes and Company.]
The Super-multiformer, consisting of four matched radio frequency transformers for use in the conversion of simple receiving apparatus to the superheterodyne arrangement.

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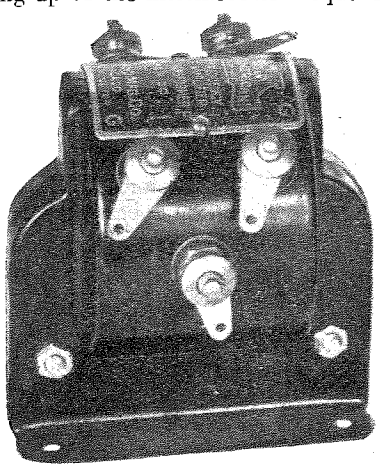
THE SUPER-MULTIFORMER.

Probably the greatest difficulty the amateur meets with in superheterodyne receiver construction is the setting up of the intermediate frequency amplifier. The transformers of which it is composed need to be carefully matched one with another, and whilst permitting of a high degree of amplification, must be adjusted to occupy a sufficiently broad tuning band for good quality telephony work. The instrument is intended to assist in the simple conversion of an ordinary receiver to a superheterodyne, and consists essentially of four transformers all adjusted as to wavelength, screened from one another and entirely enclosed in a metal box.



[By courtesy of Gaston E. Marbaix.]
Rauland transformer, with secondary mid-point tap.

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PRECISE L.F. TRANSFORMERS.

American instrument work is, in general, well finished, and the Precise transformer has an attractive appearance. It is smaller in size than a typical British intervalve transformer, and the space occupied by the windings is correspondingly restricted. A pamphlet supplied with the instrument gives no information concerning the windings, though an amplification curve plotted by the manufacturers is available. To render the curve in a form in which it can be easily understood by the non-technical user, horizontal lines are shown representing the staves adopted in music and the various notes of the scale are shown.

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RAULAND L.F. TRANSFORMER.

The range includes three models, two small instruments for first amplifying stage intervalve coupling, and the other a large instrument—"The Lyric"—which it is claimed will maintain unusually even amplification.

The smaller models only differ in the inclusion of a mid-point tap on the secondary winding of one of them for the purpose of connecting up to the push-pull circuit arrangement. This is a useful feature, the provision of which on British instruments would be welcomed by amateurs.

It is probable that the American home constructor does not pay the same attention to the matching of valves and transformers as does his *confrère* in this country. One does not find a wide range of windings and transformer ratios available, and it would seem that many manufacturers publish amplification curves regardless of the circuit and apparatus in which the instrument was connected when under examination.

Broadcast Organisation in Germany

A Record of Development and Progress.

By Our Special Correspondent in Germany.

THE development of broadcasting in Germany began considerably later than in America, England, and France. There were various causes for this delay, but principally it was due to the war and the period of financial difficulty which followed. The installation of public broadcasting stations began simultaneously with the stabilisation of currency. In October, 1923, the first broadcasting station was erected in Berlin, but the programmes were confined to gramophone music. By December 1st, 1923, this station had a total of 500 paying subscribers, but an astonishing development has taken place since that date. In July, 1924, the number of broadcast subscribers was 100,000; by the end of 1924 500,000, and, at the present rate of increase, the organiser of German broadcasting, Dr. Bredow, calculates that by July, 1925, the number of paying subscribers will have reached a million.

The Broadcasting Network To-day.

This increase in the number of subscribers would not have been possible if at the same time the number of broadcasting stations had not been considerably increased. Berlin to-day has three different broadcasting stations, besides twelve in other towns, the positions of which are shown in the accompanying sketch map.

Of these stations Nürnberg, Bremen, Hanover, and Cassel are relay stations, operated through neighbouring stations; and as a rule these stations have no programme of their own. Further such relay stations are projected for Stettin, Elberfeld, Kiel, Dortmund, and Gleiwitz, all but the last two being already under construction.

Several millions of the population are excluded from the broadcasting system, particularly all those who live in the occupied territory. When the occupation terminates the construction of more broadcasting stations in the west of the German Empire will no doubt be undertaken.

How Broadcasting is Paid For.

The fee for broadcast reception is two marks per month in Germany and only war invalids and officials of the Imperial Post services are exempt. Broadcasting brings in a considerable sum monthly in this way, and by careful organisation the participants in broadcasting benefit considerably. As the German authorities were fortunately able to take advantage of the experience in broadcasting in America and England, many an error was avoided which at least in America was brought about by the rapid progress there and lack of experience. The German Postal authorities have always adopted the view that broadcasting, even when it only serves for entertainment, should be a monopoly of the State. But as it is not desirable that the State should be charged with the preparation of an amusement programme it was arranged that in each large area a private company should be formed under State control to undertake the work of organising the broadcasting station. The construction and technical arrangement of a broadcasting station is,

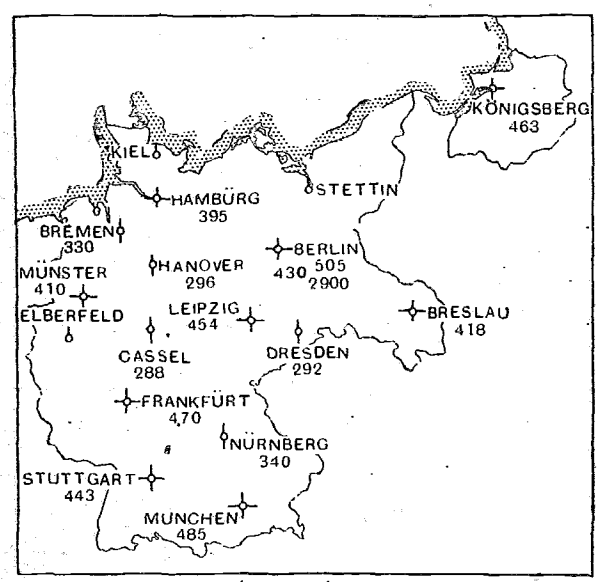


Fig. 1.—Outline map showing the positions of the stations in the German Broadcast network.

on the other hand, entrusted to the Government Telegraph Department, therefore all German broadcasting stations are very similar in their construction and design. The Telegraph Department receives two-fifths of the revenue, and the broadcasting companies three-fifths; out of which they have to pay the artists and authors, as well as the running expenses of the broadcasting stations. These costs in the first year have been and are still very heavy, because improvements have been introduced continuously; in fact, several German broadcasting stations have been reconstructed three or four times in the short period of their existence.

The result of these frequent improvements will have been observed by listeners abroad. In a very short time a new broadcasting station will be opened in Berlin, with a power of 5 kW. so that it will be heard easily at considerable distances.

Crystal Receivers Come First.

The efforts of the organisers are directed to making it possible for the greatest possible number of people to be connected with the broadcasting stations by means of simple crystal receivers. This is the reason for the erection of numerous relay stations. The network of broadcasting stations over Germany will eventually be made so close that at least in all the large towns it will be possible to receive with a simple crystal set. It has also recently been decided to construct a 10 kW. broadcasting station in Frankfürt.

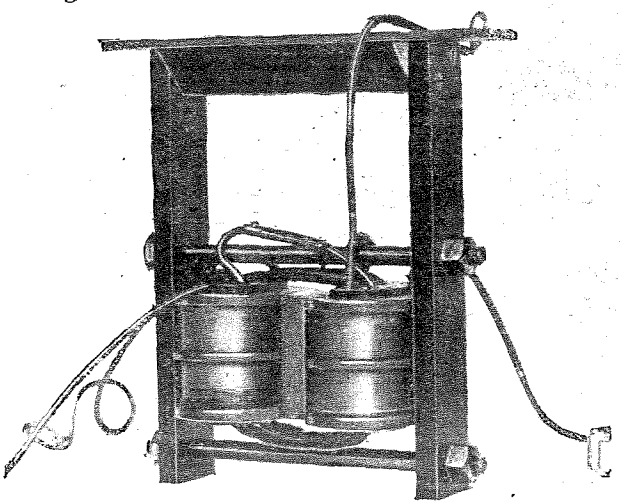


Fig. 3.—The Pungs and Gerch choke which provides coupling between the microphone circuit and the oscillator circuit in certain types of transmitter.

A review of the various types of receiving apparatus would be difficult on account of the variety. The crystal detector is the most common, as in other countries. But valve receivers from the simplest to the most complicated are also very popular, and the home construction of valve receivers is industriously carried on. The authorities have issued strict conditions as to the use of home-made valve receivers in order to obviate interference from the unskilled use of reaction coupling. Anyone in Germany desiring to use a home-made valve receiver must first show that he has the necessary knowledge for the proper use of a valve receiver. Tests are carried out by a number of the more important broadcast companies, who are empowered by the Government to undertake these tests. This method has the advantage

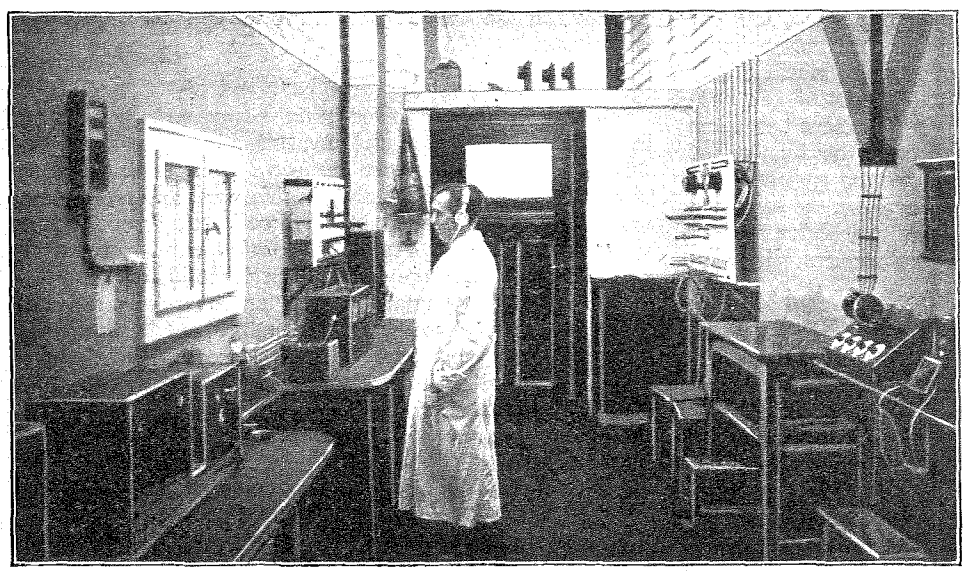


Fig. 2.—Interior of a control room. The engineer watches movements in the studio through the window on the left.

Broadcast Organisation in Germany.—

that unnecessary constraint is obviated as far as possible, and the authorities are not burdened with additional duties.

The Oscillation Nuisance.

So far this system has operated very well, but particularly in the large towns reaction coupling disturbances

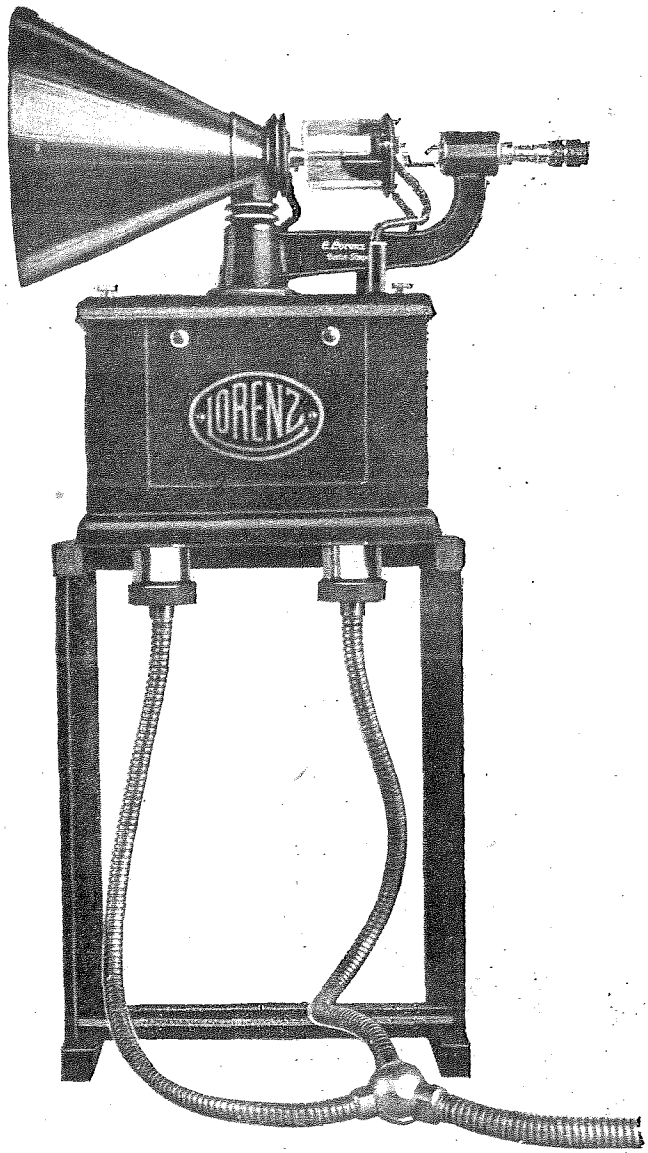


Fig. 4.—The Kathodaphone a special type of microphone used at some German stations.

cause trouble, but on the whole there has not been much inconvenience on that account and certainly considerably less than in the early days of broadcasting. It was intended at first that reaction coupling should be prohibited, or that in any case it should be so weak that an excitation of the aerial would be impossible. It was found, however, that this standpoint of the authorities could not be maintained, since anyone who constructed his own receiver was in a position to employ reaction coupling.

At first the German broadcast programmes served simply for entertainment, particularly in the form of music. This musical entertainment has been supplemented by interesting lectures, market reports, press news, talks on sport, and finally educative broadcasting. These uses are still in the stage of experiment.

Whilst the first German broadcast station was erected in the centre of Berlin, the feeling grows more and more

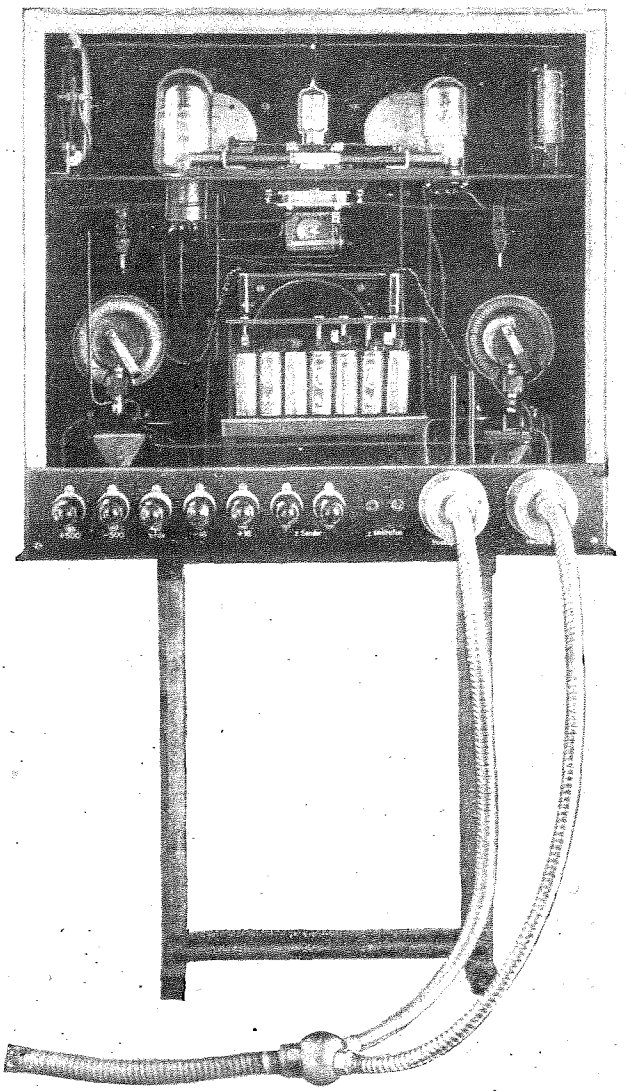


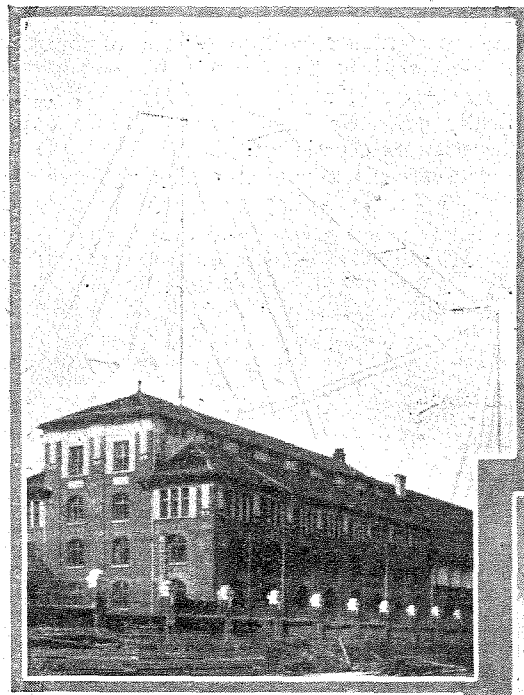
Fig. 5.—The Amplifier of the Kathodaphone.

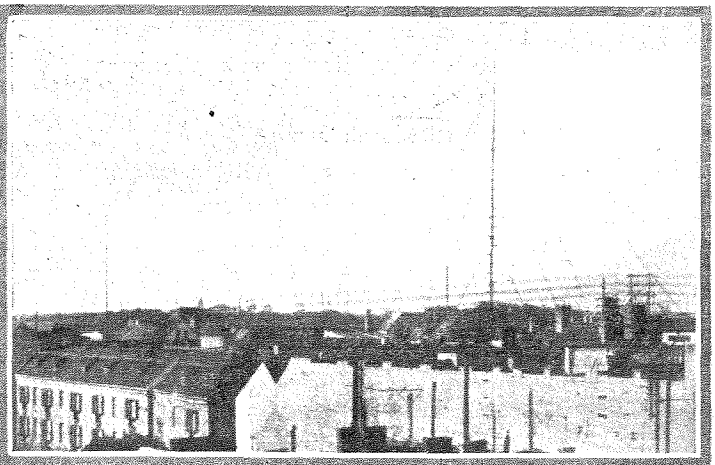
that it is better not to put the stations in the large towns, but yet to retain the studios in the towns. The Königswusterhausen station is situated in a small village about 30 kilometres from Berlin, and is used primarily for wireless telegraphy, but in the evenings and on Sundays the Berlin programme is broadcast at the same time from this station on 1,500 and 2,900 metres.

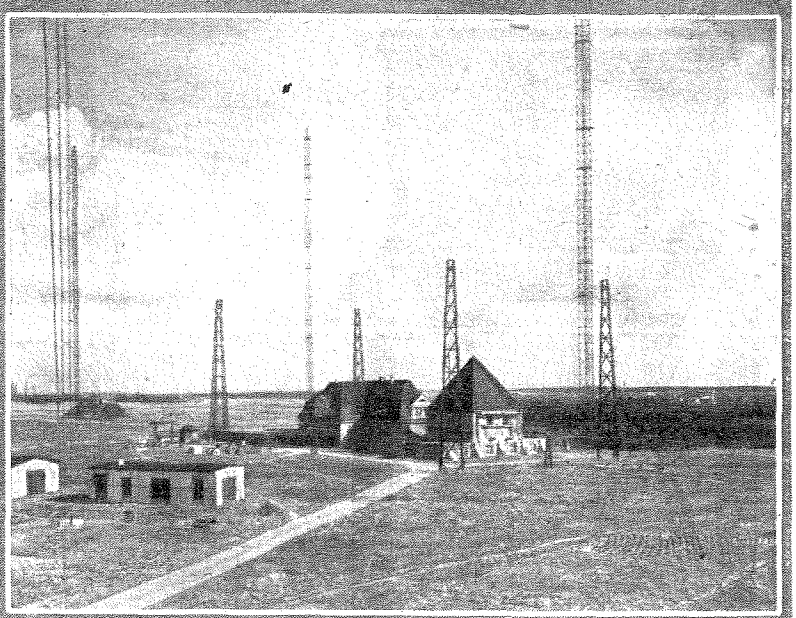
A Competitor of the Valves.

At present all the German broadcast transmitters employ valves, but recently a proposal to use high-frequency alternators is being seriously taken up.

The Schmidt and Dornig alternator has been used







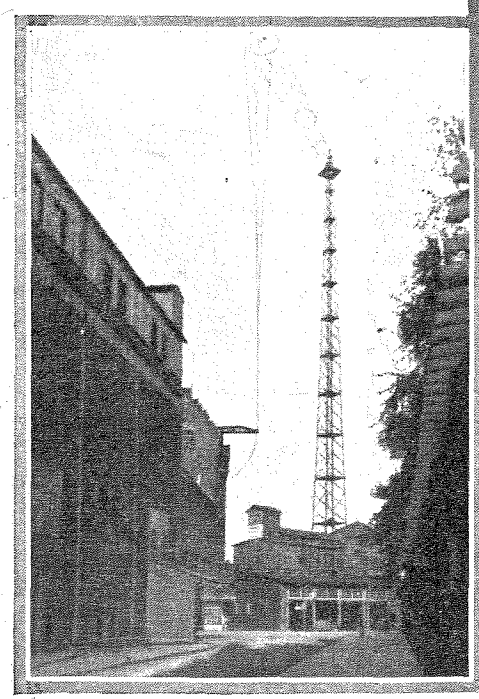
(*Above*) The Stuttgart station.

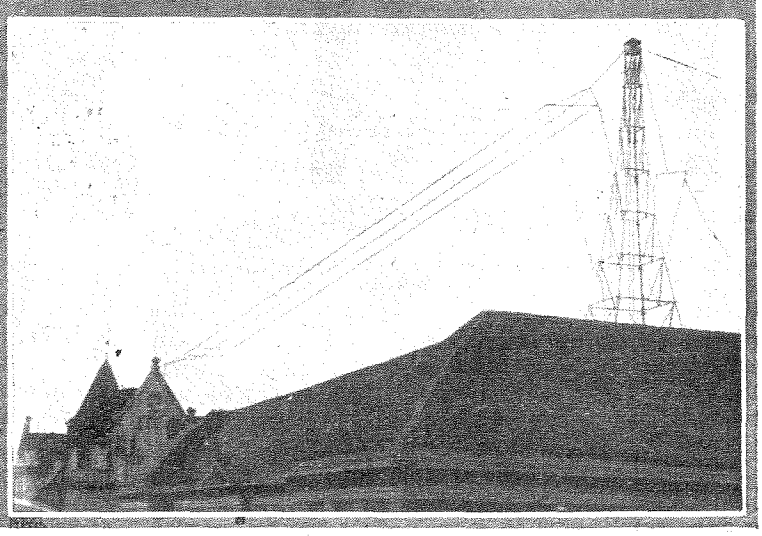
(*Top right*) The aerials of one of Berlin's Broadcast stations.

(*Centre*) Koenigswusterhausen, just outside Berlin.

(*Bottom right*) The mast and aerial at Müchen.

(*Below*) The Münster station.





Interesting views of the aerial systems of a few German Broadcasting stations.

Broadcast Organisation in Germany.—

successfully in producing short-wave continuous waves. The machine in its appearance does not greatly differ from the usual type of alternator.

A small high-frequency machine of about 5 kW. capacity is being fitted into the Berlin transmitter and will be in operation very shortly.

It is to be expected that there will be sharp competition between the valve and the alternator interests if the high-frequency machine in Berlin shows that it is capable of giving results equal to the valve.

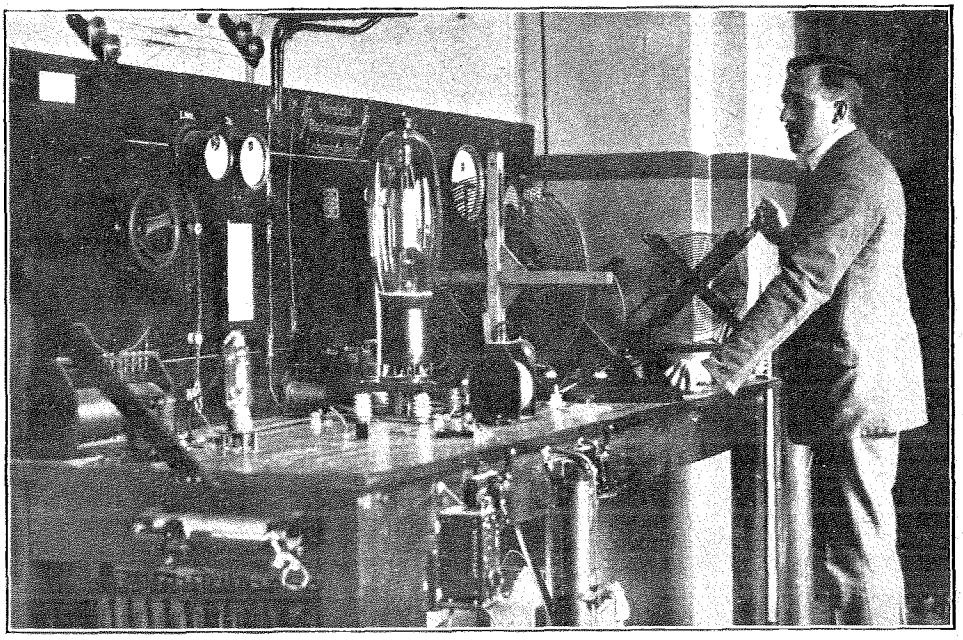


Fig. 6.—A view of the transmitter at Hamburg.

An amplifier for voice currents is shown in Fig. 5. This amplifier is specially designed for the kathodaphone, a receiving apparatus which differs materially from other types. The principle of the kathodaphone, which is shown in Fig. 6, consists in an ionised gas arc influenced through the sound vibrations to be transmitted. The resistance of this gas arc varies exactly with the sound vibrations. The advantage of the kathodaphone is that the inertia is very small, so that no damping effect takes place which might eliminate some of the overtones.

A serious competitor for the kathodaphone and microphone has appeared in the Siemens ribbon microphone. This is a reverse of the principal of the Siemens loud-speaker. In the Siemens loud-speaker the electrical oscillations are transformed into sound by being sent through a broad band of thin aluminium sheet, which is stretched in the field of a powerful magnet; in the ribbon microphone this aluminium band is set in motion by the sound oscillations, and thus induces alternating current in the surrounding field exactly corresponding to the sound oscillations.

The ribbon microphone is seen in the illustration of the studio of a Berlin broadcast station.

The German broadcast stations are still very much in the development stage; and just for that reason at the present moment pictures of the actual transmitting plants cannot be had.

So far it is evident that the public of the great towns is satisfied with broadcasting; and this public is in point of numbers by far the most important. In order to achieve a greater range it will be necessary to increase the efficiency of the transmitting plant by the use of more or larger valves, and the first step in this direction is the new 5kW. transmitter at Witzleben, near Berlin.

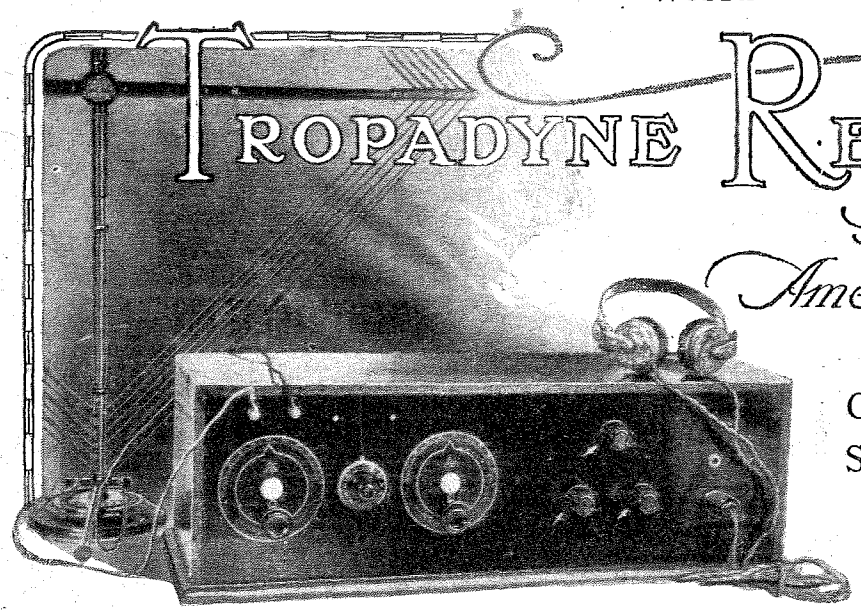
THE MARVELS OF MODERN PHYSICS.

ANY book which tends to popularise the study of science and to demonstrate to the non-scientific or, indeed, anti-scientific mind how greatly the ordinary events and comforts of our daily life are dependent on physical research, is warmly to be welcomed.

In the opening chapter of "The Marvels of Modern Physics," one of the most recent publications of this nature, the author, Mr. Joseph McCabe, states "we are not merely going to tell of the brilliant triumphs of thought, such as taking the temperature of a star on the edge of the universe or weighing and measuring minute specks which are less than the billionth of an inch in diameter . . . I am going to try to tell the story and explain the procedure in such language that you can sit by the fire, or lie by the river, and read it." After a brief mention of the work of the earliest men of science, he takes us by easy stages, and avoiding all mathematical formulæ, through the discoveries of the past century, relating in plain language and with frequent homely analogies the progress of science in measuring and investigating quantities almost infinitely small and speeds almost incredibly great, which have enabled the patient investigators to determine facts concerning the structure of matter and the laws governing the ordered universe.

Throughout the book the author emphasises the fact that though there are a few names popularly associated with "discoveries," the actual achievement has been accomplished by the co-operation of scientists of all kinds and nationalities.

THE MARVELS OF MODERN PHYSICS. By Joseph McCabe. 120 pp., with four plates. Published by Watts and Co., Johnson's Court, Fleet Street, E.C.4.



TROPADYNE RECEIVER

A Typical American Design

Constructional Details of a Six Valve Superheterodyne Receiver.

By W. JAMES.

IN the *Wireless World* for May 6th the writer discussed the principles of the Second Harmonic superheterodyne receiver, and explained how the first valve operated as a rectifier and as an oscillator. It was explained that for satisfactory results the valve should oscillate at a frequency very different from that of the signal, in order that the circuits used for generating the oscillations and those for tuning in the signal should not mutually interfere. In that type of set the valve generates oscillations which differ in frequency from the frequency of the incoming signal by something of the order of 100 per cent., and the second harmonic of the locally generated oscillations is utilised to beat with the incoming signal. In this—the so-called Tropadyne receiver—a single valve is used as the first detector and oscillator (in other words, a single-valve frequency changer is used), and more or less satisfactory results are obtained by a special arrangement of the circuits.

The circuit of the complete set is given in Fig. 1, and the distinctive feature is the peculiar connections of the apparatus to the first valve, the remainder of the receiver being of normal type and suitable for connecting to any variety of frequency changer. In the grid circuit is a coil L, which is tuned by C, and in the plate circuit a coil R. Coils L and R in this set are the stator and rotor of a vario-coupler, and form the oscillating part of the first valve. Connected between the filament and the centre point of the grid coil of the oscillator is the frame aerial and its tuning condenser C_1, condenser C_2, and resistance R_1 being the usual grid condenser and leak.

It is claimed that this unusual scheme of connections is such that adjustments of one circuit do not affect the tuning of the other. Hence, to produce currents of the frequency of the H.F. amplifier, it is only necessary to tune the oscillator (by adjusting C) to a frequency differing by that amount from the frequency of the incoming signal. In practice the correct adjustments are fairly easily made, but attention is drawn to two things. In the first place, both sets of plates of the condenser C tuning the oscillator are "live" ones, and hand effects are liable to be troublesome. This difficulty is minimised by employing a dial with an ebonite knob fairly well

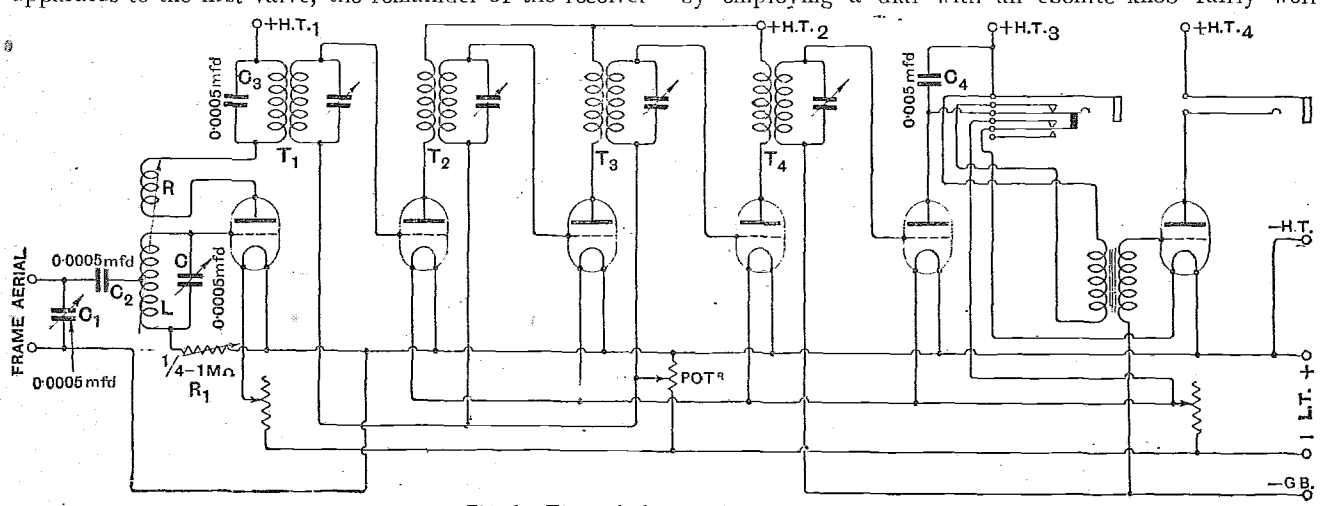


Fig. 1.—Theoretical connections of the set.

Tropadyne Receiver.—

removed from points in contact with the rotor plates. Secondly, the resistance of the grid leak R_1 is critical, and it is advisable to employ a good adjustable grid leak, as is done in this set. The capacity of the grid condenser C_2 does not appear to be critical, but it was found desirable to make an occasional adjustment to the reaction coil setting. As is well known, the strength of the oscillations generated in a circuit such as LC depends partly on the ratio of the capacity and inductance, and under given conditions as to plate and filament voltages, as the capacity of condenser C is increased, the strength of the oscillations diminishes. By a readjustment of the coupling of the grid and reaction coils, however, the strength of the oscillations can be brought to a suitable value. This adjustment is made, of course, by turning the knob of the variocoupler.

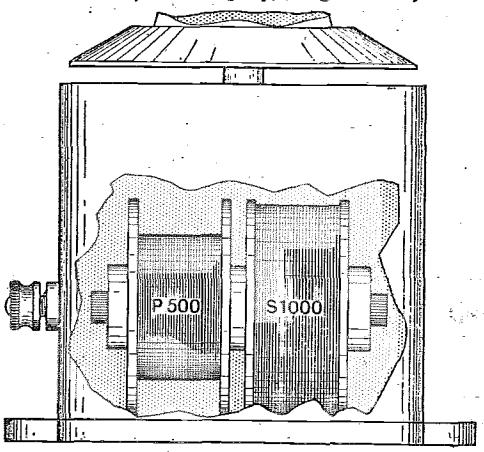


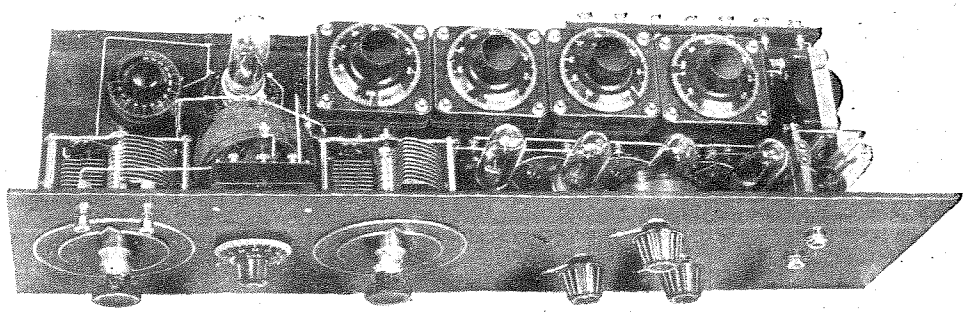
Fig. 2.—View of one of the tropaformers.

The H.F. Amplifier.

Turning now to the amplifier, three stages requiring four transformers are employed. These transformers are marked T_1, T_2, T_3, and T_4 in Fig. 1, and are of identical construction, although the primary winding of the first transformer, T_1, is shunted by a fixed condenser of 0.0005 mfd. This fixed condenser, C_3, is not part of the transformer, but is connected externally. All the transformers have an adjustable mica-dielectric condenser across their secondary windings. A sketch of one of the transformers (called a Tropaformer) is given in Fig. 2. It has a core of thin silicon steel, a primary winding of 500 turns of No. 30 S.S.C., and a secondary winding of 1,000 turns of No. 30 S.S.C.; the two coils are wound in the same direction and mounted $\frac{1}{4}$in. apart. The adjustable condenser is mounted on the top of the case of the transformer, and its capacity range, is sufficient to tune the device between about 3,000 and 9,000 metres.

Transformer T_4 is connected to the second detector, which is adjusted for anode rectification, the valve having a suitable negative bias and plate voltage. Following the detector is a note magnifier, which may, however, be cut out by inserting the telephone plug into the six point jack.

The grid return wires of transformers T_1, T_2, and T_3 are connected to the sliding contact of a potentiometer, which has its ends joined to the positive and negative terminals of the filament battery. Hence, when the contact of the potentiometer is nearest the end connected to positive, the grids are positive by the amount of the filament battery, grid current flows, and the amplifier is damped. With the potentiometer in this position the amplifier should not oscillate. As the contact is moved towards the end joined to negative, the grid potential is



A view of the set which shows practically the whole of the components. The four H.F. transformers are easily identified.

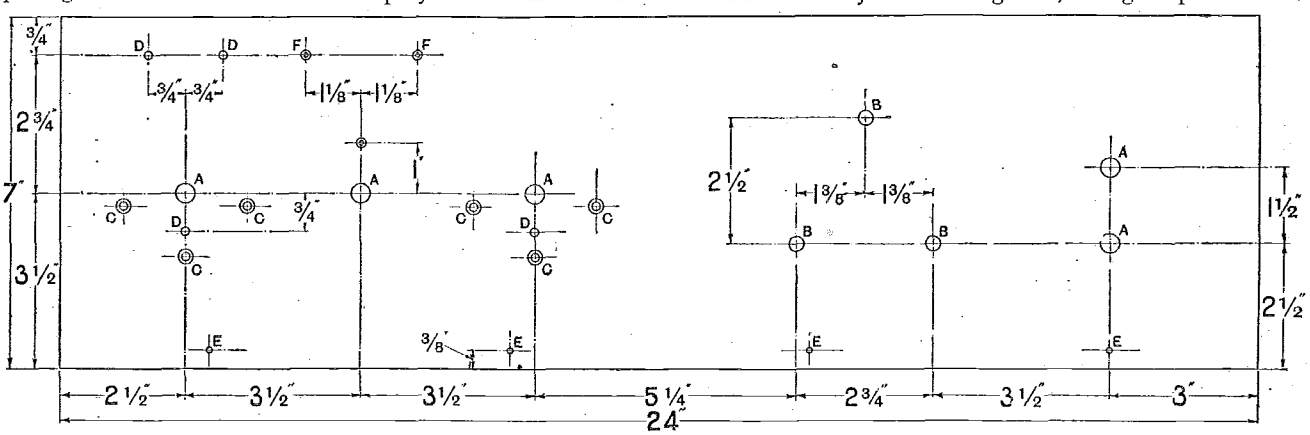
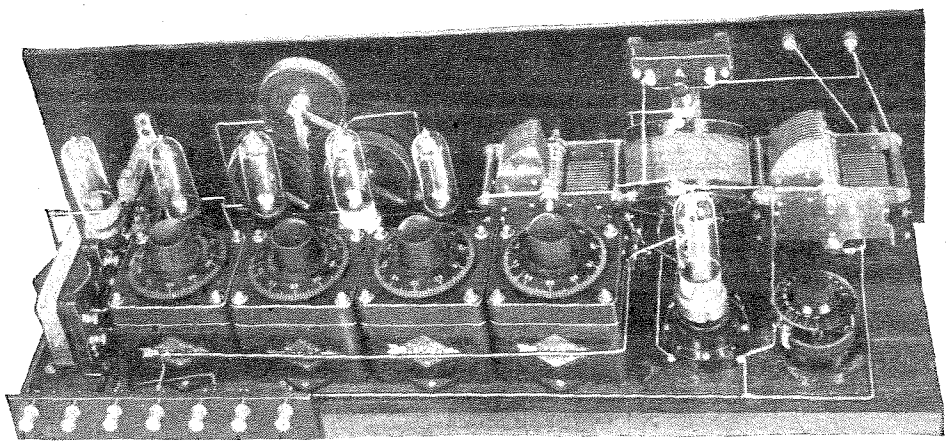


Fig. 3.—Arrangement of parts on the front panel: A, $\frac{1}{16}$in.; B, $\frac{1}{16}$in.; C, $\frac{1}{32}$in. and countersunk; D, $\frac{1}{32}$in.; E, $\frac{1}{32}$in.; F, $\frac{1}{32}$in. and countersunk.

made less positive, and, of course, the normal anode current taken by the amplifying valves is reduced. It is, therefore, desirable so to adjust the transformers, plate voltage, and filament current that the amplifier is just not oscillating when the potentiometer is set almost over to the negative side. Then the minimum amount of current is being taken from the plate battery, and the amplifier is in its most sensitive condition for amplifying signals.

With the set of transformers supplied in the Tropadyne kit of parts, it was found rather a difficult matter to stop the amplifier oscillating, although great care was taken to try various combinations of plate voltage and filament current. One or two changes were also made in the wiring diagram supplied with the parts. In the first place a separate filament resistance was used for the first detector, and tests proved this to be desirable, and, secondly, a separate plate battery tap was provided for the first detector, high-frequency amplifier, second detector, and note magnifier. In the diagram of connections supplied, a common voltage is shown for all the valves except the second detector, but here again it was found practically essential to use different voltages as indicated by the diagrams of Figs. 1 and 6. A further improvement was made by connecting fixed condensers of 1 micro-farad capacity between the positive plate battery terminals and the filament battery, but these are not shown in the illustrations because there was not room for them on the baseboard.



Another view. The adjustable grid leak lies by the side of the valve on the right-hand side of the base, while on the extreme left-hand side is the L.F. transformer.

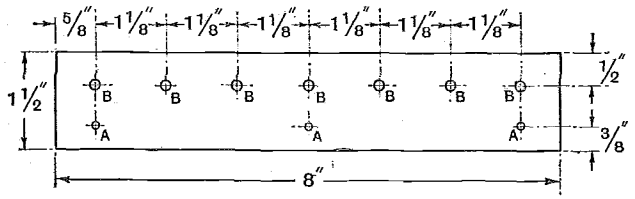


Fig. 5.—The terminal strip; A, $\frac{7}{32}$in.; B, $\frac{5}{32}$in. for No. 4B.A. terminals.

Assembling the Parts.

The set has a front radion panel which carries the two tuning condensers, vario-coupler, filament resistances, potentiometer, jacks, and two terminals for the frame aerial. These parts are arranged as indicated in Fig. 3, and great care should be taken not to rearrange them without carefully examining the position of the parts on the base. If Apex vernier dials are to be used, it will be necessary to remove a short length from the ends of the shafts of the variable condensers, as these have to project $\frac{1}{2}$in. from the surface of the panel.

On the baseboard are mounted the remaining components in the positions shown in Fig. 4. These parts are all screwed to the base, and here again care should be taken in the laying out of the parts, as there is little room to spare. In fact, if valves of the D.E.5 class, or valves of similar dimensions, are to be used, it is necessary to employ valve holders without the wide flanges, such as those on the antiphonic valve holders used in the set illustrated, and to fasten them as near the trans-

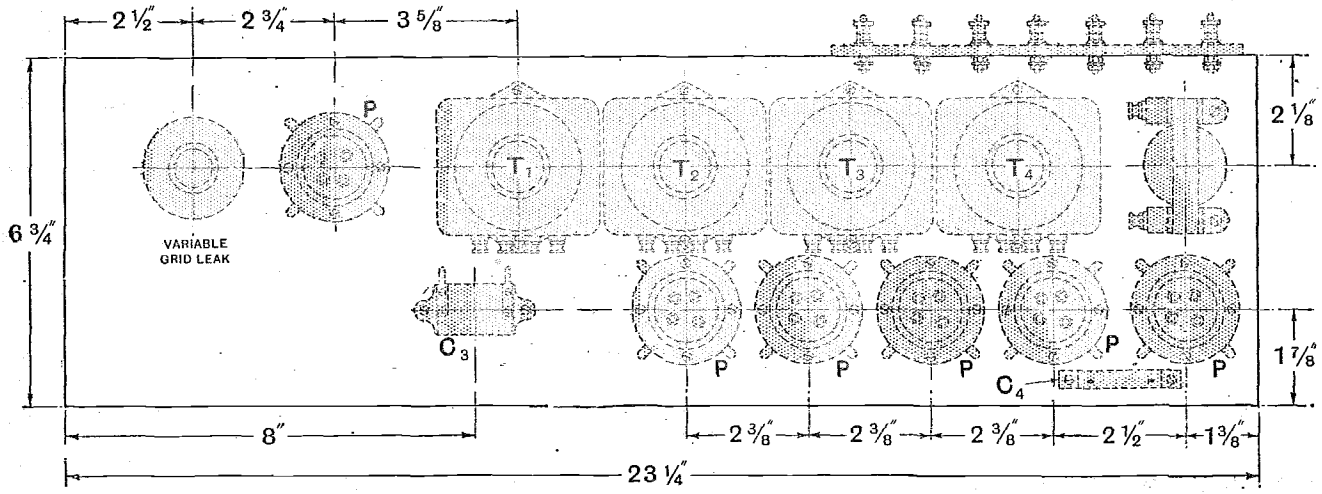


Fig. 4.—Lavout of parts on the baseboard.

Tropadyne Receiver.—

MATERIALS REQUIRED.

1 Oscillator coupler.
4 Tropaformers.
2 Variable condensers, 0·0005 mfd. (Cardwell).
1 L.F. intervalve transformer (Royal).
2 Filament resistances, 6 ohms (Frost Radio).
1 Potentiometer (Frost Radio).
6 Valve holders, anti-phonic (Burndept).
1 Fixed condenser 0·0005 mfd. (Dubilier).
1 Fixed condenser 0·005 mfd. (Dubilier).
1 Variable input condenser (Haynes-Griffin).
2 Vernier dials (Apex).
1 Variable grid leak, 0·1 to 7 megohms (Royalty).
1 Filament control jack (Frost Radio).
1 Single circuit jack (Frost Radio).
1 Plug (for jacks) (Frost Radio).
9 Terminals (No. 4B.A.).
1 Radion panel, 24in. × 7in. × $\frac{3}{16}$in. (American Hard Rubber Co.).
1 Radion strip, 9in. × $1\frac{1}{2}$in. × $\frac{3}{16}$in.
1 Base board, 23in. × $6\frac{3}{4}$in. × $\frac{3}{4}$in.
1 Cabinet for 24in. × 7in. panel (Carrington Manufacturing Co.).
1 Frame aerial (Bodine).
6 Valves (Metro-Vick SP18 valves were used).
(The American components were supplied by R. A. Rothermel, Ltd.)

formers as possible. Valves of the narrow tubular or small pear-shaped type, such as the M.O.D.E.R., or Metro-Vick S.P.18, just clear when the holders are arranged as indicated in Fig. 4. Finally, construct and fix the terminal strip (Fig. 5), and secure the base and panel by wood screws passed through the panel.

Wiring the Set.

The wiring connections (Fig. 6) are quite straightforward, but the work has to be done slowly on account of the small space between the components. It is necessary to separate the panel and baseboard, and to wire as much as possible before putting them together again. Some of the wires are No. 16 tinned copper wire, and others are No. 20, while a few are run in systoflex to prevent their accidentally making contact with other wires. Measure off and shape those wires which connect a contact on the panel with another on the baseboard, and solder one end before finally fixing the panel and baseboard.

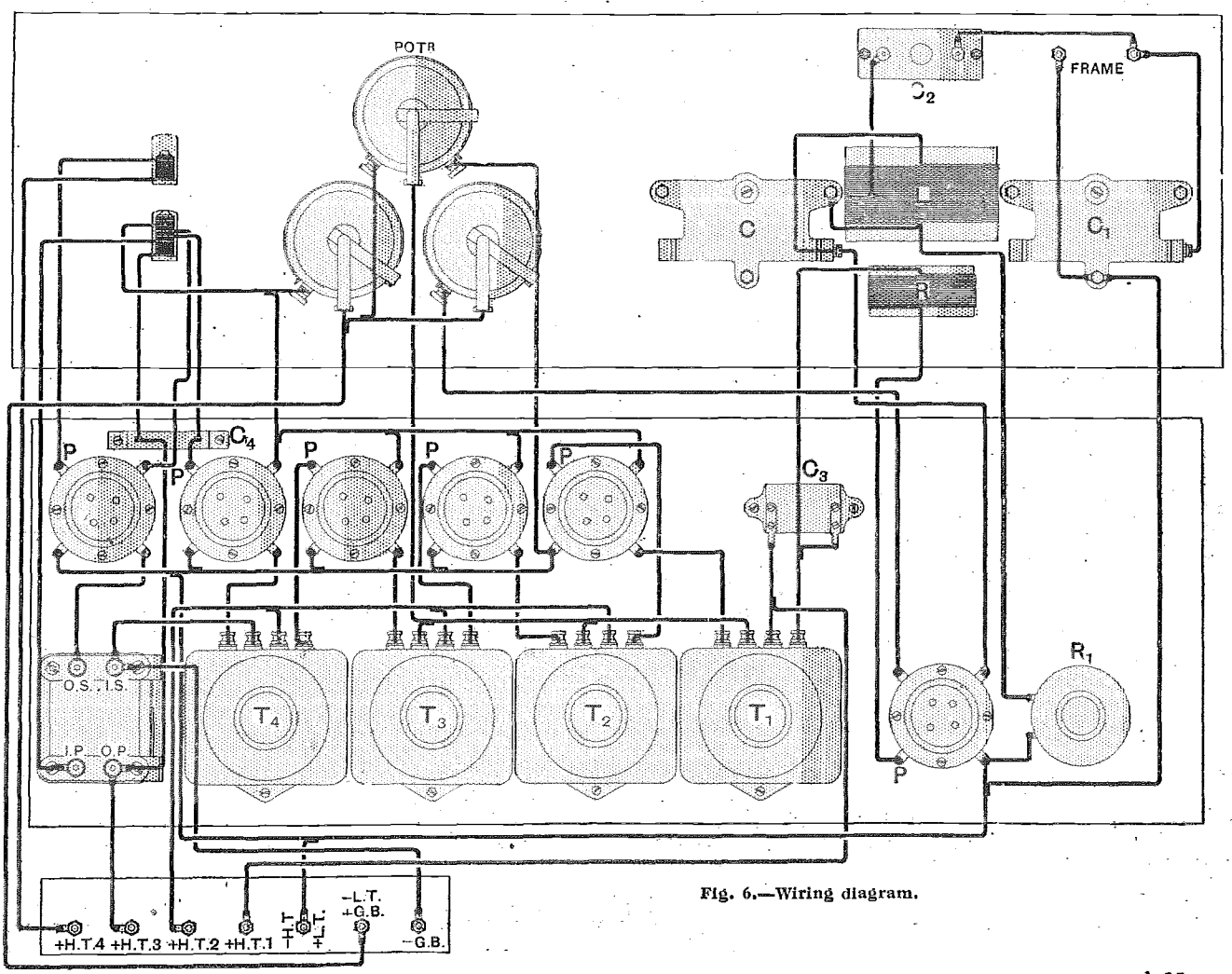


Fig. 6.—Wiring diagram.

Tropadyne Receiver.—

Operating the Receiver.

Connect appropriate batteries, the frame aerial and the telephones, and tune in a signal by adjusting the two variable condensers. Normally, the same station will be heard at two places on the oscillator dial, and the setting which gives the loudest signals or freedom from interference should be chosen. Then adjust the filament resistance of the first valve, its plate voltage, and the setting of the rotor of the variocoupler. Now endeavour to tune the H.F. transformers to the same wavelength by adjusting the variable condensers connected across their secondary windings. To do this, turn the condenser of the transformer nearest the second detector to, say, 80 degrees, then adjust the third transformer, then the second, and, finally, the first, until best results are obtained.

It might be found necessary to readjust the setting of the oscillator as the tuning of the amplifier is carried out, and it might also be found that when the four transformers are tuned to about the same wavelength that the amplifier oscillates. To stop the oscillations, experiment with the plate and filament voltages, and with the potentiometer. If the oscillations persist, set the condenser of the fourth transformer to a higher value, readjust the others, and again experiment with the values of plate and filament voltage. When the amplifier is stable, tune in a weak signal, and make final adjustments to the H.F. transformer, the voltage of the second detector, and to the grid leak and variocoupler connected to the first detector. It is usually found that if the grid leak has too high a value, or if the variocoupler is set too high, the set squeals when the tuning condensers are turned to a low value.

Hand effects are troublesome when the amplifier is oscillating, and the writer has found a variable high resistance (30,000 ohms) connected across the primary winding of the last high frequency transformer of great help in controlling the tendency of the set to oscillate.

Swansea and District Radio Society.

"Portable Sets and their use in Summer Time" was the title of a talk given before the Society on April 28th by Mr. W. H. Thomas, who demonstrated a very light two-valve portable set.

Mr. D. P. Willans, on May 5th, gave an interesting lecture on "Aerials." He remarked that many people neglect their aerials by failing to clean them and attend to the insulation.

The Society is arranging to hold several field days during the summer.

Hon. Secretary: E. H. White, 100, Bryn Road, Swansea.

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Streatham Radio Society.

At the annual general meeting, held on May 14th, great satisfaction was expressed at the excellent balance-sheet presented by the treasurer. Mr. H. Bevan Swift was re-elected as chairman for the ensuing twelve months, while Mr. Carpenter was appointed treasurer. Regret was expressed that Mr. A. G. King, who had served the Society as treasurer since its inception, was unable to continue in office. The meeting concluded with a discussion on the Society's wireless equipment at the new headquarters.

The secretary is Mr. N. J. H. Clark, of 26, Salford Road, S.W.2.

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The Radio Society of Highgate.

"Power Amplification" was the subject of a very instructive lecture given on May 7th by Mr. L. Grinstead, B.Sc. The lecturer emphasised that power valves must have a low impedance and a long straight portion on their characteristic curve. Reference was made to the inefficiency of the thermionic valve as a distortionless amplifier, and it was pointed out that, but for the fact that the input of the average loud-speaker is only 30 to 50 milliwatts, modern amplifying apparatus would require to be on a much larger and more costly scale.

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

NEWS FROM THE CLUBS.

Ipswich and District Radio Society.

"The Use of Town Mains for High Tension Supply" formed the subject of an instructive lecture by the president, Mr. F. Mellor, A.M.I.E.E., on April 27th.

Mr. Mellor proved by a series of experiments and calculations that the cost of supplying a four-valve receiver with H.T. current by this method would be 1s. 2d. for an estimated working period of 1,000 hours. He considered that with the increasing popularity of the power valve, there was every prospect of this system being seriously considered.

FORTHCOMING EVENTS.

WEDNESDAY, MAY 27th.

Radio Society of Great Britain.—At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "The Rectification of Small Radio Frequency Potential Differences." By Mr. F. M. Colebrooke, B.Sc.

North Middlesex Wireless Club.—Ordinary Meeting.

WEDNESDAY, JUNE 3rd.

Institution of Electrical Engineers (Wireless Section).—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "The Effect of Wave Damping in Radio Signal Measurements." By Dr. R. L. Smith-Rose, M.Sc.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Lecture by Capt. K. E. Harbridge (5CB).

THURSDAY, JUNE 4th.

Kensington Radio Society.—At 8.30 p.m. Talk on: "Inductance Capacity and Resistance in Oscillatory Circuits", by Mr. L. F. Fogarty.

SUNDAY, JUNE 7th.

Golders Green and Hendon Radio Society.—Field day.

Hackney and District Radio Society.

A lantern lecture on the Continental Broadcast Stations was given by Capt. L. Plugge on April 27th. In the course of his remarks the lecturer said that, in his opinion, the superheterodyne would be the set of the future.

The Society meets every Monday evening at 8 o'clock at the King's Hall, Lower Clapton Road, E.5. Prospective members may obtain full particulars from the hon. secretary, Mr. G. E. Sandy, 114, Parnell Road, E.3.

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Dublin Wireless Club.

A loud-speaker demonstration on the club's four-valve set was a feature of the meeting held on April 30th. The demonstrators were Messrs. H. J. Wilson and E. Jackson. The circuit employed in the set comprises a detector valve and three stages of low-frequency amplification, the first being choke coupled and the other two resistance coupled. The demonstration proved the great range of the set, as well as the strength and purity of signals received.

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Kensington Radio Society.

At the Society's May meeting Mr. H. Andrewes, B.Sc., was the lecturer, his subject being "Modern Condensers and their Uses for Radio and Other Work." All sorts and conditions of condensers were shown, and by means of an excellent series of lantern slides members were able to study a complete range of instruments, from the small fixed types for broadcast receivers to an example 5 feet high for use in a high-power station.

Hon. secretary, Mr. Herbert Johnson, 81, Cromwell Road, Wimbledon, S.W.19.

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Wimbledon Radio Society.

The Society has arranged to hold a Field Day on the second Sunday of each month throughout the summer. The first of these was held on May 10th, when several members brought very efficient portable receivers.

THE AMERICAN NEUTRODYNE.

A Short History of the Neutrodyne Circuit: its Past, Present, and Future Status.

By KIMBALL HOUTON STARK.

THE past four years in America have seen the birth and death of an infinite number of radio receiving circuits. Four years ago there existed the usual regenerative circuit which had been, until that time, the universally used circuit by amateurs on amateur relay work on a wavelength of the order of 200 metres, and by commercial ship and shore stations at 300, 450 and 600 metres.

The regenerative circuit has had an interesting and extremely nerve-wracking history. When I say regenerative, I might define the term a little more closely and include within its meaning any oscillating or regenerative circuit as was applied to radio receiver design. Obviously, regenerative circuit receiving equipment as designed could be made to oscillate very easily by exceeding the point of maximum regeneration.

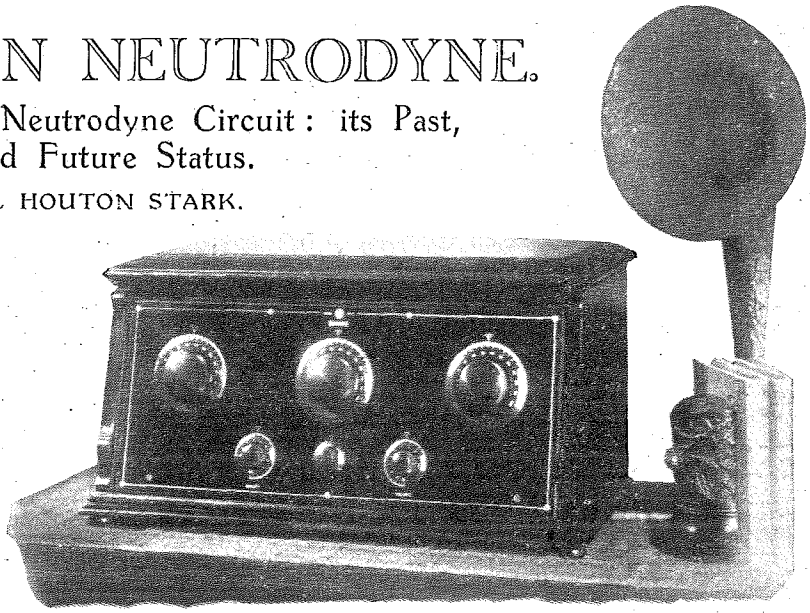


Fig. 2.—The "Neutroceiver" enclosed in a cabinet which also has space in it for the plate battery.

It is desirable to point out that these types of circuit, included within the meaning of the word regenerative, were invented before broadcasting became a recognised and universal public service, and were particularly designed for the reception of spark and arc telegraph signals. During this period of the growth of the art of radio reception some isolated experimental work in wireless telephony was being carried on by scientists.

Radio Communication in the World War.

With the advent of the World War, and with the enlistment of the vast engineering and research faculty into Government service, the engineering basis of the radio receiver and amplifier design using three-electrode valves was brought down to a definite point of simple mathematics and definite engineering formula which could be depended upon.

Important among the war-time problems was that of communication between ground and aeroplanes as well as point-to-point communication in the actual fighting zone from behind the lines up to and including communication along the front-line trenches. Another extremely important problem brought about by the war was the application of radio signalling to the first line of defence—the Navy. Here, again, speech or radio telephony very largely superseded, at least for short range work, the more powerful spark or arc transmitters, although high power valve transmitting sets were also developed to cover longer ranges.

Obviously, the United States Government, as well as the other Allied Governments, employed every bit of technical brains that could be found to solve as quickly as possible and with the least expense these problems of communication. One of these scientists employed by the United States Government at the Washington Navy Yard during this period was Prof. L. A. Hazeltine, now Professor of Electrical Engineering, Steven's Institute of Technology, Hoboken, New Jersey.

Prof. Hazeltine was not unknown in radio circles and far from it, for it was he who, having been attracted to radio, brought forth possibly the most concise and complete and most beautiful mathematical proof of the operation of the three-electrode valve in the state of oscillation, and in this connection his work was of extreme importance in clearing up some of the very confused (even at that time) patent litigation revolving around oscillating valve patents.

Prof. Hazeltine's work at the Washington Navy Yard was that of designing engineer in charge of radio receiving equipment, particu-

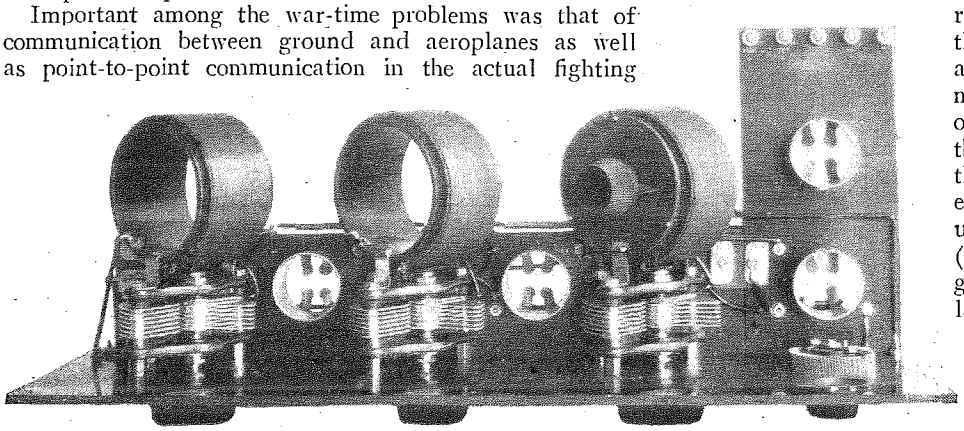


Fig. 1.—This is the interior view of the Fada "One-Sixty" receiver.

The American Neutrodyne.—

larly that equipment designed for naval use. It was during this work that he brought to a focus the results of previous analytical thinking, and designed a receiver known as the SE-1420 Navy receiver, which incorporated in its tuning circuits a fundamental scheme for the neutralisation of the capacity coupling existing between various portions of the inductances or coupling coils used in the receiver.

The Birth of Broadcasting and the Need of an Efficient Broadcast Receiver.

With the advent of the "broadcast millennium"—of broadcasting—or the transmission of speech and music by

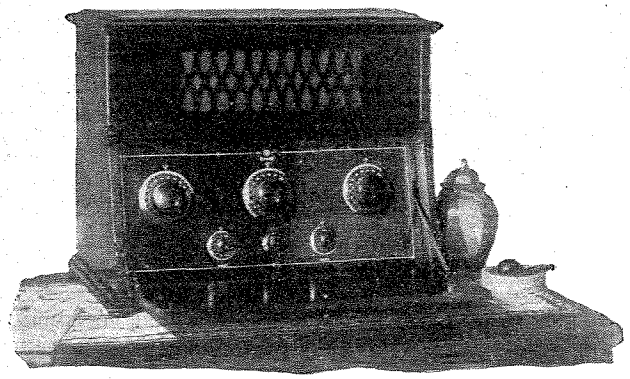


Fig. 3.—The Fada "Neutrola," which has a built-in loud-speaker.

radio telephony, and the universal public acceptance of this method of entertainment and education, radio engineers required a different kind of receiver if the public were to be most satisfied with the receiving sets which they purchased. No longer were the obsolete designs of yesterday suitable for the receiving of the highly complicated voice and music frequencies used in transmitting, either a single voice or a seventy-piece orchestra. Paralleling the requirement of quality transmission of speech and music came the universal public knowledge about regenerative receivers which, in a large majority of cases, radiated part of their energy, or, in other words, acted themselves as miniature broadcasting stations, and caused extreme confusion and undesirable interference to other radio broadcast receivers in a given locality; one such radio receiver possibly interfering with other receiving stations within a radius of one to five miles.

Prof. Hazeltine, recognising the inefficiency of regenerative receivers from every point of view, and recognising also the extreme difficulty that engineers were meeting in attempting to apply efficient methods of pure radio frequency amplification to receiving circuits adaptable to broadcast reception, on the basis of his past knowledge, was the one man who came forward with a new system of radio reception of proven mathematical correctness and of proven practical adaptability, which solved the problem of radio-frequency amplification and of satisfactory radio broadcast speech and music reception.

That system was termed the "Neutrodyne Circuit." F. A. D. Andrea, Inc., was one of the original licensees of the Hazeltine Neutrodyne circuit under the licence granted by Prof. Hazeltine to the Independent Radio Manufacturers, Inc. As a matter of fact, the first Neutrodyne receiver, which was commercially available in the United States, was the famous Fada "One-Sixty" receiver, which employed the Neutrodyne circuit using four valves, one of which did double duty, and gave to the public a four-valve circuit which did the work of five valves, namely, two stages of tuned radio-frequency amplification, detector, and two stages of audio-frequency amplification, the radio stages being properly neutralised for the elimination of undesirable capacity coupling effects both in the valves and their associated circuits.

Fig. 1 shows the interior appearance of this receiver. Note in particular the special method of mounting the tuned coupling transformers at such angles with respect to one another that the magnetic coupling between the coils is reduced to an absolute minimum.

The Growth of the Popularity of the Neutrodyne Circuit.

Never in the history of radio in any country in the world has the art become so much a matter of necessity in every home as it has in America. To-day there are approximately 3,600,000 homes which have radio receivers, and the number is fast increasing. Broadcasting has become an absolute necessity. Its services to the public has for months and months been recognised, and radio

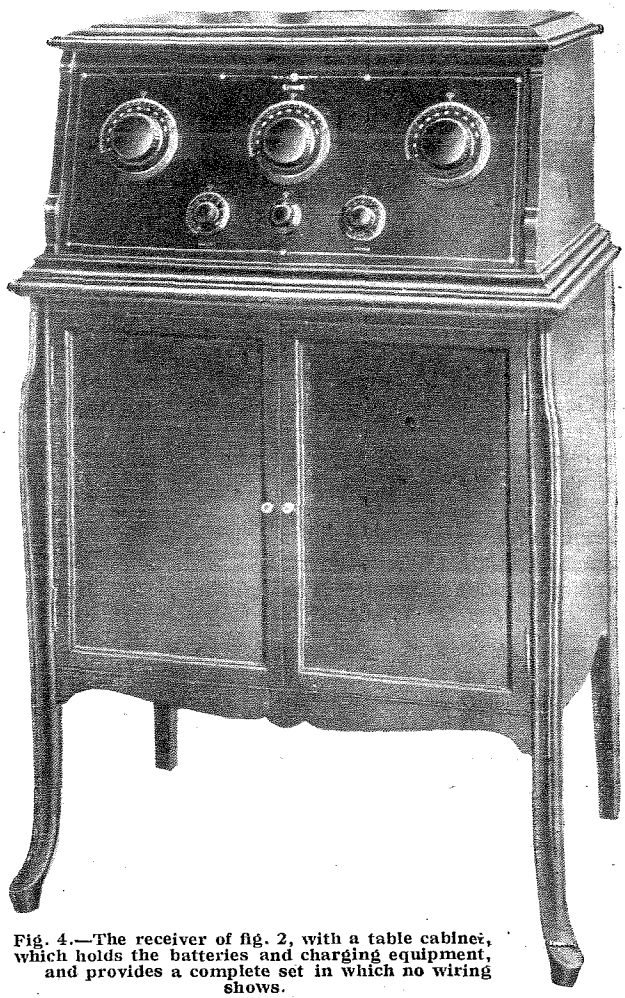


Fig. 4.—The receiver of fig. 2, with a table cabinet, which holds the batteries and charging equipment, and provides a complete set in which no wiring shows.

The American Neutrodyne.—

broadcasting has rightly earned the title "A new public service."

Paralleling the dramatic rise of radio broadcasting, there has been no greater success in radio than the acceptance by the public of the Neutrodyne receiver as perhaps the most perfect type of receiver available for the most perfect reception of radio broadcast programmes. Prof. Hazeltine's solution of the seemingly impossible problem of obtaining efficient radio-frequency amplification has been of enormous economic benefit to radio. It has given people a more truthful conception of the beauty of being able to listen to not only reproduced music, but in reality to the personality and temperamental atmosphere of the broadcast artist which is brought right into the living room of the home, be it farmhouse or palatial city mansion. As an illustration: since the Fada "One-Sixty" Neutrodyne receiver was originally made available to the public in February, 1923, over 50,000 of them have been sold to the American broadcast public, and they are proving themselves worthy of their name.

Radio engineering does not stand still. In fact, it is moving rapidly towards new perfection in design, and there has never been a circuit in the art of radio engineering which to my knowledge and in my opinion has withstood the onslaught of all other circuits to the extent that the Neutrodyne circuit has. In the United States, for the year 1924, over 37 per cent. of all radio receivers sold of all types, makes and description, were Neutrodyne, and in the music industries alone which during that year became of extreme importance in the distribution of radio receivers, over 52 per cent. of receivers sold through this trade channel were Neutrodyne receivers.

Approximately from July, 1923, the other licensed manufacturers under the neutrodyne patents were marketing receivers, and each one of these manufacturers has probably achieved a success which from the point of view of the monetary value of business done over the extremely short period of time evolved has been unapproachable and beyond comparison with the success achieved by other companies manufacturing other types of radio receiving equipment.

The "One-Sixty" receiver was not superseded, but was supplemented by an additional line of receivers which were marketed during 1924. These receivers included the "Neutro-Junior"—a three-valve neutrodyne receiver giving the effect of four valves; the "Nectroceiver"—a five-valve receiver; the "Neutrola"—which employs the same panel as the "Neutroceiver," but with the addition of a built-in loud-speaker and the modifications of the "Neutroceiver" and "Neutrola"; the "Neutroceiver Grand" and the "Neutrola Grand"—which differ only in the type of cabinet employed. Figs. 2, 3, and 4 show some of these receivers.

UV199.

TESTS ON SOME FOREIGN VALVES.

The American UV199, UV201A, WD11 and the French "Radio Micro."

WHILE the British manufacturer has produced an almost bewildering multiplicity of valves the American valve maker, on the other hand, has confined his activities to the production of three or four standard types.

Those to be described have been developed by the Radio Corporation of America, and are general purpose valves fitted with low consumption filaments.

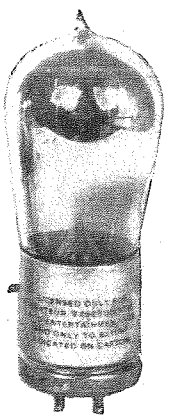
In the past a soft detector valve has been very largely used by American amateurs, but to-day the tendency is to employ hard valves for this purpose, and the soft valve is rapidly falling into disfavour.

UV199.

The first valve to be described is the UV199, which was the first in the world to be fitted with a 60 milliampere filament, and its advent has marked what is probably one of the greatest advances in radio work.

This type is very popular, particularly in the outlying districts, where battery charging is an impossibility. Its overall measurements are approximately 1in. diameter and 3½in. high, which is rather shorter than our equivalents.

The usual bench tests applied to a sample valve gave the following results:—



UV201A.

UV199.

Radio Corporation of America.

Filament Volts, 3.0. Filament Current, 0.064 amps.
Emission (total) Milliamperes, 7.3. Filament Efficiency, 38 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias.	Plate Current.[1]	Amplification Factor.	Plate Impedance. ohms.
20	0.32	0	0.32	5.3	30,000
40	1.1	−1	0.87	6.2	23,000
60	2.04	−3	1.16	6.2	19,600
80	3.15	−5	1.46	6.2	16,500

[1] Plate current when grid biased to the value of Col. III.

For detector and H.F. work the plate voltage should be adjusted to about 40, although it is by no means critical. There is one important point, however. The grid return lead *must* be connected to the positive side of the filament battery when the valve is operating as a

Tests on some Foreign Valves.—

detector. A grid leak of from 2 to 5 megohms is recommended; this may be increased to 9 megohms for the reception of very weak signals.

For L.F. amplification the plate voltage may be increased to a maximum of 80. The correct grid bias will depend, in amount, on the plate voltage, and suitable combinations will be found in the accompanying table.

UV201A.

This type is a particular favourite with the American amateur, and was the forerunner of the British B_4, DE_5, DFA_0, etc. An idea of its general appearance will be gained from the photograph, and its overall dimensions are approximately $4\frac{1}{4}$in. high by $1\frac{3}{4}$in. maximum diameter.

We have applied our usual tests to sample valves of this type, the results of which are given below.

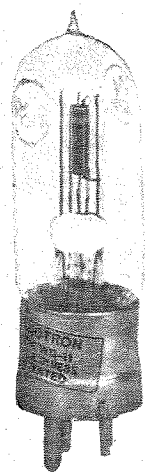
UV201A.
Radio Corporation of America.

Filament Volts, 5.0. Filament Current, 0.243 amps.
Emission (total) Milliamperes, 41. Filament Efficiency, 33.8 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias.	Plate Current.[1]	Amplification Factor.	Plate Impedance. ohms.
20	0.5	0	0.5	7.7	16,000
40	1.75	−1	1.2	7.6	16,000
60	3.5	−2	2.15	7.6	12,400
80	4.8	−3.5	2.8	7.6	11,000
100	7.25	−5	3.75	7.6	10,300

[1] Plate current when grid is biased to the value of Col. III.

For H.F. and detector work a plate potential of 20 to 45 is recommended, and in the former case the grid return lead should be connected to the positive side of the filament battery for best results. Voltages up to 120 may be applied to the plate when the valve is used as a L.F. amplifier, suitable values of grid bias being given in the table.



WD11.

The samples tested gave excellent performance and were reasonably silent in operation. The UV201A is equal to any valve we know for general use.

WD11.

This valve has a coated filament, and gives one the impression of a large Weco valve. In operation the filament glows at dull red, and consumes about 0.25 amperes at 1.1. volt. Its plate rating is 20-100 volts. The sample under test while quite stable at the lower and medium plate voltages was somewhat erratic in its behaviour when the voltage was pushed towards the upper limit, and in this region figures were difficult to get accurately.

A noteworthy point in the operation of the WD11 is its freedom from microphonic noises. In fact, it is one of the most silent valves we have tested.

WD11.
Radio Corporation of America.

Filament Volts, 1.11. Filament Current, 0.25 amps.
Emission (total) Milliamperes, 6.4. Filament Efficiency, 23.8 milliamperes per watt.

Plate Volts.	Plate Current. Milliamps.	Grid Bias.	Plate Current.[1]	Amplification Factor.	Plate Impedance. ohms.
20	0.32	0	0.32	5.2	32,000
40	1.00	−1	0.8	5.3	22,000
60	2.05	−3	1.22	5.3	19,800
80	3.2	−5	1.76	5.4	18,800

[1] Plate current when grid is biased to the value of Col. III.

Radio Micro.

Radio Micro.

We now deal with a valve of French origin. This is also of the 60 milliampere variety, but it will be noted that the filament voltage rating is rather higher than in equivalent British valves. The amplification factor, too, is slightly higher than one finds in our general purpose products. For H.F. amplification and detection the valve under review gave excellent results, but its rather high plate impedance is against it when used for L.F. work.

Particulars of our tests are given in the table; the makers figures are filament volts 3.2-3.5, filament current 0.06, plate voltage up to 80.

RADIO MICRO.
(French Manufacture.)

Filament Volts, 3.5. Filament Amps., 0.063.
Emission (total) Milliamps., 8. Filament Efficiency, 36.4 milliamperes per watt.

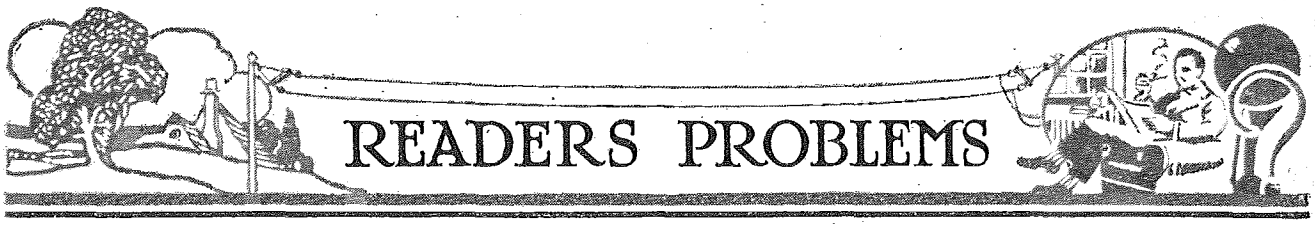
Plate Volts.	Plate Current. Milliamperes.	Grid Bias.	Plate Current.[1]	Amplification Factor.	Plate Impedance. ohms.
20	0.03	0	0.03	10.2	125,000
40	0.18	0	0.18	10.4	55,000
60	0.66	−0.5	0.51	10.3	48,500
80	1.24	−1.5	0.79	10.2	41,000

[1] Plate current when grid is biased to value of Col. III.

In practice the valve can be run as low as 3 volts on the filament, for, due to the high amplification factor, the plate current is comparatively low.

INDISPENSABLE D.F.

A recent report illustrates a service which only a direction finder could have rendered. While crossing the Bay of Biscay, a British ship fitted with a direction finder received a distress call from the Italian steamship *Citta di Elena*. Owing to the weather conditions, no sights had been obtained that day, and both ships were navigating on dead reckoning. When the call was received, the captain of the British ship decided to run down the bearing obtained by his Marconi direction finder. The report laconically states: "We found her right off. She was 26 miles from the position she gave us, and we would never have found her but for the direction finder, as visibility was so very bad." Wireless communication was then established with the salvage steamer *Brabant*, which later took charge of the *Citta di Elena*.



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

Testing for Self-Oscillation.

A READER who is situated very close to one of the main broadcasting stations makes use of a single-valve receiver without any provision for obtaining reaction. He receives very strong signals of excellent quality, but is puzzled by the fact that on touching the aerial terminal with his finger a loud click is heard, which he has always understood to be indicative of self-oscillation, and he cannot reconcile this with the fact that he makes use of no reaction, and at the same time is unable to produce a heterodyne beat note with the carrier wave of the local station in any position of his aerial tuning condenser.

The reason of the production of a click when the aerial terminal is touched is due to the stoppage of the strong oscillations induced in the aerial system by the emanations from the neighbouring transmitter. When in the neighbourhood of powerful transmitters, the customary test of touching the aerial terminal with the finger cannot be said to be reliable. If no heterodyne whistle can be produced when the neighbouring station is transmitting, it may be safely said that no oscillations are being produced by the receiver.

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Importance of Capacity Losses in Aerial Insulators.

A CORRESPONDENT who has experimented a great deal on the American transmissions makes use of a single-wire aerial, in which he uses very large insulators of the shell type at each end of his aerial. Recently he dismantled this aerial for cleaning purposes, and temporarily rigged up an aerial supported at either end by two small insulators of a cheap type, and was very much surprised to find that signal strength, particularly on the lower wavelength of KDKA, showed a distinct improvement over his permanent heavily insulated aerial.

The probable cause of this apparent anomaly is undoubtedly due to the fact of the much greater capacity of the larger insulators. It must be remembered that in the case of oscillatory current a condenser is as much a conducting path as is a direct wire, and the higher the frequency the more pronounced does this effect become. Consequently, when dealing with short waves, it is necessary to reduce the capacity of the insulators to as low a value as possible, otherwise a direct path to earth will be offered through the capacity existing between the actual aerial wire and the aerial supporting halyard across the dielectric formed by the insulator. While not in any way neglecting the D.C. ohmic resistance of the insulator, it is desirable to pay attention also to capacity losses, and in this respect a long, thin type of insulator would be preferable to short ones of excessive cross sectional area.

o o o o

A Stable Valve and Crystal Circuit.

A READER who is situated just outside normal crystal range of one of the main broadcasting stations requests us to furnish him with a circuit embodying two valves and a crystal with which he will be enabled to operate several pairs of telephones from the nearest broadcasting station, and at the same time be able to tune in one or two of the more distant broadcasting stations.

When considering the employment of two valves and a crystal it has become customary to connect up such a combination in the form of a dual amplification circuit. Whilst this arrangement is ideal in cases where very loud signals are required from the local station with a minimum number of valves, it must be admitted that the efficiency of an H.F. amplifier, when called upon to amplify at two frequencies simultaneously, is very much reduced; furthermore, it is not possible to use a very great degree of reaction before low-frequency buzzing commences.

By following the diagram given in Fig. 1 the experimenter will find that he has a circuit which is not productive of such great signal strength from the local station as a two-valve crystal reflex receiver, but at the same time is considerably more sensitive and easier to handle. By coupling the anode coil of the first valve to the aerial coil the full benefits of reaction may be obtained without any possibility of setting up low-frequency buzzing. It will be found that if used on a normal aerial and earth anywhere within crystal range of a B.B.C. station quite sufficient volume will be obtained from a loud-speaker for use in any ordinary room, whilst the quality of reproduction will be high.

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Restoring the Emission of a Dull-Emitter.

IF at any time a dull-emitter valve of the thoriated filament class has been overrun, due either to accident or carelessness, it will be found that the emission from the filament falls off considerably. The result is a great falling-off in efficiency, and unless the proper steps are taken, the valve will be permanently ruined. If the valve be lighted at a low temperature for a period of several hours with the H.T. battery disconnected, in many cases the valve will be restored, and once more do useful service. It is, however, doubtful whether the valve will ever again have the same efficiency as when new.

Another method sometimes advocated is known as "flashing." This consists of connecting the valve filament for a fractional space of time across the H.T. battery. A wire should be attached to each filament leg, one being permanently connected to one pole of the H.T. battery. The other wire should then be lightly brushed across the other pole of the H.T. battery. Great care should be taken, but as the valve will be useless in

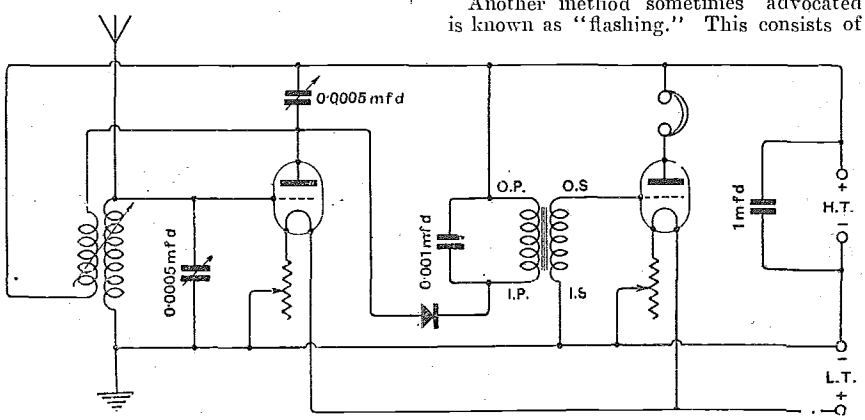

Fig. 1.—A two valve and crystal dual circuit.

any case, this method may be tried as a last resort. It is recommended, however, that the former method be tried out first.

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Uses of a Carborundum Crystal for Rectification.

THE use of a high-frequency valve preceding a crystal rectifier is a practice which has always been popular among amateurs, since it combines the clear reproduction and simplicity of a crystal receiver with the sensitivity of a valve set without greatly adding to the trouble of maintenance and operation, as it is quite possible to use a dull emitter operated from dry cells entirely.

One difficulty, however, which has always been present, is the uncertainty

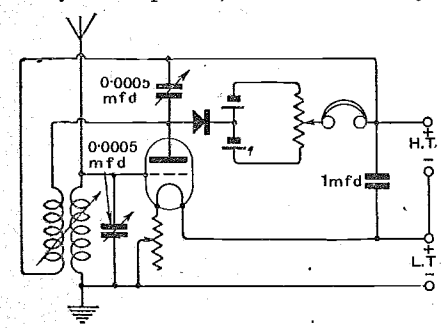

Fig. 2.—Circuit arrangement where a high-frequency valve is followed by a crystal detector.

of the crystal detector adjustment, and although many excellent attempts have been made to produce reliable crystal detectors of the permanent type, it will be found that one of the most reliable "permanent" detectors which can be used is the carborundum crystal with potentiometer adjustment.

Instead of employing a light catwhisker contact, firm pressure is made on to the crystal with a flat steel plate or with a rigid point such as a gramophone needle, which is excellent for this purpose. In order to obtain best results from this crystal, it is necessary to operate it on the correct point of its characteristic curve, and this is effected by applying an initial potential to it by means of dry cells and a potentiometer. A suitable circuit is illustrated in Fig. 2. This circuit will be found to be sensitive, and at the same time very constant in its action. Actually, the crystal contact can be set and not touched again for some considerable time, but a slight readjustment of the potentiometer should be made at the commencement of every period of listening-in.

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Definition of Grid Potential.

WHEN speaking of applying a negative grid bias to the grid of a valve many readers are puzzled as to the exact meaning of this term, and they frequently enquire why the grid cannot be biased negatively by connecting the grid return lead to the negative side of the accumulator.

When we say that the grid of a valve is biased two volts negatively or two volts positively, it is obvious that we must have some fixed standard of potential to work upon, otherwise the term becomes meaningless. When the grid is made two volts negative it indicates that it has been made two volts more negative than the fixed standard, which is the negative side of the filament. Obviously, if we connect the grid return lead to the negative pole of the accumulator, the grid will be at the same potential as the negative side of the filament, assuming that no external filament resistance is used in the circuit, whilst connecting the return lead to the positive side of the accumulator will give the filament a positive bias of two, four, or six volts, according to the type of accumulator used.

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Filament Control by Means of Jacks and Plugs.

THE switching of L.F. amplifiers by means of plugs and jacks instead of the conventional two- and three-pole switches is coming more and more into popular favour, since it cannot be denied that these components tend to greater simplicity in wiring than do the switches. Many readers have informed us that they are adopting this method of switching their sets, but are puzzled concerning the correct connections of the six-point jacks which have provision for filament control.

In order to clear up these uncertainties, we show in Fig. 3 a typical three-valve set, consisting of a detector valve followed by two stages of low-frequency amplification, provision being made by means of plugs and jacks to use either one, two, or three valves as desired. Until such time as a pair of telephones or the loud-speaker are plugged into one of the jacks, all batteries are disconnected, and, of course, the filaments do not light. Upon thrusting the telephone plug into the first jack, the detector valve only lights up, and the telephones are brought into the anode circuit of this valve. Plugging the telephones into the second jack causes the first two valves to light, and if it is desired to use all three valves, the telephone plug is inserted into the final jack. Since it is only necessary to withdraw the telephone or loud-speaker plug in order to disconnect all batteries, the set will be found very convenient and suitable to be placed in the hands of people having no knowledge of wireless, but who desire to listen to the broadcast programmes, since they can simply thrust the telephone or loud-speaker plug into any jack, according to the volume desired. Of course, if it is desired to use several pairs of telephones, a distributing board may be attached to the plug, or one of the new type plugs can be obtained, having several pairs of terminals attached to the "handle." The connections of those portions of the jacks controlling the lighting circuit should be very carefully made. A separate H.T. tapping may be used for each valve, but in order to simplify the diagram these connections are purposely omitted. Connection is, of course, made from the "bracket" of each jack to a tapping of the H.T. battery.

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Care of Accumulators.

WHEN the accumulator has been in use for several weeks it will frequently be found that the level of the electrolyte has fallen below the level of the top of the plates. This should be remedied immediately, otherwise the uncovered portion of the plates may rapidly disintegrate. The remedy lies in the adding of distilled water and not of diluted sulphuric acid, as many people seem to suppose. The specific gravity of the electrolyte in an accumulator should be in the neighbourhood of 1.250, and if acid is added to cause this deficiency, the specific gravity will be increased, with disastrous results to the plates. This remark only applies to losses by evaporation; losses due to actual spilling of electrolyte are made up by adding acid of the correct specific gravity. The addition of water in the latter case would lessen the specific gravity, which would be equally detrimental to the accumulator. When evaporation takes place it must be remembered that it is only the water component of the electrolyte which evaporates, consequently only water must be used to make up the deficiency. When electrolyte is actually spilled, however, it is obvious that it is not only the water component which is lost, and so actual acid of the correct density must be added.

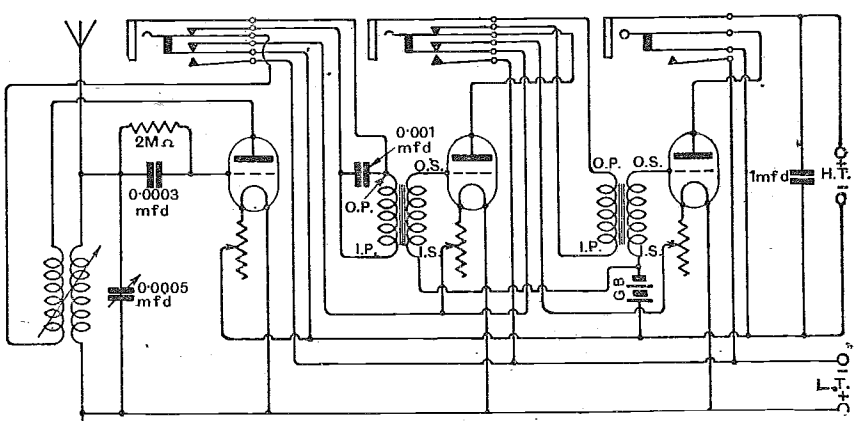

Fig 3.—A method of switching L.F. amplifiers by means of plugs and jacks.