The WIRELESS WORLD AND RADIO REVIEW

CERTIFIED TESTS.

ON the occasion of a recent visit to the Testing and Research Departments of the National Physical Laboratory the idea immediately occurred to us that something might be done with regard to subjecting wireless apparatus and component parts to certain routine tests for the purpose of indicating their reliability and that they are built to conform to certain standards.

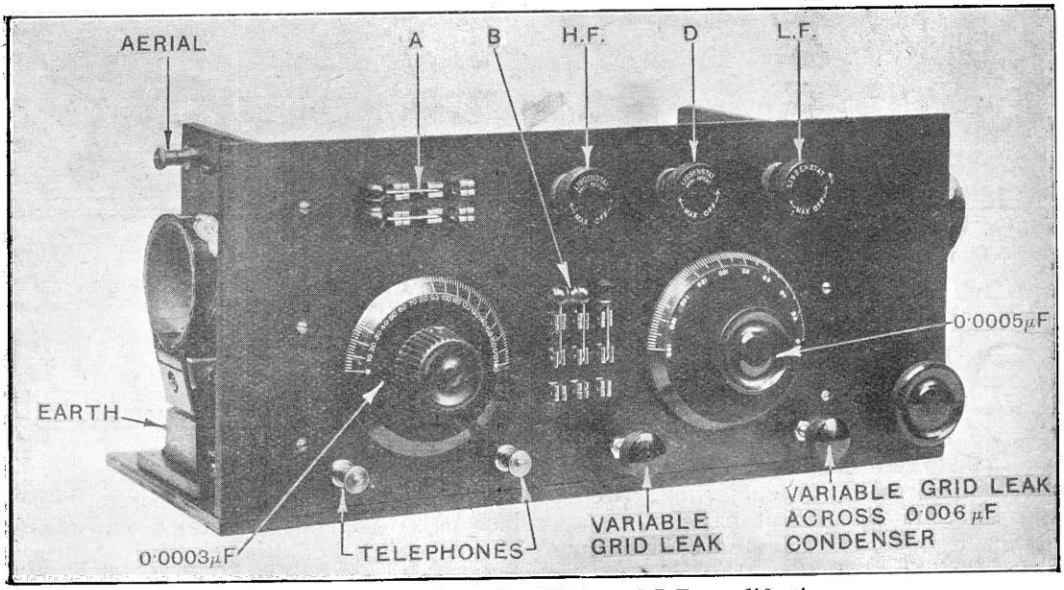
Wireless, like all other new sciences in their day, is victimised to a great extent by individuals who make wild claims concerning the merits of their own products, whilst the manufacturer of correctly designed apparatus which represents honest value has very little means at his disposal for obtaining an endorsed statement concerning the operation of his goods. He may thus be placed in a position by which unfair competition arises, but he is not the only sufferer. The user, in being guided by unqualified statements, may find that he has an instrument which is not necessarily the best of its class and for which he may have paid a top price.

Now it would seem to us that the testing of the many wireless component parts is just as important as the testing of the merits of the component materials used in general electrical work. Apart from the scientific interest, wireless components are not always handled by essentially skilled individuals of the scientific class but are purchased by those without testing facilities, and just as a clinical thermometer may be certified to be correct over a portion of its scale, so should an intervalve transformer be certified to function with reasonable accuracy of magnification over the band of usual note frequencies.

Testing work of this sort is carried out by the National Physical Laboratory, yet how often does one see stated the results of such tests? For although these tests may be carried out on behalf of the manufacturers who are interested in putting the best apparatus on the market, one cannot go to the National Physical Laboratory and inspect the amplification curve of a particular transformer.

It may be said that testing work of this nature could be carried out by a wireless journal whose technical accuracy is beyond dispute, but it will at once be appreciated that this work could not be done without conspicuously drawing attention to the relative merits of various instruments, and such tests might be a little unfair. In our Test Department we have carefully examined the performance of various valves and these results have been published for the benefit of readers, but it would not be possible to extend such test work to anything else other than valves, for the valve manufacturers are few in number and their products in every case represent the greatest technique that it is possible to introduce into their products.

The testing of apparatus by an authoritative body would appear to be a service that every wireless user needs, whether experimenter or broadcast listener.



Flewelling Receiver with optional H.F. and L.F. amplification.

THREE-VALVE SET INCORPORATING A FLEWELLING CIRCUIT.

Many experimenters favour the Flewelling circuit, and details are given here for extending the scope of this super circuit by the addition of high and low frequency amplifiers. The Flewelling arrangement, when preceded by a high frequency circuit of the type described, is found to be quite stable and give consistently good results.

By Stanley Cursiter, O.B.E.

THE set described in this article was designed to give results under particular circumstances. A relay station at two miles or so and a main B.B.C. station at between 30 and 40 miles could both be got on one valve, but other stations at 100 miles or more made a second, and for longer distances, a third valve desirable. This also suggested the necessity for switching so that the detector alone or with either one stage of H.F. or L.F., or all three could be used as required. In making up the set one or two features of the design are capable of adaptation to any three-valve set of the same order, and in describing this set in particular their application to other circuits need not be lost sight of.

In the first instance a single valve Flewelling circuit was experimented with and the excellence of the results prompted the hope that it might be extended further. In Figs. 1 and 2, two versions of the circuit

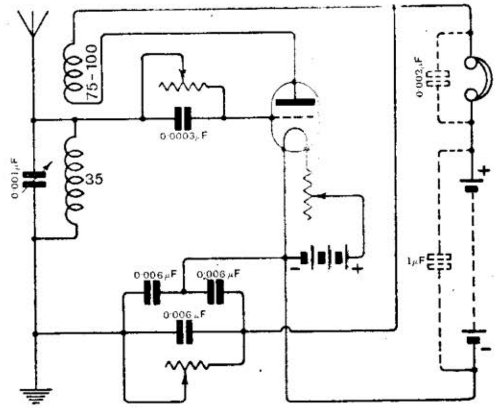


Fig. 1. The original single valve Flewelling circuit from which the circuit of the three-valve receiver is developed.

are given, Fig. 1 being the original form as given by Flewelling, and No. 2 a simplified circuit which he subsequently published. In the end the original form with the bank of three 0·006 condensers was adopted—not because of any superiority of results, but because it seemed that the extra condenser capacity gave a richer and fuller tone, an effect which was added to by the addition of condensers across the phones and H.T. battery (shown dotted), but which in reality only repeat the function of one of the 0·006 condensers.

The single 0·006 condenser version is an excellent circuit though very critical, and it will be found that results depend largely on the quality of the components.

The next stage was a simple L.F. note magnifier. As this does not differ from the accepted practice it calls for no particular

in the *Wireless World and Radio Review* of October 31st, 1923, page 156, was first adopted but it was not completely successful

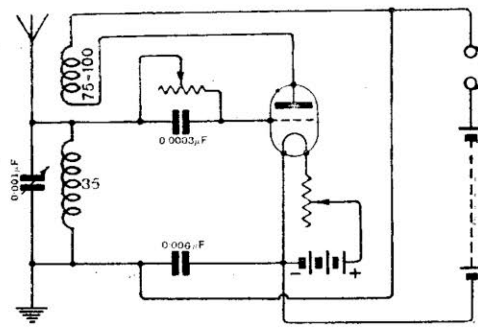
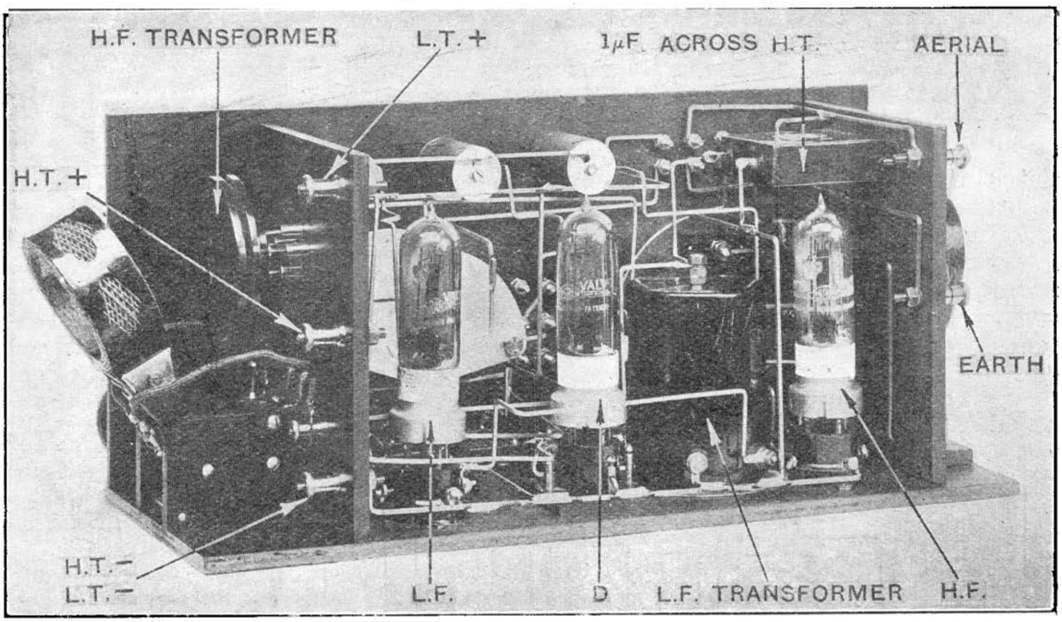


Fig. 2. Simplified Flewelling circuit.

as it was found necessary to tune both the primary and secondary transformer coils



Rear view. The vertical brackets not only support the front panel, but carry several of the components.

description. The circuit is given in Fig. 3. It makes a splendid receiver, but requires to be used with care and a proper respect for the reaction coil.

The problem of adding a stage of H.F. presented some difficulties and various means of coupling to the detector were tried. A three-coil arrangement as indicated

and also vary their inductance by the coil holder, making a series of adjustments too complicated for easy manipulation. A variety of transformers were tried using coils of different types, including basket, lattice, honeycomb and duo-lateral, wound on top of each other and side by side. For convenience these were mounted in an ordinary coil mount to plug into the aerial coil holder of the Flewelling detector with leads from the one coil to the plate and H.T. + of the H.F. valve. (At this stage winding led to standard pin transformers of the flat type being used and, as arranged in the set, reaction is obtained on the transformer with perfectly satisfactory results.

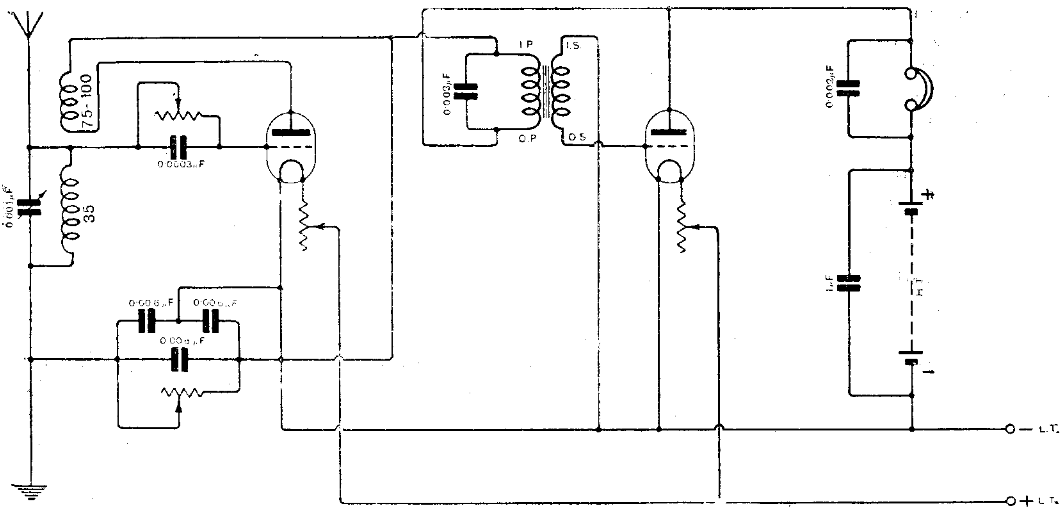


Fig. 3. Flewelling circuit with note magnifier.

the three units were in separate parts and linked up in the usual way in a table layout).

It was found that a transformer of two lattice coils wound on top of each other was in many ways most satisfactory, but in the end the desirability of using standard parts which would allow a large range of wavelengths without undue exertions in coil

In Fig. 4 the circuit and switching are shown and the values of the components noted. In the lay-out, which the photographs make clear, it will be seen that the set is built on a front panel, baseboard and two end pieces. The end-pieces carry at one side the aerial coil and at the other the two-coil holder, the latter carrying the aerial coil for the detector if the H.F. is switched off.

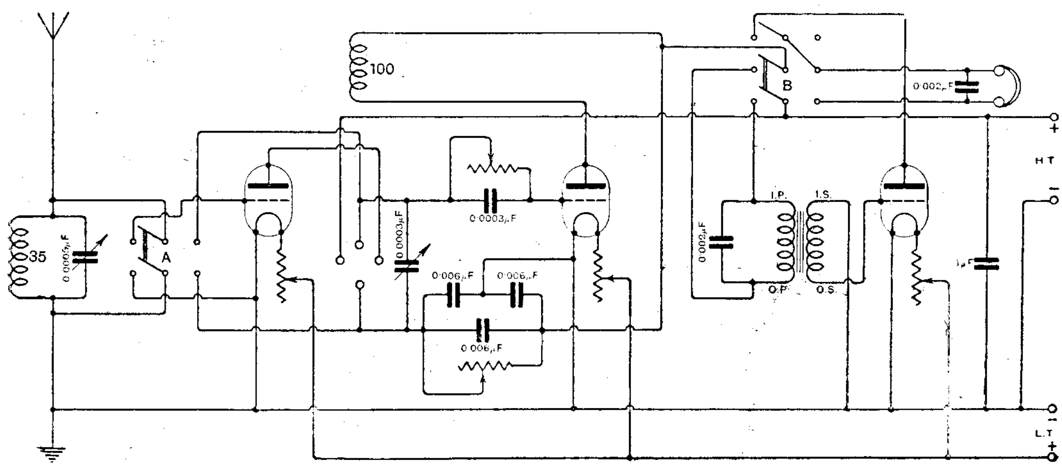
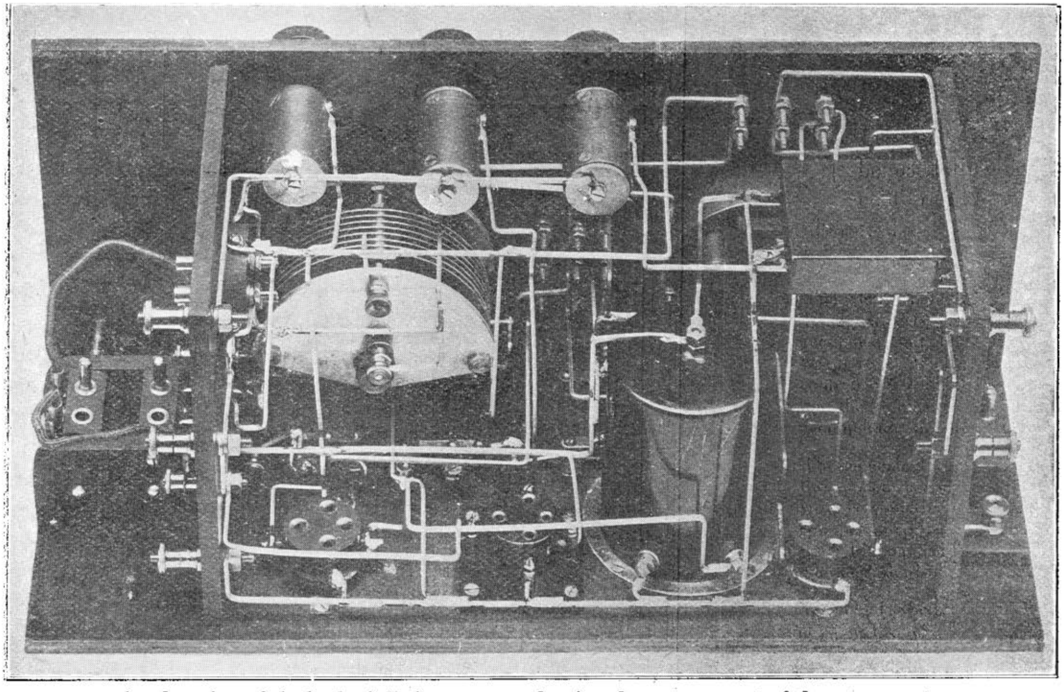


Fig. 4. Flewelling circuit showing method of adding H.F. amplification. Switches are introduced for bringing the H.F. and L.F. circuits into operation.

The moving unit carries the reaction coil. In line with the centre of the reaction coil, on the end-piece, is the valve socket into which the pin transformer is plugged. The front panel is continued beyond the end-pieces so that with the reaction coil closed up the whole set is within the parallelogram of the front panel.

The aerial coil is connected to the 0·0005 variable condenser and the centre points of the double-pole switch "A," by which it will be seen that the condenser can be connected to the H.F. valve. With the H.F. cut-out, the 0·0005 and 0·0003 condensers are placed in parallel to tune the detector and L.F. With the switch "A" to the left and the transformer in place, the H.F. is in circuit. With the switch to the right, the transformer removed and the aerial coil in the fixed unit of the two-coil holder, the reaction is directly on to the aerial coil and the two variable condensers in parallel give the finest shades of tuning.

Here it should be noted that the connections to the pin transformer are shown as seen from the back or looking at the legs; but all makes of transformers do not agree in their methods of winding and it is wise to make some preliminary trials to see if the connections given fit the type of transformer used. Also the connections to the reaction coil and to terminals from the plate of the detector and middle point of switch "B" on the end-piece should be of flex. This allows the connections to be reversed when the aerial coil is used to replace the transformer; an extra switch could be arranged to do this, but the use of terminals and flex is simpler and saves some complexity of wiring.



Another view of the back of the instrument, showing the arrangement of the components.

However, all these replacements are not necessary. By simply turning switch "A" to the right and leaving the aerial coil and pin-transformer in their original positions, the transformer becomes a sort of extension of the aerial coil and gives quite good results at a very small sacrifice of signal strength.

The $1\mu F$ fixed condenser across the H.T. battery is at the opposite end of the set from the H.T. terminals and this has some advantages in the distribution of energy.

Some attention has been given to the placing of the wire, and with the terminals all to the back, the most direct routes have been selected. The switches made for some complexity and the fact that the set was designed in an almost too compact form made the assembly a matter of alternate hope and despair. The writer recommends a table lay-out as a preliminary ; the intending constructor can then adopt any plan that suits the form of the components.

It is a debatable question whether the Flewelling used in this way has any demonstratable advantages, but even if it has no value above that of a well balanced single-valve circuit it has no disadvantages. Used as a one-valve receiver or with the valve and L.F., it is a most acceptable circuit and of the greatest interest to the experimenter.

It is not perhaps a circuit for the novice, but in the hands of an experienced operator it need not be the cause of the slightest interference, and with a stage of H.F. it seems to have less disagreeable ways than many variations of the tuned anode arrangements.

WIRELESS IN A MINE.

Bristol Society's Interesting Experiments.

Above : A group of members listening-in 1,500 feet below the surface.

Below : Mr. L. W. J. Silcocks **(5 KM)** *operating his transmitter at the pit head.*

Interesting experiments in the transmission of wireless messages into a coal mine at Midsomer Norton were carried out by members of the Bristol and District Radio Society on Saturday, June 21st.

A R.A.F. transmitter was used with a short aerial run over some coal trucks. The bottom of the mine is 1,500 feet below the surface and at the foot of the shaft the first aerial was slung up, another being fixed in a pump room. In addition to the Club receiver a number of portable sets with self-contained or loop aerials were used by individual members.

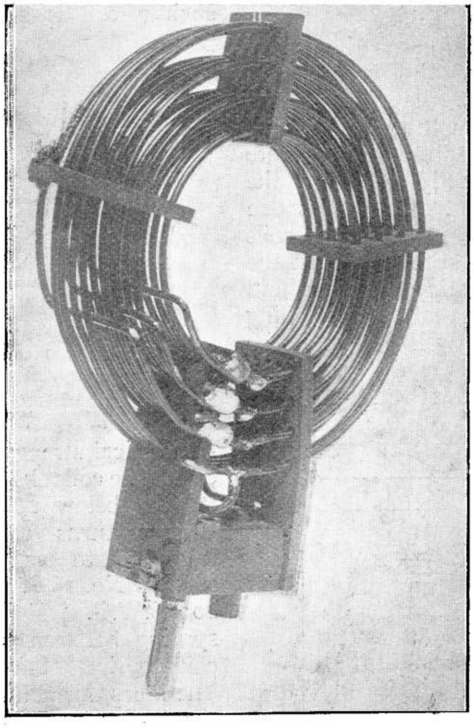
Transmissions from the surface were carried out by Mr. W. J. Silcocks (**5 KM**) and Mr. W. A. Andrews (**5 FS**) on a power of 2 watts, and signals were received with a fair measure of success.

LOW LOSS INDUCTANCE COILS

A new form of interchangeable inductance coil having low losses and of simple construction. Air dielectric coils are becoming increasingly popular, and in order to minimise losses dead-end turns must be avoided. The loss due to the plug and socket holder is inappreciable, and the plug-in coil is convenient for the purpose of coupling.

By F. H. HAYNES.

ATTENTION has recently been devoted to the construction of tuning coils having minimum losses and in this connection experiments have been made with various forms of inductances for the purpose of determining those patterns which deliver a maximum energy to the detecting or amplifying apparatus. It is admitted, of course, that the ratio of inductance to capacity employed in the tuning circuit to produce maximum efficiency will depend upon the wavelength to which the circuit is to tune and upon the constants of the aerial system to which it is connected, but apart from such considerations as these, there are certain fundamental aims in the design of the tuning inductances themselves which lead to improved reception.



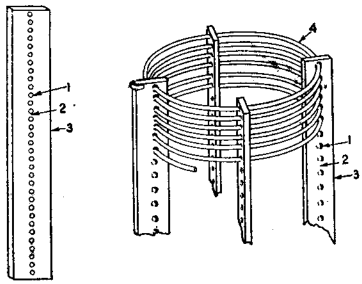
Low loss plug-in coil of strong construction wound with No. 16 enamelled wire.

Foremost among the causes of loss of efficiency in tuning inductances is the capacity which is present between the turns and the dielectric loss brought about by the insulating material. The writer has made tests with coils of various designs which show conclusively that coils having air dielectric are superior to those in which solid dielectrics are employed and particularly is this the case when tuning to short wavelengths, say below 600 metres.

The difficulty in the construction of an air dielectric coil is that of rigidly supporting the turns without adopting a design embodying a great deal of precision in instrument work. A description has already been published of solenoid coils making use of insulating strips for supporting the turns.* The construction consisted of shaping the turns of wire by bending round a former of suitable size and threading the spiral thus produced on to four insulating strips with uniformly spaced holes. Such a coil is not very difficult to construct, but as the number of turns increases it will be found that the friction between the strips and the turns of wire increases so much that the finished solenoid is apt to be tapering towards one end. It will be observed moreover that there is almost a limit to the number of turns that can be threaded on to the strips, for as the number of turns increases,

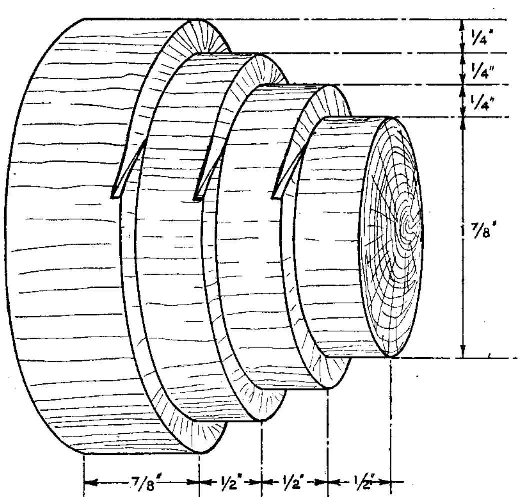
* Page 613, February 13th, 1924.

the friction becomes proportionally greater and there is difficulty in forcing the strips along the wire. Another objection exists inasmuch as the drilled strips are very liable to break, owing to their thinness and the weakening of them by the drilling of the holes.



An air dielectric solenoid inductance, made by threading the drilled strips on to a wire spiral.

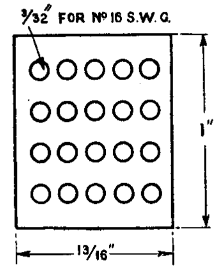
Solenoids thus built up can be easily tapped out to tune to the required wavelength, but it became apparent that by making use of only a portion of a tuned coil that a loss of efficiency might arise and it is therefore desirable to use coils embodying exactly the required number of turns. This leads one to make use of interchangeable plug-in coils and although it may be suggested that the customary form of mounting with pin and socket is not good, tests reveal that providing the socket connection is well designed, the losses arising through this cause are almost negligible, whilst the great advantage is secured of interchangeability with standard coils, and inductances of various sizes. A single layer solenoid coil too, requires more turns to produce a given inductance than a coil of more compact design, and bearing this and the foregoing points in mind, a plug-in air dielectric coil of the type shown in the accompanying illustrations was designed.



Former for shaping the turns for the several layers.

In this coil the long supporting strips with a tendency to snap are dispensed with and replaced by rectangular pieces. The difficulty of building a long single layer coil, owing to friction between turns and insulating pieces, is also overcome as considerably fewer turns are employed for each layer, whilst the finished inductance is much more compact and is interchangeable in a standard holder with other inductances.

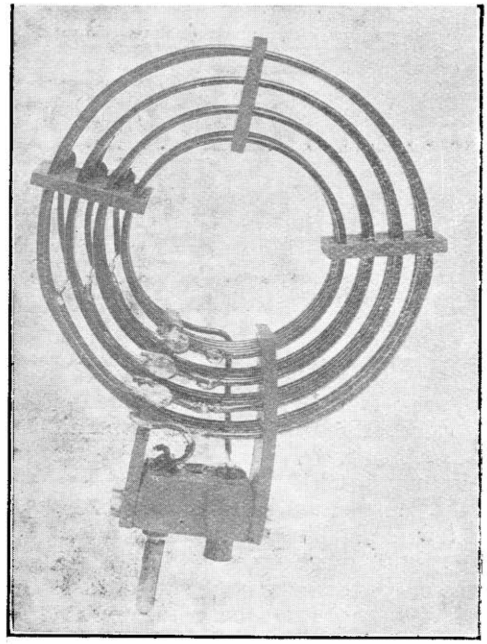
The gauge of the wire selected for winding such a coil is governed primarily by the mechanical strength required in the finished coil. The coils shown are for tuning to wavelengths below 200 metres and have only twenty turns and consequently it was necessary to employ a heavy gauge wire such as No. 16 S.W.G. Wire as fine as No. 20 S.W.G. might be used where the spacing between the turns is less and the coil consists of a larger number of turns. The holes through which the wire has to pass should be about a third as large again as the diameter of the wire in order to simplify construction, for it will be found that the turns will lie quite uniformly together and remain quite evenly spaced as the turns will probably engage on one particular side of the holes.



The supporting pieces. Being almost square they are much stronger than the strips formerly employed and are easier to wind.

To shape the wire, a wooden former was made, having in this instance, four rings of decreasing diameter and of the requisite total width. Rotating this former it was only necessary to wind each face full and then continue on to the next smaller face by passing the wire over a small cut to prevent the turns slipping. With all the four surfaces wound full the wire is allowed to run slack and is cut up into four coils each comprising the same number of turns. It is quite easy now to thread the ebonite spacing pieces on to the smallest coil and then to proceed to fit the other coils on to the ebonite pieces in turn. All four coils are thus wound in the same direction and they are connected in series by linking across the finishing end of one with the commencing end of the next.

A method of attachment for the pin and socket holder can be seen from the photograph and the tension put upon the ebonite strips which causes them to bend, produces a very firm grip upon the turns of the inductance. The wire employed in this instance, as with the coils previously described, has an enamel covering in order that the surface may not become oxidised, which would give rise to an increase in the high frequency resistance of the winding.



Another view, showing the spacing between the layers.

THE CRYSTAL DETECTOR IN THEORY AND PRACTICE—V.

THE DIRECTION OF RECTIFIED CURRENT IN CRYSTAL DETECTORS.

By JAMES STRACHAN, F.Inst.P.

A VERY large majority of crystal rectifiers give a rectified current which is constant in direction with reference to the loose contact. This may be either + *ve* or —*ve*, according to the composition and nature of the crystal. A few crystalline substances give both + *ve* and — *ve* currents from different spots on the same crystal, but in these cases it has been observed from repeated experiments that the current is much stronger in one direction than the other—generally three to four times stronger—so that even in such cases when the detector is adjusted to work at its maximum efficiency we may regard the direction of the rectified current as constant.

In dealing with this subject it is necessary for convenience to describe a crystal as + *ve* or —*ve* according to the direction of the rectified current flowing across it. A positive crystal is one in which the crystal is + *ve* and the metal point or "catwhisker" — *ve* with reference to the rectified current flowing across the loose contact, while a negative crystal is the reverse.

In the case of crystals which are both + *ve* and —*ve*, all of which are natural minerals, it is interesting to note that any attempt to associate the + *ve* and — *ve* spots with particular crystal faces or planes of symmetry failed absolutely, and it was frequently found that + *ve* and — *ve* spots occurred on the same sensitive plane.

Table I. gives a number of such crystals and shows how much stronger the current is for one sign than the other. These figures are based on experiments with a number of specimens in each species.

It will thus be noted that for all practical purposes natural galena and zincite are — *ve*, while molybdenite is + *ve*.

All other crystals examined gave only one sign. It is interesting to observe the signs of natural and synthetic galena and various compound sulphides containing lead sulphide (Table II.).

TABLE I.

Name of Crystal.	Composition.	+ve current m.a.	—ve current m.a.
Galena ..	$Pb\ S$ ..	·25	·75
Molybdenite	$Mo\ S_2$ ..	·5	·1
Zincite ..	$(Zn\ Mn)O$ ..	·3 to ·5	1 to 1·5
Jamesonite..	$2\ PbS{\cdot}Sb_2S_3$	·75	·25
Stromeyerite	$Cu_2S{\cdot}Ag_2S$ ..	·3	·1

TABLE II.

Name of Crystal.	Composition.	Sign.
Galena (natural)	$Pb\ S$ ..	— ve (+ ve weak)
Galena (synthetic)	$Pb\ S$ ..	+ ve
Galena (synthetic) with traces of tin sulphide.	$Pb\ S$ with traces $Sn\ S$	— ve
Galena (synthetic) with traces of silver sulphide	$Pb\ S$ with traces $Ag_2\ S$	+ ve
Sulphide of lead and silver.	$Pb\ S{\cdot}Ag_2\ S$	+ ve
Jamesonite ..	$2\ Pb\ S{\cdot}Sb_2\ S_3$	+ ve (—ve weak).
Bournonite ..	$3(Pb\ Cu_2)S{\cdot}Sb_2\ S_3$.	— ve
Frieslebenite ..	$5(Pb\ Ag_2)S{\cdot}2\ Sb_2\ S_3$.	+ ve

It will thus be seen that the sign of lead sulphide is affected by its composition. Similar variations have been observed in the cases of lead selenide (Pb Se) and lead telluride (Pb Te) in combining these substances synthetically with other metallic tellurides, selenides and sulphides. It may be noted in passing that all the galena-type proprietary crystals examined, including all the well-known brands, were constantly and strongly + *ve* in sign.

Table III. gives the sign for a selection of the more useful crystals or those frequently referred to in the literature of the subject.

TABLE III.

Name of Crystal.	Sign.
Galena (natural)	— ve (+ ve weak).
Galena (synthetic)	+ ve
Zincite	— ve (+ ve weak).
Iron pyrites	— ve
Iron pyrites (marcasite)	— ve
Copper pyrites (most specimens)	+ ve
Copper pyrites (a single example)	— ve
Tin pyrites (stannite)	+ ve
Covellite (copper sulphide) ..	+ ve
Silicon (fused)	+ ve
Carborundum	— ve
Molybdenite	+ ve (— ve weak).
Graphite	+ ve
Tellurium	+ ve
Cassiterite (tin binoxide) ..	— ve
Magnetite	+ ve
Cerium oxide	+ ve
Ilmenite	+ ve
Lead and silver telluride ..	— ve
Lead and gold telluride.. ..	+ ve

Thus out of a fairly representative selection of crystals about 60 per cent are + *ve* and 40 per cent — *ve* in sign.

The above signs are, of course, taken with reference to a metallic point or "catwhisker." In the case of zincite-crystal combinations the other crystal may be regarded as the "catwhisker," and as already observed, this crystal should not be a pronounced rectifier, but a good conductor. Bornite, which has been found to be very weakly — *ve* in sign, is ideal for this purpose and a sharp point of this crystal may be used advantageously in conjunction with any other crystal of approximately the same degree of hardness. It is not subject to rapid atmospheric oxidation, and in this respect is better than copper or bronze points.

With regard to crystal-crystal combinations generally, it is found that two different crystals, both being good rectifiers and of opposite sign, oppose each other in rectification, while two of the same sign give at best only about fifty per cent. of the rectified current obtainable from one only with a metal point. Crystal-crystal combinations therefore are only effective when one of the crystals is neutral, or nearly so, and thus takes the place of the "catwhisker."

The sign of a crystal may of course be most easily found out by including a galvanometer (a milliammeter or microampmeter) in series with or switched in shunt across the phones, but where a galvanometer is not available the sign may be determined by placing a crystal detector of known sign in series with the one to be tested. When the two rectified currents oppose each other the one neutralises the other more or less completely, and reception is nil, or very weak, but when the two rectified currents are flowing in the same direction reception is normal. The detector of known sign should be reversed several times in order to make certain of these directions.

A knowledge of the direction of the rectified current in a crystal detector is useful and necessary to obtain the best results from this apparatus.

In a simple crystal circuit it will be found that with good 'phones slightly better results are obtained by connecting the latter up in a particular direction. In the majority of standard makes of telephones the terminal leads are marked + *ve* and — *ve* for this reason, and also because the passage of even a weak current through the 'phones in the wrong direction gradually weakens the permanent magnets of the receivers. In the case of sets situated near to a B.B.C. station where it is possible to work a loud speaking telephone with fair results, this effect is most marked.

In the case of a crystal circuit using an applied potential through a potentiometer the best results are obtained when the applied potential is directed in the natural direction of the rectified current from the crystal. When the applied D.C. current is passed in the reverse direction, a slightly higher potential is necessary, the crystal is not quite so sensitive to reception and just about the neutral point where the applied potential is neutralising any rectified current flowing in the crystal circuit serious distortion may result.

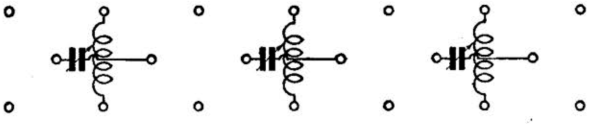
In the case of the addition of a low frequency amplifying valve to a crystal set it is obvious that a knowledge of the direction of the rectified current is essential to obtain the best results. This is more marked in the case of dual circuits where one valve amplifying both H.F. and L.F. is followed by a crystal rectifier. In several cases I have seen an L.F. transformer getting the blame of distortion which was caused by the crystal detector being inserted in the wrong direction. In all valve-crystal circuits the current flow should be checked up to various points with a galvanometer.

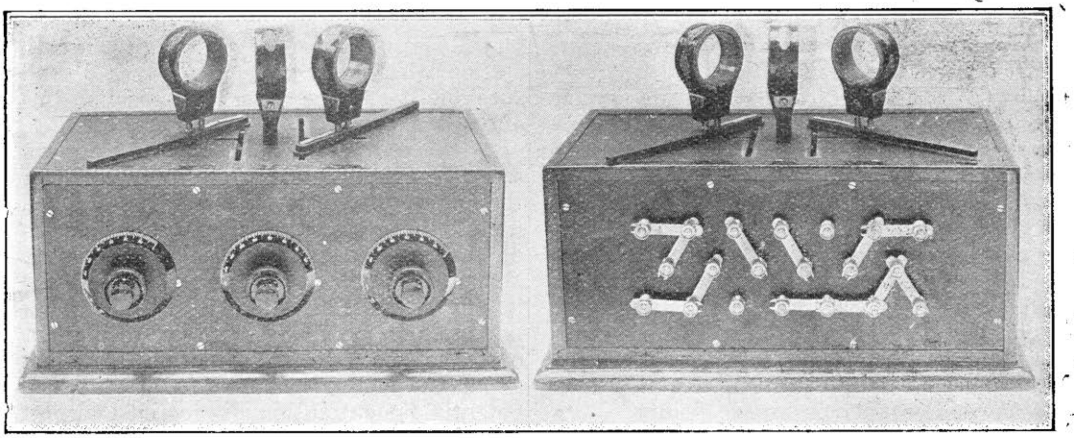
The makers who supply proprietary crystals would be well advised to mark their packages with the sign of the crystal, and to give all the information they can about its properties. Particularly in the case of synthetic galenas is this necessary, because the + *ve* sign of many of these crystals is reversed by heating them for too long a time or at too high a temperature in fusible alloy, and the resulting — *ve* crystal is generally no better than natural galena in its rectifying powers.

CHAPPELL TUNER.

The tuner shown in the accompanying photograph has been arranged to combine the greatest variety of uses with the simplest design. There are no complications such as series parallel, tuned stand-by or reaction reversing switches.

The three tuning coils and the three condensers are connected to a terminal board on the back of the instrument, the terminals being spaced so as to form the vertices of equilateral triangles in accordance with the accompanying diagram. By means of the connectors, any single, loose coupled or variometer circuits can be quickly set up. Extra terminals facilitate connections to aerial, earth, grid, etc. The coil holder shown here is the Ward-Heatly, which allows of a 180 degrees movement to each of the two moving coils by means of elliptic trammel mechanism. Condensers are Sterling square-law, fitted with vernier.





REFLEX RECEIVERS.

A description of reflex receivers arranged and connected in a different manner to that ordinarily employed by experimenters.

By W. JAMES.

PROBABLY the majority of the readers of this journal are acquainted with the reflex circuit of Fig. 1. The aerial is connected to a coil L_1, which is tightly coupled to the secondary tuning coil L_2. A variable condenser C_1 is connected across this tuning coil and tunes it and the aerial circuit. It should be noted that the use of a coil in the aerial circuit in this way does not make the aerial aperiodic.

Tuning may be made fairly sharp by correctly proportioning these coils; in general, as the number of turns in L_1 are reduced, tuning becomes sharper and the signal strength less. The best number of turns depends largely on the constants of the aerial, and can be found experimentally. If a large aerial is used, L_1 may consist of about 15 turns of No. 20 D.C.C. wound over one end of L_2. When a small aerial such as an indoor aerial is employed, it is generally better to dispense with L_1, and to connect the aerial to the grid end of the secondary coil L_2; L_2 may consist of 60 turns of No. 22 D.C.C. wound on a former $3\frac{1}{2}$ ins. in diameter. This connection is recommended because a small aerial naturally lends itself to selective reception, and the use of coil L_1 would result in very weak signals.

The anode circuit contains a tuned circuit C_2 L_3, which has the usual values, namely 0·0002 microfarad and 350 microhenries (80 turns No. 26 D.S.C. $2\frac{1}{2}$ ins. diameter), and across a portion of the anode coil are connected the crystal detector and primary winding of the reflex transformer.

Notice particularly that the detector is connected across only part of the anode coil L_3. Most crystal detectors of the wire contact type, which are the sort usually employed by experimenters, have a fairly low resistance, and if they are connected across the whole of the anode circuit, the anode circuit is heavily damped, and besides the signal strength being less than it need be, the selectivity is reduced. The disadvantage of employing ordinary plug-in coils in a circuit of this kind lies in the difficulty in securing reasonable selectivity because the crystal is usually connected across the ends of the plug-in coil.

The secondary winding of the reflex transformer is connected between the filament battery and the tuned grid circuit, a by-pass condenser C_3 being employed to carry the radio frequency currents between this circuit and the filament.

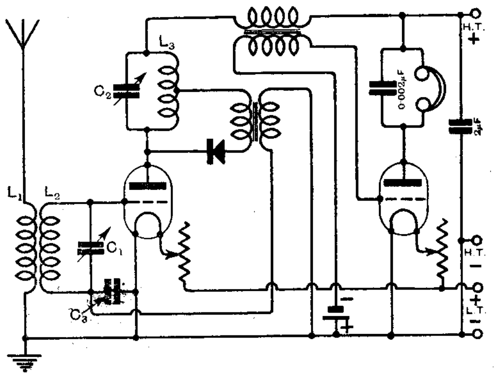


Fig. 1. A simple reflex receiver giving one stage of H.F. amplification and two of L.F. amplification. Notice that the crystal circuit is connected across only part of the anode coil L_3.

The operation of this circuit is as follows: Incoming signals flowing in the aerial are transferred to the secondary circuit by the coupling between coils L_1 and L_2, and are applied to the grid and filament of the valve. Amplified signals appear in the tuned anode circuit C_2 L_3, are rectified by the crystal detector, and transferred by the reflex transformer coupling to the grid circuit. The low frequency signals are then amplified and pass to the second valve through the intervalve transformer.

It will be noticed that the purpose of the condenser C_3 is to provide a break in the grid circuit so that the L.F. voltages may be applied between the grid and filament, but yet to provide a path of low impedance to the H.F. currents. If no condenser were connected here, the H.F. currents would reach the filament through the capacity of the secondary winding of the reflex transformer, and a proportion might pass through the capacity between the windings of the transformer to the anode circuit.

The value of condenser C_3 is usually fairly critical, and depends a good deal on the constants of the transformer. If it is too large, the higher frequency elements of the speech frequency voltages set up across the secondary of the reflex transformer may send currents through it.

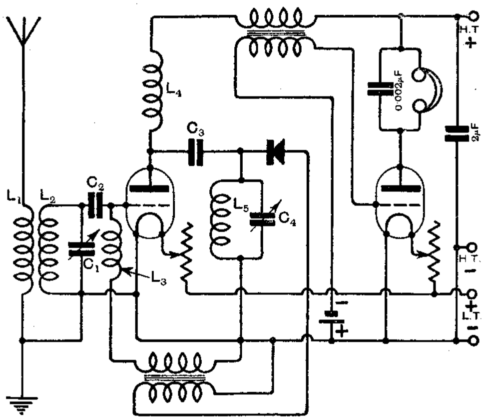


Fig. 2. A reflex receiver giving one stage of H.F. and two of L.F. amplification. It is usually easier to operate a receiver connected in this way than that of Fig. 1.

Difficulty is sometimes experienced in stabilising a circuit of this type, and it is essential that the experimenter should experimentally determine the best value of condenser C_3 and the most suitable proportion of the coil L_3 across which to connect the crystal detector circuit. When the circuit is carefully proportioned, very good results may be obtained.

It is, however, generally easier to operate a circuit of the type shown in Fig. 2. In this circuit, the incoming oscillations are applied to the grid of the first valve through a small capacity condenser, C_2. The anode circuit contains the high frequency choke coil L_4, which is connected to the positive terminal of the anode battery through the primary winding of the intervalve transformer, and a second tuned circuit comprising coil L_5 and tuning condenser C_4, which is joined to the anode through the fixed condenser C_3 and to the filament battery. Incoming oscillations are therefore amplified and appear in the coil L_4 and the tuned circuit L_5 C_4.

The degree of amplification is determined by the efficiency of the choke L_4 and the tuning of L_5 C_4.

As explained in connection with Fig. 1, the crystal detector is connected across as much of L_5 as is consistent with good signals and selectivity.

Rectified signals are applied to the grid of the first valve through the high frequency choke coil L_3. Condenser C_2 should have such a capacity that it will pass the high frequency currents to the grid of the valve without hindrance, but yet will not pass low frequency currents. Coil L_3 must pass the low frequency currents, but not allow high frequency currents to leak to the filament.

The amplified low frequency signal appears in the anode circuit, which includes the primary winding of the intervalve transformer, and is amplified by the second valve.

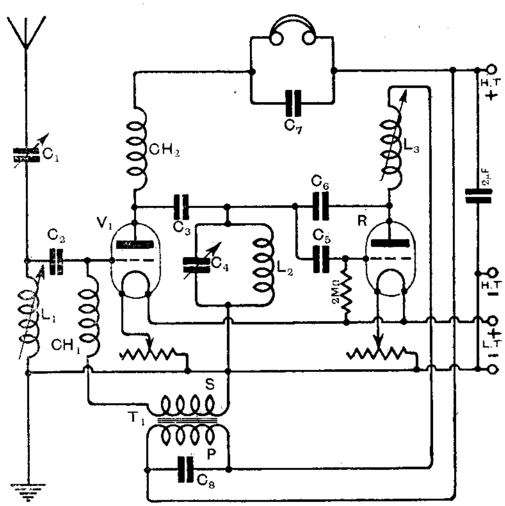


Fig. 3. A reflex receiver similar to that of Fig. 2, but a valve detector is employed, and reaction introduced into the intervalve H.F. coupling.

In place of the crystal detector we may connect a valve detector as in Fig. 3. The high frequency oscillations are then led to the detector valve, which has a grid condenser C_5 and a 2 megohm leak. In this circuit a condenser, C_1, is connected in series with the aerial circuit, and L_1 is a variometer.

To obtain reaction effects a condenser C_6 is connected between the anode of the detector valve and the top of the tuned circuit C_4 L_2, and a variometer L_3 is connected in the anode circuit of the detector in series with the primary winding of the reflex transformer. This receiver operates as follows :—

Incoming oscillations flow in the aerial circuit, and pass to the grid through condenser C_2, and amplified high frequency oscillations appear in the anode circuit Ch_2 and C_4 L_2.

A stage of low frequency amplification may be added to this receiver as shown in Fig. 4, where the primary winding of an intervalve transformer replaces the telephones, and the secondary is connected to valve V_2.

- C_1 is a fixed condenser connected in series with the aerial, and may have a value of 0·00025 microfarads.
- L_1 the aerial variometer.
- C_2, the coupling condenser ; capacity 0·00025 μF.
- Ch_1 and Ch_2, are high frequency choke coils, and may be Nos. 250 or 300 plug-in coils for experimental work.
- C_3, a coupling condenser, capacity 0·00025 μF.

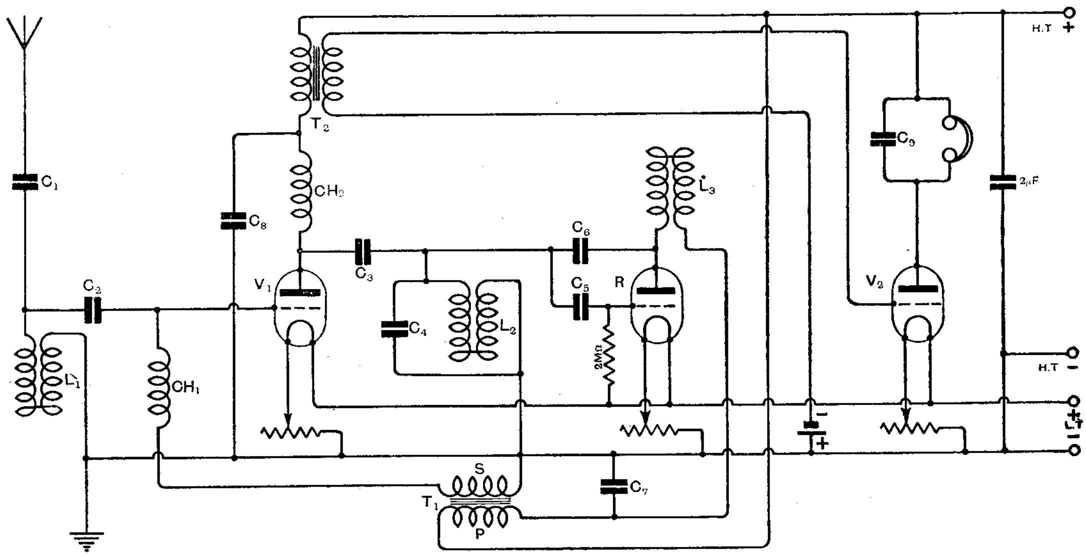


Fig. 4. A reflex receiver provided with a reaction control and giving one stage of H.F. amplification, valve rectification and two stages of L.F. amplification.

The oscillations are rectified by the detector valve and pass through the primary winding of the reflex transformer T_1 ; the secondary winding is connected between the filament and the grid of valve V_1.

Valve V_3 then amplifies the low frequency signal which appears in the telephones.

Condensers C_2 and C_3 are both of such capacity that they will pass high frequency currents but not low frequency currents.

The degree of reaction is controlled by altering the inductance of the variometer L_3.

- L_2, a variometer similar to L_1.
- C_4, a fixed condenser of about 0·00025 μF connected across the variometer.
- T_1, the reflex transformer.
- C_5, a grid condenser of 0·00025 μF.
- C_6, a reaction condenser about 0·0001 μF, but the best value should be found experimentally.
- L_3, is the reaction variometer.
- C_7, a by-pass condenser, capacity 0·002 μF.
- C_8, a by-pass condenser, 0·002 μF.
- T_2, an intervalve transformer.
- C_9, a telephone condenser, 0·002 μF.

TUNER EFFICIENCY.

Having viewed with some concern the tendency of the experimenter to incorporate variable condensers in conjunction with plug-in coils in his receiving gear as a means of tuning the aerial, the writer recently conducted a series of experiments with a view to establishing the efficiency or otherwise of various methods of tuning. The results are, in many cases, surprising.

By ASHTON J. COOPER.

IT is a recognised fact that the human ear is a very poor piece of mechanism for gauging or comparing any degree or volume of sound, and in order to illustrate the points at issue properly, a horizontal galvanometer was used. This instrument is, as far as I know, one of the most sensitive obtainable, is dead beat, and has no mechanical lag. The fixed coil is stated by the makers to be wound from the centre to a resistance of 1,000 ohms with copper wire 0·0049 in. to 0·0051 in. thick (single silk covered), and that a deflection of 10 deg. on the needle should be given by a current of 1/40,000th of an ampere, or 25 micro-amperes, the whole scale reading of 40 deg. representing 100 micro-amperes.

The needle is magnetic, and is carried in bearings of agate with sapphire points similar to the needle of a mariner's compass, and before commencing operations the needle (which is inside the coil and not projecting, the projecting needle being the scale indicator) is aligned with the earth's magnetism.

The tests were carried out in one evening on signals emanating from **2 LO**, which station is about 10 miles from my aerial, and the crystal used was a good specimen of Hertzite with resistance wire contact. On the evening previous to that on which the tests were carried out, signals from **2 LO** were closely observed as to their consistency in strength, and no variation or fluctuation was noticeable save for, perhaps, 0·5 deg. of modulation caused by the impression of speech, music, etc., on the carrier wave. The detector crystal was placed in such a position that the sensitivity was not altered from one end of the evening to the other, and a tapped coil tuner was used as a standard for comparison throughout. After each test the instrument and detector were switched to the tapped coil in order to confirm that the crystal sensitivity had not altered. This is mentioned in order that it might be quite clear that the tests were carried out as carefully and under as uniform conditions as possible.

The first test was carried out with a series condenser tuner, with a plug-in coil arranged as shown in Fig. 2. This is a type of tuner which is very much in vogue at the present time, and after setting the crystal to maximum sensitivity and securing sharp tuning the galvanometer deflection was recorded as 5 deg.

The instrument and detector were now switched back to the tapped coil, and the reading noted after securing maximum sharp tuning, but it is not intended to disclose this reading until a later stage. The reading of the first test was confirmed as 5 degrees.

Test No. 2 was a smaller plug-in coil with variable condenser in parallel, as illustrated in Fig. 2. The galvanometer read 3 degrees. The standard reading was checked off and the reading again taken on circuit Fig. 2 as being 3 degrees.

Test No. 3 was on a tuner arranged as in Fig. 3. Here we have a coupled tuner, tuned with plug-in coils and variable condensers. The closed circuit condenser was, as shown, of small value. The galvanometer reading was 5·5 degrees with a tight coupling.

Test No. 4 was with a circuit as shown in Fig. 5, which is a coupled circuit with the aerial tuning condenser in series with the aerial. The deflection was 10 degrees, a marked improvement.

No. 5 test was again with a circuit as is shown in Fig. 1. In the first test, a 0·001 variable condenser was used, and this was made up from bought parts. Test No. 5, however, was with one of the very best built up condensers available, one in which the vanes were solid with the supports. The reading was 9 degrees. This test was made in order to check the advantages of purchasing best quality condensers, and, as will be seen, there is a decided advantage.

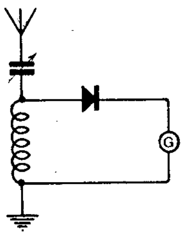


***Fig.* 1.** *This circuit gave* **5°** *deflection on the galvanometer.*

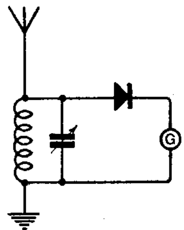


Fig. 2. *Gives* 3° *deflection.*

The sixth test was on a variometer of one of the most efficient types, the windings being cotton covered without former, but held together by the aid of some form of glass hard varnish. A very tight coupling exists between the rotor and stator. The circuit arrangement was as Fig. 5. The reading was 18 degrees. A built-up variometer was tested and gave a reading of 14 deg., the loss probably being due to the fact that the coupling was not so tight and the tuning less sharp.

The seventh test consisted of a series of

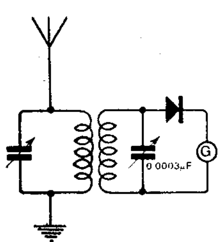


***Fig.* 3.** 5·5° *obtained with tight coupling.*

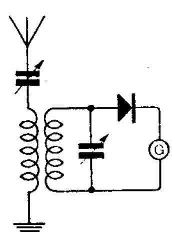


Fig. 4. *This circuit gave* 10°.

trials with condenser in series with the aerial lead on the best variometer.

The results were :—

0·0003 mfd. variable condenser	..	3·5°
0·001 mfd. variable condenser	..	11°
0·001 about 20° scale reading	..	3·5°

(All moving vanes in engagement with the fixed vanes.)

It will therefore be seen that when a variable condenser is used in series with a given coil that the maximum efficiency is obtained on the higher condenser readings, and that the smaller the condenser reading the lower the efficiency. It becomes apparent that variable condenser tuning is for this reason alone hopelessly inefficient as compared with other methods, especially on the end of the scale.

Test No. 8 was carried out with two coils wound with bare No. 16 and No. 20 wire, and mechanically supported by strips of ebonite, the coils being made to slide one within the other so as to form a sliding variometer. The arrangement was as shown in Fig. 7. The galvanometer reading was 24 deg. This is, to say the least of it, a

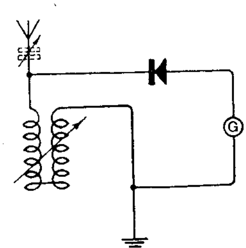


Fig. 5. *Gave* 18° *deflection.*

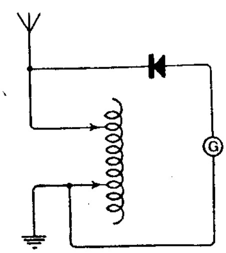


Fig. 6. *Tapped air spaced coil which gave* 20°.

huge increase in efficiency, this reading representing approximately 55 micro-amperes.

The ninth test was on the tapped coil, the readings of which had been taken as the standard all the evening (Fig. 6). This reading was 20 deg. A four-wire counterpoise substituted for the earth lead reduced the reading to 19 deg., and a 0·0005 fixed condenser placed across the instrument leads reduced the reading from 20 deg. to 12·5 deg., although the tuning was adjusted. This condenser would, if telephones had been connected up, constitute the blocking condenser often seen on crystal sets, and the reason for which has never been apparent to the writer.

The substitution of twisted telephone cords for single No. 20 D.C.C. to the instrument reduced the reading from 20 deg. to 16 deg. A 0·0003 variable condenser (all in) placed in series with the aerial and the earth lead reduced the readings from 20 deg. to 4 or 5 deg. in each case.

This then concluded a very interesting series of experiments, from the results of which the reader may draw his own conclusions. The outstanding fact is that the addition of capacity in any shape or form in a tuner results in a certain loss of efficiency when dealing with this band of wavelengths. These losses would obviously become increasingly serious as we get on to high frequencies. Apart from a special bare wire, or skeleton type of tuner, the tapped coil proved the most efficient. One noticeable fact might be mentioned in passing, and that was that the use of the tapped coil in conjunction with valves, but without reaction, provided signals perfectly clear and as loud as those obtained with a plug-in coil tuner and full reaction on the aerial. Another point was that the addition of reaction to the tapped coil did not result in a gain in strength as would be expected and as is generally obtained with plug-in coils; presumably dead-end effects and the lack of condenser damping and losses (to be otherwise made up for by reaction) was the reason for this. One fact is perfectly plain, and that is that ten miles from **2 LO** and with two valves (one detector and one low frequency) there is no need whatever to use reaction for loud speaker effects if a reasonably good outdoor aerial is obtainable.

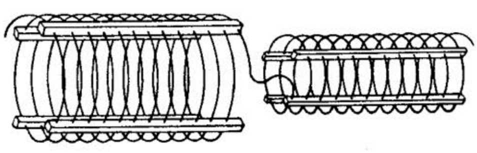


Fig. 7. Air spaced coils with variometer gave 24°.

No new discovery is claimed as a result of these experiments. In fact, it has long been known that capacity, when working on short waves, is an unwanted ingredient in the tuner, but I don't think that the matter has ever been brought to notice quite so forcibly.

One might expect to sacrifice selectivity for efficiency when working with low capacity coils in the ordinary way, but it is thought that a properly designed tuner minus any unwanted capacity, is not an impossible matter. In any event, these figures and facts are passed to fellow experimenters as the basis perhaps, for more extensive research and inquiry into tuner efficiency.

A.C. BATTERY CHARGER.

Wireless users in districts served by alternating current are seriously handicapped in the matter of accumulator charging. Where only one or two batteries are to be charged occasionally, there is no justification for the installation of a motor generator set or perhaps even a synchronous rotary rectifier. The battery charger shown in the accompanying illustration has recently made its appearance on the market and operates on the principle of a polarised interrupter, while it is of durable construction and simple to manipulate. On test it was found to run on full rated load for long periods with scarcely any sparking at the contacts. The battery on charge may be connected in any direction and fuse protection is provided.

The Runbaken Battery Charger.

A POLARISED BUZZER.

FOR ENERGISING A WAVEMETER OR OTHER OSCILLATORY CIRCUITS.

Greater stability, economy in battery power and ease of adjustment are obtainable by the use of a polarised buzzer in place of the ordinary buzzer in which the armature returns to its normal position by the operation of a spring. Practical constructional details of a useful instrument are set forth in this article.

By MAURICE CHILD.

THE polarised buzzer possesses many advantages over the usual non-polarised type, the chief of which being great stability in working, economy in battery power and ease of adjustment. In the ordinary type of non-polarised buzzer, the armature is caused to return to its normal position by virtue of the elasticity of the spring, and it is found that the springs vary in their tension from time to time, thus causing considerable irregularity in the frequency of armature vibration. Again, the contacts having to carry a fairly heavy current, sparking generally occurs, and they thus become oxidised and the buzzer fails to operate satisfactorily. All these disadvantages are largely overcome in the polarised buzzer. Firstly the making and breaking of the battery circuit is forced by a definite magnetic stimulus to the armature and the elasticity of the springs have very little effect on the note which is produced when once the contacts have been adjusted. Again, the amount of current necessary to make the armature operate satisfactorily is very small; (in the instrument about to be described it is in the neighbourhood of about 1/10th ampere using a battery of two or three dry cells), therefore, with the provisions made for eliminating sparking, there is no likelihood of this being the cause of unreliability.

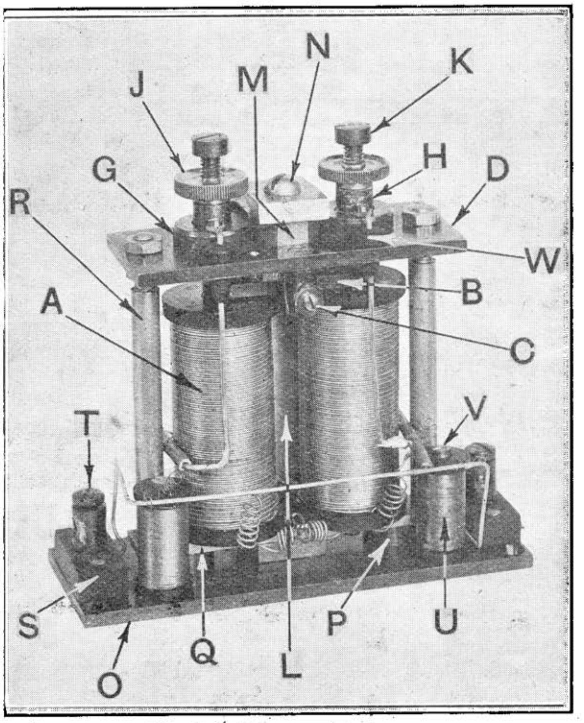


Fig. 1. The complete buzzer.

The photograph, Fig. 1, shows the complete instrument which in this particular case has been built up by employing some of the parts of an electric bell of the magneto type; these will no doubt be familiar to most readers, as they are fitted with two gongs and are used by the Post Office in the standard telephone system. The original windings were removed and the bobbins subsequently wound differentially with No. 26 D.S.C. copper wire. Prior to rewinding, the cheeks near the free end of the cores were pushed up somewhat and the length of the iron core filed down to that of the bobbins marked A, Fig. 2. In winding differentially the two wires from separate bobbins are wound carefully together in layers and, in order to keep the winding even, a thin wrapping of paper is placed between every second layer of wire, thus two

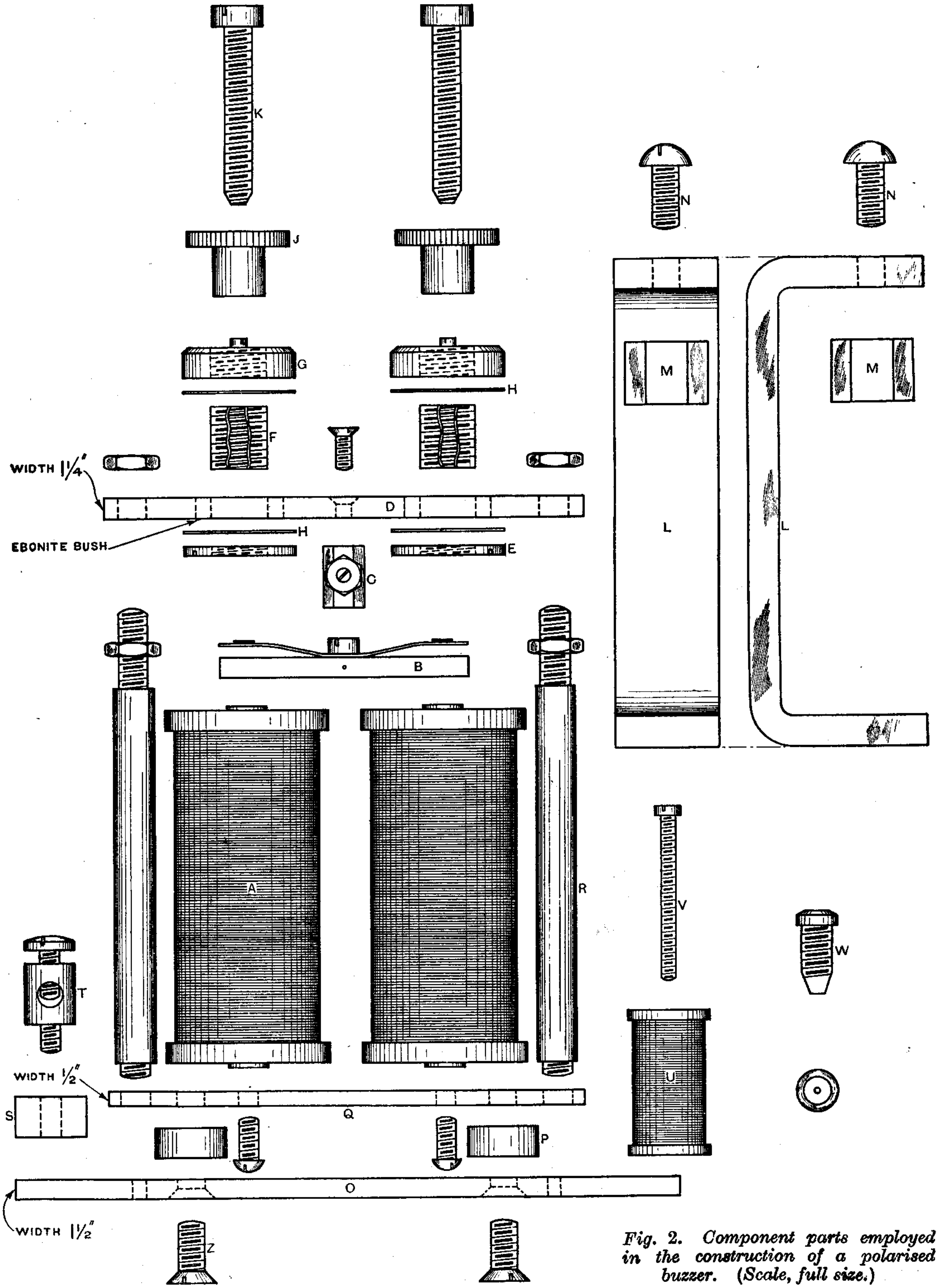


Fig. 2. Component parts employed in the construction of a polarised buzzer. (Scale, full size.)

bobbins with two inner ends and two outer ends each, together with their iron cores are constructed. The back bar (Q) is modified somewhat as regards shape at the ends, as in the standard instruments these are provided at one end with a hole and at the other with a slot for fixing to the instrument box; these holes and slots are cut away, leaving a plain straight back bar with the uprights marked R in Figs. 1 and 2.

A base (O) and top (D) of brass $\frac{1}{8}$ in. thick and of the dimensions shown are next prepared, together with two ebonite blocks $\frac{1}{4}$ in. thick and terminals (T), one of which is screwed into a block, the other passing through a clearing hole and screwing into the brass base. The latter terminal is shown on the right-hand side of the photograph, that marked T being insulated and attached to the stiff copper wire which is shown passing across the lower portion of the instrument and which is mechanically supported at the other end by passing it through a small hole in the right-hand ebonite block. Two rather massive brass collars (G) are fixed in holes drilled in the top plate, and they are insulated from the latter by ebonite bushes (F) and washers in the ordinary way. They are locked in position by their lock nuts E. Brass screws (K) carrying silver tipped contacts and provided with lock nuts (J), work in these brass collars, and it will be observed on reference to the photograph that there are two small screws to which stout copper (No. 18 S.W.G.) wires are attached and which pass through ebonite bushes (W) in the top plate. The permanent steel magnet from the bell mechanism is provided with a hole at one end and a screw (N) passing through this originally attached it to the back bar. In the present use of the magnet the undrilled end of it is gripped between the back bar and the brass base, when the countersunk screws (Z) passing through the spacing washers P are tightened up. The drilled portion of the magnet is fitted with a small piece of iron (X) by means of the screw N, and this acts as a pole-piece and projects through the central opening in the top plate and very nearly touches the central screw of the armature B.

Supporting armature pivot bearings are made from $\frac{1}{4}$ in. hexagonal brass and are marked C on the diagram. Two No. 6 B.A. steel grub screws have one end turned down to form a fairly long taper point which engages in a small hole shown in the centre of the armature B. The armature is provided with a contact spring bent up at each end in the form shown, the contacts being of silver which are quite easily soldered on to the springs before assembly. Two small bobbins (shunts) of ebonite (U), must be turned up and are wound non-inductively with a single layer of No. 40 D.S.C. Eureka resistance wire, the ends being brought out through two small holes drilled in one of the

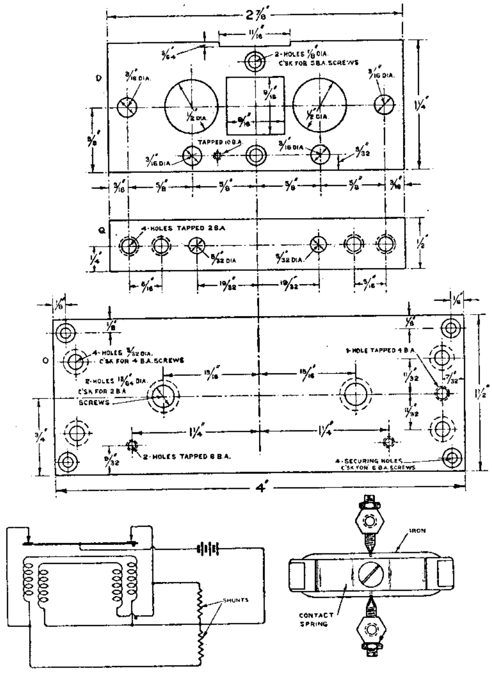


Fig. 3. Drilling dimensions and circuit adopted.

cheeks and available for subsequent connection. Two long No. 6 B.A. brass screws (V) pass through the centre of these bobbins and fix them to the brass base in the positions shown in the photograph. The diagram of connections is shown in Fig. 3.

A small spiral of No. 36 copper wire should be soldered to a tag fixed under the armature centre screw, the other end being fixed under a small screw (the position of this can be seen as a white dot slightly to the left of M) in the top plate. This connection is important as it ensures the armature being in reliable electrical contact with the frame. Pivots themselves are most unsuitable for this purpose.

The method of adjustment is as follows. Screw down one of the contacts K until it is just touching the armature, which should be temporarily held in an equal-distance position from the magnet cores. The battery should now be connected up and if the connections are correct, on completing the circuit the armature should be attracted towards that core immediately underneath the contact screw which has been adjusted. Should this not be the case, the battery must be reversed.

The second contact screw must now be brought down until it just touches the spring, the previous contact screw having been removed. The battery circuit should now be completed once again and the armature should be attracted to the core immediately underneath the contact screw. If this does not occur, the connections of one of the coils must be reversed. Subsequently both contact screws may be adjusted until the best note is given by the armature. It is of some assistance at first, to place a low reading ammeter in series with the battery, and adjust the contacts so that the current is at a minimum with the greatest steadiness of note.

Correspondence.

Fine Wire Coils.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—My attention has been drawn to a misconception of the scope of the fine wire coils I described* and I shall be obliged if you will allow me to correct it.

The coils are not for all-round use but are merely supplementary to the normal commercial type. They were investigated, developed and used in the reception, by loud speaker, of the nearest B.B.C. station, *i.e.*, in circumstances where the ample volume of sound available permits a certain amount of loss of efficiency; this margin is made use of by broadening resonance with increased ohmic resistance. I am still at work trying to increase efficiency while maintaining the improved definition which I think may now be taken as being amply proved.

J. H. REEVES.

London, S.W.5.

* *Wireless World, April* 30th, 1924, p. 132.

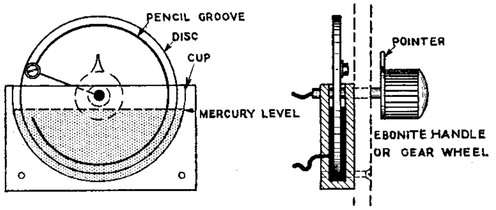
A Variable Grid Leak.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—One hears so many grumbles these days anent variable grid leaks that I venture to suggest that some of your readers may find, in the following device, a solution of their troubles.

It is an arrangement on which I fell back for precision working, and, as far as I can see, it has the real advantage that it can actually be calibrated to known values which thereafter remain constant for the same position of the pointer.

An ebonite disc of some 2½ to 3 ins. diameter, and about ⅛ in. thick, has a groove running close to its circumference nearly all the way round.



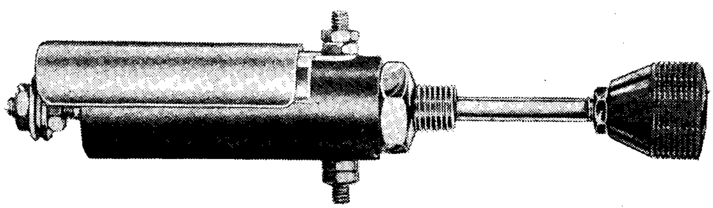
This groove is lightly rubbed round several times with a lead pencil. The centre of the disc works on an axis which is mounted in a bearing and allows the bottom of the disc to dip into a cup containing mercury. The necessary connections are taken from the mercury and from one end of the pencilled groove.

The leak is very useful where one utilises a standard receiver which does not need to be moved about.

D. SINCLAIR.

A USEFUL LOW CAPACITY CONDENSER.

The spindle has both a sliding and rotary movement, by which it is possible to obtain very critical capacity values. A coarse adjustment is obtained by merely pulling out the knob, whilst extremely fine adjustment is obtained by rotating the knob. A feature of the device is that it may be attached to a panel simply by making one hole and tightening up the nut engaging on the threaded stem.



Courtesy: Radio Communication Co. Ltd.

A NEW LOUD SPEAKER.

The development of wireless telegraphy and its application to broadcasting has turned the attention of a number of engineers to the problem of devising efficient loud speakers which will give faithful reproduction of speech and music. The instrument described here is of German design and embodies new principles.

As this subject of loud speaker design is very much to the fore at the present time and interests everyone associated with wireless, the following notes on a recently produced loud speaker, operating on a somewhat novel principle, will be of general interest.

The apparatus here described is constructed by the well-known firm of Siemens & Halske, and has been developed in Germany by two engineers of that company, K. W. Wagner and Lüschen.

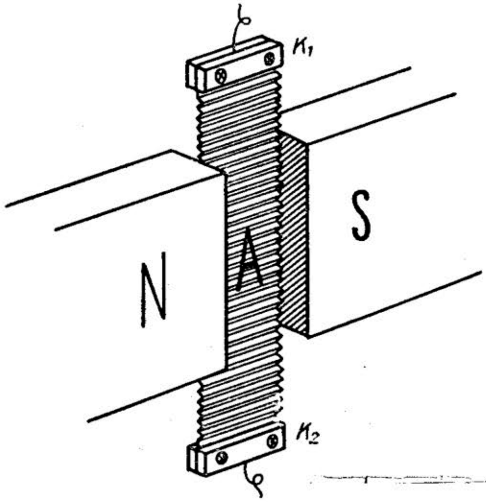


Fig. 1. The crinkled metal strip is the diaphragm of the loud speaker set in a magnetic field.

Nearly every type of loud speaker which has been developed and is of practical value depends for its operation on some means of influencing a diaphragm, the diaphragm being controlled either directly or indirectly by the received speech currents. In addition to having to set the diaphragm vibrating at frequencies corresponding to the frequencies of the speech currents, there is an expenditure of energy in overcoming the inertia of the diaphragm and also in moving the mass of air which the diaphragm displaces in vibrating.

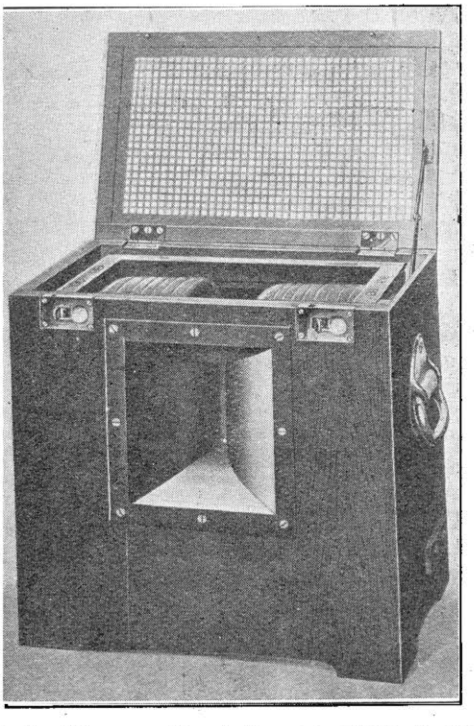


Fig. 2.—The complete instrument, which is very compact.

Prof. Schottky, who has made a theoretical study of the problem, has proved that to obtain maximum efficiency the mass of the diaphragm must not exceed that of the air moved by it, and that it is preferable for the mass of the diaphragm to be less. Hence the necessity arises for the diaphragm itself to be extremely thin and light. In the present loud speaker an arrangement has been adopted which resembles the principle of the Sykes-Round microphone for instead of the more usual method of influencing a magnetic field by means of the speech currents and so controlling the movement of the heavy diaphragm, the speech currents are led through the diaphragm itself, which is placed in a powerful magnetic field. In the loud speaker illustrated here this principle has been adopted. Between the poles of the powerful electro-magnet, L.S. Fig. 1, is stretched an extremely thin waved aluminium foil "A," and the output connections of the wireless receiver or amplifier are made to K 1 and K 2. A current carrying conductor placed in the magnetic field is deflected vertically to the direction of the magnetic field, and consequently the aluminium foil will oscillate in a vertical direction at the rate of frequency of the currents passed through it.

Fig. 2 shows the method in which the aluminium foil is mounted in a frame. The external appearance of the loud speaker is shown in Fig. 4, which gives a very good idea of its compactness, and also shows the coils of the powerful electro-magnet which provides the magnetic field. It is stated that this instrument has been demonstrated in various parts of Germany with great success, and has made speech distinctly audible in the open air to 50,000 persons.

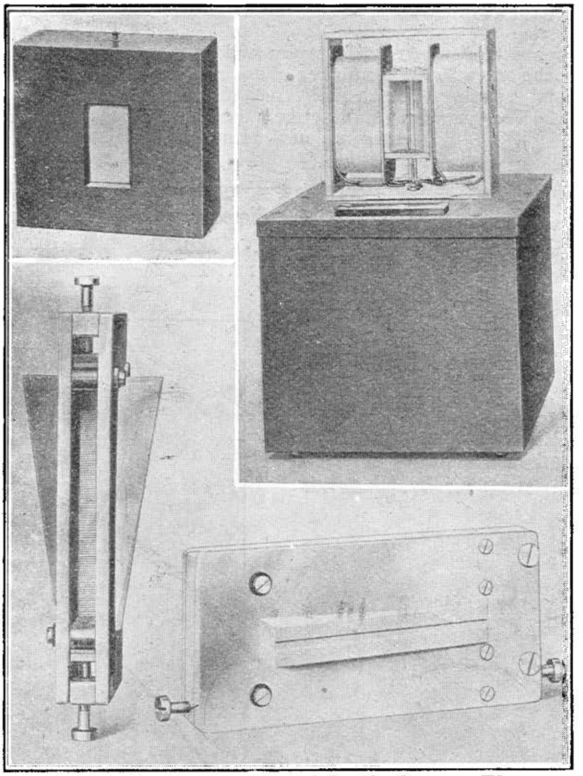
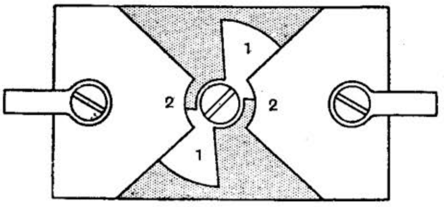


Fig. 3. Details of construction of the diaphragm. The upper right hand figure is a microphone operating on the same principle.

The same principle has been applied by the company to the production of a microphone in which the movements of the aluminium strip controlled by speech vibrations acts as a current generator, and this, in conjunction with an amplifier, has given such satisfactory results that it is suggested that all German broadcasting stations will employ this instrument in the near future. The microphone is shown in the upper right illustration of Fig. 3.



MICRO CONDENSER.

A useful adjustable condenser of small capacity and dimensions, suitable for many purposes in receiver construction, essentially for providing feed back and oscillation neutralising potentials.

NOTES & CLUB NEWS

The opening of the 1,600 metre broadcasting station at Chelmsford (**5 XX**) is expected to take place on or about July 7th. It is understood that the preliminary power employed will be 25 kilowatts.

* * * *

In a letter to the Secretary of the Swansea Radio Society, the B.B.C. states that the town will be provided with a broadcast relay station in the Autumn.

* * * *

In addition to Swansea, relay stations are to be erected by the B.B.C. at Hull, Nottingham, Stoke-on-Trent and Dundee.

* * * *

The Admiralty announces that the personnel employed in manning naval wireless and D.F. stations at home shall in future be known as the Royal Naval Shore Wireless Service.

* * * *

Four broadcasting stations are to be established in Brazil at Sao Paulo, Bello Horizonte, Bahra and Pernambuco.

* * * *

Argentine **CB 8** has now been twice received by Mr. W. A. S. Batement, of North-West London.

* * * *

The Leeds-Bradford Relay Station.
The land wires are now complete between **2 LO** and the studio of the Leeds-Bradford station.

The station is to open on Tuesday, July 8th, at 8 p.m.

Wireless Photographs.
On Thursday, June 19th, M. Belin, the well-known French inventor, demonstrated his system of wireless photographic transmission before a number of experts in Paris.

The Paris *Matin* reproduced several of the photographs and expressed conviction that television would soon be an accomplished fact.

Brussels Wavelength.
On June 24th, the Brussels Broadcasting Station reduced its wavelength from 265 to 262 metres.

It is hoped by this slight alteration to eliminate a certain amount of interference produced, it is thought, by unknown transmitters working on the former wavelength.

Two-Way Working with Finland.
Mr. W. Guthrie Dixon (**5 MO**), of Rowlands Gill, near Newcastle-on-Tyne, reports that on the 11th June he was in communication with Finnish **I-NA** at Turku, the wavelength employed being 165 metres. The Finnish station used straight A.C. supply and his signal strength is reported as consistently good on a detector and one stage of low frequency.

Wireless in Mining Disasters.
Working under the assumption that a wireless receiving set could be successfully operated at 1,000 feet underground, the United Mine Workers of America are investigating radio as a means of life saving in mining disasters.

Committee to Consider Broadcasting Wavelengths.
An International Committee has been set up to consider the subject of wavelengths for broadcasting, as in many districts transmitting on waves of from 300 to 500 metres is rapidly becoming impossible, owing to the interference from Morse transmissions.

Wireless in Turkish Waters.
The Angora Government has issued an order prohibiting vessels of all nationalities from employing radio in Turkish waters without special permission from the Government.

Low Power Transatlantic Working.
5 IK, the station of Mr. B. L. Stephenson, of Manchester, has been heard by Canadian **1 AR,** of Dartmouth, Nova Scotia. The British station employed a power of 8 watts on 200 volts D.C. and the circuit used was a slightly modified Colpitts.

Mr. Stephenson enquires whether any other transmitter has crossed the Atlantic with only 200 volts H.T.

Broadcasting from the French Academy.
An innovation has been introduced into the French Academy in the shape of of a microphone by means of which a speech by a recently elected member—M. Henri Robert—was broadcast.

French Amateur Expansion.
So great has been the growth of amateur radio transmission in France that the staff of the administration of P.T.T. has had to be considerably enlarged. Three experts have been appointed to study the question of organising a permanent control bureau for amateur work.

New Spanish Wireless Association.
The cause of the Spanish amateur is now being championed by a new organisation, the Associacion Radio Espanola, which has just been formed in Madrid.

Wireless and Forest Fires.
To cope with the risk of forest fires in the South of France, a radio station has been installed by means of which it is hoped that speedy relief will be obtainable in the event of conflagrations.

Unidentified Station.
On the night of May 31st, Mr. C.W. Titherington (**5 MU**), of Dorchester, received a station signing **4 WR,** but owing to atmospherics was unable to maintain touch and identify the station. He will be glad if any reader could give the location of **4 WR.**

Ether Poaching.
The call sign **2 QN,** which is owned by Mr. Arthur Hobday, of Flint House, Northdown Road, Margate, is being used illicitly by a transmitter in the West of England.

Information leading to the detection of the offender will be welcomed.

New U.S.A. Broadcasting Proposal.
A plan for the replacement of the present 500 broadcasting stations in the United States by ten powerful stations, was discussed by Mr. Boucheron, a radio expert, speaking at a recent meeting of the Associated Manufacturers of Electrical Supplies.

Victoria Day Will Be A Go-As-You-Please Holiday In Halifax This Year

First with the news fearless in views — **THE EVENING MAIL** — Forty six years in the public service

VOLUME 46, NO. 116. (PHONE SACKVILLE 3360) HALIFAX, CANADA, WEDNESDAY, MAY 14, 1924. The Weather—Warmer. 16 PAGES

ENGLISH RADIO EXPERT GETS SURPRISE IN HALIFAX

POINCARE SAYS HE WILL NOW TAKE A COMPLETE REST

Biggest Ever

COUNCIL HAS NOT POWER TO CHANGE DATE OF HOLIDAY

Victoria Day Being a Statutory Holiday Must Be Observed On Saturday, May 24.

Dalhousie Graduates After Convocation

ENGLISH RADIO EXPERT TALKED TO HIS ENGLISH FRIENDS FROM HALIFAX

Mr. Marcuse, Secretary of the Transmitters Section of the Radio Society of Great Britain, Now on a Visit to This City, Was Given the Most Delightful Thrill of His Life at a Halifax Amateur Radio Station Yesterday.—Delighted With His Reception by the Halifax Radio "Gang."

A rousing welcome awaited Mr. Gerald Marcuse, Secretary of the Transmitter and Relay Section of the Radio Society of Great Britain, on his recent arrival in Canada. The above cutting indicates the importance attached to the event in Halifax.

[Photo: Barratts.

Operations over a wide stretch of country were carried out at a Field Day of the Western Metropolitan Association of Affiliated Societies held on Sunday, June 22nd. Transmitters and receivers were erected at Gerrard's Cross, Batchworth Heath and Stanmore, and some successful short-wave work was accomplished. Our photo shows the party at Stanmore.

Such a scheme would be justified on the grounds of efficiency and economy and each station would cover a zone of about 500 miles. The upkeep of these stations would be provided for by a foundation fund to which the radio industry would contribute.

Australian Wireless News to Ships at Sea.

Much has been done in the carrying out of a press news service from Australia to ships at sea and further developments are in progress, stated the Amalgamated Wireless (Australasia), Ltd., recently, in reply to the criticisms of Vice-Admiral Sir Frederick Field.

Early last year the Company commenced the publication of a daily newspaper on board ships and special arrangements were made with the leading press agencies and newspapers in Australia, Great Britain and Canada, for the receipt and transmission of news.

This news is transmitted every night across the Pacific to ships at sea from the wireless stations at Pennant Hills, Sydney; Awanui, New Zealand; Suva, Fiji; Estevan, Vancouver Island.

A French Colonial Station.

A new radio station is to be erected in Noumea (French New Caledonia) which will be used for direct relay work from France to Tahiti. At present Noumea is receiving wireless messages through the large station at Saigon.

A Removal.

Messrs. The Watmel Wireless Company state that owing to increased business it has been necessary for them to remove to larger premises situated at 332A Goswell Road, London, E.C.1. Telephone: Clerkenwell 7990.

Fluxite for Case Hardening.

We have received a pamphlet from Messrs. Fluxite, Ltd., manufacturers of the well-known soldering paste, explaining how Fluxite can be employed for case hardening. The pamphlet is obtainable from the Company at Simplex Works, Bevington Street, Bermondsey, S.E.

Change of Address.

Mr. P. H. Dorte (**6 CV**) has moved to Lynwood, Oatlands Park, Weybridge.

A Correction.

Through an unfortunate mistake prices of two models of the Marconiphone Range were wrongly given in the Marconiphone advertisement which appeared on page xii of last week's issue.

The price of the Marconiphone Baby Crystal Receiver is 27s. 6d., not 25s. 6d., and of the Marconiphone V3 De Luxe £80, not £50.

Wanted: Reports.

Reports on the quality of his transmissions are welcomed by Mr. C. S. Frowd (**2 FS**), of Ranamere, Knebworth Road, Bexhill-on-Sea.

Transmissions take place on between 150 and 200 metres and a power of 10 watts is employed.

U.S. Democratic Convention Broadcast

The proceedings of the United States Democratic Convention for the purpose of nominating presidential and vice-presidential candidates, which opened in New York on Tuesday, June 24th, were broadcast at various times by fifteen wireless stations, including **WJZ.**

The Radio Corporation of America would be glad to receive any interesting observations from British listeners who were able to receive any of the transmissions.

If reports are sent to the Secretary of the Radio Society of Great Britain, 53 Victoria Street, S.W.1, they will be forwarded to America.

British Wireless in India.

In the House of Commons on June 24th, Mr. Hartshorn, asked by Mr. Hannon (Moseley U.) whether he was aware that the service of British official wireless news in India had now ceased owing to the superiority of French and German installations, and whether steps were being taken to re-establish the British wireless service, replied that he understood that adverse atmospheric conditions were responsible for difficulty in reception of British official wireless messages. He stated that although German and French Radio

SHORT WAVE TRANSMISSIONS FROM EIFFEL TOWER.

The series of experimental transmissions from the Eiffel Tower is being continued during July under similar conditions to those outlined in our issue of June 11th.

Tests will take place as follows :—

Monday	Tuesday	Friday	Saturday	Wavelength
7	1	4	5	115 metres
14	8	11	12	75 ,,
14	15	18	19	50 ,,
28	22	25	26	25 ,,
	29			

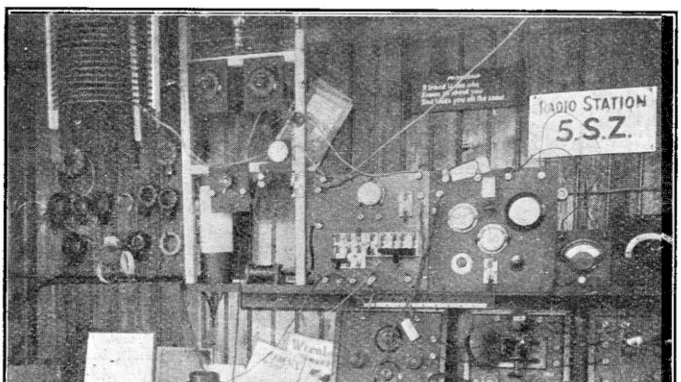
Time (G.M.T.)	Identification Signal.
From—0500 to 0510	f f f f f
0515 to 0525	h h h h h
0530 to 0540	f f f f f
0545 to 0600	h h h h h
1500 to 1515	f f f f f
1520 to 1535	h h h h h
2100 to 2115	f f f f f
2120 to 2135	h h h h h

As hitherto, reports should be forwarded to Chef du Centre Radio-télégraphique de Paris, poste de la Tour Eiffel.

stations were superior to any British stations at the moment the trouble would be remedied with the opening of the new Government station at Rugby.

BOOK RECEIVED.

The A.B.C. of Wireless Television by H. A. Bohringer. (London: Taunton Bros., 89 Shaftesbury Avenue, W.1. 33 pages. Price, 9d. net.).



*The equipment at **5 SZ**, the station of Mr. J. W. Riddiough at Baildon, Yorks, which has now been dismantled owing to the owner's removal to Morecambe, Lancs. **5 SZ** will not long remain silent, however, and hopes to commence testing from his new address in a fortnight's time.*

Lewisham and Catford Radio Society.*

On June 12th the Society gave a wireless demonstration to the guests of the East Lewisham Conservative Association at a garden fete, held at Bromley Road.

The success of the demonstration was largely due to the kindness of Messrs. A. Graham & Co., to whom the Society are indebted for the loan of "Amplion" apparatus.

The bi-monthly meeting on June 19th consisted of a short talk by Mr. Harrison N. Orme, of Messrs. "Hightensite," on the subject of "Ebonite."

The lecturer dealt very fully with the processes necessary for the conversion of rubber in the raw state to the finished product known in the trade as "hard rubber," but better recognised by the wireless amateur as ebonite.

The Society is open to receive applications for membership and intending members should apply for particulars to the Hon. Sec., Chas. E. Tynan, 62 Ringstead Road, Catford, S.E.6.

The Hounslow and District Wireless Society.*

The Society held its third annual general meeting on June 5th. The Hon. Secretary, in his annual report, stated the year had been a very successful one. Twenty-five lectures had been delivered and ten demonstrations had been given. The Hon. Treasurer reported a very satisfactory financial position. Among the officers re-elected for the forthcoming year were the President, Vice-Presidents, Chairman and the Hon. Secretary.

The President, Mr. A. R. Pike, moving a very hearty vote of thanks to retiring officers, stated he wished to place on record the yeoman service done to the Society by the re-elected Secretary, Mr. A. J. Myland, and also by the retiring Treasurer, Mr. H. W. Parker.

It should be noted that it is the new Committee's intention to hold weekly meetings through the coming summer months, an excellent programme having been arranged. All local enthusiasts should note that all particulars of membership can be obtained on application to the Hon. Sec., A. J. Myland, 219 Hanworth Road, Hounslow.

Newcastle-on-Tyne Radio Society.*

On Monday, June 16th, "Electricity and Magnetism" was the title of a lecture given by Mr. R. Torry. The lecturer had evidently taken considerable care in the preparation of his demonstrations, which were observed with great interest and appreciation by all present.

It has been decided to continue the Monday evening meeting throughout the summer, and it is hoped that a number of members will take advantage of this.

Hon. Sec., Colin Bain, 51 Grainger Street, Newcastle-on-Tyne.

West Bromwich Engineering Society (Radio Section).

On Friday, June 20th, an interesting loud speaker test was conducted by the Asst. Hon. Secretary. A large number of loud speakers were brought by the members for comparative tests and a highly instructive evening was spent in discussing the merits of the various types.

Wireless enthusiasts in the West Bromwich district are invited to write for particulars of membership to H. C. Richardson, Asst. Hon. Sec., 57 Birmingham Road, West Bromwich.

The Birmingham Wireless Club.

An informal meeting was held on Friday, June 13th, when several members of the Technical Committee overhauled the Club's aerial, which, owing to its awkward position, has not been touched for several years.

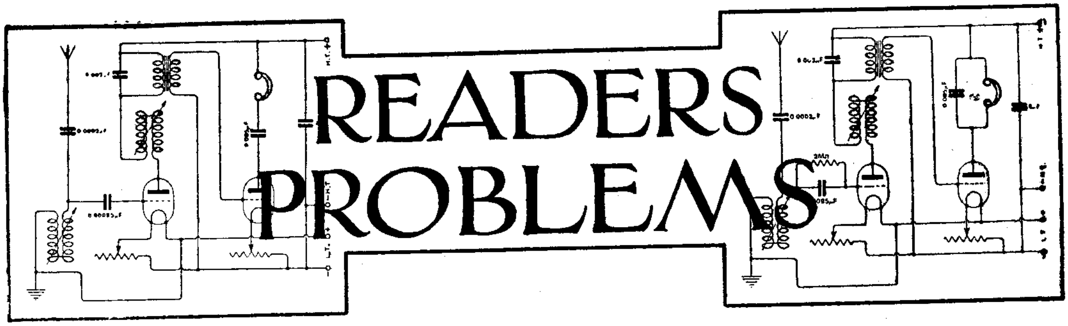
A portable set was afterwards tested on the aerial and it was noticed that results had somewhat improved.

Hon. Sec., H. G. Jennings, 133 Ladywood Road, Birmingham.

The Clapham Park Wireless and Scientific Society.

The second session of this Society ended on Wednesday, June 18th. A full programme of lectures on various wireless and general scientific subjects has been enjoyed during the winter and spring months, and the Society has had no small measure of success in its second year.

With the advent of Summer the enthusiasm for indoor meetings slackens off very noticeably, and it was decided that the best policy to adopt was to close down until the Autumn. The Society will therefore recommence meetings on the first Wednesday in October, when it is hoped all members and intending members will be present. Meanwhile all enquiries should be addressed to the Hon. Sec., H. C. Exell, 41 Cautley Avenue, S.W.4.



1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for 1/-, or 3/6 for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.

" *F.R.*" (*Bristol*) **asks for a circuit diagram of a Reinartz short wave receiver with one stage of L.F. amplification.**

The circuit is given in Fig. 1. A radio-frequency choke coil is connected in series with the primary winding of the intervalve transformer to prevent leakage to earth of H.F. currents by way of the self-capacity of the transformer winding and H.T. battery.

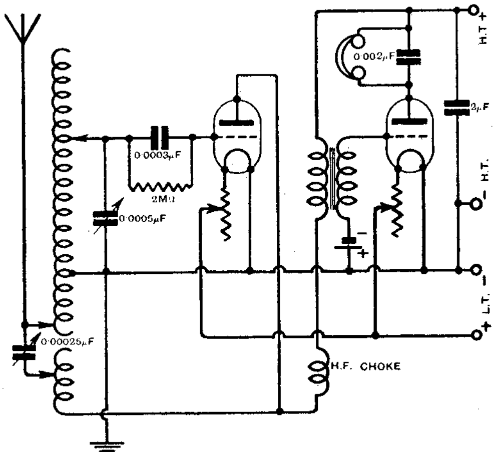


Fig. 1. " *F.R.*" (*Bristol*). *A Reinartz receiver with one stage of L.F. amplification*

" *A.W.*" (*Macclesfield*) **asks what adjustments to make in order to eliminate " backlash " from the reaction coupling of his receiver.**

When oscillations start and stop abruptly, and when the coupling required to start oscillations is greater than the coupling at which oscillations cease, it will generally be found that the reaction coil is too large, or the grid leak has too low a value for the particular capacity of grid condenser in use. In general it is best to use a reaction coil having a natural wavelength slightly lower than the lowest wavelength which it is required to receive. With a grid leak variable between 1 and 5 megohms, you should have no difficulty in obtaining the exact value corresponding with the characteristics of the valve and the capacity of the grid condenser, which will enable oscillations to start and stop smoothly.

" *W.T.*" (*Bradford*) **asks what is the usual method of connecting intervalve transformers.**

The majority of makes operate best when the I.P. terminal is connected to the anode of the preceding valve, and O.P. to +H.T., and when O.S. is connected to the grid of the succeeding valve and I.S. to −L.T. However, it is always best to find the correct connections by trial. The secondary winding should be connected permanently in the manner indicated above, and the effect should then be tried of reversing the primary winding.

" *A.R.T.*" (*London, W.C.*1) **asks if it would be possible efficiently to extend the range of a variometer by connecting a fixed condenser in parallel with the windings.**

This method is quite practicable, provided that the capacity necessary to reach the wavelength required does not exceed 0·0005 μF. A much better method of increasing the wavelength would be to connect a load coil in series with the variometer.

" *T.C.*" (*Liverpool*) **submits diagrams of several proposed aerial systems, and asks which arrangement will give the best results.**

We do not recommend the use of a " T " type aerial in your particular case, as the distribution of surrounding objects is not symmetrical about the centre of the aerial. The electrical midpoint of the aerial would not, therefore, coincide with the geometrical mid-point, and you would have great difficulty in determining the correct position for the lead-in wire. We recommend that you use an inverted "L" type aerial and take the lead-in from a point several feet from the house end of the aerial, in order that the lead-in may not have to be bent back over the roof of the house. It is important that the insulators at the house end of the aerial should be placed immediately after the points from which the down leads are taken. These leads should be spaced as far as possible from the side of the building.

As you intend to use not less than three valves, it is probable that less distortion will take place if the resistance capacity or choke method of coupling is employed. The latter method of coupling has the advantage that the H.T. voltage required is considerably less than that required with resistance capacity coupling. On the other hand, the iron used in the construction of choke coils must be of very high quality, in order to reduce the distortion caused by hysteresis losses, etc. The considerations involved in the choice of a suitable method of L.F. coupling were fully dealt with in an article entitled "Resistance, Choke, or Transformer Low Frequency Coupling," in the issues of February 6th and 13th.

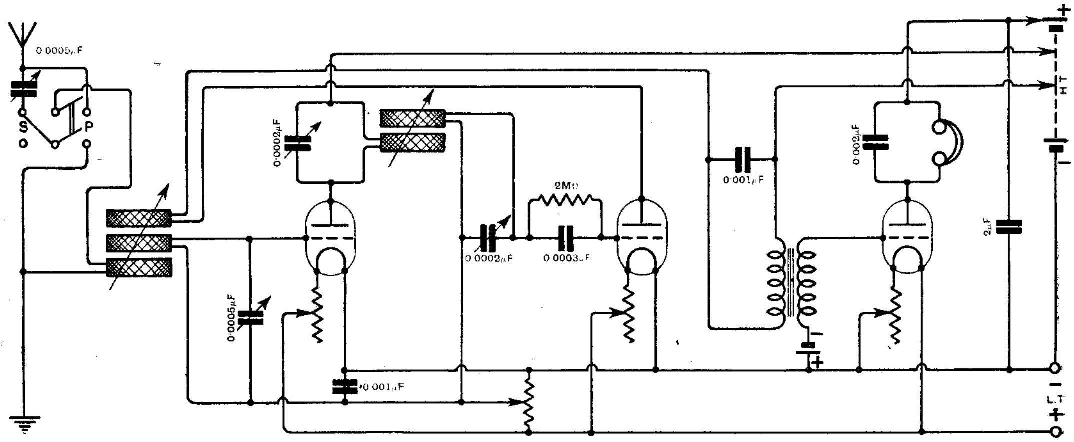


Fig. 2. "G.G." (Northwich). A selective three-valve receiver tuned throughout by plug-in coils and condensers.

"*J.H.T.*" (*Birmingham*) **has been experimenting with smoothing choke coils and condensers in the H.T. leads to his transmitter, and finds that in all cases the terminal voltage at the transmitter is reduced.**

There can be little doubt that the condensers which you are using are not designed for high voltage work, and are leaking badly. Condensers in which the dielectric consists of waxed paper are of little use for this purpose, and mica condensers of good quality should always be used when the voltage exceeds, say, 500 volts.

"*E.N.C.*" (*London, S.E.*19) **asks how to construct a coupling transformer for use between the detector valve and the H.F. amplifier in a supersonic heterodyne receiver.**

The transformer may consist of two multilayer coils of equal size tightly coupled together. It is not necessary to tune the windings by means of variable condensers. If you use two Igranic No. 1,500 coils, the natural wavelength of the transformer will be in the neighbourhood of 6,000 metres.

"*E.S.W.*" (*Richmond*) **asks questions regarding the coupling of L.F. amplifying valves.**

"*G.G.*" (*Northwich*) **asks for a diagram of a selective three valve receiver, in which the tuning is carried out by means of plug-in coils and variable condensers.**

The diagram is given in Fig. 2. It will be seen that transformer coupling is employed between the H.F. and detector valves, the primary and secondary windings consisting of plug-in coils, each tuned by means of a 0·0002 μF condenser. Separate H.T. tappings are provided for each valve, and the grid potential of the H.F. valve is controlled by means of a potentiometer. With this receiver a high degree of selectivity will be obtained if the coupling between the tuning coils is kept as loose as possible, and if the A.T.C. is connected in series on short wavelengths.

"*A.Z.*" (*Bognor*) **asks questions about the resistances used in the anode circuits of a resistance coupled L.F. amplifier**

We do not think that the type of carbon resistance to which you refer would function satisfactorily when passing a current of 12 milliamperes. Even if the resistance did not actually break down, the heating of the carbon resistance element would seriously affect its effective resistance. We think you would be well advised to use the wire wound resistances referred to in your letter.

Calls Heard

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order. Full address (not for publication) should be given to enable correspondence to be forwarded.

Hanley.
2 BG, 2 FQ, 2 KO, 2 LX, 2 MY, 2 NO, 2'OD 2'OQ, 2 OX, 2 OS, 2 RS, 2 SD, 2 SO, 2 SY, 2 WN, 2 YQ, 2 YX, 2 QR, 5 DD, 5 JN, 5 KO, 5 KX, 5 LP, 5 NI, 5 RI, 5 UN, 5 UQ, 5 VK, 5 QX, 6 BH, 6 GW, NS, 6 QS, 6 XQ, 6 XX, 8 AP, 8 AQ, 8 DQ, 8 DR, 8 RS, 9 NY, B 7, A 0 D. (1—v—1.) (W. M. Bakewell and C. Ashton, **6 UZ**).

Leigh, Lancs. (April 20th to May 25th).
2 AAC, 2 AAF, 2 AAL, 2 AAN, 2 ADH, 2 ADP, 2 AF, 2 AG, 2 AHT, 2 AR, 2 ASF, 2 BF, 2 EB, 2 EI, 2 FO, 2 II, 2 IN, 2 KE, 2 QJ, 2 UF, 2 VF, 2 ZK, 2 ZU, 5 AY, 5 BF, 5 CR, 5 DC, 5 FW, 5 KL, 5 LH, 5 NX, 5 OT, 5 VF, 6 BQ, 6 CF, 6 FV, 6 HS, 6 IK, 6 IL, 6 LC, 6 LF, 6 LM, 6 LY, 6 NI, 6 SD, 6 SP, 6 TD, 6 YB. All telephony. (0—v—1.) (W. R. Stainton.)

Southgate, London, N.14 (May 4th to 25th.).
2 AF, 2 AQ, 2 AU, 2 BO, 2 DX, 2 FK, 2 FM, 2 HF, 2 JV, 2 KT, 2 LT, 2 LZ, 2 MC, 2 MK, 2 NM, 2 OW, 2 PB, 2 PX, 2 QC, 2 QZ, 2 SH, 2 SK, 2 SY, 2 TA, 2 TS, 2 UV, 2 VJ, 2 VS, 2 VW, 2 VY, 2 WJ, 2 XD, 2 XO, 2 XR 2 YK, 2 YR, 2 ZO, 2 ABR, 2 ABZ, 2 ACZ, 2 AIF, 2 AKS, 2 AMA, 2 ARX, 2 ATS, 5 AC, 5 AS, 5 BT, 5 CB, 5 CF, 5 CP, 5 CS, 5 CV, 5 DS, 5 DT, 5 DY, 5 FC, 5 FL, 5 GF, 5 IO, 5 LF, 5 LH, 5 LP, 5 LT, 5 OY, 5 PZ, 5 QV, 5 PZ, 5 TR, 5 UL, 5 UV, 5 WM, 5 XD, 6 BT, 6 BY, 6 GM, 6 HP, 6 HY, 6 IM, 6 IV, 6 PD, 6 PY, 6 QA, 7 QO, 6 QV, 56 TO, 6 VO, 6 XC, 8 BM, 8 DU. (0—1—v.) (B. C. Cowper.)

New Southgate, London (May 2nd to 26th.).
2 BCF, 2 CC, 2 NA, 2 RH, 2 SV, 2 UF, 2 VI, 2 VO, 2 ZU, 5 RF, 6 UD, 8 BP, 8 CC, 8 CN, 8 DU, 8 JC, 0 FN, 0 PC, 3 NB, 4 YS, 5 ALD. (0—v—1). (W. D. Keiller, **6 HR**).

Northampton (April 21st to May 25th).
Telephony: **0 MR, 2 ASH, 2 JR, 2 JX, 2 OP, 2 QQ, 2 QZ, 2 WQ, 5 AJ, 5 CP, 5 MF, 5 OY, 5 YW, 8 AP, KFI.** Morse: **9 OAA, 0 BA, 0 BQ, 0 FN, 0 GG, 0 HD, 0 KY, 0 NN, 0 ST, 0 XF, 0 XP, 0 XQ, 0 XY, 1 ER, 1 LA, 1 MT, 2 AC, 2 ACU, 2 AGT, 2 ATI, 2 BCF, 2 CC, 2 DF, 2 DR, 2 FN, 2 LH, 2 MG, 2 NA, 2 NM, 2 OD, 2 OQ, 2 SH, 2 TR, 2 UF, 2 VJ, 2 VQ, 2 VS, 2 VW, 2 WJ, 2 XA, 2 XAR, 2 YQ, 5 AD, 5 BA, 5 CC, 5 CX, 5 DN, 5 FS, 5 GL, 5 GX, 5 HN, 5 ID, 5 JX, 5 LF, 5 LV, 5 NN, 5 RQ, 5 SI, 5 UG, 5 UQ, 5 VN, 5 WI, 5 WM, 6 BT, 6 BO, 6 CV, 6 DF, 6 DW, 6 DZ, 6 EA, 6 FG, 6 MK, 6 NO, 6 OM, 6 RC, 6 UU, 6 XG, 6 XJ, 6 YJ 8 AE 3, 8 AQ, 8 AZ, 8 BN, 8 BV, 8 CM, 8 CZ, 8 DA, 8 DC, 8 DI, 8 DP, 8 DX, 8 ÉB, 8 ÉM, 8 ÉN, 8 ÉP, 8 ÉU, 8 GG, 8 JB, 8 JM, 8 KP, 8 ML, 8 MN, 8 NA, 8 PX, 8 RO, 8 TK, 8 ZM, FL, PCRR, 7 ZM, 9 AB, 4 C 2, 4 TU.** (0—v—0). (P. H. Brigstock Trasler.)

Near Nelson, Lancs. (during May).
2 AD, 2 ADM, 2 ADU, 2 AHT, 2 AS, 2 AW, 2 IN, 2 JO, 2 KF, 2 KS, 2 LI, 2 SO, 2 US, 2 YW, 2 ZK, 2 ZU, 5 AD, 5 AF, 5 AY, 5 BD, 5 BE, 5 BF, 5 BH, 5 CF, 5 CR, 5 DC, 5 HF, 5 HM, 5 ID, 5 LB, 5 LI, 5 MH, 5 ML, 5 NX, 5 OM, 5 RY, 5 WY, 6 BL, 6 BR, 6 CL, 6 DI, 6 FA, 6 FH, 6 FI, 6 HF, 6 IC, 6 IK, 6 IS, 6 LD, 6 LF, 6 LI, 6 SH, 6 UB. (1—v—1). (A. Robinson.)

Holland Park, London (January, 1924, to April, 1924).
2 AGT, 2 LIX, 2 AJ, 2 BO, 2 BT, 2 BZ, 2 FU, 2 FQ, 2 GO, 2 KG, 2 KZ, 2 ML, (?) 2 MO, 2 OB, 2 OM, 2 PY, 2 PZ, 2 QC, 2 ST, 2 UC. 2 VJ, 2 XX, 2 XZ, 2 ZA, 2 ZO, 5 BT, 5 BV, 5 CB, 5 CP, 5 DK, 5 IO, 5 OB, 5 OF, 5 PD, 5 PO, 5 PU, 5 VR, 6 GT, 6 IM, 6 KI, 6 PU, 6XX.

(C. L. Bradley.)

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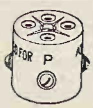

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The WIRELESS WORLD AND RADIO REVIEW

EXPERIMENTS WITH MOBILE SETS

WITH the prospect of summer weather, many experimenters are giving attention to the design of receiving sets specially intended for use out of doors. Practically no difficulty is encountered when reception on an improvised aerial is attempted and the amateur only too often finds that the results obtainable on a hurriedly erected aerial out of doors are very much better than those he obtains from his aerial at home, and particularly is this the case where the permanent aerial is surrounded by buildings and dozens of other aerials. In most cases it is remarkable how much reception is improved when one takes the receiving set away into the country and remote from the usual causes of interference and absorption.

Having so easily obtained good reception with a fixed station out of doors, the next step is probably to attempt reception by means of a mobile station, such as might be carried in a motor car or side car. We think that most experimenters will be surprised with the results obtainable with a wireless receiving set carried in a car on the road and utilising only a small aerial. Some tests which we made last week revealed that a straight aerial from the bonnet of the car to the hood gave much better reception than a frame. When using an aerial of this sort carried by small pieces of ebonite to insulate it from the metal work of the bonnet and the wind screen and with the lead-in taken from the mid-point, it was found that the London station could be received very strongly on three pairs of telephones, some thirty miles north on the Great North Road using a receiver consisting of an H.F. amplifying valve, a detector valve and note magnifier.

Travelling receiving stations of this sort permits of easy investigation of the so-called blind spots and during this particular test it was found that no appreciable weakening of signals occurred in any area and that only when passing under a low railway bridge did signal strength fluctuate. When passing down among avenues of tall trees laden with moisture, there was an almost inappreciable drop in signal strength and when travelling along tramway tracks beneath overheated trolley wires the **2 LO** transmission came in as strongly as it did in the open country.

The outstanding conclusion for a simple test of this sort is that signal strength may be weakened by screening in the immediate neighbourhood of the aerial, but as to the existence of areas in which wireless reception is unsatisfactory there was no evidence.

When building a receiver for mobile purposes it is essential that all the control levers, and particularly that operating the reaction coupling, shall remain rigidly in position wherever they may be set and for this reason a receiver was employed that did not make use of plug-in coils for variable coupling because it was thought that owing to the weight of these coils some movement could not be avoided. Tapped single layer inductances were used with ball reaction coupling. It might be mentioned that the filament heating was supplied from the car lighting system, which permitted of the use of bright emitter valves, and in consequence the microphonic effects such as are obtained with valves of the dull emitter type, were entirely avoided. An earth connection was made on the petrol pipe which passes along the chassis beneath the footboards.

Transmission from vehicles in motion is a matter which is yet to be investigated by the experimenter and by the time these lines appear in print the results will be known of the interesting experiments which are being carried out by the Radio Society of Great Britain on a north-bound express.

FOUR-ELECTRODE VALVE RECEIVER.

The last few months have seen a revival of interest in the possibilities of the four-electrode valve. This revival, which started on the continent, has spread to this country, and for the next few months at any rate this valve seems likely to engage the attention of a very large number of experimenters. It should be borne in mind that the four-electrode valve is no novelty. It was first developed several years ago, and its possibilities were then fairly thoroughly worked out. It was even used commercially on receivers in this country at least three years ago. It is therefore not likely that any very revolutionary results will arise from its present phase of popularity, and it is quite possible that after a few months it will "go out of fashion" and be almost as seldom heard of as it has been for the last few years. The valve will doubtless continue to exist, but it should be noted that improvements in the ordinary three-electrode valve are likely to bring its efficiency more nearly up to the level of the four-electrode type, and also the special circuits which the additional grid make possible are all of a type which are of greater merit for the reception of very weak signals than for the comfortable and convenient use of broadcast telephony.

THERE are two main types of four-electrode valve circuit. In one of these a positive potential of a few volts—generally about 10—is placed on the inner grid. No other, or practically no other, use is made of this electrode, and the outer grid and plate are used in any of the ways common in three-electrode valve practice. Without going into the theory underlying this method it may be stated that in effect the positive potential on the inner grid considerably improves the ratio of the voltage amplification factor to the plate impedance of the valve, and therefore correspondingly improves its performance either for amplification or detection.

The second type of circuit is a good deal more complicated, and aims at using the larger number of electrodes available to obtain dual or triple functions from the valve. It is possible, for instance, to make one of these valves act efficiently at one time as a high frequency amplifier, a detector, and as a low frequency amplifier. It might at first sight be thought that if this is the case the valve is likely to supersede the three-electrode valve entirely; but here a few words of caution are necessary. Firstly, nearly as much apparatus and as many adjustments are necessary to get these results from one four-electrode valve as from two three-electrode valves used in an ordinary reflex circuit; and secondly the power handling capabilities of the four-electrode valve used in this way are not very great, certainly less than those of two three-electrode valves of ordinary receiving type. It will be found that the results obtainable with a circuit of

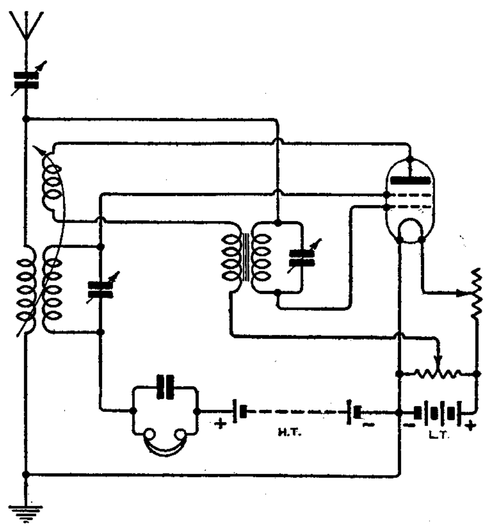


Fig. 1. The circuit diagram.

this type are approximately as good as a "straight" three-valve circuit, where really weak signals are being dealt with, but fall a good deal short of this figure when the signals are at all strong.

It is of course fairly well known by this time that the improved efficiency of four-electrode valve circuits of both types on weak signals makes it possible to reduce the high tension battery to very small proportions, and in fact to use the low tension battery for high tension purposes, and still to retain nearly the efficiency of a three-electrode valve circuit on its proper value of high tension, but a sacrifice of efficiency in this way is not likely to become popular.

As the first type of circuit, in which a fixed positive potential is applied to the inner grid, differs so little from normal practice, it may be dismissed here with the remark that its use is preferable wherever a four-electrode valve is to be employed on strong signals. Attention will now be turned to a particular circuit of the second type, and the construction of a receiver on these lines described.

The circuit used is given in Fig. 1, the operation of which is as follows. High frequency oscillations in the aerial circuit are transferred to the inner grid through the grid condenser, and high frequency amplification takes place between this electrode and the outer grid. A certain controllable amount of reaction is introduced at this stage between the two grid circuits by means of magnetic coupling of the aerial and outer grid tuned coils. Detection then takes place between the outer grid and the plate, which is kept at a suitable potential for the purpose by means of a potentiometer across the filament battery. Reaction is again introduced here by means of a coil in the plate circuit variably coupled with the outer grid circuit coil. The rectified signals in the plate circuit are passed back to the inner grid by means of the low frequency transformer, and are then amplified at low frequency between the inner and outer grids. A pair of telephones, or the input winding of a transformer to a low frequency amplifier if loud speech is required, is connected in the outer grid circuit.

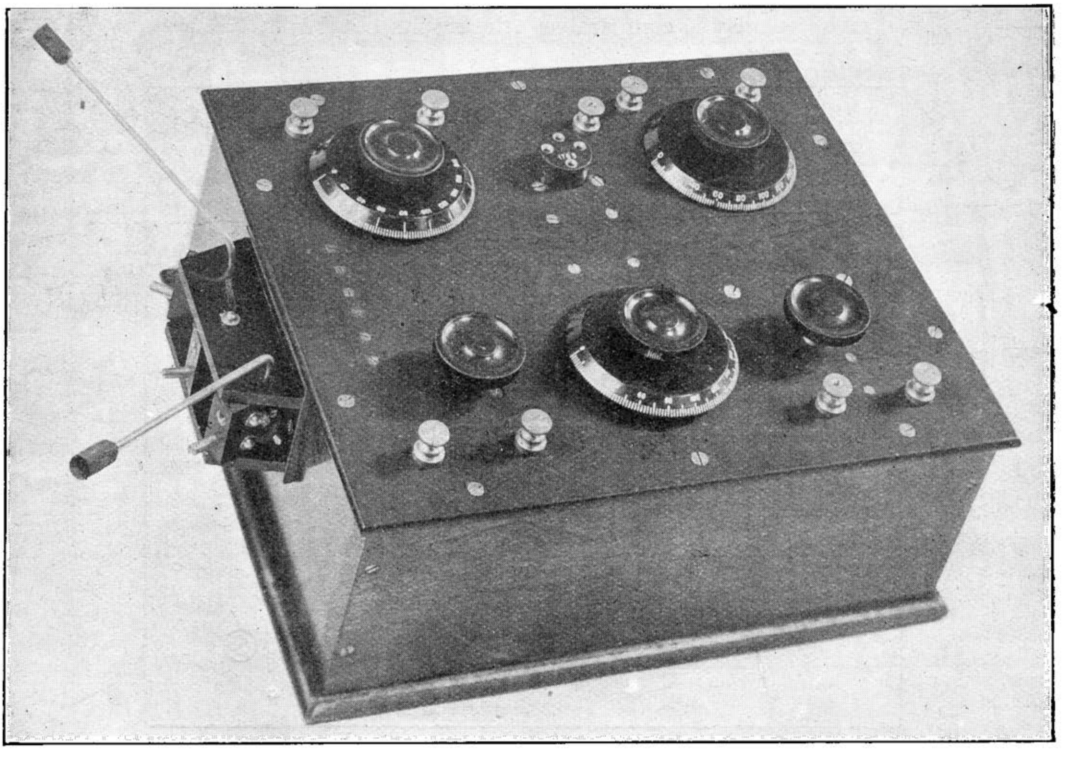


Fig. 2. The finished receiver.

There are two types of valve available

for this circuit. One is the older form resembling a "V24" but larger and with an additional "pip" for the second grid. There is also the recently developed type which makes use of the ordinary "R" valve type socket, and provides connection to the inner grid through a terminal attached to the metal sheath at the base of the valve. The latter type has been adopted in this receiver because it is rather less trouble to mount, and allows of a wider choice in the makes of valve employed. The valves of the two types have very similar characteristics, and give closely comparable performances. The valve actually used was a Marconi-Osram D.E.7, which has the same general construction and filament as the well-known D.E.R. of this make. The filament requires about 0·4 amps at 2·0 volts, and the plate voltage may be from 30 to 50.

In Fig. 2 is shown a view of the completed instrument. In order that a large range of wavelengths may be covered without the instrument becoming too bulky and requiring expensive switchgear, the tuning coils are made interchangeable, and are used in a three coil holder mounted on the left-hand side of the box. The coil nearest to the top of the box is in the aerial circuit, the next is the tuned outer grid coil, and that at the bottom is in the plate circuit. Three variable condensers are provided, that in the top left-hand corner being in series in the aerial circuit. The condenser in the top right-hand corner is the grid condenser. This might possibly have been a fixed condenser of about 0·00015 mfds., but the possibility of adjustment of this value to suit the wavelength does improve the results obtained.

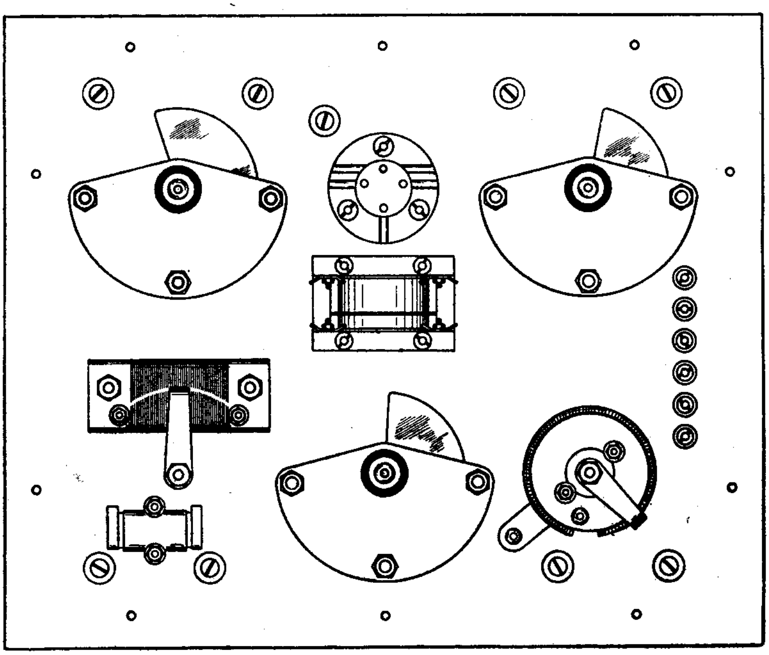


Fig. 3. Arrangement of the components on the underside of the panel. (Scale ½ full size.)

The condenser directly below the valve is the outer grid tuning condenser, which should have a value of about 0·0005 mfds., which will also be suitable for the aerial condenser. The value for the grid circuit tuning condenser can be less than this, 0·0003 mfds. being a very suitable figure.

On the left and right of the outer grid tuning condenser respectively are the filament resistance and the potentiometer. The arrangement of the terminals is shown in the figure, the special one close to the valve holder being for a flexible connection to the grid terminal on the valve cap. On the left-hand side of the panel will be seen a row of six screw heads. These screws carry flexible leads from the main stiff wiring of the panel out through the sides of the box to the three coil holder. This arrangement allows the whole panel to be wired up independently of the coil holder, and it may be removed after completion at any time for examination without disturbing any soldered connections. An alternative construction could be adopted if desired in which the three coil holder is permanently fixed to the deck by strips of angle brass. The coil holder and deck would then be removable in one unit without any flexible leads having to be taken off. It is doubtful, however, if the advantage of this possibility would be worth the extra work necessary and the difficulty of making a really neat job in this way, particularly as access to the interior is possible by removing the bottom of the box.

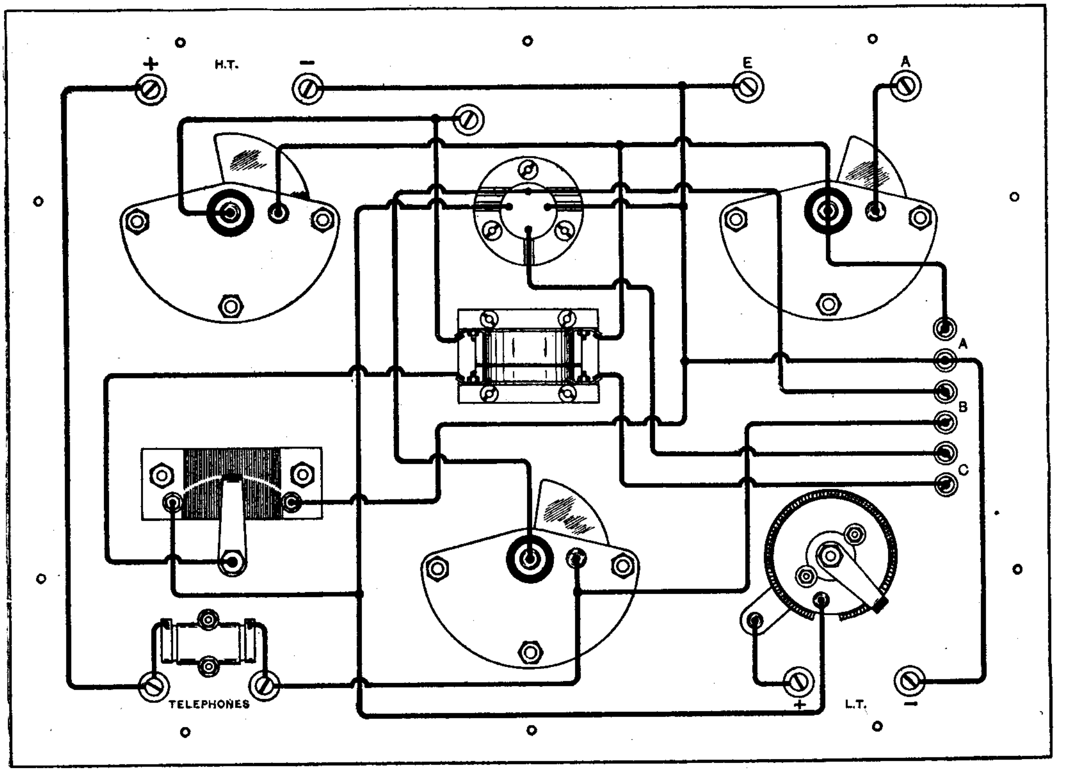


Fig. 4. Wiring diagram of the panel.

The only other items of importance in the set are the low frequency transformer and the blocking condenser for the phones, which will be described later.

A.M.G.

(Details of the assembly and operation of this receiver will be included in our next issue.)

THE HOLWECK DEMOUNTABLE VALVE.

This type of valve, intended for transmission, is built so that it can be easily dismantled for the purpose of fitting a new filament or modifying the arrangement of the electrodes. The vacuum is created by means of a rotary pump at the base of the valve and a water jacket provides the necessary cooling when the valve is in operation. This article describes some recent modifications.

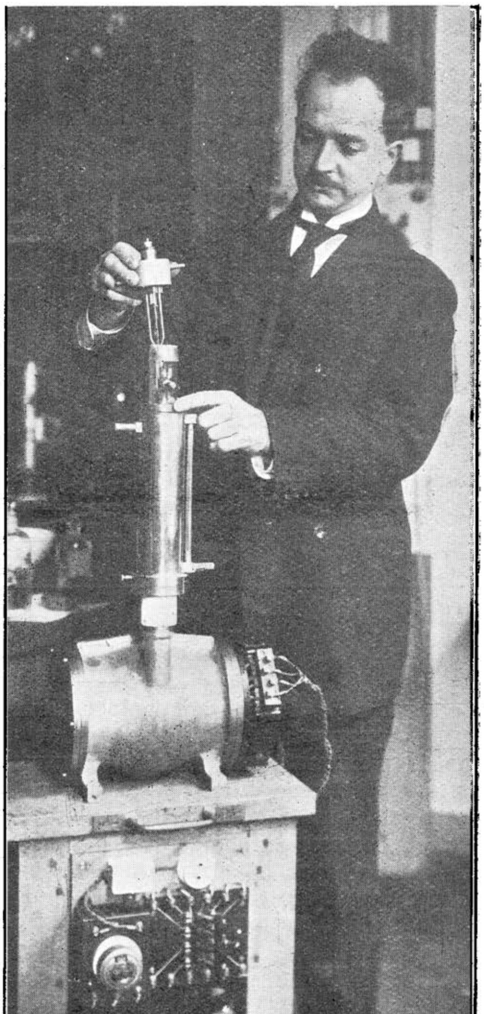
It is to be expected, as with any new invention, that after it has been in use for some time that possibilities of improvements will appear, and such is the case with the Holweck demountable portable valve. This valve has been in use since May, 1923, at the Eiffel Tower Station and as the result of experimental work certain modifications have been introduced.

The principal difficulties, as might be expected, arose at the various points of sealing where joints were made by means of indiarubber fittings. The improved design completely dispenses with the use of rubber in the making of the joints.

All the surfaces are now fitted together in very much the same way as the metal faces of cylinders and valves as used in general engineering work. The various component parts are ground precisely to the required dimensions and prior to assembly are given a smearing of grease. The grease, of course, must not reach the interior of the valve and under no circumstances may it be submitted to bombardment by the electrons as this would cause it to rapidly decompose and immediately release large volumes of gas. This difficulty is overcome by the fitting of guard rings which are shown at B in the accompanying diagram. A separate water circulation is also provided to ensure that these rings will not become overheated, which is another addition to the original design of the valve. The flanges D and E in the figure are the barriers of the separate water jacket.

Another modification is that the filament and grid are assembled as one component part, and these are attached to the piece C, which allows of accurate spacing being arranged between these two electrodes. The glass stem pieces F, form the insulating supports of the grid. Contact with this electrode is made by means of a spring pressing against an extension on the grid and communicates with the exterior through a solder-filled joint.

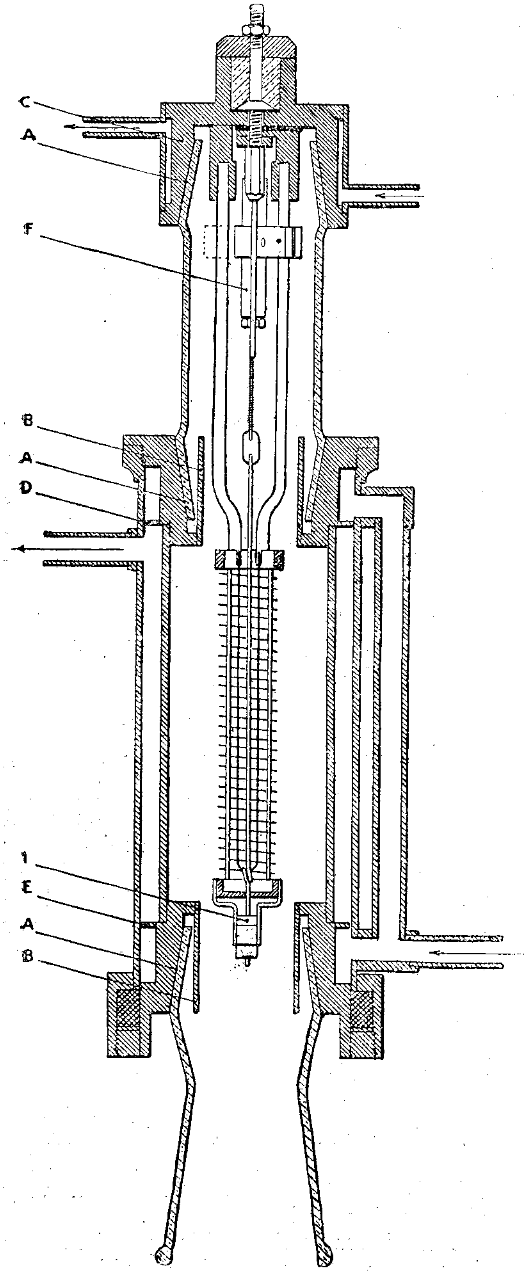
The characteristics of the valve have remained much the same as before and with a current supply at 5,000 volts, the valve will deliver 8 kW. into the aerial system at



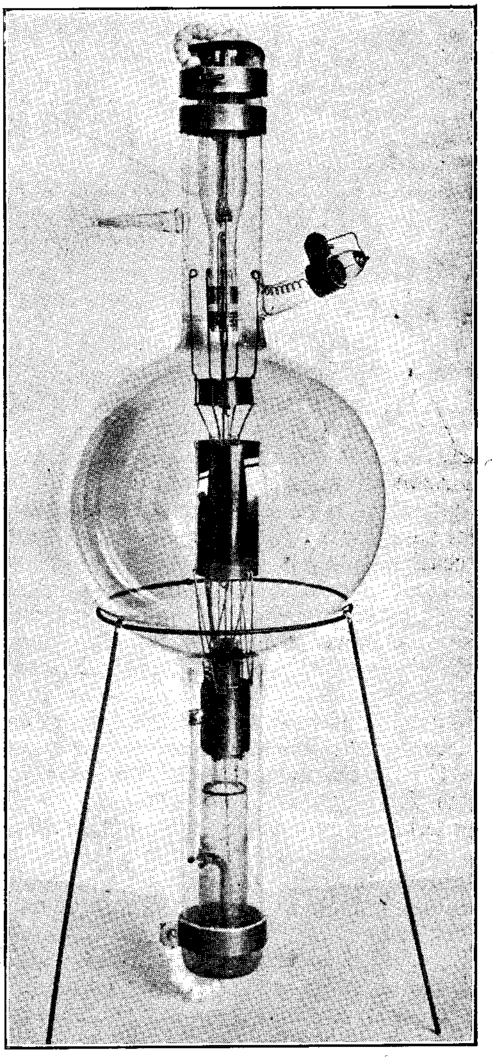
Dr. Holweck assembling a valve. The lower chamber is the rotary pump.

the Eiffel Tower, or an aerial current of 35 amperes on a wavelength of 2,600 metres.

A larger valve has recently been constructed to the new design and is capable of producing an aerial current reading of 70



Sectional view of demountable transmitting valve, showing the location and construction of the joints.



New design of transmitting valve, arranged to render refilamenting an easy operation.

amperes on the same aerial and handles a power of 32 kW. making use of a current supply at 7,000 volts. The plate current for this transmitter is derived from stepped-up and rectified alternating current at a frequency of 1,000 cycles. Rectification is carried out by means of demountable valves built on the same general lines as the one here described.

Dr. Holweck is responsible for yet another improvement in valve construction in which he arranges for all metal parts in a glass enclosed valve to be readily replacable.

CRYSTAL DETECTORS IN THEORY AND PRACTICE—VI.

MOVEMENTS AND VIBRATIONS AT THE LOOSE CONTACT.

By JAMES STRACHAN, F.Inst.P.

ANYONE who has experimented on strong reception from a B.B.C. station with a crystal detector of the simplest type, in which the horizontal "catwhisker" consists of a lever supported by a single ball-bearing as its fulcrum, must have observed that on certain occasions the loose contact was suddenly broken, or nearly so, without any apparent cause. This phenomena has been attributed to mechanical vibrations of the detector, but during the past year several amateur observers have insisted that the sudden breaking of the contact coincided with sudden increases or variations in the aerial current.

The attention of the present writer was forcibly drawn to this matter while experimenting with crystals in the field of a powerful electro-magnet. In this case the detector used was of such a type that any mechanical vibration of the detector caused the "catwhisker" to fall by gravity towards the crystal, so that any such external disturbances would cause firmer contact. It was observed that on switching the electro-magnet either off or on during reception the "catwhisker" was literally (to use an expression made by one of the observers mentioned above) "jogged off the crystal" and the metal point had to be depressed to re-establish reception conditions. In this instance the cause of the phenomena was proved to be clearly due to the spark discharge at the make and break producing a sudden surge of current in the crystal set.

This suggested another experiment and it was found that by touching the terminals of the crystal detector momentarily, during reception, with the leads from a H.T. battery (24 to 36 v.), the sudden flow of current produced exactly the same effect, *viz.*, a sudden breaking of the loose contact, the "catwhisker" and its support being moved upwards against the force of gravity, such movement being permitted by the ball-bearing fulcrum of the support.

About this time my attention was drawn to the curious behaviour of a crystal set coupled to a L.F. amplifier. The telephone leads from the set passed through into another room from that in which the set was installed and in this room the leads for a few yards ran parallel and close to the leads from the household telephone installation. It was observed that on every occasion a telephone call came through, during broadcasting hours, the crystal contact was suddenly broken immediately the bell rang. In this case it was abundantly clear that the inductive action of the current in the telephone leads reacted on the crystal-valve circuit.

Again, while experimenting with a zincite-bornite detector in which the bornite point was carried on a strip of springy copper and depressed on to the zincite by a micrometer screw, it was found that during reception of loud music, the crystal contact could be adjusted to produce vibrations of the copper spring which sounded quite violent in the telephone and which could be felt as actual mechanical tremors by placing the tip of the forefinger lightly on the spring. It was found possible to repeat this experiment with a galena detector but in this case the micrometer adjustment necessary was very fine. These vibrations at the loose contact appeared to be quite independent of outside mechanical disturbances and caused very bad distortion during reception.

While investigating this problem the writer was at the same time making some tests on a series of synthetic galenas. One of these preparations was composed of lead sulphide and silver sulphide crystallized in molecular proportions ($PbS\text{-}Ag_2S$). This compound was found to give good rectification but was also found to be supersensitive in manipulation of the loose contact. With this crystal it is impossible to obtain a stable contact without a rigid "catwhisker." In crystal detectors of the ordinary type where the support is free to move on a ball-bearing, or where the contact is made with a fine wire, one may adjust this crystal to obtain good reception but a few seconds later, with the varying current passing the contact, vibrations and distortion occur and finally the contact breaks of its own accord. Similar results were obtained with natural Jamesonite ($2\ PbS\text{-}Sb_2S_3$) and synthetic lead selenide (Pb Se).

It was further observed that some crystals which operate best with an applied D.C. potential have their loose contact broken when the applied potential is increased gradually, by moving the potentiometer slide very slowly, beyond the point of maximum sensitivity. This is most marked in the case of magnetite (Fe_3O_4). Also with numerous crystals, particularly those of a fairly hard nature such as silicon, cassiterite, zincite and iron pyrites, the application of an applied D.C. potential in the reverse direction to that of the natural rectified current produces during reception violent vibrations and distortion about the neutral point, where the rectified current is a little more than balanced by the applied current.

Direct observation of the loose contact during such experiments as those described above, by means of a compound microscope, failed to demonstrate the actual movements of the metal point, but under the conditions it was not found possible to use higher powers than about 100 diameters. Micrometer measurements of the displacement of the metal point when the loose contact was broken during reception proved that its dimension was about 0·002 mm. (slightly less than a ten-thousandth part of an inch), which is beyond visual observation with the above magnification.

It was found possible, however, to render not only the maximum movement visible when the contact was broken, but also the vibrational movements during the distortion by means of simple apparatus.

This is shown in Fig. 1 where a simple crystal detector is mounted on a base B_1. The crystal is held at C and a metal point of platinum wire, carried by a thin strip of thin steel S, makes contact with the crystal by regulating the micrometer screw M. Attached to the free end of S is a thin pointer of spun glass G, the magnified end of which appears in the compound microscope field F. The base B_1 is suspended by four rubber bands to supports on a larger base B_2, which in turn is suspended by four cords. By this means the whole apparatus is rendered as far as possible free from mechanical vibrations. The minute movements of the metal point are mechanically magnified by the pointer of glass fibre G, and these magnified movements are examined under a power of about 200 to 250 diameters, using a good half-inch (12 mm.) objective and a deep eyepiece. The connections to the crystal detector are made with very thin copper wire and during observations the apparatus must be protected from air currents by cardboard screens.

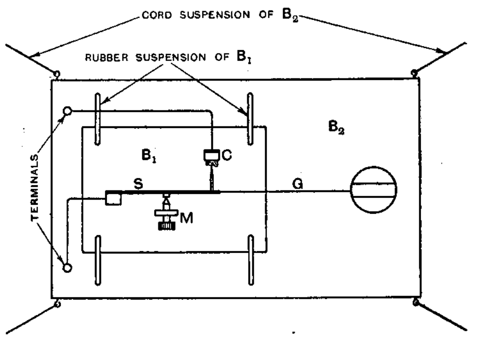


Fig. 1. Diagram of simple apparatus for observing movement when the contact is broken, and for detecting vibrational movements during distortion.

In crystal detectors where the nature of the contact allows of a fair degree of pressure, *e.g.*, as in the zincite-bornite combination, such movements do not of course occur, but there is often a small amount of vibration. In the "catwhisker" type of detector, even when the metal point is rigidly supported, there is always a certain amount of vibration at the loose contact. It appears quite evident that the evolution of the spiral type of "catwhisker" has been a practical effort towards making a more stable contact by establishing a means of applying a slight and variable pressure. It may be observed that some detectors are much more silent in their action than others. When hard crystals such as silicon and iron pyrites are compared with synthetic galena, it is found that the latter frequently emits a harsh buzzing note, often accentuated by strong reception. This is entirely due to vibration at the loose contact and it may be almost completely eliminated by using a massive lead point instead of the light "catwhisker" (*vide* Fig. 2). Another and better method of accomplishing this end lies in embedding the loose contact, after adjustment, in an insulating medium which holds the crystal and metal point together, thus giving a permanent setting free from vibrations, internal or external.*

It should be clearly understood that the vibrations which occur at the loose contact of a crystal detector are not essential to its operation but are secondary phenomena and interfere with perfect rectification. The more sensitive the crystal, apparently, the worse such movements become, probably due to an intensive molecular movement at the point of contact.

The ideal method of using a crystal as a rectifier would undoubtedly be to replace the metallic point by an atmosphere of conducting gas so that the action would not be confined to a single point, but over an area. In the writer's opinion the evolution of the cold valve lies in this direction and although much research work may require to be done we will eventually find a crystal detector much more efficient and perfect than the present forms.

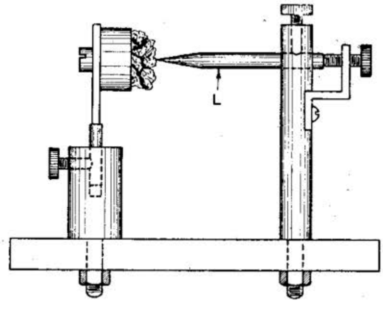
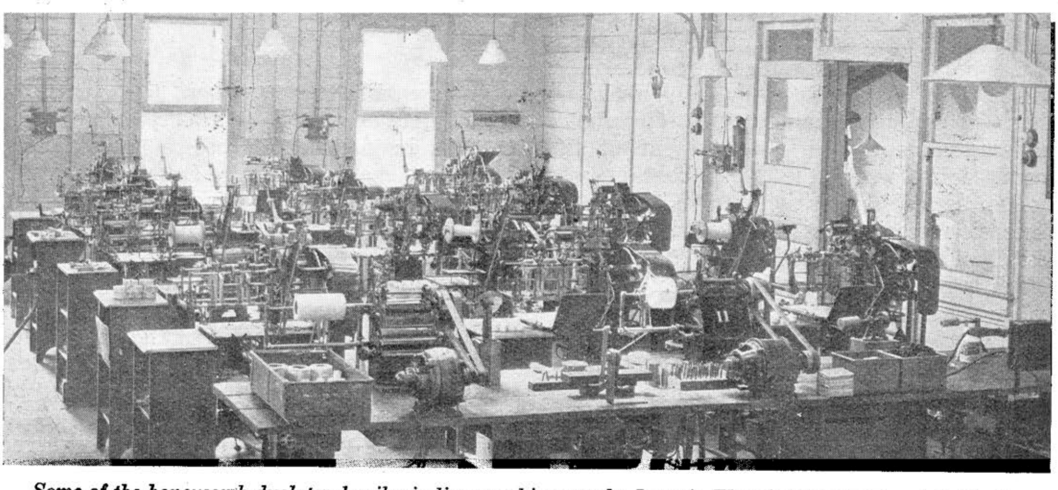


Fig. 2. *A massive lead point used in place of a "catwhisker" to eliminate vibration.*

In the present state of our knowledge concerning the exact nature of rectification it is difficult to suggest the cause of such vibrations at the loose contact. In the writer's opinion they are due more probably to rapid movements of the surface molecules of the crystal than to the passing of electrons, but as the latter are intimately connected we have some conception of what takes place on the basis of the theory advanced in a former communication.

* Prov. patent.



Some of the honeycomb duolateral coil winding machines at the Igranic Electric Co.'s works at Bedford.

DESIGN FOR A CRYSTAL RECEIVER

WAVELENGTH RANGE 200—2,000 METRES.

The opening of the high power broadcasting station at Chelmsford is directing the attention of owners of crystal sets to the reception of longer wavelengths. While it is possible to extend the range of existing receivers to a fixed value of 1,600 metres by means of plug-in coils, there is much to be said in favour of a receiver capable of adjustment to intermediate values.

By F. L. DEVEREUX, B.Sc.

THE circuit of the receiver is given in Fig. 3. The aerial tuning inductance consists of a cylindrical coil tapped in tens and units, and a group of six basket coils. The coils are connected in series and are mounted on the same axis as that of the cylindrical coil, forming with that coil a continuous winding. The inductance of each basket coil is made equal to that of the cylindrical coil so that the amount of inductance in circuit may be adjusted throughout the range of the instrument to the nearest turn. In order to prevent resonance effects, the load coil switch has been arranged so that the sections not in use are short-circuited. The crystal detector and telephones are connected across the tuning inductance in the usual way. The two pairs of telephone terminals are connected in parallel, as this arrangement seems to give best results with the 4,000 ohm telephones and synthetic

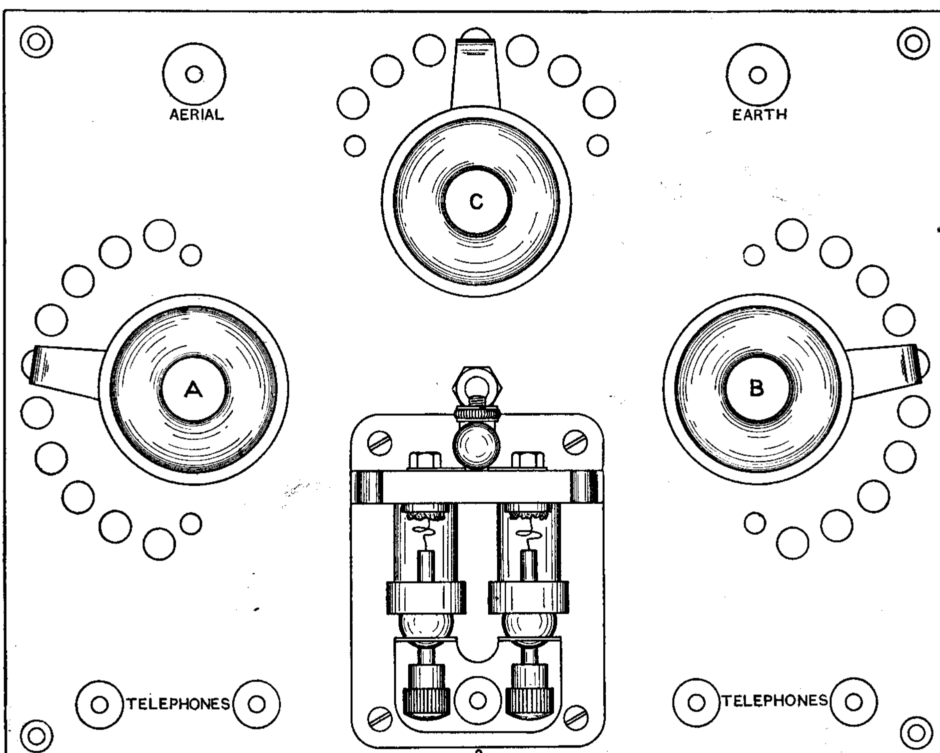


Fig. 1. Plan showing arrangement of components on top of panel.

galena crystals in common use. In order to anticipate possible criticism, it may be as well to state at once that the fixed condensers usually connected in series with the aerial and in parallel with the telephones have been omitted advisedly. It often happens that the use of either of these condensers effects no change in the strength or quality of reception and in cases where their use may be desirable the correct values should always be chosen by trial. The capacity of the series aerial condenser will be determined to a large extent by the capacity of the aerial itself and the telephone condenser must be adjusted to correct defects in the acoustic characteristics of the telephones. These condensers, therefore, are most conveniently fitted to the set externally.

In the following paragraphs constructional details are given to supplement the photographs and drawings of the instrument.

The Panel.

A plan of the top of the panel showing the layout of the components is given in Fig. 1. With the exception of the tuning coils which are secured to the underside by a length of screwed rod, the components are mounted on the top of the panel. The arrangement of the switches shown in the diagram was adopted with the object of simplifying the wiring of the tappings on the cylindrical coil. It will be seen in Fig. 5 that the units tappings are all taken from the side of the coil facing switch A and the tens tappings from the side opposite switch B. The tapping points

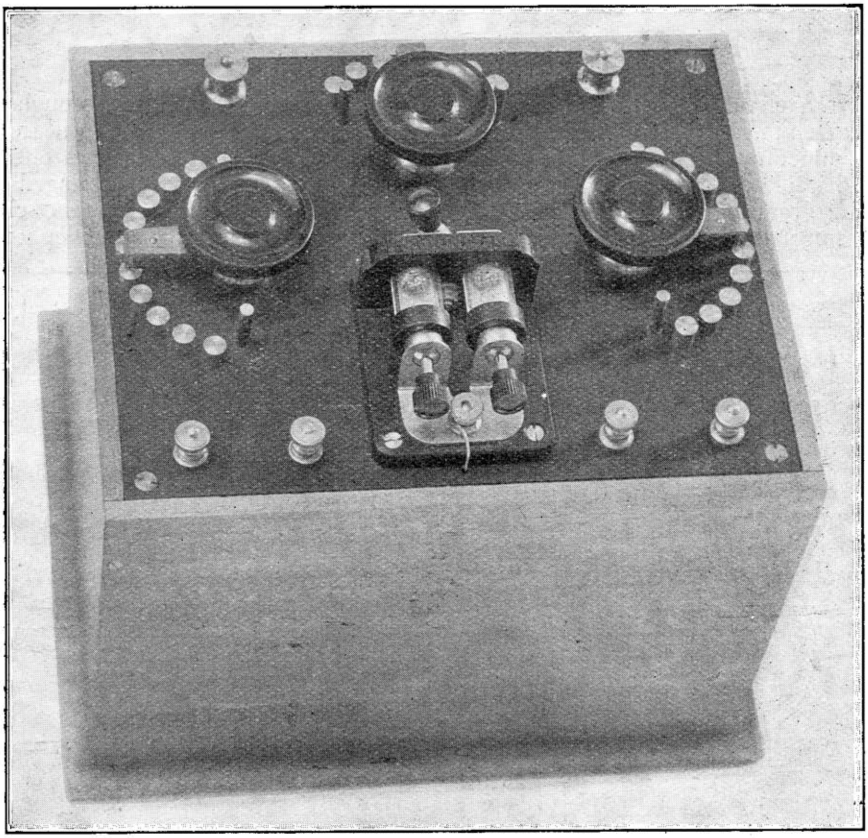


Fig. 2. View of finished receiver. The crystal detector is placed in an accessible position at the front of the panel.

on the coil are thus brought opposite their corresponding switch studs and may be connected across directly. The use of insulating sleeving is therefore rendered unnecessary. The overall dimensions of the panel are 6 ins. × 7½ ins. × ¼ in.

The Tuning Inductances.

The cylindrical coil providing the fine tuning adjustments is wound on an ebonite former 3 ins. long and 2 ins. in external

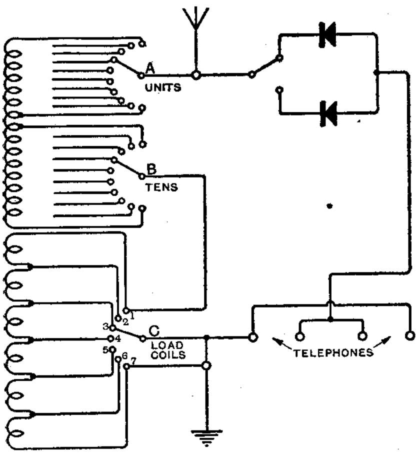


Fig. 3. The connections of the receiver.

diameter. After having been filed up square, the ends should be marked with twenty equally spaced dividing lines as shown in Fig. 4. From each of these marks, parallel lines should be scratched down the length of the coil by means of a scriber. During the winding of the coil these parallel lines will be found of great assistance in locating the position of the tappings. Pairs of small holes about ⅛ in. apart should be drilled on one of the dividing lines near each end of the former for the purpose of securing the ends of the winding. No. 28 D.C.C. copper wire is used for the tuning coils throughout and ½ lb. will be found more than sufficient for the purpose. Securing the beginning of the wire at one end of the coil, a total of 110 turns is wound on with tappings after the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th, and 100th turns. The tappings are made by twisting the wire to form a small loop. Each tapping is made at the line following that at which the previous tapping was made, in the direction of rotation. Thus the beginning of the coil will be diametrically opposite the tapping at the 20th turn.

The coil should now be treated with shellac varnish or paraffin wax (according to the prejudices or predilections of the individual) and should then be thoroughly baked to drive off all traces of moisture. The cotton covering should now be removed from each tapping loop with some smooth glass-paper and the exposed wire should be tinned with a clean iron.

Each of the basket coils consists of 60 turns of No. 28 D.C.C. wire. The inside diameter should be about 1 in., when the outside diameter will be about 3½ ins. The number of spokes in the "spider" former is not of great importance and may be any odd number between 9 and 15. The coils are treated with hot paraffin wax, all superfluous wax being shaken off while hot. Six of these basket coils will be required.

The assembly of the coils is best explained by reference to Fig. 4. A piece of 2 B.A.

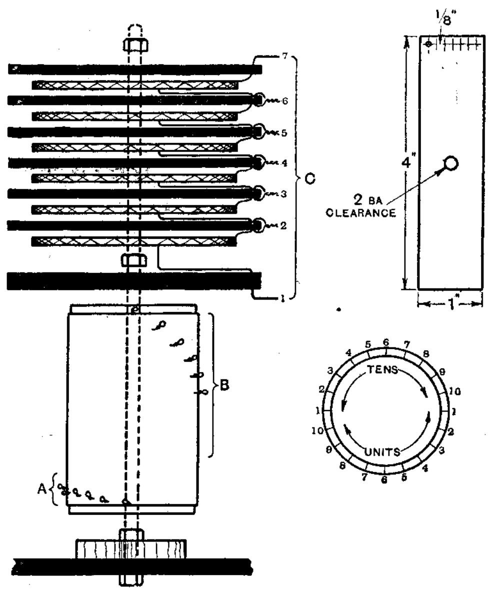


Fig. 4. Details of the tuning coils. The method of assembling the coils is shown diagrammatically on the left.

screwed rod 5¾ ins. in length passes through the centre of the coils and through a clearance hole in the panel and the coil, are prevented from moving laterally by a wooden disc fitting inside the base of the cylindrical coil. Seven ebonite spacing strips 4 ins. × 1 in. will be required. The first is $\frac{1}{4}$ in. in thickness and serves to pull the cylindrical coil up to the panel. The coil should be mounted so that the units tappings are at the bottom and facing switch A. The remainder are $\frac{1}{8}$ in. thick and are used to separate and clamp the basket coils. A small hole is drilled in the end of each strip for the purpose of securing the ends of the basket coils. The hole in the first strip is drilled $\frac{1}{8}$ in. from one side, that in the second $\frac{1}{4}$ in., the third $\frac{3}{8}$ in. and so on. By this means the ends of the coils will form a diagonal line as shown in the photograph in Fig. 5 and there will be less likelihood of short circuits taking place. The method of connecting the basket coils in series will be obvious from an inspection of the diagrammatic sketch at the left of Fig. 4. ***It is most important that the direction of winding in each basket coil should be the same as that of the cylindrical coil.***

The wiring of the switch C can be followed from Fig. 3, but in order that there may be no ambiguity regarding the connections of the other two switches a table is given below.

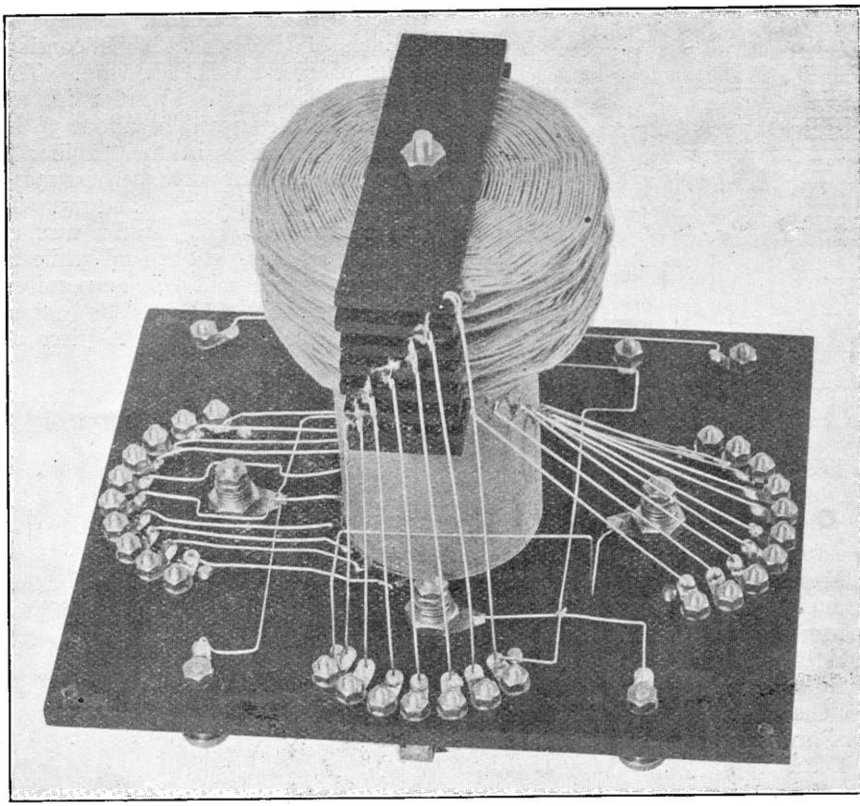


Fig. 5. View underneath the panel. Soldering tags are used under all terminals and switch contacts.

Tapping on Coil	Contact.		Tapping on Coil.	Contact.	
End of coil	1	Switch "A"	20th turn	1	Switch "B"
1st turn	2		30th ,,	2	
2nd ,,	3		40th ,,	3	
3rd ,,	4		50th ,,	4	
4th ,,	5		60th ,,	5	
5th ,,	6		70th ,,	6	
6th ,,	7		80th ,,	7	
7th ,,	8		90th ,,	8	
8th ,,	9		100th ,,	9	
9th ,,	10		End of coil	10	

The remainder of the wiring is straightforward and can be followed from the circuit diagram.

Wavelength Range.

The finished instrument was tested at Croydon on a single wire aerial 50 ft. in total length and 18 ft. in height and the following stations received :—Amateur transmitters (200 metres), **2 LO** (365 metres), Marine traffic (600 metres, spark), Croydon Aerodrome (900 metres), Radiola (1,780 metres, very faintly), Eiffel Tower (2,600 metres, spark). A fixed capacity of 0·0001 μF was connected across the aerial and earth terminals to bring in the last named station, but this would in all probability be unnecessary with a larger aerial.

CORRESPONDENCE.

To the Editor of The Wireless World and Radio Review.

Sir,—Your reference in the June 18th issue of *The Wireless World and Radio Review* to a Society having been formed to further the cause of Esperanto as an international wireless language, may cause misapprehension among your widespread readers owing to the Esperanto propagated by the Association not being the same as that now being so widely adopted for radio, and particularly DX work, throughout the world.

It will be appreciated that the International Delegation decided to adopt Esperanto in principle but modified to a marked degree ; this simplified Esperanto is best known as Ido or Ilo.

Ido has registered correspondents in all the principal countries and its register, " Vak," contains nearly 5,000 addresses.

La Internaciona Ido-Radio-Klubo has sections in each country and their standing will be appreciated from the fact that Mr. E. F. W. Alexanderson, the Chief Engineer of the Radio Corporation of America, is President of the U.S.A. Section.

The widespread American Radio Relay League recommend and are organising the adoption of Ido for all Transoceanic work.

For American stations regularly broadcasting Ido and for other confirmation I beg to refer you to the enclosed reprint from the (American) *Radio News* and to big newspapers like the *Boston Sunday Advertiser* and *La Presse*, of Montreal, which give weekly Ido lessons to their 2,000,000 readers.

Many Continental stations have broadcast Ido, and similar progress is being made there too.

Radio is to be the Voice of the World, and a simple auxiliary must be its natural language.

That one easiest for the greatest number of peoples is the requirement—and that one is Ido.

E. H. Turle, A.M.I.E.E.

London, W.1.

A New Theory of Crystal Detectors.

To the Editor of The Wireless World and Radio Review.

Sir,—I append herewith translation of an appreciative letter on the new theory I have suggested for the action of contact detectors. The writer, who is a physicist in a Vienna wireless factory, encloses a copy of his paper entitled " Eine Schwebungsmethode zur Prüfung der Trägheit von Kontaktdetektoren " (An Oscillation Method of Testing the Inertia of Contact Detectors), describing an interesting piece of research work carried out in the Physical Institute of the University of Vienna and published in the " Physikalischen Zeitschrift," pp. 208-214, 1920.

This paper deals with an aspect of the subject upon which I have laid stress from the practical point of view, viz., that of general experimental evidence, but by an entirely different method. The author, by means of an ingenious arrangement of apparatus, has determined what may be called the " reaction-time " of the galena detector to be less than a millionth part of a second in duration, thus demonstrating by a directly positive method the complete failure of the older theories, involving comparatively slow molecular vibrations, to explain rectification. The rapid response to H.F. oscillations during rectification, can be explained only by a theory such as that I have outlined, viz., based on the displacement and movements of the electrons of small mass and low energy content.

James Strachan.

Aberdeen.

Translation.

Sir,—I have read with great interest your series of articles on contact detectors in *The Wireless World and Radio Review* and permit me to send you one of my works dealing with a similar theme.

I have in this research specially investigated the question of the time of the reaction in detectors and definitely determined that this is shorter than a millionth part of a second, whereby the two formerly accepted theories (thermo-electric and electrolytic polarisation) must be refuted.

Robert Ettenreich.

Vienna.

Protection of Crystal Detectors.

To the Editor of The Wireless World and Radio Review.

Sir,—On page 340 of *The Wireless World and Radio Review* for June 18th, Mr. Strachan refers to a provisionally protected idea for protecting crystal detector elements from atmospheric influences by immersing them in a suitable insulating medium. May I point out that this principle was covered by the patents of Pickering nearly 20 years ago. He recommended the immersion in oil of all crystal detectors.

My own detectors are made airtight to prevent oxidisation. This has proved satisfactory on a 12 year test. Immersion in suitable oil is quite satisfactory, but complicates matters from a commercial point of view.

B. S. T. Wallace.

Upper Tooting, London, S.W.17.

PATENTS AND ABSTRACTS

Improvements in Receiving Circuits.

The object of this invention* is to provide a tuning system applicable either to single or multivalve circuits arranged in such a manner that reaction effects may be obtained, but without danger of setting up oscillations

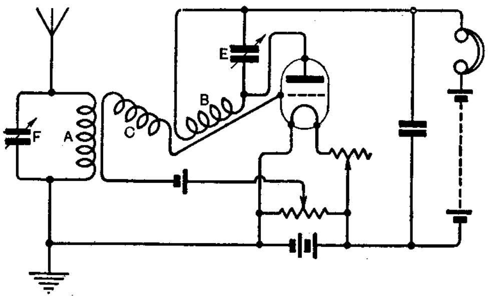


Fig. 1.

in the aerial. One arrangement is shown in Fig. 1, where F, A is the tuned aerial circuit, C a grid coil, and B, E the tuned anode. The anode and aerial coils are situated approximately at right angles and adjusted so that there is no coupling between them. Coil C is then placed inside coils A and B, and is therefore coupled to the aerial and anode circuits. If there were no stray capacities no current would flow in the grid circuit, and consequently the magnetic field would not be distorted. Therefore, although oscillations might be set up in the grid circuit there would be no radiation from the aerial. As it is not possible to make such a perfect grid circuit, it is necessary to readjust the coupling between the anode and aerial coils until the total coupling has again been brought to zero, or to connect a coupling condenser between coils A and B.

Rectification is obtained by working on the lower bend of the anode current curve, and is controlled by the potentiometer and grid battery.

This invention enables signals to be reinforced without danger of radiating from the aerial, and in multivalve circuits signals can be reinforced at each stage of H.F. amplification without rendering the circuits unstable.

* British Patent No. 213,699, by P. G. A. H. Voigt.

Improvements in Wireless Aerials.

According to this invention† an aerial is constructed of one or more lengths of wire carried by two or more supports, each consisting of a rod projecting from the centre of a sucker or vacuum cup, as sketched in Fig. 2. A is the vacuum cup, mounted on one end of a rod B, the other end of which is provided with a hook C. The screw D is

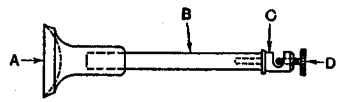


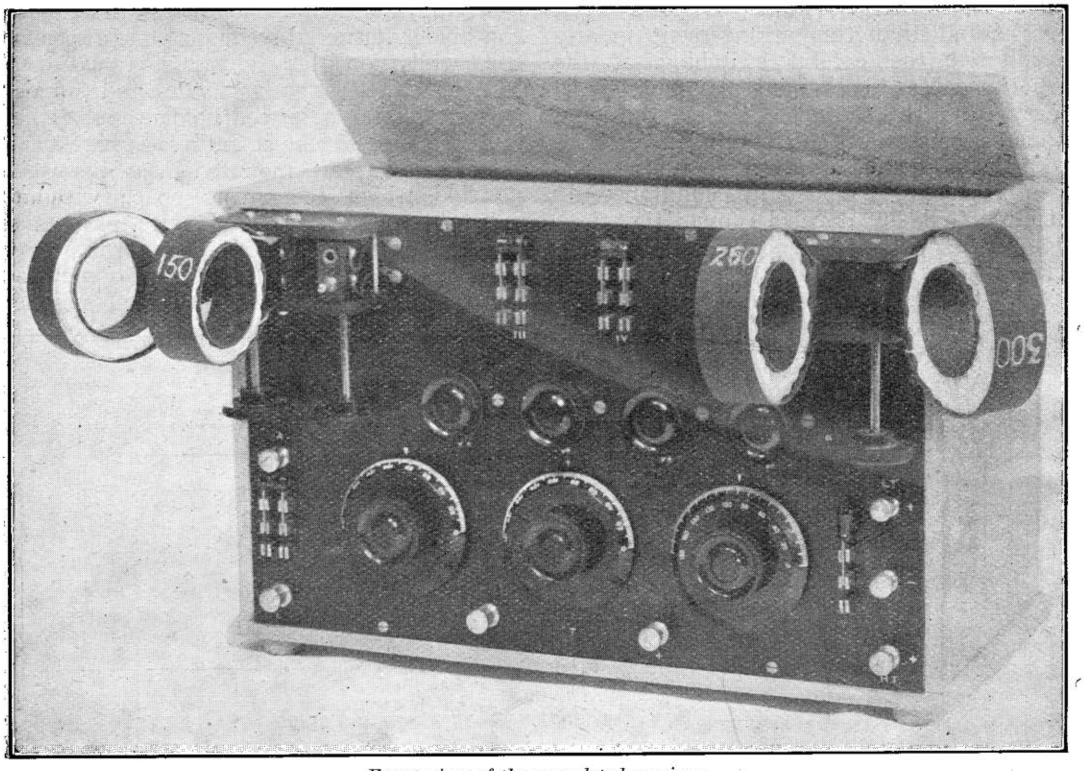
Fig. 2.

provided so that the wire may be inserted into the hook and clamped tightly by turning the screw.

Such an aerial may be very quickly put up in a room by pressing the suckers against the glass of a window, a picture, or any other suitable smooth surface.

W.J.

† British Patent No. 215,151, by E. W. Hynes.



Front view of the completed receiver.

A FOUR-VALVE RECEIVER.

The four-valve set is probably the most useful of receivers. The high frequency amplifying stage is easy to manipulate, and can be operated with reasonable efficiency from the shortest of the generally used wavelengths to the longest. A valve detector following the H.F. amplifier gives good reaction control, and the filament current it consumes is of little importance now that dull-emitter valves are available. The two stages of low frequency amplification with switches for throwing them in circuit permit of loud speaker work as required. The design given here entails a minimum of work, and the circuit is a good standard arrangement.

By H. NINNIS.

HAVING constructed almost all types of receiving sets embodying various arrangements of detection and high and low frequency amplification, the writer came to the conclusion that probably the best set for reception under varying conditions is an arrangement of four valves in which the first is a high frequency amplifier followed by a valve detector and two stages of low frequency amplification.

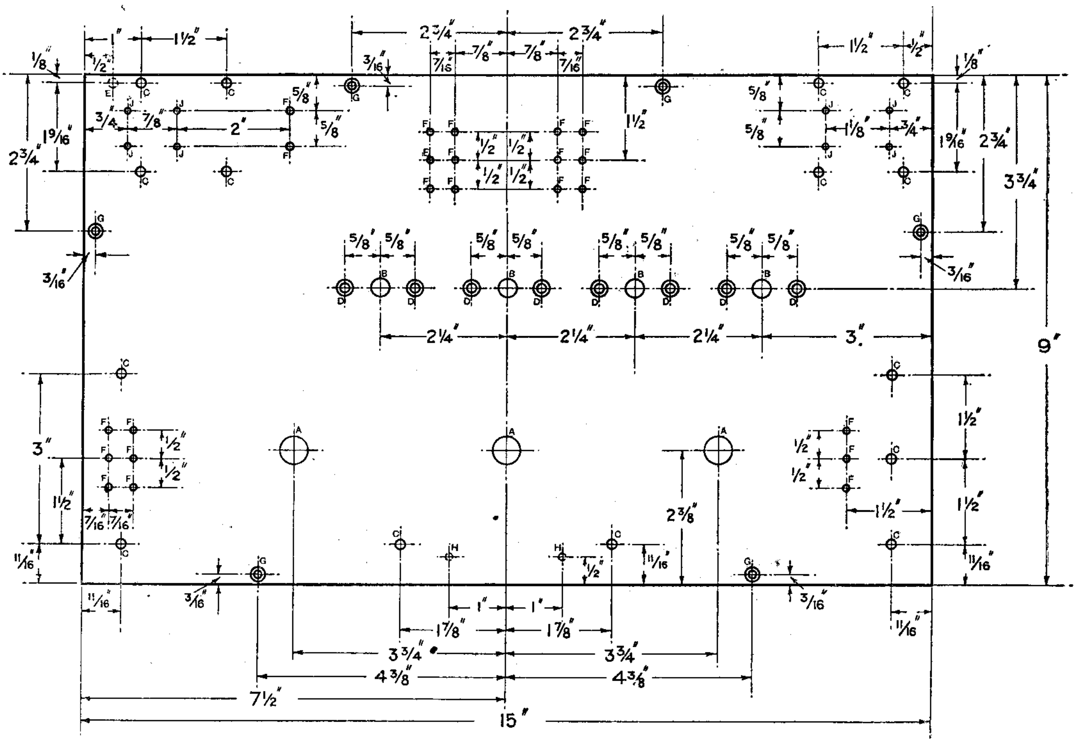
Switches are introduced for the purpose of connecting the aerial tuning condenser in series or parallel with the aerial inductance, whilst the inductances are of the plug-in type, so that tuning to any wavelength can be effected.

It is not desirable always to make use of the two stages of low frequency amplification and so switches are here again introduced, perceptibly cutting out the last two valves. Reaction is arranged to either the aerial or the tuned anode inductance by merely transferring reaction coil across from one coil holder to the other. A somewhat unusual feature is the adoption of tuned aerial and secondary circuits but it was found that this arrangement greatly facilitated the careful switching of the reaction coil as to obtaining maximum signal strength. By the use of the additional tuned secondary circuit, tuning is perhaps a little more difficult as three tuning condensers have to be more or less simultaneously manipulated, but it will be found that with the aerial and closed circuit coils lying closely together that careful tuning of the aerial tuning condenser is not necessary when bringing in the signals of a particular station and that this adjustment can be made afterwards by moving the two coils further apart and somewhat slightly readjusting the tuning and greatly improving signal strength.

General Arrangement.

The distribution of the components on the face of the panel can be seen from the accompanying illustration.

At the top left-hand corner is the three-coil holder for aerial secondary and reaction coil, whilst on the right is a tuned coil holder for the tuned anode and anode reactance coils. The coil holders are of the geared type, which is rather a necessary feature. They are mounted in an inverted position which economises space without being inconvenient to manipulate, providing that the type of holder selected permits free rotation of the knobs. This method of mounting also lessens the likelihood of the spindle becoming damaged and makes the set quite compact.



The front panel, showing the positions and sizes for the holes. Minor modifications can be made according to the types of components used, but a well balanced arrangement is easily obtainable on a panel of this size. Sizes of holes: A, Drill 1/2" dia., B, drill 5/16" dia., C, drill 5/32" dia., D, drill 5/32" and c/sink on topside for No. 4B.A. screws, E, tap 4B.A. × 3/16" deep on underside, F, drill 1/8" dia., G, drill 1/8" dia and c/sink on topside for No.4 wood screws, H, tap 6B.A. × 3/16" deep on underside, J, drill 3/32" dia.

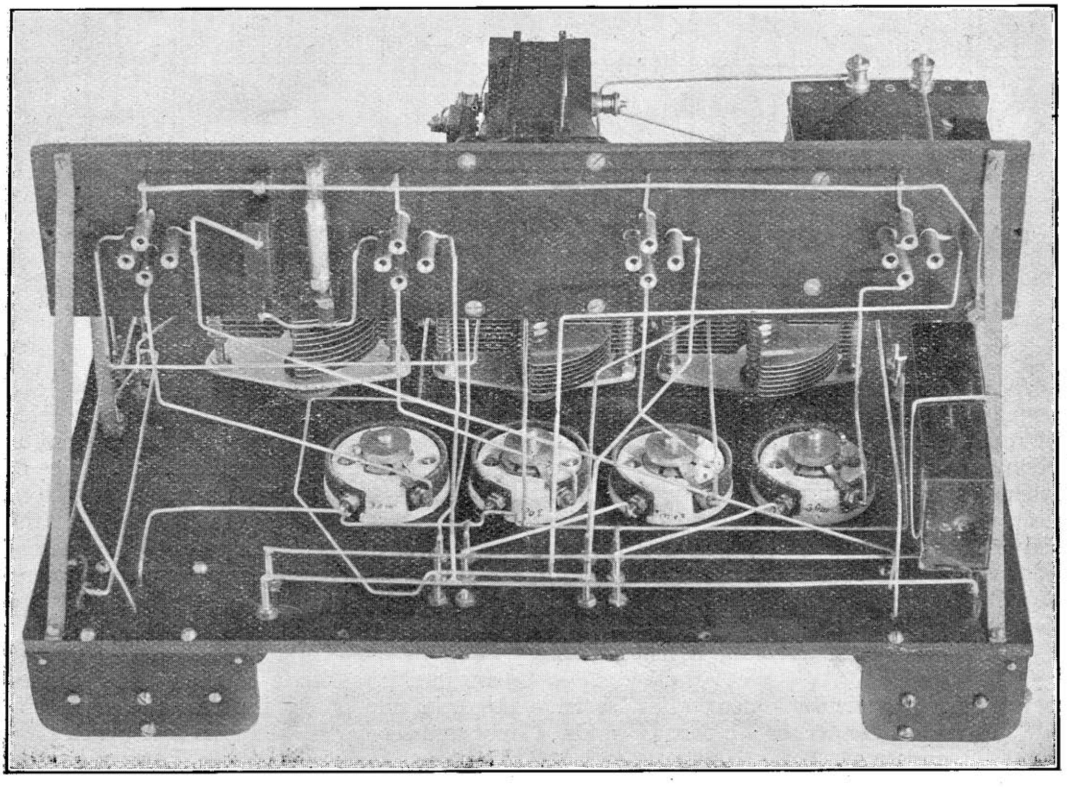
Between the coil holders are the switches which control the number of low frequency stages in use, the down position in each case putting the valves on in turn.

Across the centre of the panel are the filament resistances, which, in the set described, have a maximum resistance of 30 ohms, valves of the dull emitter type being employed. Resistances to suit the type of valve it is intended to use must, of course, be procured and if filament current is a consideration one must not overlook the fact that there are now on the market power valves of the dull emitter type; it may be found necessary to introduce a valve of this class in the second stage of low frequency amplification.

The aerial tuning condenser, to the left of the set, has a maximum capacity of 0·0005 mfds. The centre condenser has a maximum capacity of 0·00025 mfds. and is used for tuning the secondary circuit, whilst the tuned anode condenser is on the right and also has a capacity of 0·0005 mfds.

Verniers are not fitted but would undoubtedly be an advantage, especially for finely tuning the aerial circuit. The aerial terminal is the uppermost on the left inside, the earth terminal being the lower one. The series parallel switch is situated between them. In a corresponding position on the right is a single pole switch which cuts off both H.T. and L.T. when in the down position, being on the common lead for both H.T. — and L.T. —. In connection with this switch it should be noted that it is also desirable to connect the 2-mfd. condenser, which is shunted across the H.T. battery on the "switching" side, thus disconnecting it when not in use.

The three terminals on the right are for the filament and H.T. batteries, whilst those near the centre of the panel at its lower edge are for the telephones or loud speaker. No switch is provided for cutting out the H.F. valve as it is thought that perhaps the beginner might find difficulty in efficiently arranging the wiring, whilst the problem is also encountered of replacing the terminals to reaction coil, which becomes necessary, as the H.F. valve is connected in the outer circuit.



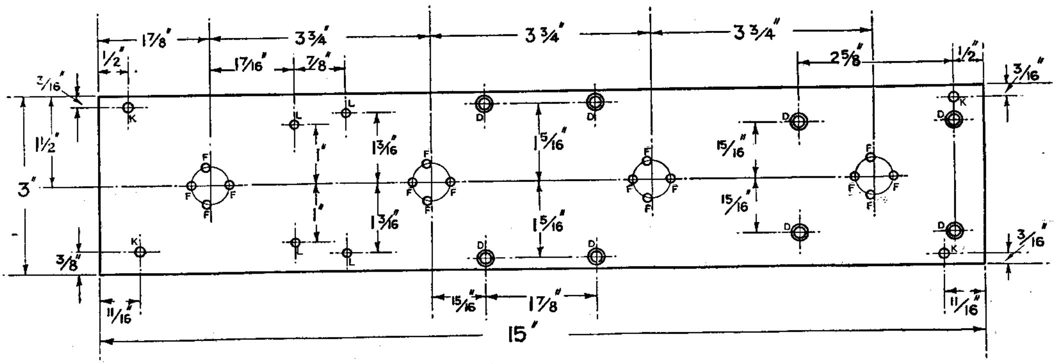
Rear view of the panel showing the method of fixing the valve platform.

Selection of Components.

The components require careful selection, as the success of the instrument depends largely on the quality of the apparatus employed in building up the set. Everything is in favour of selecting only those parts which in the opinion of the individual constructor, at least, are considered reliable and of sound reputation.

Mahogany, for case, 4 ft. 4 ins. × 7¾ ins. × ⅜ in., planed.
Four rubber "feet."
Various screws, nuts, etc., etc.

All of the apparatus is attached to the front panel.



Details of the valve platform. Sizes of holes: D, drill 5/32" dia., and c/sink on topside for No. 4B.A. screws, F, drill ⅛" dia., K, tap 4B.A., L, tap 6B.A.

As regards wireless component parts you usually get what you pay for in the form of results. The materials used comprise an ebonite panel of good quality, measuring when finished, 15 ins. × 9 ins. × ¼ in. and also another piece of ebonite to form the valve platform, measuring 14½ ins. × 3¼ ins. × ¼ in.

One three-coil holder.
One two-coil holder.
Four rheostats, 30 ohm, if using D.E. valves.
Variable condenser 0·0005 mfds. aerial.
Variable condenser 0·00025 mfds., secondary.
Variable condenser 0·00025 mfds. anode.
Three D.P.D.T. miniature switches.
One S.P.D.T. miniature switch.
Seven terminals.
Two L.F. transformers.
Twelve valve pins.
Grid leak, 2 megohms or 3 megohms.
Fixed condensers, 2 mf., for H.T. battery.
Fixed condenser, 0·001, for 1st L.F. transformer primary.
Fixed condenser, 0·002, for 'phones.
Fixed condenser, 0·0002 or 0·0003, for grid.
Half-pound tinned copper wire, 14 or 16 S.W.G.

The valve holder panel is situated 5¼ ins. from the top of the main panel to give clearance to the tops of the valves and is held in position just clear of the rear face of the condensers by a brass strip ¼ in. × 1/16th in. bent, drilled and screwed to support the shelf horizontally, making use of the aerial and the L.T. + terminals to hold the brackets at the bottom and the coil holder across to hold them at the top.

The valve platform is 14½ ins. × 3¼ ins. × ¼ in. and in addition to the valves, carries the grid condenser and leak between the first and second valve mountings on the top side together with the two L.F. transformers, which are supported below their respective valves. These might be mounted at right angles to minimise interaction, and it is recommended that they be arranged so that the primary side of the first one is towards the aerial tuning condenser and the secondary side of the next one is towards the rear of the set. By this means the wiring is shortened and simplified, and space is thus left for the inclusion of grid cells as desired.

CONSTRUCTIONAL DETAILS.

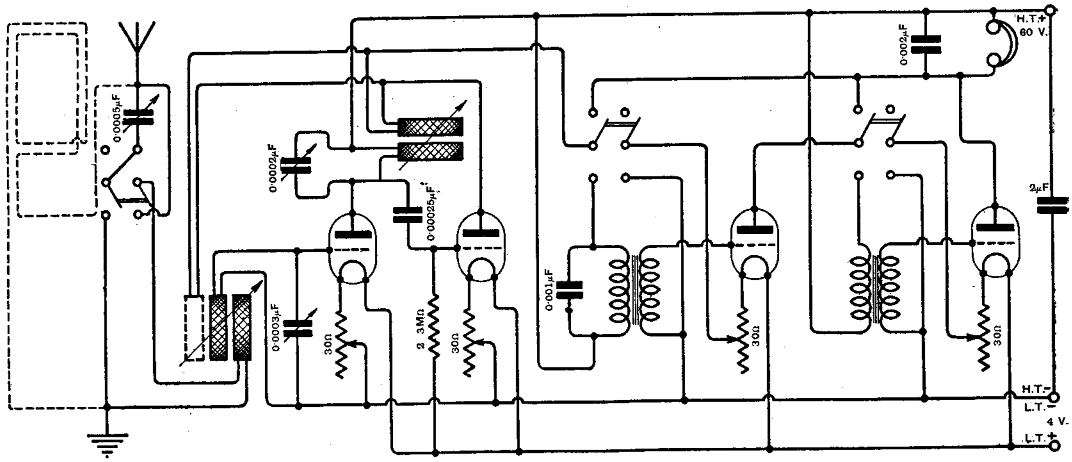
The first step in the construction of the instrument is to true up the two panels carefully with saw and file, using a straight edge and steel square to make sure that they are precisely rectangular.

In setting out the location of the components it is helpful to make a margin or line ¾ in. from the edge all round the panel, on which will fall the holes for the terminals and also the centre position for the series parallel switch.

The dimensional drawing gives the position for all the other components and it should be the aim of the reader to obtain a layout that is well balanced.

The positions of the coil holder screws can be carefully transferred from the coil holder and, with the positions of all holes carefully centre punched, drills of suitable sizes can be put through.

To avoid scratch lines on the face of the panel it is customary to do all the marking out on the reverse side, though one must bear in mind that the positions of the components are transposed as viewed from the front of the panel.

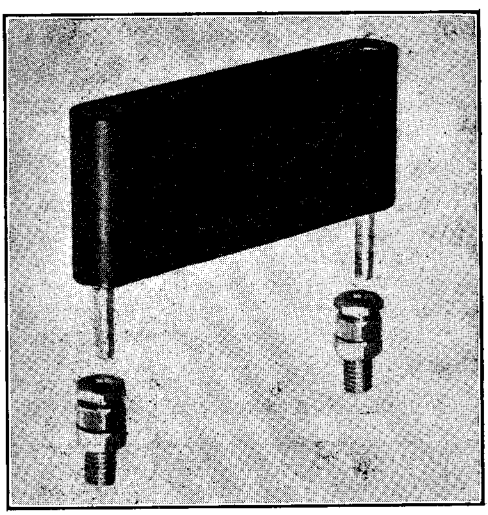


The circuit to which the instrument is wired.

The amateur who is familiar with the use of taps may, with advantage, thread the holes in which the terminals are secured so that the tightening up of backnuts serves to prevent the terminals from unscrewing.

Little need be said concerning the mounting of the components on to their respective panels and the fitting up of the instrument generally.

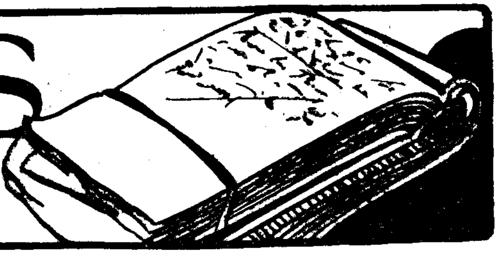
(Full details of the mounting of the components, wiring up and construction of the case, will be given in the next issue).



Courtesy Peto-Scott.

A new method of fixed condenser mounting, which allows easy interchanging of various condenser values. Another feature of the design is that several condensers can be plugged one into another so that a combined capacity is obtained. Thus with two or three condensers many capacity values can be produced.

NOTES & CLUB NEWS



The Broadcasting Board is considering the question of an extension of the facilities for the broadcasting of news.

* * * *

After much hesitation the Bournemouth Town Council has decided to allow weekly broadcasting of the performances of the Municipal orchestra.

* * * *

Experimental transmissions on 1,600 metres from the new high power broadcasting station, **5 XX**, at Chelmsford, begin on the date of this issue. The hours of working are provisionally fixed as follows:—11.30 a.m. to 12.30 p.m., 4 to 5 p.m., and 7.30 to 8.30 p.m. Reports on reception of the transmissions will be welcomed by the B.B.C. at 2, Savoy Hill, particularly from crystal users.

* * * *

The French Post Office station at Lyons has ceased transmissions on 3,150 metres and a new station is in operation working on a normal wavelength of 470 metres.

* * * *

During the recent "tour de France" cycle race, results were reported daily by wireless

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Telephone Communication Between Transatlantic Liners.

The establishment of a wireless telephony service between the "Columbus" and "Deutschland" is the latest enterprise of the Hamburg American Company. Passengers are able to converse between the two ships at a charge of 10s. per call.

Broadcasting from German Theatres.

No obstacles, apparently, are placed in the way of German broadcasters in transmitting theatre performances. The Voxhaus station at Berlin has been connected by cable to the Grand Opera, the Esplanade Hotel, the German Gramophone Society, the Thalia Theatre and other buildings of importance. Microphones have also been installed in the Reichstag and debates can thus be enjoyed (*sic*) by the multitude.

A Spanish CQ Call.

On Sunday, June 22nd, Mr. C. Edington Sutton, of Wimbledon, picked up a Spanish CQ call, **3 XY**, the transmitter being Senor Castano, of Madrid. The wavelength was in the neighbourhood of 200 metres and signals (pure C.W.) were transmitted at intervals up to about 11.30 G.M.T. It would be interesting to learn whether this transmission was received generally in this country.

No Longer Impregnable.

Readers may be interested to learn that the Captain's cabin of H.M.S. Impregnable, which has been in use by Messrs. Autoveyers, Ltd., as a wireless demonstration theatre, is to remain intact for six or seven weeks only. H.M.S. Impregnable was the largest and the last of the old "wooden walls" of England.

The cabin will be open free for inspection to visitors at the British Empire Exhibition until August 17th, when it will probably be dismantled and shipped abroad to an American visitor who has made a tempting offer to purchase the cabin for use as a smoke-room in Adirondacks.

Indian Broadcasting Stations.

Although the reception of broadcasting from India in this country is unlikely, amateurs may be interested to learn that two Indian broadcasting stations are now flourishing, with the call signs **5 AF** and **2 BZ.**

According to the Radio Club of Bengal, the power used is 1½ kw. Times of transmission (Indian standard times) are as follows:—

Daily, 1030 to 1130; Mondays and Fridays, 1830 to 1930; Wednesdays, 2130; Tuesdays and Thursdays, 1930 to 2030.

Oxford Expedition to Arctic.

The Oxford University Arctic Expedition arrived at Tromso on June 28th on board the "Polarbjorn." The Expedition will leave after certain alterations to the wireless equipment have been effected.

Rugby Station Masts.

Sections of the aerial masts for use at the new Rugby station recently arrived at the adjoining station of Kilsby and Crick. Some idea of the immensity of the masts will be gathered from the fact that the work had to be done by night and on Sundays, the steel sections being so big as to prevent trains from passing on the adjacent track. The aerial will be a mile and a half long and half a mile wide and will be supported by twelve steel masts, each weighing 300 tons and having a height of 820 feet.

Each mast will be fitted with a lift capable of carrying four men.

Amateur Transmissions from Finland.

Amateur transmissions from Finland are remarkably regular and a table of times has in fact been drawn up. The principal stations are **1 NA,** operated by Mr. Erkki Heino, of Suomi, **2 NC, 2 NM** and **3 NB.**

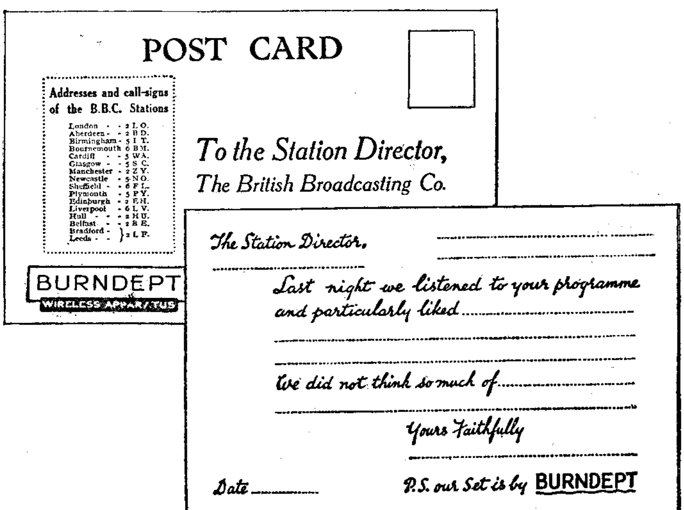
The following is a tentative programme:

1 NA. Daily. 2100-2105 and 2200-2205 G.M.T.
2 NC. Monday and Friday, 2000-2015 G.M.T.
3 NB. Sunday, 1030-1040 G.M.T.
1 NA ,, 1000-1010 G.M.T.
2 NC ,, 1010-1020 G.M.T.
2 NM. ,, 1020-1030 G.M.T.

Communications in respect of any of these transmissions can be forwarded by Mr. Erkki Heino, of Helsinki, Runebergin-kata 29, Suomi, Finland.

Trinity House D.F. Tests.

The s.s. "Vestal," owned by the Trinity House Authorities, has been fitted with the latest type of Marconi Marine Direction Finding equipment for the purpose of collecting data in regard to the Beacon Transmitter fitted at Nash Point Lighthouse.



Until now, the broadcasting applause card, which is in extensive use in America, has not made its appearance in this country. Above is a reproduction of an applause card which should prove highly popular.

An Active Field Day.

An interesting report has reached us of the activities of the Western Metropolitan Association of Affiliated Societies on the occasion of their field day on Sunday, June 22nd, to which reference was made last week.

Portable transmitting receiving stations were established at Stanmore, **5 GF**, Batchworth Heath, **6 IV** (control station), and Gerrards Cross, **2 GO.**

A single valve transmitter with a reversed feed-back circuit was installed at **6 IV.** An input of six watts at 300 volts was employed and an aerial current was obtained of 0.28 amps. **5 GF** employed a single valve Colpitts transmitter. With approximately 5 watts at 200 volts, an aerial current of 0.3 amps. was obtained. A single valve reversed feed-back circuit was used at **2 GO** and an Evershed H.T. generator, hand-driven, was employed for transmission, an aerial current of 0.6 amps being secured.

The first station to begin working was **6 IV,** but not until 1.30 p.m was communication established with either **2 GO** or **5 GF.** It was subsequently discovered that the latter station had receiver trouble. **2 GO** was also slow in "getting to work," but before 2 o'clock communication was established.

Some interesting work was then carried on but for some unexplained reason Stanmore (**5 GF**) completely failed to get in touch with Gerrards Cross (**2 GO**). At 7 o'clock the controlling station transmitted a "good-night" message after a fairly successful day.

Amateur Progress in Germany.

Now that the Government restrictions on the purchase of wireless material has been removed, German amateurs are rapidly increasing in number and applications for licences are reported to be pouring in.

Who is 10 KZ ?

Mr. W. A. S. Batement, of North West London, reports the reception of a CQ call from **10 KZ** at 12.15 a.m. (B.S.T.) on May 31st. The wavelength employed was 170 metres, the system of transmission being interrupted C.W.

No reply was received from the station when called and information which might lead to its identification would be welcomed.

Burndept in Australia.

In consequence of the growth of wireless interest in Australia, Messrs. Burndept, Limited, have established a branch in Sydney, to be known as Burndept of Australasia, the head office being situated at 219 Elizabeth Street, Sydney, N.S.W. (Manager, M. A. W. Dye).

Faulty Liverpool Broadcasting.

Noises transmitted from the Liverpool Relay Station were the subject of a discussion at a recent meeting of the Liverpool Wireless Society. The Society is communicating with the station expressing regret at the poorness of the transmissions and expressing the hope that every effort will be made to see that improvements are effected.

The director of the station, it is reported, has explained that the trouble is due to induction effects on a portion of the Post Office lines between Liverpool and Manchester. The Post Office engineers are making every effort to locate and deal with the trouble.

Children's Wireless Message.

A message sent on behalf of more than four million of the school children of Great Britain was sent through the Leafield Wireless Station on June 28th, by the League of Nations Union as a greeting to the children of sixty-two countries throughout the world.

Wireless on Pleasure Steamers.

For the second year in succession the Clyde Pleasure Steamer, "Queen Alexandra," has been fitted with an Ethovox loud speaker receiver. A similar installation has been placed this year on the "King Edward," which is employed in the same service, visiting various lochs and the Firth of Clyde.

We understand that excellent results are obtained in the reception of broadcasting from the Glasgow station

Marconi D.F. Apparatus on Liners.

The Marconi International Marine Communication Co., Ltd. have received instructions from the White Star Line to install the latest type of Marconi Direction Finding apparatus on the steamers "Adriatic," "Baltic," "Celtic," "Cedric," "Pittsburgh," and "Arabic." The installation of this apparatus will be accomplished during the normal stay of the vessels in port. It will be recalled that this apparatus has been in use for a considerable period on the "Majestic," "Olympic," "Homeric," "Canada," "Regina," "Doric," "Megantic," and the efficiency of these sets has been the subject of many appreciative comments.

Wireless Exhibition at Manchester.

A large wireless exhibition is to be held in the City Hall, Deansgate, Manchester, from October 14th to October 25th, under the auspices of the *Manchester Evening Chronicle*, which is being assisted on the technical side by the Manchester Radio and Scientific Society.

The Society will organise a series of lectures and demonstrations in wireless reception and special attention will be paid to the reproduction of broadcasting concerts on loud speakers. Several novel competitions will be open to wireless amateurs and a bureau will be established where experts will deal with wireless difficulties.

4 RS Heard.

4 RS, who recently asked in *The Wireless World and Radio Review* for reports of his transmissions, will be interested to know that his call sign was heard, strength R5, by **5 LS** at Blackheath. The call sign, however, was not very definite and when the station was called up, no response was obtained.

New Broadcast Licences.

The Postmaster-General announces that the new and simple type of wireless receiving licence referred to in a recent announcement is now on sale at Post Offices at a fee of 10s. This licence contains no conditions concerning the marking of apparatus, and it covers the use of any receiving set, whether purchased complete or made from parts, provided that the set or parts are of British manufacture. The licence will be issued in place of existing broadcast, constructor's and interim licences, as they fall due for renewal, and will cover any set which the holder of such a licence is entitled to use.

Now that the licence fee for home-made sets has been reduced and the conditions simplified, the Postmaster-General feels confident that there will be no attempt on the part of the "listening" public to avoid payment for a service which gives them so much pleasure. He thinks it right, however, to call attention to the fact that heavy penalties are prescribed by the Wireless Telegraphy Act, 1904, on conviction of the offence of establishing a wireless station without a licence.

Mr. Dowsett on the Amateur.

Not the least significant feature of "Wireless Telephony and Broadcasting," the recently published work of Mr. H. M. Dowsett, M.I.E.E. (see page 368, *Wireless World and Radio Review*, June 25th) is the prominence given to amateur experimental work, to which a special section is devoted. This includes some valuable details on the operations of particular and representative amateur transmitters, and attention is given to the increased scope vouchsafed to the amateur experimenter by the introduction of Armstrong super-regenerative principles, which are carefully described in numerous circuits.

The author also refers to the active part taken by amateurs in this country in helping forward the British broadcasting movement.

Appeal for Lecturers.

In giving the weekly talk from **2 LO** on behalf of the Radio Society of Great Britain on Thursday, June 19th, Mr. J. F. Stanley issued a special appeal to the Affiliated Societies for lecturers. The Radio Society of Great Britain recently attempted to compile a list of people who were willing to deliver lectures, but unfortunately the effort met with a poor response

"Now that the Societies are formed into groups—at least some of them are, I am afraid the groups do not form themselves as readily as one might wish—it would appear a simple plan," said Mr. Stanley, "for the Societies in a group to exchange lecturers amongst themselves. Every Society, however small, must surely have two or three members who are capable of giving a lecture, or at least an informal talk, and who would be willing to visit neighbouring Societies occasionally.

"I therefore appeal to all Societies to send to their group representative a list of their members who are willing to assist by giving lectures or talks, together with an indication of the particular subjects in which the lecturer is mostly interested. The group representative will then be able to circulate a full list of lecturers to all the Societies in his group. If you, or the Secretary of your own Society, do not know who your group representative is, do not let that deter you. Send your list to me, care of the Radio Society of Great Britain, at 53 Victoria Street, London, S.W.1, and I will do the rest.

"I would like to add that we at Headquarters are looking forward to the time, let us hope in the near future, when we shall be able to say '*You* want the best lecturers: *We* have them.' But please bear in mind that it is against the nature of things to reap where we have not sown, and that the best way to *receive* lectures is to *give* them in exchange."

The Radio Society of Great Britain.

An informal meeting of the Society will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, on Wednesday, July 9th, at 6 p.m., when Mr. P. R. Coursey, B.Sc., F.Inst.P., will give a talk on the "Manufacture of Condensers." The talk will be illustrated with lantern slides. Members of affiliated Societies are cordially invited to attend. Tickets of invitation may be obtained by application to the Hon. Sec. of the R.S.G.B., 53 Victoria Street, S.W.1.

Hackney and District Radio Society.*

There was a good attendance on June 19th when a film entitled "An Englishman's Home" was shown. This film was lent to the Society by the General Electric Co., and proved most interesting.

The evening of June 26th was devoted to general discussion. Mr. A. Bell was elected Publicity Secretary in the place of

Mr. Parry, who resigned owing to pressure of business.

All local wireless enthusiasts are invited to become members and can obtain particulars on application to the Hon. Sec., Geo. E. Sandy, 70 Chisenhale Road, E.3.

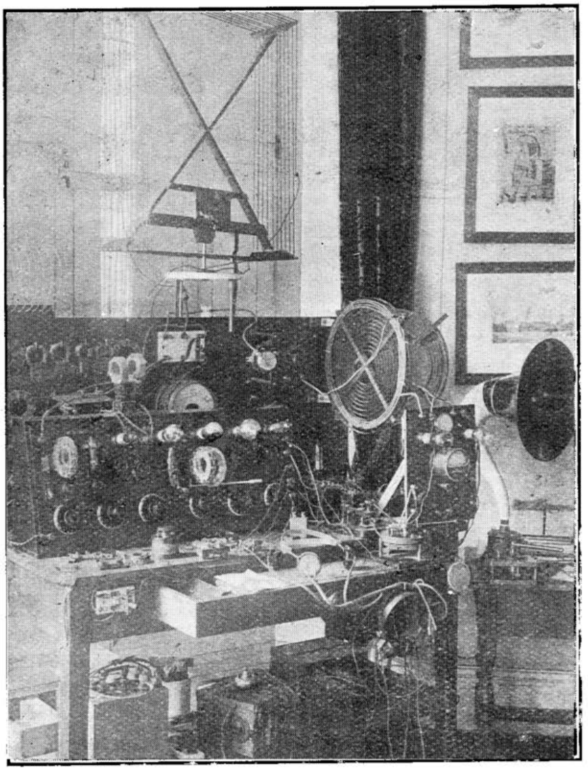
Tottenham Wireless Society.*

On Wednesday, June 11th, Mr. T. Vickery gave a very interesting demonstration of various Reflex Circuits employing one and two valves, paying special attention to an adaptation of the ultraflex circuit invented by the technical officer. With this circuit London was received on a loud speaker without aerial and earth. Two valves brought in Birmingham on a loud speaker. London broadcasting, using a large Amplion loud speaker, was audible 40 yards away in the open air. It was noted that purity of tone was excellent.

On June 18th, Messrs. Glyde and Vickery gave a very instructive demonstration of most of the standard types of coils. A careful explanation of the method of winding the various coils was given by Mr. Glyde, who illustrated his talk by excellent large scale drawings. A discussion on the relative merits of the coils, as determined by theoretical considerations, preceded the practical demonstration by Mr. Vickery on a loud speaker set. The following coils were tested :—Gambrell, Sunflower, Burndept, Cosmos, Igranic, Lissen, Lokap and Magnum Tapped. Two sets of home-made coils were included in the test. It would be invidious to discriminate between these sets of coils, all of which gave satisfactory results. The manufacturers of the Sunflower coils assisted the demonstration by the loan of a set of well-made and efficient coils of neat appearance. The lecturer and demonstrator were heartily thanked for their excellent performance.

Meetings for July and August are held on the first and third Wednesdays, when practical demonstrations will be the chief features. New members are being enrolled weekly, but more are welcomed.

Hon. Sec., A. G. Tucker, 42 Drayton Road, Tottenham.



The transmitting and receiving equipment at **6 BV**, *the station of Mr. V. F. M. Oliver, at Sunning Hill, Berks.*

The Wireless Society of Hull and District.*

Although attendances at recent meetings have not been as large as during the winter session, those who do attend are of the keen type, thus compensating for smallness of numbers.

The meetings are at present devoted to the assembling and construction of a three-valve portable receiving set for field day purposes. When this is completed, a start will be made on the construction of the Society's three-valve and crystal experimental receiving set for headquarters. This is to take the form of the necessary component parts mounted on 36 ebonite panels, each 4½ ins. square, so as to be easily movable on a wooden frame. This set should prove a valuable asset to the Society for next winter session.

A number of standard works on wireless subjects have recently been added to the Society's library, which is free to members. There is also an efficient wavemeter which may be hired for the period of one week for 6d.

Intending members will find the headquarters (The Co-operative Social Institute, Jarratt Street) open every Friday evening from 7.45 p.m. to 10 p.m. Full particulars of membership can also be obtained from the Hon. Sec., "Glen Avon," 202 Cottingham Road, Hull.

The Leicestershire Radio and Scientific Society.*

"Plugs, Jacks, etc.," was the title of an interesting lecture given by Dr. F. S. Pool on June 17th. Despite the alluring weather a comfortable little gathering attended and a very instructive evening was spent. The lecturer first dealt with simple plugs, explaining their various uses, and then passed on to the more elaborate types. A very neat and well-made four-valve set was afterwards shown, having no terminals and with all connections made by means of one or other of the methods previously described.

The Society is still open to receive new members who, it should be emphasised, do not require any qualifications other than a keen interest in the radio science and a genuine desire to improve.

All communications should be addressed to the Hon. Sec., Jos. W. Pallett, 111 Ruby Street, Leicester.

Streatham Radio Society.*

An interesting lecture was given on June 11th by Mr. Hurst on the subject of Western Electric apparatus. Mr. Hurst showed and demonstrated various sets, using the Society's and also a frame aerial, with excellent results.

On June 25th an excellent lecture was given by Mr. C. H. Roddis, who spoke on "Wireless Work During the War."

Excellent attendances have been obtained by the Society during the summer months in spite of counter attractions.

Hon. Sec., N. J. H. Clarke, 26 Salford Road, S.W.2.

Forthcoming Events.

WEDNESDAY, JULY 9th.

Radio Society of Great Britain. Informal Meeting. At the Institution of Electrical Engineers. Illustrated Talk: "The Manufacture of Condensers." By Mr. Philip R. Coursey, B.Sc., F.Inst.P.

THURSDAY, JULY 10th.

Hackney and District Radio Society. Surprise Night.

FRIDAY, JULY 11th.

Wireless Society of Hull and District. At 7.45 p.m. At Headquarters, Jarratt Street. Annual Business Meeting.

WEDNESDAY, JULY 16th.

Golders Green Radio Society. At 8.30 p.m. At the Club House. Lecture: "Receiving Circuits for Beginners." By Mr. W. J. T. Crewe.

SHORT WAVE DIRECTIONAL WIRELESS TELEGRAPHY.

A PAPER of unusual interest was read before the Royal Society of Arts on Wednesday, July 2nd, by Senator G. Marconi, G.C.V.O., LL.D., D.Sc., who is a Vice-President of the Society.

Senator Marconi dealt with the results he has recently obtained over very long distances by short wave directional wireless on what has been generally called the beam system.

Senator Marconi recalled the fact that when he first came to England, over 28 years ago, he was able to show to the late Sir William Preece, then Engineer-in-Chief of the Post Office, the transmission and reception of intelligible signals over a distance of 1¾ miles by means of a beam system employing short waves and reflectors, whilst, curiously enough, by means of the antenna or elevated wire system he could only get signals, at that time, over a distance of half a mile.

The progress subsequently made with the long wave system was, however, so rapid, so comparatively easy and so spectacular that it diverted all research from the short waves. After briefly referring to his early experiments in short wave work he said that during the war he could not help feeling that we had, perhaps, got into a rut by confining practically all our researches and tests to what may be termed long waves.

The investigation of short waves was again taken up in Italy early in 1916 with the idea of utilising beams of reflected waves for certain war purposes, as the speaker was greatly impressed with the advantages which such a system would afford in minimising tapping or interception by the enemy, besides greatly reducing the possibility of interference with our own stations.

Senator Marconi referred to papers on the subject read by Mr. C. S. Franklin and himself, the former before the Institution of Electrical Engineers on April 3rd, 1922, and the latter at the American Institute of Electrical Engineers on June 20th, of the same year.

The reflectors now used for this system, said the lecturer, are not composed of solid sheets of metal, such as those employed in his early tests in 1896, but of a comparatively small number of wires placed parallel to the antenna and spaced around it on a parabolic curve of which the transmitting or receiving antenna constitute the focal line, as it was soon ascertained that this was a much more practical arrangement.

"Since 1916," said Senator Marconi, "various patents have been taken out by myself and Mr. C. S. Franklin, and in the latest of these Mr. Franklin describes an arrangement in which the antennæ and reflector wires are arranged so as to constitute grids parallel to each other, the aerials or antennæ being energised simultaneously from the transmitter at a number of feeding points through a special feeding system, so as to ensure that the phase of the oscillations in all the wires is the same.

"In 1919 experiments were commenced in which Mr. Franklin succeeded in using electron tubes or valves for the generation of very short waves, the object then being to evolve a directional radio-telephonic system.

"The great value of the reflectors was demonstrated by average measurements made, which showed that the value of the energy received when both reflectors were used was 200 times that of the energy that could be received without reflectors.

"In April, May and June of last year a series of long distance tests on short waves were carried out under my direction between a small experimental transmitting station at Poldhu in Cornwall and a receiver installed on the S.Y. 'Elettra.'

"Mr. C. S. Franklin was responsible for most of the design and operation of the transmitting arrangements at Poldhu, and Mr. G. A. Mathieu was in charge of the receiving apparatus on the yacht, where I also was present during the whole of these tests.

"These tests proved by the definite results obtained:

(1) That the day ranges proved to be reliable and not inconsiderable.

(2) That the night ranges were much greater than anyone, myself included, had anticipated, and no doubt very considerably exceeded the maximum distance to which I was able to proceed with the 'Elettra.'

(3) That intervening land and large portions of continents do not present any serious obstacle to the propagation of these waves.

"Perhaps one of the most remarkable scientific results of the experimental work carried out on my yacht was to ascertain quite definitively that the coefficient of the well known Austin Formula for the propagation of the waves was defective when applied to short wave phenomena.

"During the tests to the 'Elettra' on 97 metres wave the Poldhu transmitter consisted of 8 glass valves (standard M.T.2) worked in parallel, the input to the valves being 12 kw. The radiation from the aerial was approximately 9 kw. The parabolic reflector concentrated the energy towards Cape Verde and gave a strength of field in that direction which would have required a radiation of approximately 120 kw. from the aerial without a reflector to produce."

The route covered during the experiments included Cape Finisterre (Spain), Seville, Gibraltar, Madeira and St. Vincent.

"At St. Vincent, as at Madeira, the Poldhu signals could always be received with the receiving aerial disconnected, or with the heterodyne or l.f. amplifier switched off.

"Since February of this year a further series of tests have been carried out over ranges which included the greatest possible distances separating any two places on earth.

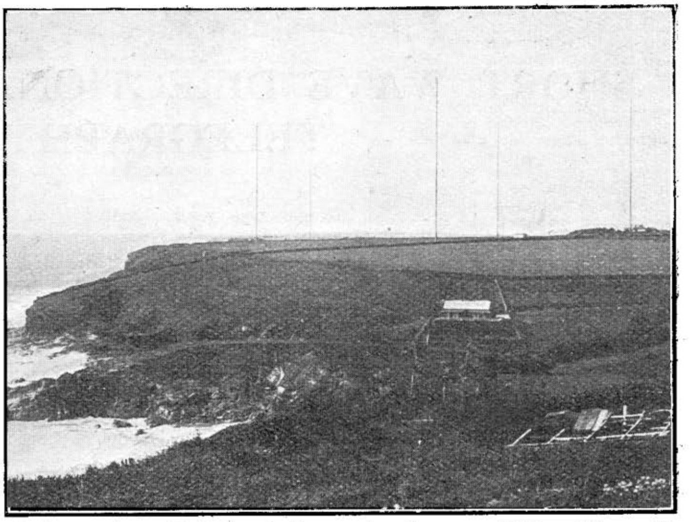
"A special short wave receiver was installed on the S.S. 'Cedric,' and reception tests were carried out with Poldhu by Mr. Mathieu during a journey of this vessel to New York and back. No reflectors of any kind were employed at either end.

"The results showed that on the 'Cedric' signals could be received during daytime up to a distance of 1,400 nautical miles, and it was confirmed that the signals' intensity is symmetrical to the mean altitude of the sun at all times.

"These results were so encouraging that I was tempted to try a wireless telephony test to Australia.

"With rather experimental arrangements at Poldhu, intelligible speech was transmitted for the first time in history from England to Sydney on Friday, May 30th, of this year.

"For the telephone test to Australia, oil-cooled valves were employed for the main valve and for modulating valves. The wavelength was 92 metres and an independent drive was employed for controlling the main valves. The total power supplied to the valves was approximately 28 kw. divided up as follows: 18 to main valves, 8 to the modulating valves and 2 to the drive valves. No reflector was employed."



A distant view of Poldhu wireless station, between which and the yacht "Elettra," Senator Marconi carried out his short wave experiments. The four largest masts support the beam transmitting aerials.

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 5 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 351 metres; **LIVERPOOL 6 LV** (Relay), 318 metres; **PLYMOUTH 5 PY** (Relay), 335 metres; **EDINBURGH 2 EH** (Relay), 325 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3 to 7.30 p.m., 8 to 11.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m. Weather Forecasts, 11.0 a.m. (Sunday); 10.45 a.m., Cotton Prices; 12 noon Market Report; 12.15 to 12.30 (Weekdays), Time Signal and Weather Forecast; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 8.0 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), Concert; 10.10 p.m., Weather Forecast.

PARIS ("Radio Paris"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (Ecole Superieure des Postes et Telegraphes), 450 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday), English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (Station du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 265 metres. Daily, 5 p.m. to 6 p.m., Concert; 8 p.m. to 8.15 p.m., General Talk; 8.15 p.m. to 10 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (weekdays), 8 to 9 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Monday, Wednesday and Saturday, 7 to 9 p.m. Sunday, 11 to 12 a.m.

STOCKHOLM (Radiobolaget), 470 metres, Tuesday and Thursday, 7 to 9 p.m. Sunday, 6 to 8 p.m.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7 to 8 p.m.

BODEN, 2,500 metres. 6.0 to 7.0 p.m., Concert.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m. Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 430 metres. 11 a.m., Stock Exchange 1.55 p.m., Time Signals; 5.40 to 7 p.m., Concert; 7 to 8 p.m. (Sunday), Concert.

BRESLAU, 415 metres.

HAMBURG, 392 metres.

STUTTGART, 437 metres.

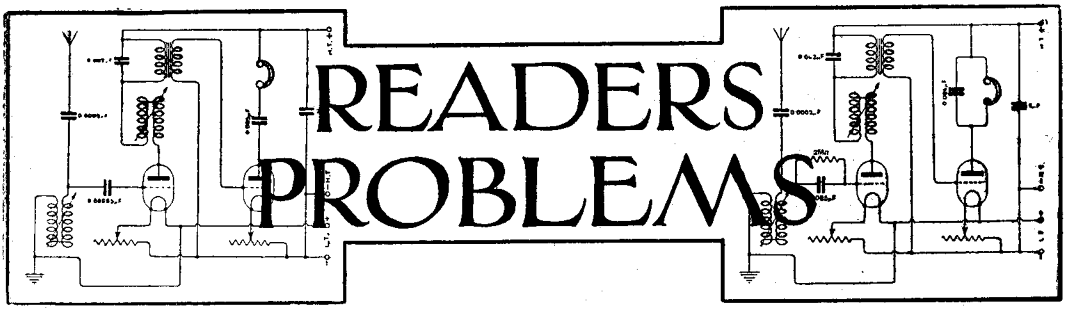
KONIGSBERG, 460 metres.

FRANKFURT AM MAIN, 467 metres. 7.30 to 10 p.m. Tests, Gramophone records.

LEIPZIG (Mitteldeutsche Rundfunk A.G.), 452 metres.

MUNCHEN (Die Deutsche Stunde in Bayern), 485 metres.

READERS PROBLEMS



1. *All questions are answered through the post. A selection of those of general interest is published.* **2.** *Not more than four questions may be sent in at any one time.* **3.** *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* **4.** *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

" *A.H.M.*" (*Dublin*) **asks for a diagram of a five-valve receiver in which the switching is carried out by means of radial switches having two parallel arms and eight contacts.**

The diagram is given in Fig. 1. Switches are provided to connect the A.T.C. in series or in parallel, to use a direct or coupled tuning circuit, and to cut out the amplifying valves when not required. Reaction may be coupled to the tuned anode coil in the plate circuit of the first valve, or to the secondary tuning inductance. The two reaction coil plugs are connected in parallel, and a reversing switch will be unnecessary if reaction is always coupled to the tuning circuit when the H.F. valve is in use, and to the secondary circuit when the H.F. valve is switched off. As your loud speaker has a low resistance, a telephone transformer will be necessary.

" *L.H.W.*" (*Bristol*) **is building a receiver in which the panel space is limited, and asks if it will be possible to use a tapped semi-aperiodic inductance coil for the A.T.I.**

As efficiency and a high degree of selectivity are essential, we strongly recommend the use of plug-in type coils for the tuning of the aerial circuit of

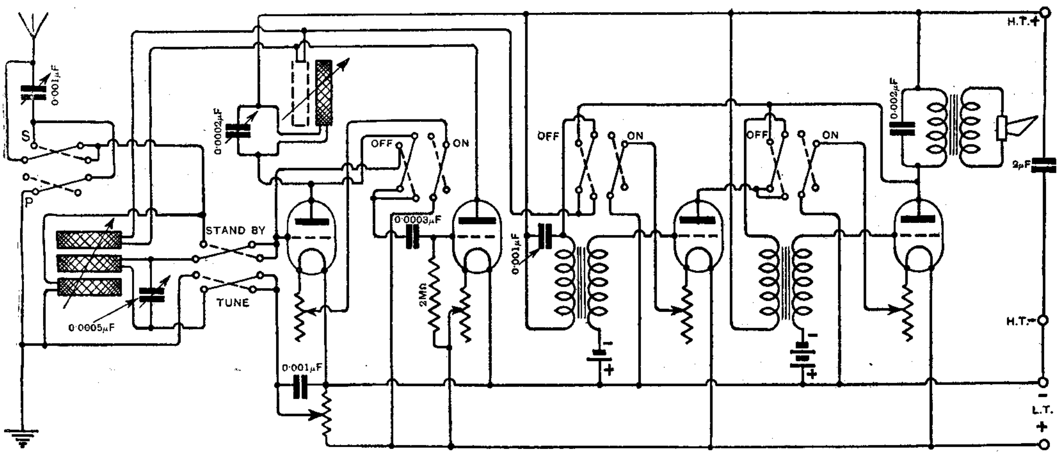


Fig. 1. " A.H.M." (Dublin). A four-valve receiver controlled by means of double pole radial switches.

your receiver. The semi-aperiodic coils to which you refer are often used as intervalve couplings, but are not suitable for aerial circuit tuning. The principal advantage of these units is to be found in ease of operation and compactness. On the other hand, the selectivity obtained is not very high, and if it is necessary to eliminate transmissions from a local station, it would be advisable to employ a coupled aerial circuit if the high frequency valves are coupled by means of these coils.

" *R.T.*" (*Oldham*) **asks (1) For a diagram of a two-valve power amplifier with an efficient method of switching, permitting separate H.T. voltage for each valve. (2) In what respects the characteristics of the L.S.1 and L.S.2 valves differ from one another. (3) Whether a capacity of 2μF will be sufficient when connected across the H.T. battery.**

(1) A suitable circuit is given in Fig. 2. We recommend the use of telephone plugs and jacks for the control of the number of valves in use. When this method is employed it is possible to supply each valve from a separate H.T. tapping, whereas in the case of switching by D.P.D.T. switches, extra H.T. cells have to be introduced into other parts of the circuit. By plugging the telephones into the jack on the extreme left of the diagram, the amplifier will be entirely disconnected and the telephones will be connected directly to the detector preceding the amplifier. (2) Although the L.S.1 and L.S.2 type valves require the same filament and H.T. voltages, there is a difference in the dimensions of the valve elements which gives the L.S.1 valve a higher impedance and amplification factor than the L.S.2 type. The L.S.2 valve should therefore be used after the L.S.1 type in a power amplifier. (3) The value of the H.T. condenser will depend largely upon the condition of the battery and its internal resistance. Often it is possible to operate a receiver successfully without any H.T. condenser when the batteries are new. When more than one H.T. tapping is employed, it is advisable to connect separate condensers between each tapping and −H.T., as in Fig. 2. Each of these condensers may be given a capacity of 2μF, as you intend to use power valves which consume a rather higher H.T. current than valves designed for general reception.

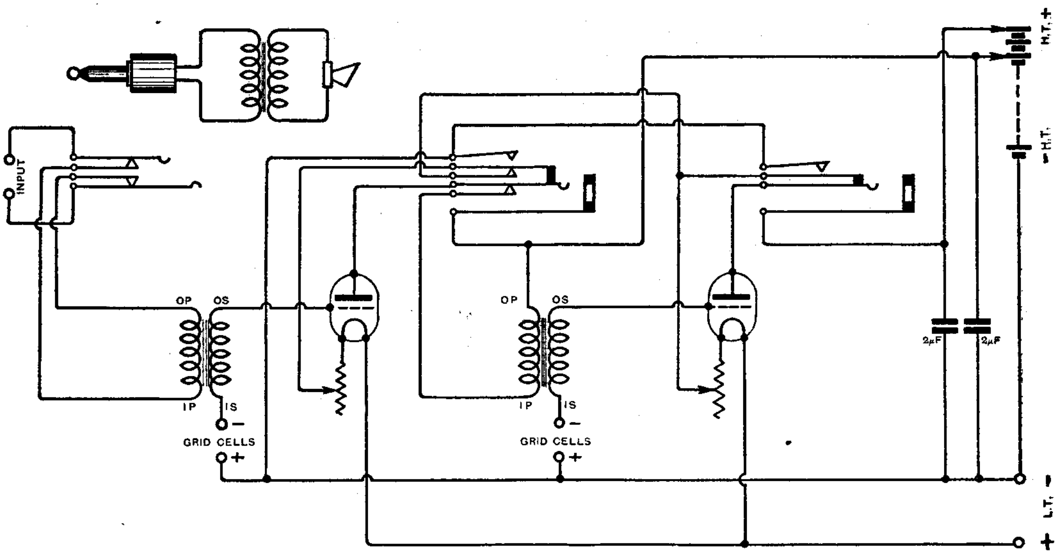


Fig. 2. " R.T." (Oldham). A two-valve power amplifier in which the number of valves in use may be controlled by telephone plugs and jacks.

" *W.A.W.*" (*Plymouth*) **asks what values of inductances and capacities would give best results with the B.B.C. wavelength in the super-regenerative receiver described on p. 151 in the issue of May 7th, 1924.**

The inductance L_1 should consist of a frame aerial 4 ft. square, wound with six turns of No. 18 or No. 20 S.W.G. copper wire, and a No. 25 Igranic plug-in coil connected in series with the frame. L_4 may be a No. 100 coil, and L_2 and L_3 each No. 1500 Igranic plug-in coils. The condenser C_1 should be given a value of 0·0005 μF, C_2 and C_3 0·001 μF each, one of these condensers being fixed and the other variable. The condenser C_4 should have a capacity of 0·002 μF.

" *A.C.Y.*" (*St. Albans*) **submits a diagram of a two-valve receiver (1 H.F. and detector) and asks why it is that he is unable to stop self-oscillation.**

It seems most probable that the oscillations are being caused by permanent magnetic coupling between the aerial and anode coils of your receiver. You should try the effect of varying the mutual position of these two coils, which should generally be mounted at right angles and as far apart as possible. It will also be an advantage to connect a 2 μF condenser across the H.T. battery.

The WIRELESS WORLD AND RADIO REVIEW

THE ALL-BRITISH WIRELESS EXHIBITION, 1924

THE first announcement has been made regarding the All-British Wireless Exhibition, 1924, which will be organised by the National Association of Radio Manufacturers, and will this year be held at the Albert Hall, Kensington, from September 27th to October 8th, inclusive.

It is interesting to note that this is the first occasion on which the Albert Hall has been used for trade exhibition purposes. The organisers state that this Hall has been selected on account of its convenience, comfort and accessibility. The size and arrangement of the Hall offers every opportunity for a very comprehensive Exhibition of the products of the new British industry which broadcasting has created.

Under the terms of the single wireless licence now issued by the Postmaster-General, sets or parts used for the construction of apparatus for broadcast reception must be of British manufacture.

The trade association which is organising this Exhibition will, we understand, be confined to British products by British firms.

The British public is proverbially slow to take advantage of innovations, even though it may be apparent that they will be of direct benefit both to the individual and to the community. So, with broadcasting, we see that, in spite of the admittedly valuable public service which it provides, not more than a small percentage of the total population of this country has so far taken advantage of it, and the endeavour will be made by the organisers of the Exhibition to impress upon the public at large the great importance of broadcasting to the nation, and in so doing, not only will the community be benefited, but employment will be found for many in addition to the present tens of thousands of British workpeople who have been absorbed into the machinery of the industry.

N. P. L. CALIBRATION WAVES.

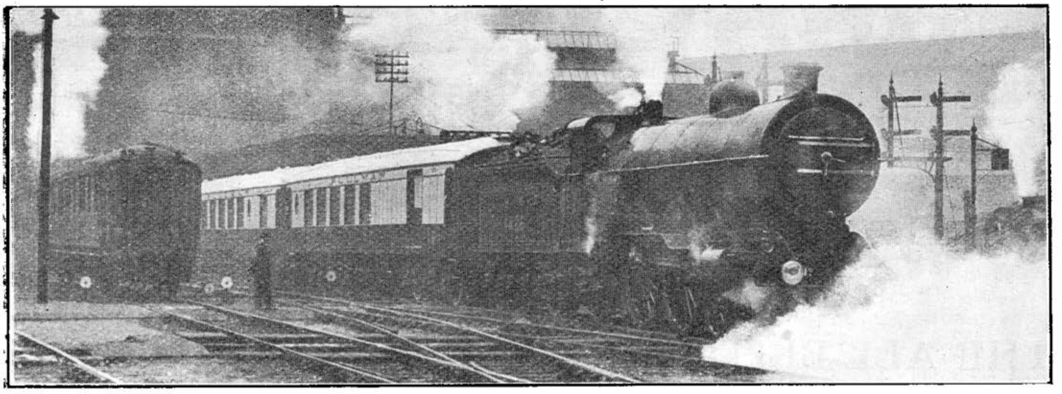
We welcome the news that a service of calibration waves is now being conducted by the National Physical Laboratory at Teddington, from their station, **5 HW.** Particulars of these transmissions are given in detail elsewhere in this issue, but we wish to call attention to the value of these transmissions to the experimenter.

The approximate wavelength range over which transmissions are taking place at present is 833 to 5,000 metres.

We hope that the N. P. L. will consider transmission of calibration waves on shorter wavelengths in the near future, as undoubtedly these would be of more value to the majority of experimenters.

Another point which we believe a large proportion of listeners will regret is that the transmissions take place in the afternoon at a time when it is not convenient for many to listen in.

Perhaps when the N. P. L. come to know how much such standard wavelength transmissions are valued they will find it possible to arrange for other or additional hours of transmission.



The Scotch Express leaving King's Cross.

RADIO COACH 6 ZZ.

A PRELIMINARY REPORT OF THE TRANSMISSION AND RECEPTION TESTS ON AN EXPRESS TRAIN.

"Radio coach **6 ZZ**" left King's Cross Station on Friday evening, July 5th, attached to the 7.38 p.m. Scotch express of the London & North-Eastern Railway. The occasion was an experiment carried out through the courtesy of the officials of the railway company by various members of the Radio Society of Great Britain to test the practicability of radio communication to and from an express train using the amateur wavelengths.

By PHILIP R. COURSEY, B.Sc., F.Inst.P.

FOR the purposes of the test a coach had been placed at the disposal of the Society and was available in a siding at King's Cross Station on the Wednesday before the test to enable the necessary experimental radio gear to be installed. The special coach was attached to the rear of the train for the run as far as Newcastle-on-Tyne, this period coinciding with broadcast transmission times and with the early darkness hours of the night.

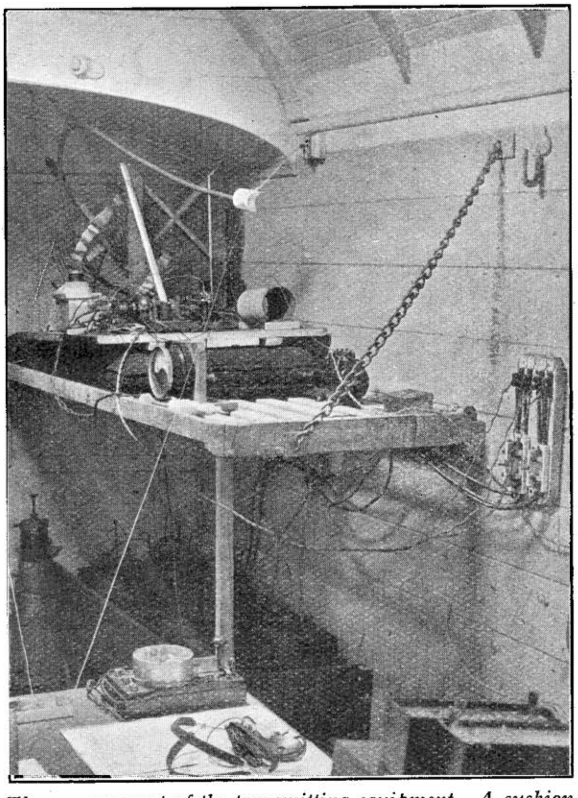
The equipment installed on the coach consisted of two practically distinct parts. Firstly, the short wave transmitting and receiving apparatus, and secondly, apparatus for the reception of broadcasting. These two main parts were installed at opposite ends of the coach on benches which had been fitted up specially for the purpose through the kindness of the railway company.

The aerial used for the test was installed entirely *inside* the coach, and consisted of two wires, spaced about 6 ins. apart, and running almost the entire length of the coach. The length of the wires was 50 ft., and they were hung 21 ins. below the roof. The insulation of the wires was provided by strips of ebonite, which served not only to space the wires apart, but also as a means of attaching the supporting cords, by means of which the whole aerial was held in position and prevented from swaying about during the motion of the train.

At one end of the aerial, the end furthest from the transmitting apparatus, the two wires were spread out towards the two sides of the coach, while at the other end they were brought together and connected to a radio frequency ammeter, and thence to a single wire leading down to a change-over "send-receive" switch mounted on the end of one of the benches fitted down the centre of the car, on which the short wave receivers, and the operating key, etc., were mounted.

The aerial circuit was completed by a coupling coil forming part of the transmitting apparatus, and an earth connection made to the steel chassis of the coach.

The energy supply for the transmitter was provided by two large 12-volt batteries installed in the coach by the railway company, and also by three 12-volt C.A.V. batteries, which were used to drive an auxiliary H.T. generator. Sundry other 6-volt and 4-volt accumulators were used for the receiving sets and for the relay key, etc. One of the 12-volt batteries was reserved for lighting the filament of the transmitting valve, and the other was used to feed the L.T. supply circuit of a Mackie H.T. generator, which machine had a rated output of 70 mA. at 1,100 volts. The valve used for the transmitter was a special Mullard low impedance valve, type O/150, control (A), which possessed the advantage of allowing the use of the comparatively low anode voltage of about 1,000 volts on a valve of liberal rating, which, while also being steadier in operation, would not be damaged if the production of oscillations was stopped while the H.T. voltage was still applied to the anode. This arrangement possessed certain advantages, as will be shown below.



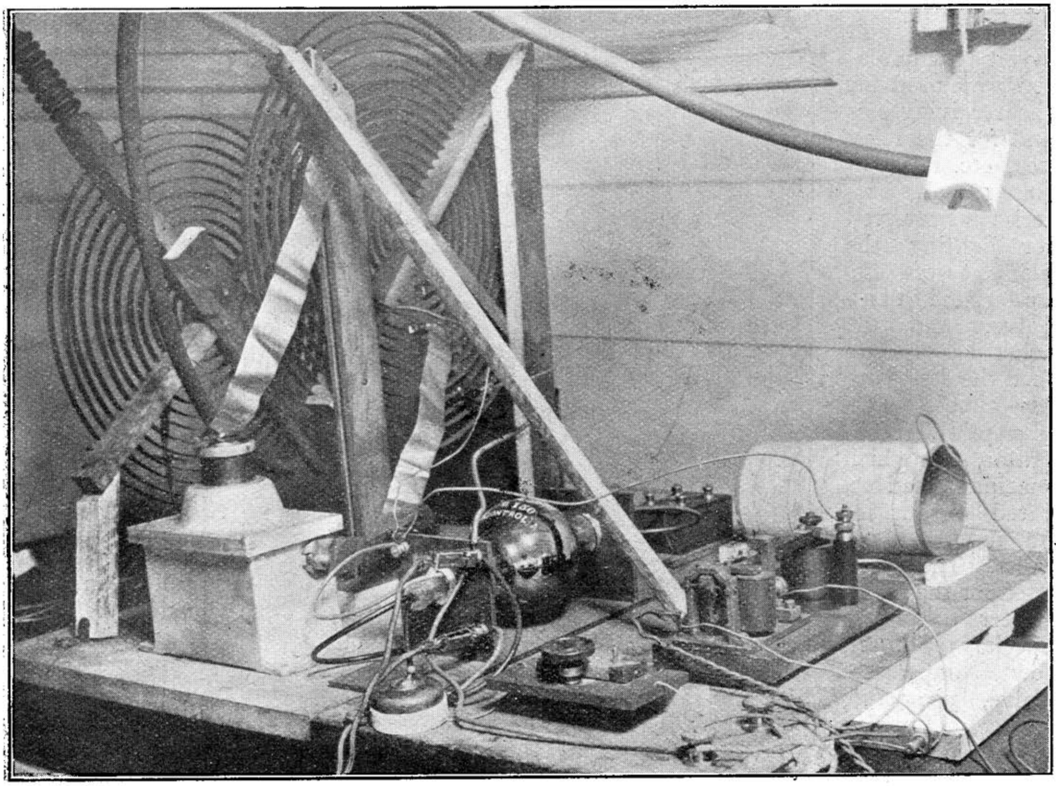
The arrangement of the transmitting equipment. A cushion is used to minimise vibration, while the accumulators used for running the Machie rotary transformer and filament heating are held in position by brackets on the floor. The signalling key through a relay short circuited the grid coil, making use of the back key contact.

The H.T. supply from the generator was taken direct to the anode of the valve through a suitable radio-frequency choke coil. An anode stopping condenser of 0·01 μF. capacity was employed between the valve anode and the anode clip on the oscillation circuit inductance, and an oscillation circuit condenser of 0·0005 μF capacity, both being of Dubilier manufacture. The oscillation circuit was loose coupled to the aerial circuit so as to give a steadier oscillation frequency independent of any likely changes of aerial capacity due to the motion of the train.

To facilitate signalling a relay key was used, controlled by a small hand key placed near the receiving apparatus. In the preliminary tests of the transmitter, when it was being installed in the coach prior to the run on the train, the relay key contacts were placed in series with the H.T. supply from the generator, but it was found that this arrangement resulted in a very unsteady C.W. note, owing to the changes of speed of the H.T. generator when the load was thrown on and off by the key. It was therefore decided to maintain the load on the machine more nearly constant by keeping the H.T. supply connected to the valve anode continuously, and to start and stop the valve oscillating by placing the key directly between grid and filament of the valve, so as to short circuit the grid circuit. This necessitated using the back contacts of the hand key, so as to cause the relay key to operate on reversed morse, opening the circuit for signals, and closing for spaces. The advantage of having a valve of liberal rating for the power used was rendered more obvious when using this method of keying, as when the valve was prevented from oscillating the anode naturally tended to heat up, but this heating was not excessive. as the anode was able to dissipate all the available energy under these conditions.

with V 24 and QX valves. Either receiver could be used at will by means of a simple change-over switch.

As has already been stated, the broadcast receivers, of which there were two, were installed at the opposite end of the coach to the short-wave apparatus. Either receiver



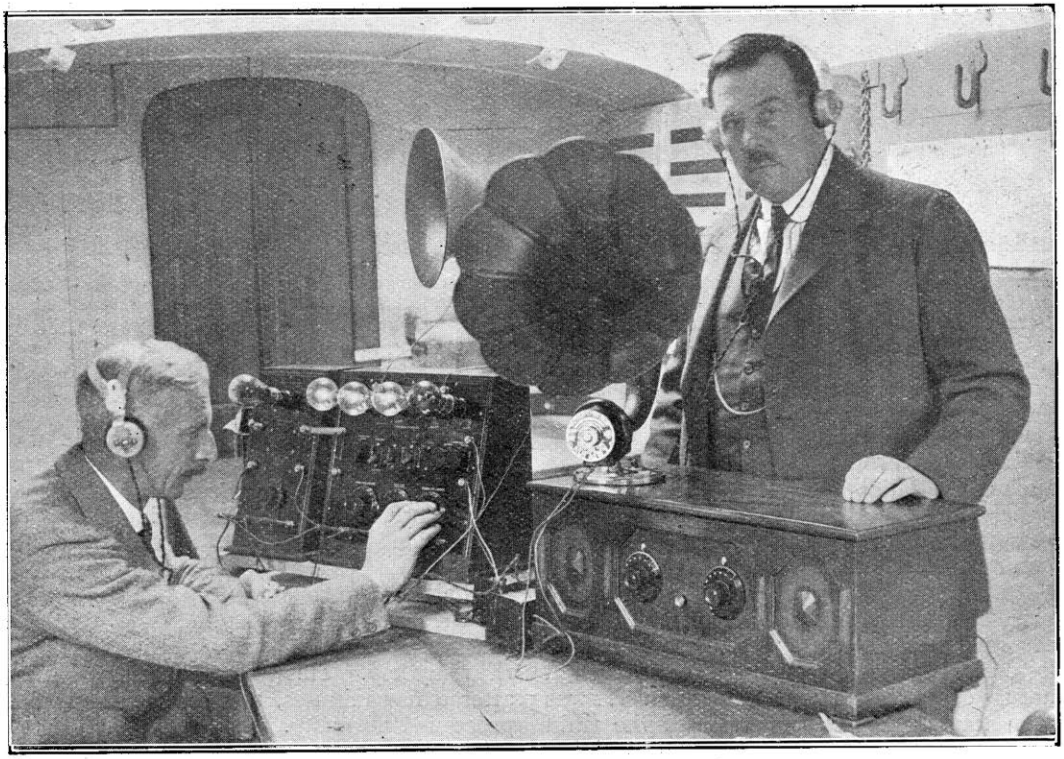
The transmitter. The tap on the centre of the right-hand coil connects to the valve grid, the closed circuit is tapped off and joined to the condenser by the metal foil connectors, the filament tap is midway between the closed circuit taps, and the anode tap is near the outer edge of the inductance. The left-hand coil is the loose-coupled aerial circuit, which is held rigidly in position by means of a bracket. The high frequency choke, stopping condenser, relay key and filament resistance can be seen.

could at will be clipped on to the free end of the transmitting aerial, the "send-receive" switch at the opposite end of the aerial being opened for this purpose. A spring clip was used to make the aerial connection for these broadcast receivers when required, so as not to interfere with the transmission of signals by any additional capacity of switches, etc., hanging on to the aerial.

The transmitter was adjusted to work on 185·2 metres wavelength, this figure being as nearly as possible identical with the wavelength used by the fixed control station **6 XX** during the tests.

For the reception of short waves two receivers were installed, one being lent by Mr. H. Andrewes and the other by Mr. F. H. Haynes. The former was equipped with Myers dull emitter valves, and the latter

For the purposes of the test a number of amateur transmitters along or near the L.N.E.R. route to Newcastle had been communicated with beforehand, and a programme of transmissions arranged, including (if possible) two-way communication between the train station, and these various running in three portions, the second part leaving at 7.38 p.m. B.S.T.), some preliminary tests of the reception of broadcasting from **2 LO** were carried out. It was noted that the signal strength fell off very much as the coach entered "Gas Works Tunnel," immediately to the north of the station, but that



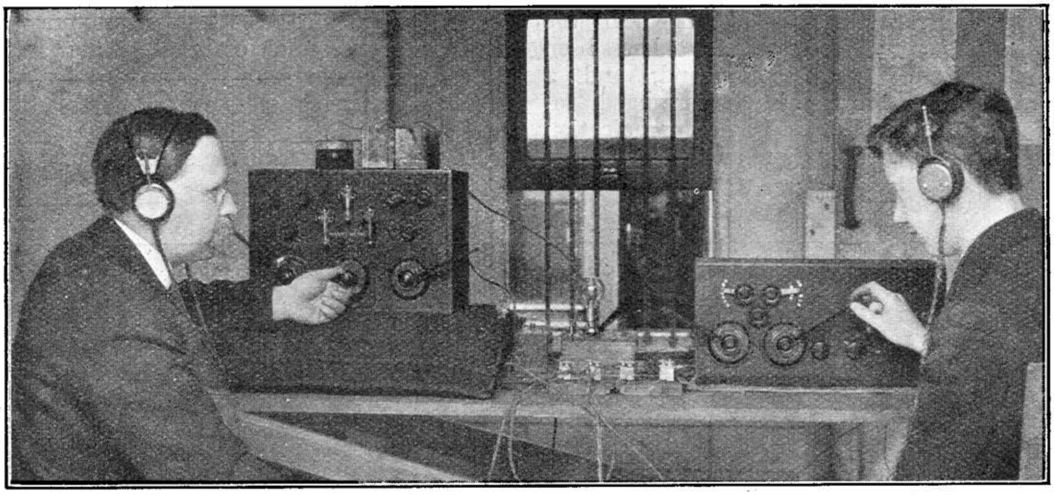
Sets used for broadcast reception. Mr. B. Hesketh (left) is seen operating the McMichael set which, together with the General Wireless receiver, brought in broadcast transmissions from several stations during the journey. Mr. L. McMichael, Vice-President of the Radio Society, is on the right of the picture.

fixed stations. Schedules had been arranged with the following stations along the line :

2 WD (Mr. C. W. Clarabut, Bedford).
5 DN (Capt. L. A. K. Halcomb, Sheffield).
2 DR (Mr .S. R. Wright, Shipley, Yorks).
2 OG (Mr .A. Cooper, York).
5 MO (Mr. W. G. Dixon, Rowlands Gill, near Newcastle-on-Tyne).

As the coach was shunted into King's Cross station preparatory to attaching it to the rear of the second portion of the "7.30" Scotch express (which on this evening was

the transmission could still be heard very faintly. On emerging from the tunnel normal strength was regained, but a sharp diminution took place again when the coach entered the station and came under the screening effect of the steel girders supporting the roof. The signal strength continued to fall as the coach further entered the station, falling to a sharp minimum near the centre, and rising again as the coach approached the southern end of the station. This appeared to indicate that the waves



Mr. Philip R. Coursey (left) operating one of the short wave receiving sets. Readers will recognise this set as the one recently described in the pages of this journal by Mr. F. H. Haynes. A heterodyne wavemeter is in the centre. On the right is Mr. H. Andrewes with his short wave set which comprises one stage of H.F., valve detector and two optional L.F. stages. The valves are enclosed and possessed the special merit of being non-microphonic.

were penetrating into the space under the station roof through the (more or less) open ends of the building, and that possibly some interference effect between the waves entering at opposite ends was the cause of the central minimum.

As the train started, test signals were picked up from **6 XX** station, but these were comparatively weak, probably owing to local screening, in addition to the screened nature of the aerial inside the coach. It was soon found that the vibration of the train rendered the use of the receiver containing the ordinary receiving valves practically impossible, even although it was mounted on a soft cushion, etc. The rigid nature of the Meyers valves in the second receiver, however, permitted its use without these troublesome microphonic noises. A further receiving trouble developed in the imperfect and variable contacts between the steel chassis, springs, wheel axles, etc., which caused loud noises in the receiving telephones. These interfered very much with reception, particularly of weak signals, and doubtless prevented the interception of many signals which would otherwise have been heard during the test. During the few brief periods during the run, when the train was stopped in a station, reception was very much better, and the troublesome noises were absent. A similar absence was also noticed when the brakes of the train were in use, this probably being due to the brake control rods acting as an electrical short circuit to the imperfect contacts, and giving a positive connection between the chassis and the wheels.

The first transmission to **6 XX** from **6 ZZ** on the train, at 7.45 p.m., was partially interrupted by the incorrect functioning of the relay key. This was fortunately rectified after a few minutes, and transmission then proceeded normally.

The first transmission from **6 ZZ to 2 WD** (Bedford), at about 8 p.m., was intercepted by **6 XX**, although there was considerable jamming from local amateur stations making telephone transmissions. Many of the subsequent transmissions made by the train were also intercepted by **6 XX** over very much larger ranges than had been expected. Shortly after this, signals were exchanged with the Bedford station, although his signals were weak as received on the train for the reasons already stated.

Subsequent communications were effected with **5 DN** (Sheffield), **2 OG** (York), and **5 MO** (Newcastle), as well as **6 XX** (London), and other interceptions were made. Very successful contact was also again made with **2 WD** (Bedford), and two-way communication established when the train was about 100 miles north of Bedford.

On after leaving York, **5 MO** (Newcastle) was called, and communication established soon afterwards. Two-way communication was continued with **5 MO** for approximately one hour until Newcastle was reached. From a message received from **5 MO** soon after contact was established it transpired that he had been receiving the signals from the train for the entire distance from Grantham, *i.e.*, when the train was about 165 miles south of Newcastle, in spite of very bad atmospherics from a local thunderstorm during the evening.

Later on atmospherics became worse in the London district and interfered with communications between **6 XX** and the other stations taking part in the tests.

It is not yet possible to give anything like a complete account of what was accomplished in signalling range from the train transmitter, but, in addition to what has been stated above, it may be mentioned that its signals were intercepted by **6 XX** for a distance of approximately 150 miles in spite of local jamming, and interference from the first harmonic of **2 LO**, which was rather troublesome. A station in Glasgow intercepted signals from the train **6 ZZ** for some considerable time over ranges well in excess of 150 miles, and **2 AKS**, at Golders Green, London, intercepted transmissions from the train even when it was passing over Newcastle Bridge, about 270 miles away.

In brief, it may be stated that the tests were eminently satisfactory, and in many ways gave results much exceeding expectations. They showed conclusively that two-way communication with an express train moving at high speed is possible, not only over very limited distances, but also over considerable ranges running into upwards of 100 miles, even when using quite small power and simple apparatus, with wavelengths of the order of 185 metres. The fact that these results were obtained with an aerial entirely inside the railway coach being all the more remarkable. The tests have also shown up the difficulties attendant upon reception on the train, and have indicated how these difficulties may be minimised or overcome. Such improvements should enable much better reception ranges to be obtained with consequent increase in the effective area of two-way communication.

Other important conclusions, reports on fading of signals, etc., will probably also be obtained when all the reception logs of the test have been properly examined and the results compared, but the report of this examination must be reserved until a later date.

In conclusion, especial thanks are due to the London & North-Eastern Railway Co. for their interested co-operation in the tests, and for the way in which they assisted in their planning and prosecution, to Mr. A. J. Bull who represented the Chief Mechanical Engineer and Mr. J. R. Hind, Chief of the Press Section, L. & N.E. Rly., to Mr. Maurice Child and others for the indefatigable manner in which they helped in the installation of the apparatus before the test, to Messrs. Mullard Radio Valve Co., Ltd., Messrs. W. Mackie & Co., Messrs. C. A. Vandervell & Co., Messrs. General Wireless, Ltd., Messrs. L. McMichael, Ltd., Mr. H. Andrewes and Mr. F. H. Haynes, for the loan of apparatus and parts; to Messrs. Dubilier Condenser Co., Ltd., both for the loan of apparatus and for help in fitting up the transmitting apparatus; and to all who helped in carrying out the tests, not only on the train, but in the various fixed stations with which the tests were conducted.

Reports of reception of the signals transmitted by 6 *ZZ are coming to hand, and as soon as these have been analysed in conjunction with the records kept on the moving train and the stations with which communication was established, a further article will be published which should contain some most interesting data on the operation of the mobile set in varying conditions and localities.*

A FOUR-VALVE RECEIVER.

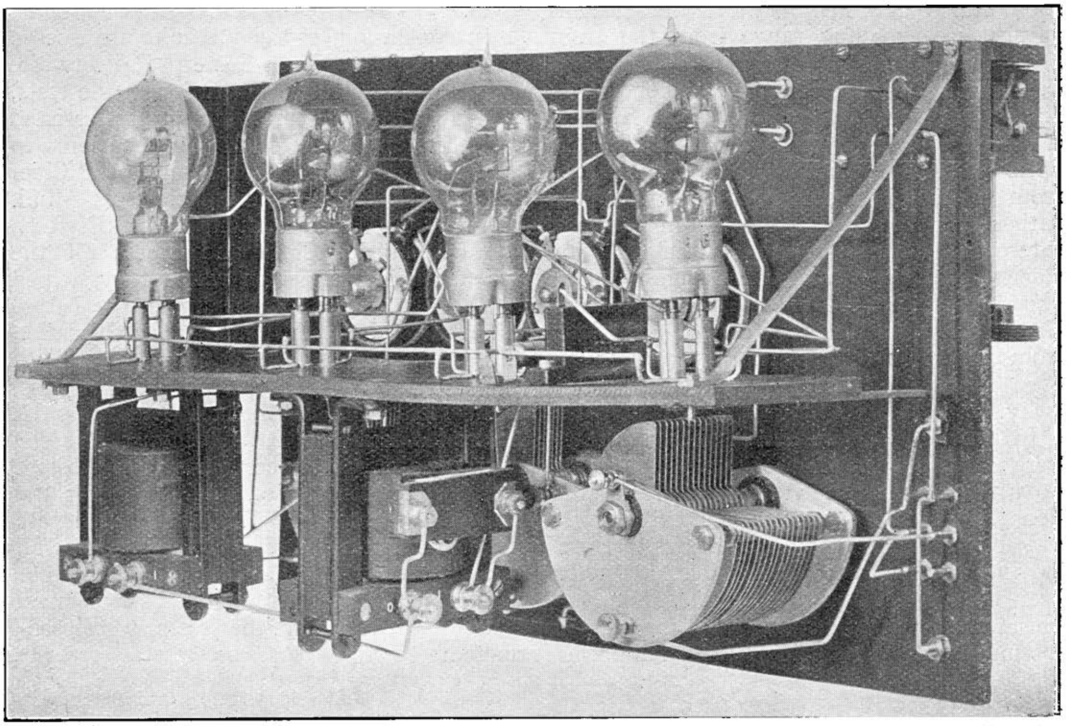
In the previous issue the requirements for a good four-valve set for general reception were discussed and preliminary constructional details given. The finishing of the receiver and the construction of the cabinet are dealt with here, and much useful information is given concerning the wiring-up of a set.

By H. Ninnis.

(*Continued from page* 437, *July 9th*, 1924).

The difficulty which often arises when wiring up is in hand is the overheating of small parts such as valve stems, when making the soldered connection. To avoid this short pieces of No. 14 S.W.G. wire may be bent to form a loop at one end and have an "L" turn of about ½ in. from the loop. These pieces may be clamped down under the valve stems and greatly facilitate the making of solder connections on to the valve circuits.

In the mounting of the valves it is as well to arrange for the plate socket to be towards the transformer end of the small panel so that leads can be taken from the inner filament pieces of the rheostats and from the outer pieces to a common lead which can be run right across the set to form the L.T. + and passing the grid condenser clip to which it may be attached.



Rear view showing the valve platform and arrangement of the components. The method of wiring up the valve sockets so that the leads are conveniently distributed above and below the valve platform can be clearly seen.

Soldering.

Before the soldering up of the connections is undertaken it is advisable to clean off the tips of all screws by means of a smooth file and as the use of fluxite greatly facilitates

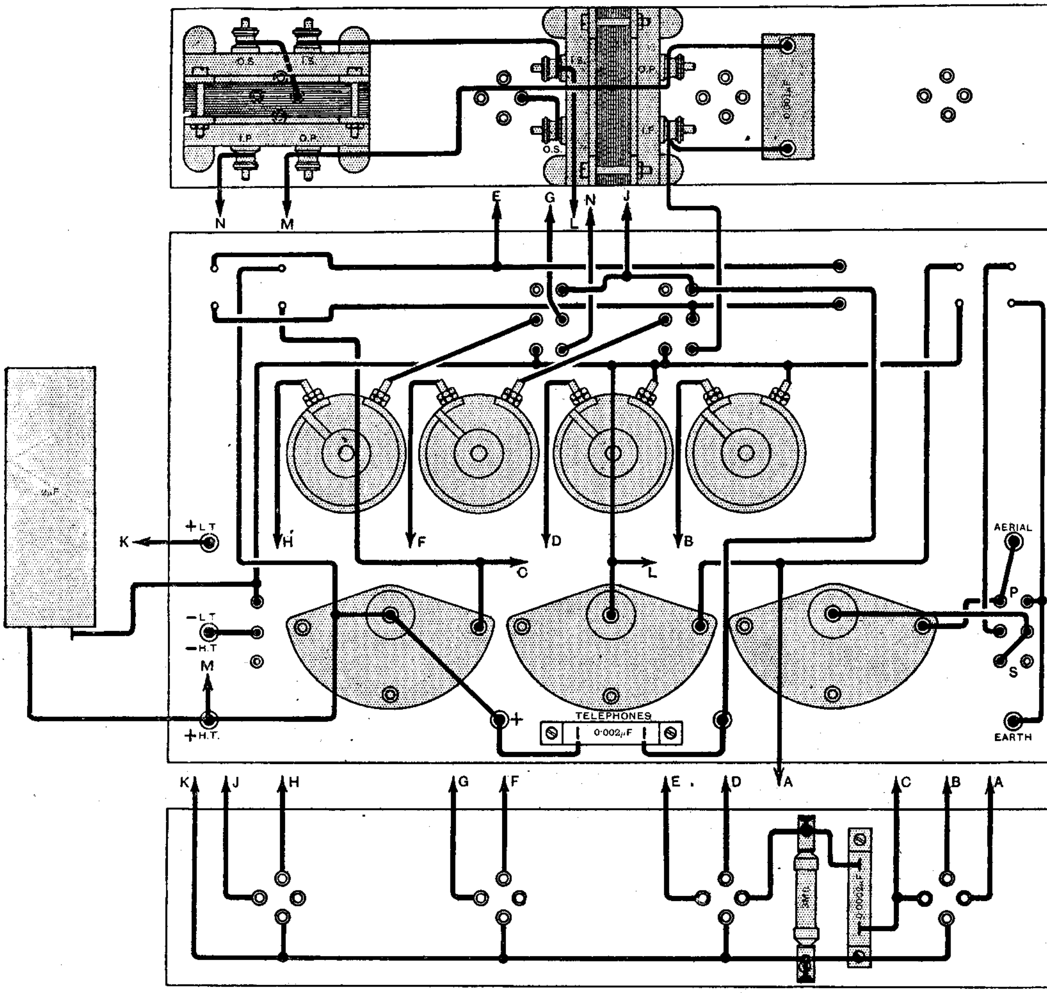


Diagram showing the actual points between which leads are run.

the making of a good joint a little may be very sparingly applied by means of a small camel-hair brush. The use of soldering flux of this sort is not generally recommended when constructing wireless apparatus, but if it is applied in this manner the making of solder connections will be rendered quite easy, and at the same time there is not much danger of there being any excess of flux which might spread to the face of the panel. All points to which solder connections are to be made should be tinned at this stage, using a clean hot iron.

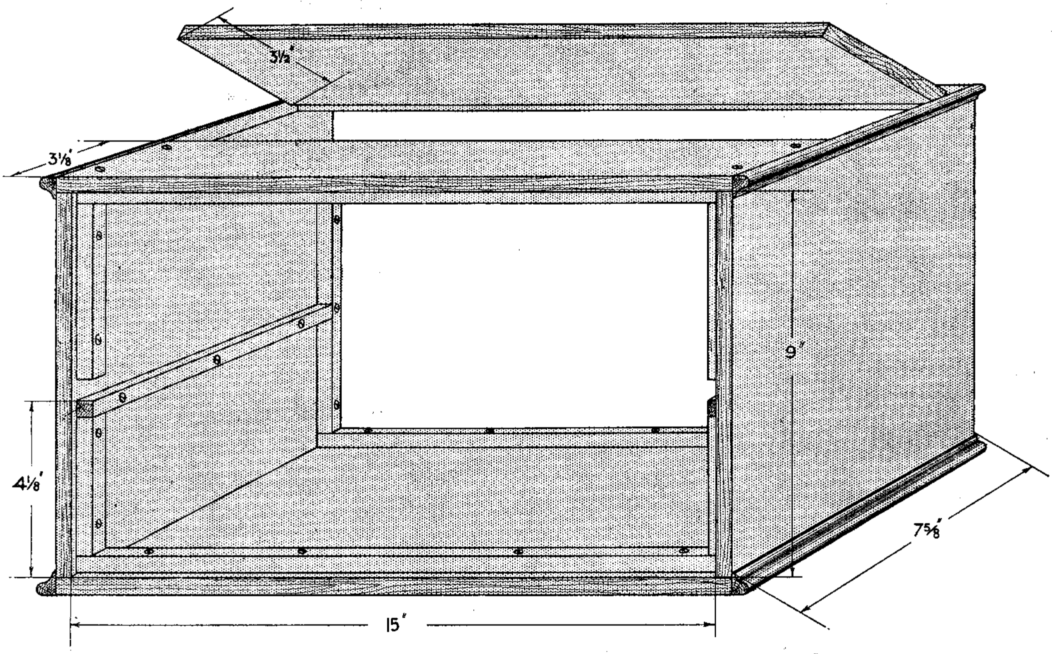
The ends of the wires should also be tinned before they are attached with a slight excess of solder and by this means the joints can be easily made without overheating the metal parts; herein lies the secret of neat soldering.

When the joints are made it is advisable to wipe off all excess flux with a clean rag whilst the metal is still hot.

WIRING.

This requires thought, and it may be said that a good neat job carefully carried out is much easier than one in which the wires are run at random. The lengths of wire to be used may be straightened by securing one end and stretching.

Before any lead is actually shaped up, consideration must be given to ensure that it is being taken by the best route. The



Details of the cabinet, which can be easily made up from planed mahogany.

eye can be used to gauge short distances as to the points at which the bends are to be made, whilst a spare length of softer wire may be roughly bent to the required shape and used as a guide for bending the actual connecting pieces.

THE CASE.

This may be built from ⅜ in. plain mahogany, which can be obtained from dealers in fretwork supplies. Complete constructional details are given in the accompanying drawing and no great difficulty should be experienced provided the reader takes every precaution to ensure that all ends are made perfectly square.

The sides are secured together by ¾ in. No. 4 countersunk brass screws and glueing may also be made use of. Fillets are used to secure front and back panel in position and also to serve as a guide for supporting the valve platform.

To permit the withdrawal of the instrument panel from the box it is necessary to make breaks in the side fillets so that the valve platform can easily be withdrawn. After the usual sandpapering, the case may be polished, or it is almost equally satisfactory to give it a couple of coats of good varnish inside and out. Four rubber feet may be now screwed on and the box is complete.

OPERATION.

A full set of coils from No. 35 to 400 can easily be wound to the details given in a recent issue of this journal, using No. 26 D.C.C. wire. As far as possible, the author uses dull emitter valves of the 0·06 class, which are operated from two accumulator cells of the D.T.G. type connected in series, and with all four valves in operation, give approximately 25 hours reception. With the set connected to a small frame aerial and using only three of the valves, the local broadcasting station is received quite well on a loud speaker at a distance of about ten miles.

In recommending this set to other experimenters, the author may point out that the design is free from constructional difficulties and can be built by a reader who does not possess any great workshop experience.

The amount of work involved in making up the set has moreover been kept to a minimum and in the particular set illustrated it might be pointed out that it was laid out and all components fitted and the bigger part of the permanent wiring soldered in place, in the course of five hours. The complete set was finished in a matter of eight hours and at once gave satisfactory reception.

FOUR-ELECTRODE VALVE RECEIVER.

The circuit principle having been described, particulars of construction are given in this instalment. It will be remembered that this receiver makes use of the four-electrode valve for the purpose of providing efficient dual amplification.

(*Continued from page* 421 *of previous issue.*)

Turning to the actual work of construction, we may commence with the box. This should be of mahogany if good appearance is desired and the small additional expense is not objected to. The wood may be of any thickness from about ⅜ to ½ inch, and the outside dimensions of the sides when assembled should be 9½ by 11½ inches. They can, of course, be dovetailed together if desired, but simple screwing and glueing with two ¾ in. No. 6 wood screws at each corner will be quite a satisfactory job. After glueing up and before putting on the bottom, the whole should be well papered up with glass paper of about No. 1 grade. The bottom should be 12 ins. by 10 ins., of about the same thickness as the sides, and should be rounded off at the edges with a smoothing plane and glass paper. This will greatly improve the appearance of the box, but care should be taken in using the plane across the grain of the wood not to knock off the corners. In a job of this sort the planing is best done from the corners inwards, and not right across the strip.

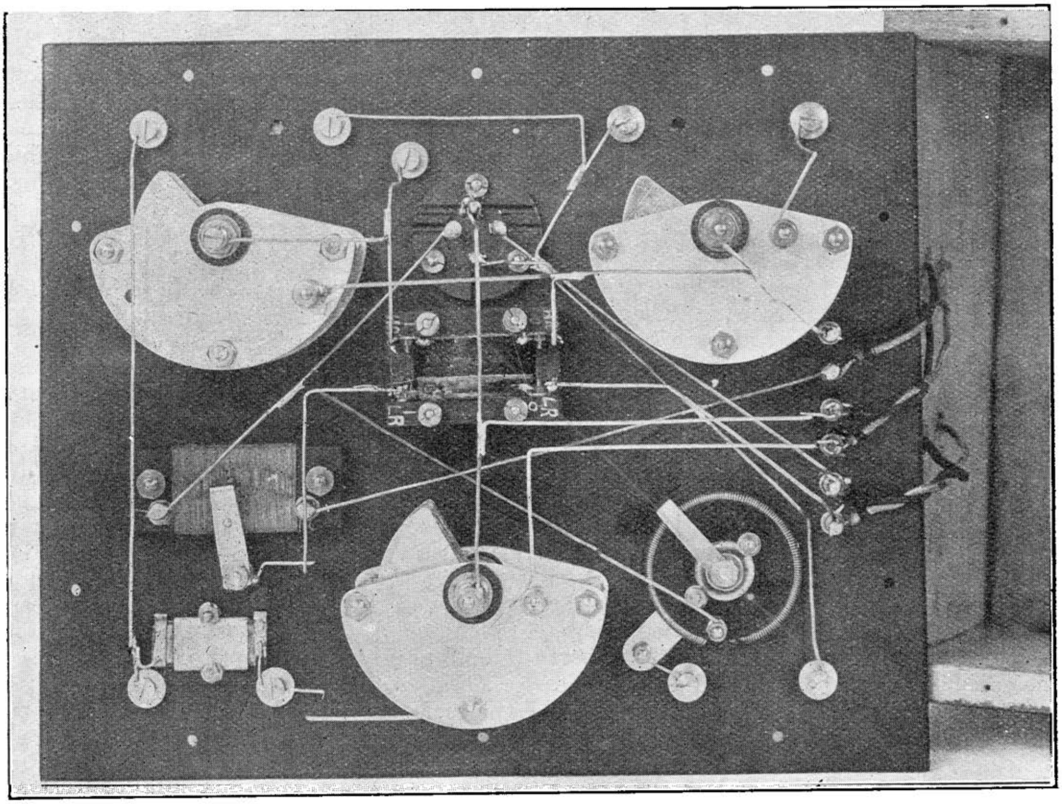
The bottom should be screwed only to the sides, and not glued, as it may be convenient to remove it sometimes to get at the internal wiring. The box should of course be french polished if this can be done, but if this is not possible it can be varnished with one of the varnish stains on the market, but the results will, of course, not be so good. In polishing or varnishing, it is better to do the glued up sides and the bottom separately, screwing them together after they are quite finished. No actual dimension for the depth of the box has been given, as this will depend on the condensers used, which will probably be purchased and not made. The box should be deep enough to clear these condensers and their wiring by at least ½ inch. With most condensers on the market of the capacities stated, a depth of 4 inches for the box will be sufficient.

We may now consider the panel. This should be of ¼-inch ebonite, 12 ins. by 10 ins. The edges of this panel, which will overlap the sides of the box, should be neatly rounded off with emery cloth, and drilling may then be proceeded with. Details for drilling the panel will be found in Fig. 3, page 420 of our previous issue.

In this diagram the holes for mounting the condensers and the filament resistance are to be regarded as provisional only. They will naturally depend on the exact type of components chosen, and as these items are now obtainable in many different forms at attractive prices the question of choice may be left to the builder of the set, with the warning that the panel drilling should not be carried out until the parts have been purchased, as the methods of fixing have not been in any way standardised.

The type of valve holder fitting is also optional. If preferred, valve legs may be bolted directly to the panel, or the flanged type of holder here used may be bolted to the panel with the flange on the upper side and exposed to view. The construction shown in which the valve holder is bolted up with the flange on the under side of the panel, is not difficult to carry out, and has the advantage of improved appearance as well as allowing the soldering of wires to the pins to be easily carried out. A hole an inch in diameter will be required in the panel for the body of the holder to pass through ; and as a drill of this size is not found in every amateur's kit, this might be thought to be rather a serious disadvantage. In actual fact, however, the difficulty can be got over fairly simply by making up a pin drill out of a piece of scrap brass sheet say $\frac{1}{16}$ to $\frac{1}{8}$ inch thick, soldered into a slot in a piece of brass rod to enable it to be held in a brace, and trimmed up to shape with a file. No great accuracy is necessary in either shaping or sharpening it, and if the necessary scrap is available it can be made in about a quarter of an hour. In use, a small hole the size of the central pin of the drill should be put through the panel with a twist drill as a guide to the large drill following it. Incidentally, it may not be known by all readers that ebonite can be quite well worked with brass tools, which stand up to the work nearly as well as tools of high grade steel which would be used on harder materials. This is a point worth bearing in mind, as it is at times possible to save a valued tool, such as a tap, by making up and using a rough substitute of brass where work on ebonite has to be undertaken.

Similarly, home-made diamond pointed brass drills are often useful for holes in ebonite when the correct size of proper twist drill does not happen to be available. After all the holes in the panel are drilled, and countersunk where necessary, it may be finished off by rubbing down carefully with fine emery cloth, using a circular motion as evenly as possible, and finishing with a well worn piece of a very fine grade, after which it may be given a dull polish by well rubbing with a piece of linen rag lightly smeared with vaseline.



Underside view showing the wiring.

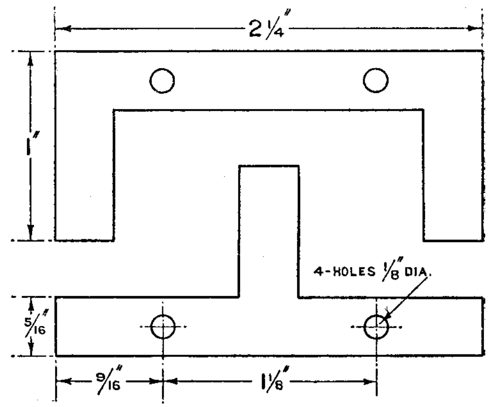
As stated above, the choice of a filament resistance can be left to the maker of the set, but it should have an "off" position in which the filament is completely extinguished, and a total resistance of about 5 ohms. In choosing a resistance care should be taken to see that in the maximum current position the resistance is actually negligible.

In a number of types on the market a few turns of resistance wire remain in circuit even in this position, and while this is of very little importance in dealing with valves of the "R" or similar types, it is very undesirable with valves of the "D.E.R." or "D.E.7" type. The latter valves have filaments designed to work on a filament voltage as near as possible to 2, and although they can be safely used on the voltage given by a 2-volt accumulator when nearly run down (say 1·85), any less voltage than this is likely to give a worse performance and some risk of the valve more or less rapidly losing its emission. The resistance due to the few remaining turns of wire in some makes of filament rheostat is quite sufficient to give trouble in this way.

The adoption of grid condenser and leak methods of rectification has made the potentiometer a much less popular instrument than it was a few years ago, and there is a much smaller choice of brands on the market at a reasonable price than is the case with filament rheostats. Fortunately the construction of a satisfactory article is not difficult. The necessary resistance wire, which should be of silk-covered Eureka, of about No. 36 gauge, may be wound on a strip of ebonite 3 ins. × 1¼ ins. × 3/16 in., the actual winding being confined to a length of about 1¾ ins. The edges of the strip should be rounded off with a file and emery cloth before winding, and great care should be taken to wind the turns on as tightly and evenly and as close to each other as possible. The ends of the winding should be sweated to two 6 B.A. bolts through the strip, and these bolts should be long enough to allow the stiff wire leads from the battery to be afterwards sweated to them without the heat from the iron during this process loosening the soldering of the Eureka wire already carried out. The winding given will have a resistance of about 300 ohms, which will cause a negligible drain on the battery. If, however, any difficulty is found in getting No. 36 wire, any other gauge up to about No. 30 may be used, but the latter size will only have a resistance of about 50 ohms, which will take considerably more current. No switch has been introduced to break the potentiometer current when the instrument is not in use, and therefore one lead from the L.T. battery should be disconnected from the corresponding terminal on the instrument at such times. If this is objected to an additional switch may be added to the panel, or the potentiometer winding may be connected across the filament leads to the valve instead of directly across the battery. It is quite workable in this position, but doing this makes the setting of the potentiometer variable with changes of the filament rheostat setting, which adds slightly to the difficulty of handling the set. The resistance strip should be attached to the panel of the instrument by bolts of about 4 B.A., and nuts may conveniently be introduced between them to keep the strip from touching the panel, and so prevent any possibility of the wire being cut or damaged between them. A track for the contact arm may be made by careful baring of the covering of the wire by means of a knife and emery paper. The bolts for attaching the strip to the panel may conveniently be left long enough to act as stops to prevent the contact arm from being turned right off the resistance. The arm should be mounted as shown in Fig. 1, and may consist of either a single blade of about No. 22 sheet brass, or preferably two or three finer blades of brass or hard copper. It should be soldered to the spindle after clamping up in position between nuts. The spindle should work nicely in a brass bush screwed tightly into the panel, and the stiff wire lead to make connection with the spindle should be soldered to the bush. In doing this, very great care should be taken to avoid overheating the bush and loosening it in the panel.

When the potentiometer has been completed it will be time to give attention to the throw-back transformer. This may be of any make which is known to have a good performance, but its ratio of transformation should not be too high. A figure between 3/1 and 4/1 will be quite high enough, and the lower value will be the better of the two. In case the making of this instrument is preferred to the buying of a ready-made component a description of a type which is quite easy to make is given, but any reader who has not had much experience in this sort of work is warned that great care is necessary in transformer making if the comparatively expensive material is not to be wasted. It is a rather laborious undertaking, without proper appliances, and it should be realised from the start that the few shillings that it will be possible to save over an instrument bought outright will be gained at the expense of a good deal of hard work. There is, of course, the satisfaction of doing the job oneself, and there is no reason why, with proper care, the result should be anything but successful. The points on which care is particularly necessary are the avoidance of breaks in the wire, faulty soldered joints (especially inside the windings), and short-circuited turns. In regard to the first of these points, it should be noted that with the fine wire used the strength of the silk insulation is nearly as great as that of the wire, and it is therefore quite possible for a break to be overlooked unless the wire is closely watched as it is wound. In soldering fine wires of this nature resin alone should be used as a flux, and as little as possible of that. The iron should be a good deal hotter than with a spirit or paste flux as generally used, but not hot enough to burn the solder. The completed joint should be wrapped in a little cotton wool or shellaced paper to do away with the risk of a short circuit to a neighbouring turn, as a single turn shorted in the winding will be sufficient to spoil the performance of the instrument. It is as well to carefully test any joint which is found in the wire, as even the wiremakers' joints are not always above suspicion. It is also a good plan to test the continuity of the winding already done with a galvanometer and cell, if these articles are available, whenever a joint or exposed portion of the wire is met with. This does away with the risk of winding a lot of wire on to a coil which has a break in the early part of the winding. A rough and ready test for short circuited turns can be made after completing the instrument by connecting 100 or 200 volts A.C. across the winding for a few minutes. If the coil is all right it will keep quite cool, or at most warm up slightly and evenly. If it has any short circuited turns it will show intense local heating, and the short circuited part will probably "burn out." In making this test, first be sure that the voltage applied *is* alternating, then be careful not to do it before the core has been built up through the coil; and also, if both windings are in place on the core, see that the circuit of the one not being tested is itself open.

The transformer used is shown in Figs. . . . It is a modification of a type often known as the "army" as it was used in a number of instruments supplied to the Services during the War. In this case, however, the two windings are put on separate bobbins mounted side by side, instead of with the secondary overlying the primary on a single bobbin as in the original instruments. This minimises the risk of a breakdown between them, and also means that if the primary winding does at any time break down, it is not necessary to "scrap" the secondary winding too in order to repair or replace it. The core stampings are shown in Fig. . These may be obtained from Messrs. Joseph Sankey & Sons, of Regent Street, London. Sixteen of each type will be required. They should, of



Stamping of the L.F. transformer.

course, be built up so that the paper attached to one side of each stamping separates each layer from the next, and they should also be arranged so that in neighbouring layers the positions of the two types of stamping are interchanged. Bobbins 1½ inches in diameter, and with a square hole of 11/32 inch side should be built up out of thin cardboard on a square wooden former. The length of the former for the primary winding should be ¼-inch, and that for the secondary 9/16ths inch, inclusive of the thickness of the cardboard cheeks in each case. These bobbins should be wound full of No. 44 single silk covered wire, which will give about 3,500 turns for the primary and 10,000 for the secondary, or a ratio of approximately 3:1. The first and the last few turns of each coil, and therefore also the leads into and out from the coil, should be of rather thicker wire, say No. 28, soldered to the thinner wire of the winding proper. These leads from the coil have to stand handling and a certain amount of chafing against the end cheeks of the coil, and unless the precaution of making them of thicker wire is taken, they are very likely indeed to get broken. Even with this precaution, great care of them should be taken, as it is very irritating, to say the least, to have to unwind and rewind a coil of 10,000 turns because a moment's carelessness has broken off the lead coming from the bottom of it. After the coils are wound they should be placed side by side and the core carefully built up through them, taking care that the stampings do not cut through the cardboard insulation under the windings. End plates of 5/16ths in. ebonite may then be added further to protect the coils, and the leads from the windings should be attached to sweating tabs screwed into these end plates, as shown. The appearance of the transformer is much improved by covering the windings with a layer of empire cloth or other neat binding material, which may be stuck on with Chatterton compound. The completed instrument is then attached to the deck of the receiver by means of long screws passing right through the core and ebonite plates.

(To be concluded.)

NEW BOOKS.

The Thermionic Valve and Its Development in Radiotelegraphy and Telephony.* By J. A. Fleming, M.A., D.Sc., F.R.S., etc.

This is a revised and largely rewritten edition of Dr. Fleming's book of the same title which appeared in 1919. The scope of the work is perhaps best indicated by the chapter headings :—

1. Scientific Principles.
2. The Fleming Rectifying Valve.
3. The Three and Four-Electrode Valves.
4. The Theory of the Three-Electrode Valve.
5. Thermionic Valve Construction.
6. The Thermionic Valve as a Generator of Oscillations.
7. Thermionic Valves as Amplifiers and Detectors.
8. Thermionic Valve Testing.
9. Thermionic Repeaters and Relays.
10. Thermionic Plant.

Dr. Fleming needs no introduction to the readers of *The Wireless World and Radio Review*, who will be familiar with the part played by him in the development of the thermionic valve.

The book contains over 440 pages, and 280 figures and illustrations.

The Calculation and Measurement of Inductance and Capacity.† By W. H. Nottage, B.Sc.

The object of the author in compiling this book was to bring together in a convenient form the more generally useful formulae and methods of measurement for inductance and capacity. Since the appearance of the first edition, a number of new formulae and many new instruments have been developed. Reference is made to these new developments and the more obsolete types have been omitted.

The book deals with the subject under the following headings :—

1. The Calculation of Inductance.
2. The Calculation of Capacity.
3. The Measurement of Inductance.
4. The Measurement of Capacity.
5. High Frequency Measurements.
6. Appliances for Use in Measuring Inductance and Capacity.
7. Proofs of Formulæ for Inductance and Capacity.

Tables and data appear as an appendix of 28 pages. A large amount of new material has been added, and the book now has 220 pages and over 80 figures.

Thermionic Tubes in Radiotelegraphy and Telephony.‡ By J. Scott-Taggart, F.Inst.P., A.M.I.E.E.

This is a revised and enlarged edition of Mr. Scott-Taggart's book published in 1921. A considerable amount of additional matter has been added to bring the book thoroughly up to date and in order that the reader may be conversant with the latest developments. The book contains the following chapters, covering 470 pages, and including over 380 figures.

1. Two-Electrode Valves and the Theory of Thermionic Currents.
2. The Three-Electrode Vacuum Tube.
3. The Vacuum Tube as a Detector.
4. The Vacuum Tube as an Amplifier.
5. Regenerative Amplification.
6. Multi-stage High Frequency Amplifiers.
7. Multi-stage Low Frequency Amplifiers.
8. Combined High and Low Frequency Amplifiers.
9. Multi-stage Retroactive Receiving Circuits.
10. Reception on Continuous Waves.
11. Transmission of Continuous Waves with Vacuum Tubes.
12. Vacuum Tube Oscillators, Wavemeters, Capacity Meters, and other Measuring Instruments.
13. The Vacuum Tube in Wireless Telephony.
14. The Dynatron.
15. Miscellaneous Vacuum Tube Devices.
16. Recent Developments.
17. New Invention for Selective Reception.

* The Wireless Press, Ltd. Price 15s.
† The Wireless Press, Ltd. Price 7s. 6d.
‡ The Wireless Press, Ltd. Price 15s.

CALIBRATION WAVES FROM 5 HW.

A VALUABLE SERVICE BY THE NATIONAL PHYSICAL LABORATORY.

A PROGRAMME of standard waves is now being transmitted from the National Physical Laboratory W/T Station, Teddington. These transmissions are of accurately known radio frequencies covering the range between 60 and 360 kilocycles per second.

The transmitting system consists of a master valve oscillator operated entirely on batteries and arranged to permit of fine smooth adjustment of the frequency of the oscillations generated.

This master oscillator serves to feed the grid-filament circuit of a power valve set operating on an anode potential of 2,500 volts. The aerial and an adjustable aerial inductance coil, together with an open scale small condenser, form an oscillatory circuit in the anode circuit of the power valve.

By this arrangement the variations in the aerial capacity or other conditions in the power valve circuit are rendered of almost negligible effect on the frequency of the waves transmitted.

The adjustment of the frequency of the transmitted waves is made as follows:

The waves are received into the amplifier of the standard multivibrator wavemeter and produce an interference tone with the selected harmonic of the multivibrator, representing the frequency under transmission. This interference tone is conveyed by telephone wires to the transmitting hut. The master oscillator frequency is then adjusted—with the power circuit also in operation—until the interference tone is reduced to beats of one or two per second. The minute changes in frequency during the transmission of a dash are continuously corrected by adjustment of the small variable condenser shunting the aerial. This method of adjustment forms a very sensitive means of holding the frequency constant.

The steadiness of frequency normally attained is of the order of ± 3 cycles per second at a frequency of 360 kilocycles, and at a frequency of 60 kilocycles it is of the order of 0·5 cycles per second.

The absolute accuracy of the frequencies is determined entirely and only by the tuning fork controlling the standard multivibrator wavemeter. The average frequency of the tuning fork is within two parts in a hundred thousand of its nominal value of 1,000 cycles per second. The variations of frequency of the fork are comprised within a belt of ± 2 parts in a hundred thousand.

The maximum probable error in the frequency of the transmitted wave is therefore about ± 5 parts in a hundred thousand, and the mean probable error is of the order of ± 2 parts in a hundred thousand.

The present programme of transmissions is as follows:—

Time, G.M.T.	Frequency Kc/s.	Approximate Wave-length.	Indicating. Group.
1500-1503	360	833	N1
1508-1511	280	1,072	N2
1516-1519	200	1,500	N3
1524-1527	180	1,667	N4
1532-1535	120	2,500	N5
1540-1543	100	3,000	N6
1548-1551	75	4,000	N7
1556-1559	60	5,000	N8

The programme is transmitted in the following form:—At 14·58 G.M.T. CQ CQ CQ de 5 HW 5 HW 5 HW repeated for two minutes at a frequency of 360 kilocycles.

From 1500 *to* 1503—

N1 N1 N1 ——— 20 sec. dash ——— transmitted six times altogether.

The aerial current is then immediately transmitted on the same frequency, and is given twice. The wait signal • — • — • is then given

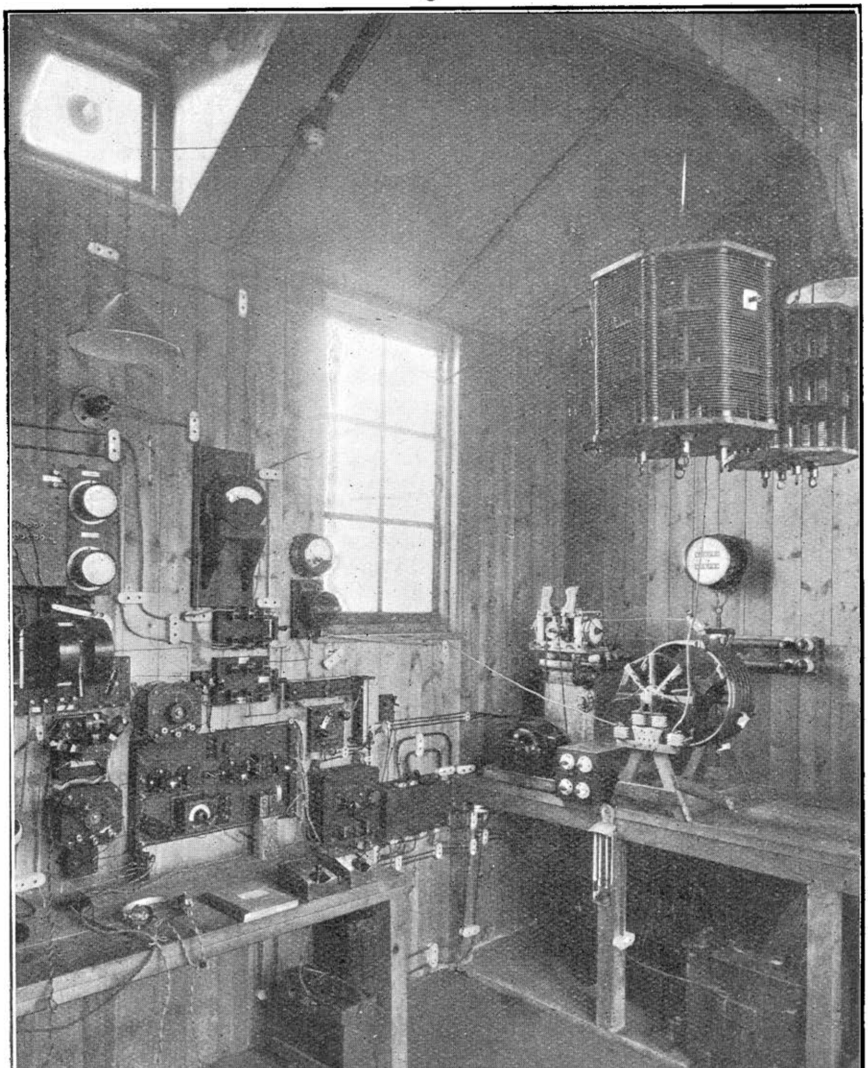
Five minutes interval.

From 1508 *to* 1511—

N2 N2 N2 ——— 20 sec. dash ——— transmitted six times.

The aerial current is then immediately transmitted on the same frequency, and is given twice. The wait signal • ▬ • ▬ • is then given.

During the five minutes' interval short programme. The effective height of the aerial is of the order of 25 metres, and the aerial current varies from about 5 amperes at 360 kilocycles to about 2 amperes at 60 kilocycles.



A view of the transmitting room at **5 HW**, *at the National Physical Laboratory, Teddington.*

dashes will he heard whilst exact adjustment of the next frequency is being made, but they are not to be considered as part of the

Transmissions are taking place on alternative Tuesday afternoons, at the hours stated in the programme given above.

THE CRYSTAL DETECTOR IN THEORY AND PRACTICE—VII.

ON THE DESIGN OF CRYSTAL DETECTORS.

By JAMES STRACHAN, F.Inst.P.

THERE is no other piece of wireless apparatus that shows greater diversity of design than the crystal detector. There has been recently some talk concerning standardisation of wireless fittings, and in this connection manufacturers might commence with the crystal detector. The writer has purchased from time to time for experimental purposes about a score of British made detectors. No two of these are alike in their dimensions. On the other hand four French made detectors, all by different makers, although differing very much from each other in their mechanism, were found to be exactly alike in their dimensions and are interchangeable, being fitted with slotted terminal lugs, with 5 cm. centres, which is said to be the French army standard for a detector fitting.

With regard to the mechanism of the crystal detector we may consider the subject under the following points :—

1. Methods of holding the crystal.
2. Methods of holding the metal point or "catwhisker."
3. Method of adjusting contacts.
4. General arrangement of components.

1.—THE CRYSTAL ATTACHMENT.

In actual practice very little difference is found between various methods of holding the crystal so far as efficiency is concerned. With a crystal cup and clamping screws the crystal should be well packed into the cup with tinfoil, rolled and pressed around it, before screwing up. It is difficult to make good contacts direct with crystals and screws. Both hard crystals like silicon and zincite, and soft galena-type crystals are easily fractured by pressure of the screws bearing direct on their surface. The type of crystal cup in which the crystal is held in position by means of a strong spring is also quite satisfactory, and very convenient for experimental purposes when one wishes to change the crystals frequently. In an experimental detector of French make the crystal is held between two small conical cups, one of which is carried by a plunger held in position by an internal spring (Fig. 1). This is very convenient for testing crystals,

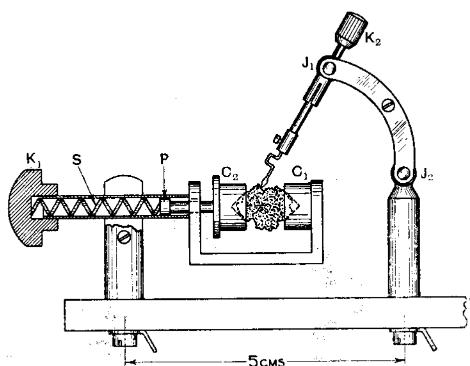


Fig. 1. Experimental Crystal Detector of French design.

as the rod carrying the cups may be rotated to expose three sides of the crystal. The use of Wood's alloy or other fusible metals for attachment of the crystal should be adopted invariably for a permanent setting. The electrical connection is positive, does not vary with use, and the crystal may be oriented to present the most sensitive area, the latter being sometimes a difficult matter with screw fixing. The use of a fusible metal attachment has another advantage in that a comparatively small fragment of a sensitive crystal may be used. The most convenient form of crystal cup for this purpose is one fitted with a small pin on its base, so that the crystal may be changed rapidly by inserting spare cups. The pin may be screwed to fit into a suitable base, or may be made to plug into a fitting where it is held by a pinching screw.

2 AND 3.—THE METAL POINT OR "CATWHISKER" AND ADJUSTMENT OF CONTACT.

In the simplest form of detector commonly in use the metal point is held at the end of a rod sliding through a ball-bearing suspension. When well made this simple design gives all the manipulation necessary for reception of strong signals, and is to be preferred to more complicated arrangements with springs and compound levers. The fineness of adjustment possible with this simple arrangement is rather surprising. This depends, of course, on the delicacy of touch possessed by the operator, but on the average it is less than a thousandth of an inch.

For reception of weak signals, where more exact adjustment is necessary, and also for use in dual and intervalve circuits, a rigid support with a fine screw adjustment is absolutely necessary. In this case simplicity of design is again the most desirable feature. The rod carrying the "catwhisker" should not rotate with the screw adjustment, and exploration of the crystal should be accomplished preferably by lateral or eccentric movement of the crystal cup or holder. In many so-called micrometer detectors three faults are evident: (1) The support for the screw fitting is too light, thus allowing of a displacement of the rod by leverage, and giving rise to movements greater than the finest adjustment of the screw, when the slightest weight is applied in manipulation.

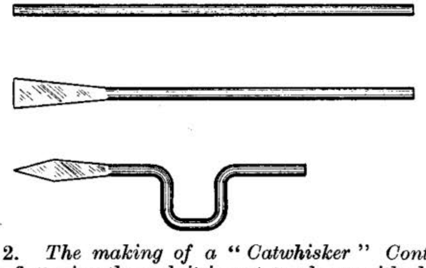


Fig. 2. The making of a "Catwhisker" Contact. After flattening the end it is cut to shape with sharp scissors.

(2) The screw is too coarse, being often much less than 40 threads per inch, which is the minimum. (3) The ebonite head on the adjusting screw is of too small a diameter; this should not be less than half an inch, preferably larger.

With regard to the "catwhisker" itself, this should be preferably of gold or platinum, and not too fine, viz., about 26 S.W.G. The end should be hammered flat and cut to an arrow-shaped point with sharp scissors. A special form may be used when the carrying rod is manipulated by a simple sliding movement, but in the case of a micrometer screw adjustment, one "hair-pin" bend is all that is necessary. (Fig. 2).

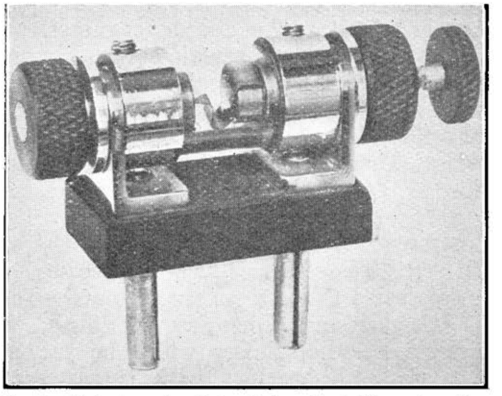


Fig. 3. Detector of substantial and rigid construction.

In "perikon" or similar detectors the bornite crystal should be a sharp splinter fixed in a very small cup or tube by means of fusible metal. This cup may be carried on a springy strip of copper fitted with a suitable arrangement for varying the degree of pressure—the simpler the design the better. The most sensitive planes on zincite are flat fractured surfaces against which the bornite point is pressed.

4.—GENERAL ARRANGEMENTS OF COMPONENTS.

The general design or arrangement of components in a detector require careful attention on many points. In the first place a crystal detector need not be very large and the French standard fitting of 5 cms. gives ample space for all that is required between centres this distance apart.

Many detectors of the enclosed type are made from flimsy nickelled stampings fitted together so that the whole is under tension, and vibrates with every touch of the hand. Further, on taking the detector to pieces, the glass tube enclosing the contacts is found to have roughly cut and irregular ends. These should be ground smooth and jointed with a little resin cerate or melted rubber if the glass tube is intended to exclude atmospheric influences, and is not merely for ornament. The metal members should be rigid and substantial, and all springiness avoided. The design in which the metal rod carrying the "catwhisker" has a vertical adjustment is less liable to movements caused by mechanical vibrations. Such faults may not be apparent in the ordinary crystal set used for reception of strong broadcasting, but for intervalve work their presence is only too much in evidence. Another fault to be guarded against, particularly for intervalve work, is the proximity of heavy metal fittings, which act as a small condenser, allowing the passage of H.F. currents without rectification. In one excellent detector of French make (Fig. 3) this is the only fault, but it is a fatal one for intervalve work.

CONCLUSION.

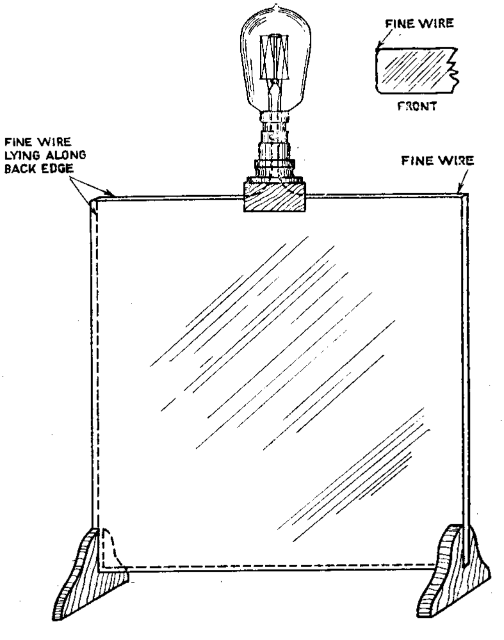
In the foregoing articles the writer has (1) reviewed the various theories accounting for the action of contact rectifiers; (2) presented a new theory which he suggests is more in accordance with the observed phenomena; (3) examined for the first time a large selection of minerals, including by typical examples the whole field of inorganic compounds and suggested a chemical classification of crystal rectifiers; (4) indicated the connection between the sensitivity of crystals and their properties; (5) shown that crystal rectifiers have a constant sign with reference to the natural direction of the rectified current; (6) described some experiments proving the existence of molecular movements at the loose contact, and (7) made a few practical observations on the construction of detectors.

A writer (in the *Mining Journal*) has recently suggested that a search should be made for rectifying crystals in the field of radio-active minerals. The present writer included a representative series of these substances in his experiments, but did not find any encouraging results. A few, as already mentioned, rectify when heated to a high temperature, but the majority of these substances, consisting of compound oxides and silicates, are non-conductors. The minerals examined included oxides of tantalum, yttrium, uranium, cerium, zirconium, therium, lanthanium, etc., in the form of simple and compound oxides, and their salts as found in such minerals as pitchblende, euxinite, samarskite, xenotine, monazite, etc.

From some experiments made with synthetic crystals a much more promising field of research lies in the metallic selenides and tellurides, some of which are quite as good as the best synthetic galenas. There is no doubt in the writer's mind that rectification in crystals depends upon the number of free electrons in the atoms comprising the molecule and their behaviour when subjected to high frequency currents. Research in the production of the cold valve is working backwards towards the crystal rectifier. The object of these articles has been to arouse interest in the subject from another point of view, and to stimulate investigations in a direction which the writer hopes will prove profitable in the future.

NOT OPERATED BY WIRELESS.

Many shops are exhibiting as a window attraction at the present time a flashing electric lamp supported upon the edge of a glass panel, and operated with no visible electrical connection. Considerable interest has been shown in this device and it has fallen to the lot of many a wireless enthusiast to unravel the mystery. The use of high frequency currents is perhaps at first suggested, but very close examination will no doubt reveal that very thin wires are attached to the outer edges. Wires thus secured to the back edges are almost completely hidden from view owing to the reflection and refraction which occurs when viewing the glass panel from the front.



NOTES & CLUB NEWS

The first Japanese Government broadcasting station has just been completed in the Shiba Park, Tokyo.

* * * *

The present hours of working **5 XX**, the Chelmsford 1,600 metre broadcasting station are at present as follows :— 11.30 a.m. to 12.30 p.m., 4.30 to 5.30 p.m. and 7.30 to 8.30 p.m.

* * * *

A chain of wireless stations is being established in the Canadian North-West by the Department of the Interior.

* * * *

Wireless Licence Figures.

In the House of Commons on July 1st, the Postmaster-General stated that the total number of wireless receiving licences on May 31st, in England and Wales, was approximately 702,000.

Mr. P. Harris (Bethnal Green—South-West, L.) asked whether the Postmaster was aware that Edinburgh wireless dealers have sold 5,000 sets in excess of the number of licences issued.

Argentine CB 8.

Probably the foremost experimenter in South America is Mr. J. C. Braggio (**CB 8**), whose signals have been heard not only in America and New Zealand, but by several amateurs in this country.

Some details concerning this station should be of interest.

The transmitter is equipped with four 50-watt valves in parallel with a 1,000 volt direct current on the plates, and 12-volt direct current on the filament. A Hartley circuit is employed and an aerial current of 5 amperes is obtained. The normal wavelength is 118 metres. A vertical conical cage of six wires 100 ft. high is used, together with a counterpoise of the fan type consisting of eight wires 25 ft. long and 10 ft. above the ground.

The receiver consists of a detector and one-stage of low frequency amplification.

During the recent Pan-American tests exceptional results were obtained and over 50 North American stations were heard. Incidentally, **CB 8** succeeded in talking to **2 AC** of Gisborne, New Zealand, for two hours, thus covering a distance of about 7,000 miles. Communication was also secured with American **3 BWJ** of New Jersey, U.S.A., on May 30th, this being the first occasion of amateur communication between North and South America.

Ecole Superieure Changes Wavelength.

According to our Paris correspondent, the Ecole Superieure de P.T.T. broadcasting station has altered its wavelength from 450 to 392 metres. The quality of the transmissions remains unchanged. Ecole Superieure and the Eiffel Tower are still conducting simultaneous transmissions.

French Prizes for Radio Research.

The French Academy of Sciences has offered a reward of 20,000 francs to be bestowed at the discretion of the publisher of the French magazine " Je Sais Tout," to the individual who is responsible for the greatest amount of progress in radio research during the present year.

Another Broadcast Speech by H.M. the King.

Arrangements are in progress for the broadcasting of the speech which H.M. the King is to deliver in St. Georges Hall, Liverpool, on the occasion of his visit to the City, for the consecration of the new cathedral on July 19th.

In addition, use will be made of the public address system to enable crowds in the neighbourhood of the Town Hall to hear His Majesty's remarks.

The installation of the system is in the hands of the Marconiphone Co., Ltd.

Spanish Broadcasting.

The recently erected Radio-Madrid broadcasting station has, we believe, been experiencing battery trouble and for a time the schedule of programmes had to be abandoned. We understand that the station is now working normally.

Two-way Working with Finland.

Using under 10 watts and an ex-Government T.V.T. unit, Mr. James Croysdale, of Burley-in-Wharfedale, Yorkshire, has succeeded in carrying on two-way communication with the Finnish station, **2 NM,** located at Helsingfors, Finland, the distance covered being about 1,200 miles. Signal strength is reported as good at both ends. Our correspondent asks whether this is a record for a T.V.T. unit.

" Deutschland Uber Alles " Again.

The broadcasting of " Deutschland Uber Alles " from Berlin, a few days back, evoked a protest from a number of German towns.

By way of explanation the broadcasting authorities stated that the tune was merely played to indicate to the world the source of the transmission.

5 HA.

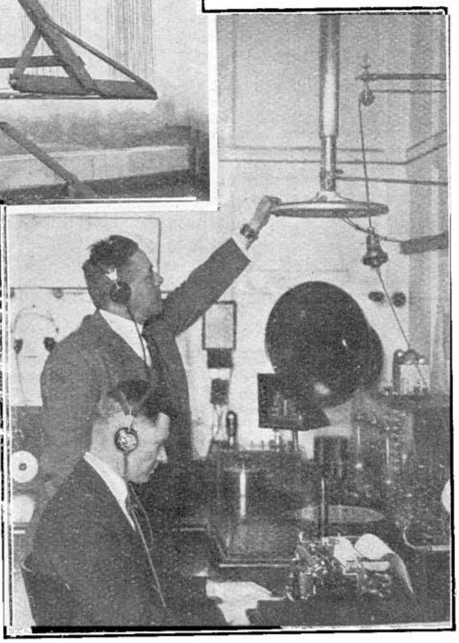
Mr. R. Watson of Whitchurch, states that his call sign **5 HA** is being illicitly used by a transmitter in the Birmingham area. Any information leading to the detection of the offender would be welcomed.

A Progressive Society.

Among the most active of the London radio societies must be included the St. Pancras Radio Society, which has now extended its activities to include Hampstead amateurs. The name of the Society has accordingly been changed to the Hampstead and St. Pancras Radio Society. Larger premises are required and new headquarters are being equipped not only with workshops and standard instru-

Mr. J. C. Braggio (Argentine **CB8**), *whose remarkable success in long-distance transmission was a feature of the Pan-American Tests.*

The aerial can be rotated in any direction by a control wheel in the instrument room. The possibility of screening is entirely absent.



In the instrument room. Full use is made of the directional properties of the aerial.

Said to be the largest of its kind in the world, this frame aerial occupies a commanding position on the roof of the Bush Building, Kingsway, London.

ments, but also with an excellent technical library.

The Hon. Secretary is Mr. R. M. Atkins, 7 Eton Villas, Haverstock Hill, N.W.3.

A Removal.

We are advised by Messrs. Fullers United Electrical Works, Ltd., that their Midland office address has now been removed to 5-9, Severn Street, Birmingham.

Radio Society of Gt. Britain.

The ordinary general meeting of the Society intended for Wednesday, July 23rd, at the Institution of Electrical Engineers, is cancelled.

Swedish Radio Exhibition.

The Radio Society of Great Britain has received a communication from the Swedish Radio Exhibition, Gothenburg, inviting British Amateurs to take part in the Exhibition to be held in Gothenburg during the period of the Swedish Fair, August 4th to 10th, 1924. The promoters are particularly anxious to enlist the support of British experimenters, some of whom, they hope, will be disposed to send radio apparatus, circuit diagrams, photographs, or other articles of interest connected with the science of radio.

In an endeavour to encourage amateurs to send apparatus, the Exhibition authorities are offering several trophies, which can be competed for by foreign amateurs, including, of course, British. They further offer to insure all apparatus exhibited, and state that the only charges which exhibitors are asked to meet will be the freightage costs to and from the exhibition.

Any members of the Radio Society of Great Britain who desire further information on the matter are invited to communicate with the Honorary Secretary of the Society, 53 Victoria Street, S.W.1, or, if they wish, direct with Mr. Bertil Lind, 14 Garlinge Road, West Hampstead, N.W.2, who is the London representative of the Swedish Exhibition authorities.

Erratum.

The receiver shown in the illustration on page 449 of this issue and referred to as being manufactured by Messrs. General Wireless Limited, of 21 Garrick Street, W.C.2, is actually a product of Messrs. R.M. Radio, Ltd., whose Offices are at the same address.

Secret Wireless.

Stated to have invented a system of private wireless communication, Dr. John Hayes Hammond, Junr., recently made some interesting observations to a Reuter correspondent.

Dr. Hammond claims firstly to have solved the problem of multiplex transmission, a concert and lecture having been both transmitted simultaneously from the same aerial, on the same wavelength and picked up separately on the same receiving aerial.

The system also provides an escape from jamming. In addition privacy of communication is obtained, for it appears that the waves transmitted are virtually immune from interception by unauthorised stations. As to the means by which these results are obtained, the inventor explained that his method was to produce a secondary modulation in the radiated waves, and thus to form a characteristic wave that would yield only intelligible signals—either telegraphic or telephonic—to a receiver acquainted with its characteristic and having the necessary apparatus to detect it. At the same time, something is taken away from the ordinary wave that has to be reinstated at the receiving station before readable signals can be obtained, and it is necessary by prearrangement for the receiving station to know exactly what factor to use in order to rectify the wave.

Amateur Work in the Summer.

In delivering the weekly broadcast talk from **2 LO** on behalf of the Radio Society of Great Britain on June 26th, Mr. R. J. Hibberd advocated useful research work during the summer months.

"Look at the gardens on each side of the railway as you travel by train and you will observe all sorts and types of aerials" said Mr. Hibberd. "Some are artistic and businesslike in their design and construction; but the majority cannot be said to come under this category. Personally, I feel that the time has come when we should be in a position to dispense with or reduce to a minimum of size our aerial systems, without the compensating use of high powered receiving apparatus. I am well aware that reflex or super-regenerative circuits partly solve this problem, but the broadcaster who eventually benefits by any radio discovery does not wish his or her patience tried with such circuits as these.

"It is up to the amateur to find the way out and now is the time. Secretaries, get your club members together, prepare your plans and decide upon a definite line of research, and have a field day during one of the summer week ends. It makes a pleasant change from the old club room, strengthens the corporate life of the club and what is more important, accomplishes some useful research work."

Tottenham Wireless Society.*

A discussion on "Crystals" was opened on Wednesday, July 2nd, by Messrs. Holness and Vickery.

Mr. Holness mentioned some of the theories put forward to account for the rectifying properties of crystals, and also of the use of crystals for the generation of oscillations. Mr. Vickery spoke of various natural and proprietary crystals.

The position of the crystal in reflex circuits was discussed, as were many other interesting points.

Hon. Sec., A. G. Tucker 42 Drayton Road, Tottenham, N.17.

The Hornsey and District Wireless Society.*

On June 23rd, Mr. G. J. Westgate lectured on the subject of "Electro-Magnetic Waves." A survey was made of the complete range of known electromagnetic radiations, from alternating currents of a few periods per second frequency, down through wireless radiations, heat, light and X-rays, to the shortest radium rays with frequencies of millions per second. The various properties of each type of radiation were discussed and compared, diagrams being made in most cases to illustrate the methods of propagation and detection. Apparatus shown to demonstrate certain types of radiation and their properties included a small X-ray plant running from a portable battery of 36 volts and giving 10-15 milliamperes through a hot-cathode tube at 70 kilovolts.

A weird effect was produced by projecting a beam of ultra-violet radiation from which the visible light had been filtered on to a black card coated with "vaseline," which glowed a brilliant blue in the dark under the radiation. The generation of X-rays was then demonstrated, illustrating certain properties such as the increase of penetration with decrease of wavelength.

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

Wireless and Experimental Association.

At a meeting of the Association held at the Camberwell Central Library on Wednesday, June 25th, the following resolution was agreed to and carried *nem. con.*:—

"That this meeting begs respectfully but emphatically to express its profound disappointment at the recent restrictions upon the Amateur Transmitter promulgated by the Postmaster-General. The amateur research worker in the wireless field has again shown his superiority in holding communication with his American confrères in spite of the meagre allowance of aerial, wavelength and electrical power allowed him to experiment with, and this meeting is strongly of opinion that the new restrictions are only imposed lest the amateur should make further advances in the science. This Association also fails to see why the amateur should reduce his wireless voice to a whisper lest our Continental or American confrères should overhear their conversation and begs the Postmaster-General not to press these onerous restrictions."

The West London Wireless and Experimental Association.*

The Association has been very active during the past month.

On June 12th Mr. F. E. Studt gave an absorbingly interesting lecture and demonstration on "A Crystal Set for Various Measurement Purposes." This was an appropriate subject, following as it did a lecture on crystals, which had been previously given by Mr. Hinderlick. On Sunday, June 22nd, about 20 members attended the field day arranged by the W.M.A.A.S., assisting to man the station pitched at Gerrards Cross, where a most enjoyable day's experimenting was carried out amidst beautiful surroundings.

There will be no more meetings at headquarters after July 10th until September, as the Polytechnic will be closed down, but it is hoped to hold some field days and rambles. Full information respecting membership of the Association will be gladly sent if intending members will write to the Secretary, Horace W. Cotton, 19 Bushey Road, Hayes, Middlesex.

The Hampstead and St. Pancras Radio Society.*

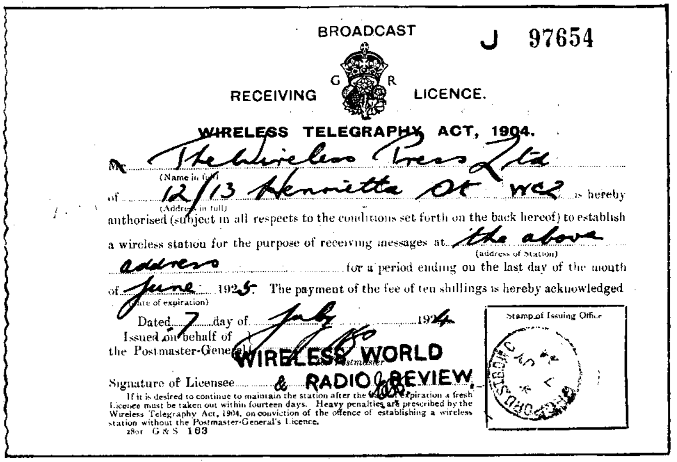
A special general meeting was held on June 5th. After the Secretary had announced that arrangements had been made for a visit to **2 LO**, it was proposed that outings should be arranged in conjunction with other societies in order to test portable transmitting and receiving gear. The committee was asked to make the necessary arrangements and the date of July 19th was fixed provisionally.

It was then proposed that, "Hampstead," should be added to the name of the Society. After this was passed the chairman announced that it had been suggested that it was desirable to have permanent headquarters with a workshop, a club transmitter and receiver, and testing instruments for the use of members. After the measure had been formally proposed, seconded and carried, the committee were instructed to proceed with the selection of suitable premises.

Hon. Sec., R. M. Atkins, 7 Eton Villas, Haverstock Hill, N.W.3.

North Middlesex Wireless Club.*

The much discussed question of whether a high tension battery is necessary in valve circuits was the subject of an interesting paper given by Mr. F. C. March, on June 25th.


BROADCAST J 97654
G R
RECEIVING LICENCE.
WIRELESS TELEGRAPHY ACT, 1904.
Mr The Wireless Press Ltd (Name in full)
of 12/13 Henrietta St WC2 (Address in full) is hereby authorised (subject in all respects to the conditions set forth on the back hereof) to establish a wireless station for the purpose of receiving messages at the above address (address of Station) for a period ending on the last day of the month of June 1925 (Date of expiration) The payment of the fee of ten shillings is hereby acknowledged
Dated 7 day of July 1924
Issued on behalf of the Postmaster-General ... Postmaster
Signature of Licensee WIRELESS WORLD & RADIO REVIEW
Stamp of Issuing Office
If it is desired to continue to maintain the station after the date of expiration a fresh Licence must be taken out within fourteen days. Heavy penalties are prescribed by the Wireless Telegraphy Act, 1904, on conviction of the offence of establishing a wireless station without the Postmaster-General's Licence.
28or G & S 163

The new 10s. broadcasting licence, which supercedes the earlier broadcasting, constructor's and interim licences.

Mr. March began by giving a short account of the theory of the action of the 3-electrode valve, showing the necessity of maintaining the anode at a positive potential with regard to at least a part of the filament. He then went on to describe some of the attempts that have been made to obtain that potential without the use of a separate high tension battery, some circuits using an ordinary valve, others taking advantage of the second grid in a 4-electrode valve.

The lecturer demonstrated that high-tension-less valve circuits are no new thing, having received the attention of many of our foremost experimenters.

A discussion which followed seemed to bring out the fact that all such attempts are in the nature of a compromise, and whatever success may attend them would be intensified by the use of a high tension battery.

Mr. L. C. Holton then described a short wave tuning unit which it was proposed to acquire for use with the Club's receiving panel. Mr. Holton spoke in detail of the advantages of the particular design of instrument under consideration, and subsequently the members present unanimously decided to subscribe to the cost of the materials, Mr. Chapple having kindly undertaken to act as "instrument maker."

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

Forthcoming Events.

WEDNESDAY, JULY 16th.

Golders Green Radio Society. Lecture: "Experiments in Transmission and Reception on a Train" By Mr. Maurice Child.

THURSDAY, JULY 17th.

Hackney and District Radio Society. Lecture: "Crystal Set Construction." By Mr. Toye.

SATURDAY, JULY 19th.

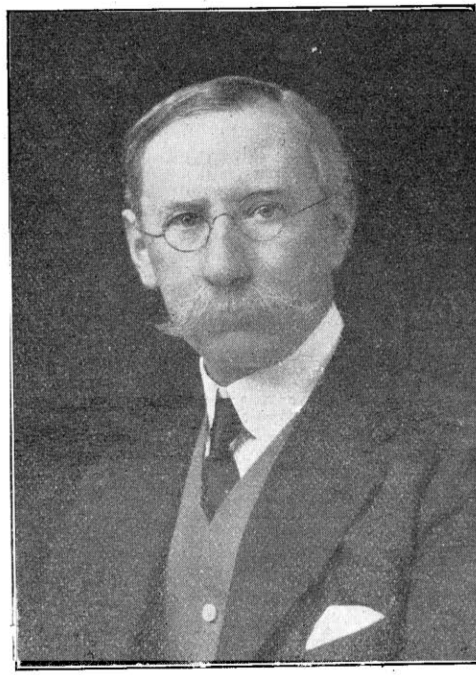
Hampstead and St. Pancras Radio Society. Field Day in Hendon district Testing with portable sets

SOLAR ENERGY

A WIRELESS PROBLEM OF SURPASSING INTEREST

By ALAN A. CAMPBELL SWINTON, F.R.S.

Weekly Talk of the Radio Society of Great Britain, broadcast from **2 LO** *on Thursday, July 10th.*



Mr. Alan A. Campbell Swinton, F.R.S.

AT a time when the first world power conference is meeting at Wembley and discussing various points connected with the generation and utilisation of power, it may not be out of place to point out that nearly all the power that we use upon this earth comes to us from the sun, being transmitted by means of wireless waves in the ether, which are analogous to the electro-magnetic waves used in wireless telegraphy though very much shorter as regards wavelength.

The amount of energy radiated continuously into space by the sun is prodigious, being some 9,000 horse-power per square foot of the sun's surface, and as the diameter of the sun is 865,000 miles, there are a great many square feet. Our earth, of course, only intercepts a minute modicum of what the sun sends out, but even so it is by no means an insignificant amount, as even in the climate and the position of England, and after allowing for the oblique angle at which the waves strike the earth in this latitude, and for absorption by the atmosphere and the clouds, the average solar energy received per acre of the earth's surface in our own country during the hours of daylight exceeds 1,000 horse-power.

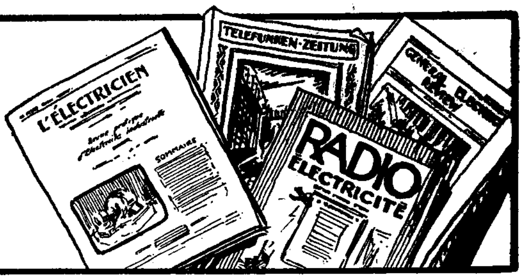
If, then, some method could only be devised for efficiently converting this solar energy into a form in which it could be readily applied for motive power and other purposes, the gain would be enormous, for in many cases sufficient energy to run all the machinery in a factory throughout the working day could be collected from an area not greater than that subtended by the said factory's roof.

Attempts to use solar energy to operate steam or other heat engines have been made in Egypt not many years ago, but have led to no commercial success, the efficiency of conversion being necessarily very low in such cases where anything of the nature of a heat engine is employed. What is wanted is some more direct and efficient method of converting the received radiation into electric currents utilisable for producing motive power without allowing the radiation to turn itself into heat at all.

With our crystal and other detectors we now do this every day in wireless telegraphy reception with very fair efficiency, but in this case the electro-magnetic waves employed have a wavelength of hundreds or thousands of metres, whereas in the case of solar radiation the wavelength is only a minute fraction of a millimetre. This, however, is only a question of degree, and though we at present know of no solution of the problem, it must not be supposed that it is a problem theoretically impossible of solution such as that of rendering available for motive power purposes the general stock of heat energy at uniform temperature. In other words, what is suggested does not appear to run counter to any thermodynamical law such as would preclude full advantage being taken of the great efficiency that is rendered possible by the enormous temperature of the sun.

Here then is a wireless problem of surpassing interest and of supreme importance to the race. If the radiant energy received on the earth from the sun could only be efficiently harnessed, the problem of the exhaustion of coal, oil and other fuel would be solved once and for all. The solar energy continually being received on the earth is ample for all human needs. There does not seem to be any theoretical reason why it should not be utilised, the only necessity is for someone to find out the way of doing so. No doubt the problem is a difficult one, but so are all problems until they are solved. Anyway, we live in an age of marvels, and of the incredulous one may ask what would have been said as to the possibility of modern wireless methods only a few years ago.

PATENTS AND ABSTRACTS



Means for the Production or Reproduction of Sound.

This invention refers to sound producing or reproducing apparatus,* of the kind in which a member rubbing upon a relatively moving surface is set into vibration by the

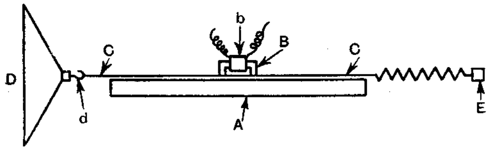


Fig. 1.

alternate gripping and releasing of the surface in contact under variable electro-magnetic attraction, the rubbing member being connected to a transmitter or sound emitter, such as a diaphragm.

Referring to Fig. 1, which shows one form of the arrangement to carry out this invention, A is a rotating disc, which may be of steel with a polished surface. B is an electro-magnet, the coil *b* being in a circuit which carries, for example, speech currents. C is the tension member, the portion immediately below the electro-magnet forming a rubbing surface. C is connected to the conical diaphragm D at the hook *d*, and the other end of C is connected through a spring to a support, E. The pressure between the two surfaces in contact with one another will vary with any variation in current passing through the receiving coil B, and if speech currents are received, the variable grip caused by the electro-magnetic action will cause a mechanical vibration of the diaphragm which will reproduce on a greatly magnified scale the variations in the control current.

* British Patent No. 214,568, by S. G. Brown.

Filament Resistances.

In filament resistances, potentiometers, and similar instruments, wire helices are commonly employed, and the helix is often supported on the periphery of an insulating base, which is formed of moulded insulating material, with a groove to receive the helix. Difficulty is experienced in forming a base with such a groove without resort to complicated dies and expensive methods. With the object of removing these disadvantages, it is proposed to construct a variable resistance, for example, as sketched in Fig. 2,† in which a peripheral groove to receive and hold the helical resistance wire

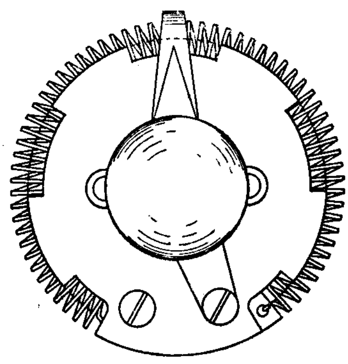


Fig. 2.

is formed. As will be seen from the figure, a number of projections are arranged on the surface of the base, which serve to keep the wire in place.

† British Patent No. 215,096, by Igranic Electric Company.

CORRESPONDENCE

Dry Batteries *v.* Accumulators.

To he Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with great interest the report on the performance of the 0·06 type of valves in the June 25th issue of *The Wireless World and Radio Review.* I started experimenting with this type of valve some eight months ago, at which time practically no published data concerning their characteristics were available. I entirely agree with all the conclusions arrived at in the report referred to except for the statement that accumulators should be used if possible in preference to dry batteries. With this I entirely disagree. During the last six months I have had under close observation two sets, one a 2-valve and the other a 3-valve receiver, and both these sets are run off two 4½-volt dry batteries in parallel. These batteries are of a well-known make, and cost 7s. 6d. each, each set thus being equipped with fifteen shillingsworth of L.T. These receivers are both in continual use, but in neither case is there the slightest sign of deterioration. The batteries are remarkably constant in action, no readjustment of the rheostats being necessary even when the set is given a non-stop run of two or three hours.

In the instances I am citing, suppose the batteries were to conk out to-morrow. Then we should have had six months' L.T. supply for 15s., which I venture to suggest will stand comparison with any accumulator running under the same conditions. It must also be remembered that this 15s. represents the *total* outlay, and not merely the upkeep cost. As a matter of fact, as I have already stated, neither of the batteries shows any signs of running out, and they are still perfectly constant in action.

A point often overlooked in connection with accumulators is that the voltage per cell may never fall as low as 1·8 or even 1·85 when a very low discharge is taken. If an accumulator has been in the habit of running three bright-emitters consuming say 2 amps. altogether, it is quite safe to rely on the "1·85 volts per cell" rule to find when the battery is run down, but if the same accumulator is now made to feed 0·06 type valves the discharge is so slow that when the battery is fully run down (as far as useful output is concerned) it may still be giving 1·9 volts per cell on load, and if the owner continues to take a load until the voltage drops to 1·85, he will completely ruin the battery.

When I started using the 0·06 valves I was very prejudiced against the dry cell batteries, but after six months' experience I am quite satisfied that, with normal care, a dry battery (or several in parallel, according to the number of valves) is in every way equal to an accumulator, and very much less trouble.

J. F. STANLEY.

Highgate, London, N.6.

"Colloid" Detectors.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—With reference to the article on "Colloid" detectors in the June 25th number of *The Wireless World and Radio Review*, it may be of interest to record the results of some preliminary experiments carried out by the writer on this type of detector during the past six months.

Suspensoids have in every case been used, and the only results worth recording have been obtained with colloidal arsenic and silver respectively.

The detector consisted of a glass U tube, approximately ¼ in. bore and limbs 1½ ins. apart, and each approximately 2½ ins. long. Silver electrodes, approximately 22 S.W.G. were fitted passing through cork stoppers.

The first experiments were made with colloidal arsenic, with and without a local battery. As stated by you in your footnotes to the above article, electrolysis appears to play a very important part in the results obtained, and I can confirm the necessity for frequently reversing the current flow from the local battery. I have, upon one occasion received signals, very faintly, without any local battery but cannot offer any explanation. Generally the best results have been obtained when using colloidal silver, and silver wire electrodes.

Attempts to obtain a "characteristic" curve by applying various potentials and measuring current flow, have hitherto proved unsuccessful.

The receiver in which these detectors have been used is of the simplest character, consisting of a variometer and fixed series condensers, connections being arranged as for crystal working.

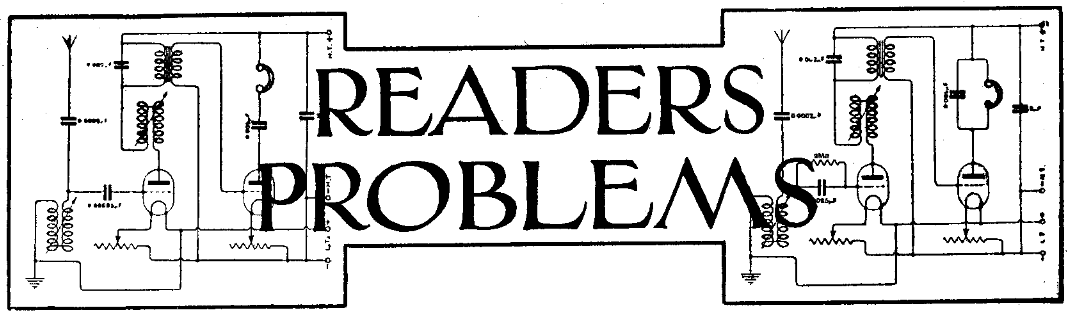
Reception so far has been unsatisfactory, but in view of the importance attached to the cleaning of the glass container, mentioned in the article referred to, it is highly probable that this has been the cause of the poor results obtained as no special precautions were taken in this direction. Further experiments will be made as a result of reading the notes now published, and if improvements result I will again venture to communicate with you.

I have also read with much interest, in the same issue of *The Wireless World and Radio Review*, the correspondence of Messrs. Strachan & Miller on "Oscillatory Crystals."

The Japanese experiments referred to were utilised in the T.Y.K. system of wireless telephony some years ago, and the writer in 1913 utilised the principle as a local oscillator for heterodyne reception of the Poulsen stations, in place of the tikker hitherto in use. The great difficulty is, however, in keeping constant the amplitude of the oscillations generated, as mentioned by Mr. Leslie Miller. Silicon and iron or copper pyrites were found to give the most satisfactory results, a P.D. of 40 volts being used, although voltages as low as 12 proved suitable for use when only feeble local oscillations were required.

GEO. SMITH.

Billericay, Essex.



READERS PROBLEMS

1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for 1/-, or 3/6 for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.

" *R.M.*" (*Coldstream*) **describes a receiver which gives distorted reception of speech, and asks what can be done to improve the quality.**

From your description of the receiver it would appear that you have no grid bias batteries connected to the note magnifying valves. It is necessary to connect cells in the grid circuits of the note magnifiers when considerable power is being handled. These cells should be connected with the negative terminal to the I.S. terminal of the transformer if the O.S. terminal is joined to the grid, while the positive terminal of the grid battery should be connected to —L.T. The number of cells required will depend upon the anode voltage used and the type of valve, and should be found by experiment.

" *J.T.D.*" (*Dublin*) **asks by what means it would be possible to amplify the speech from an ordinary telephone circuit.**

It is not permissible to make alterations to the wiring of a public telephone installation, and the only method open to you would be to place a microphone against the telephone earpiece and to amplify the microphone currents by means of a one- or two-valve amplifier.

" *A.W.S.*" (*Bury*) **asks to what cause a hissing noise in the telephones may be ascribed. He has made several tests, but has failed to locate the fault.**

The noise may be due to atmospheric disturbances or to faults in the receiver itself. We note that you have tried the effect of removing the aerial, and that this produces no change in the amount of disturbance. The source is therefore located in some part of the apparatus. As you have used different receivers and also changed the H.T. and L.T. batteries, it seems likely that the insulation of the windings of your telephones is at fault. It would appear that the same pair of telephones have been used in all your tests, and if these are at fault, it would account for the persistence of the noise. Any other components common to all the tests should receive particular attention. It might be mentioned in passing that it is not an uncommon experience to find that the valves themselves are giving rise to noises.

" *J.C.*" (*Harrogate*) **submits a diagram of a two-valve receiver (H.F. and detector) and asks why it will not function properly.**

The wiring of the circuit is correct, but it is possible that the fault lies in the connections of the H.F. plug-in transformer. The valve holder into which the transformer is plugged should be wired to correspond with the wiring of the four pins on the transformer.

" *A.M.R.*" (*Guildford*) **sends a detailed description of his 4-valve receiver, and asks in what way the design can be altered in order to improve quality.**

We are of opinion that the solution of your difficulty lies in the use of a power valve and a low ratio transformer for the last stage of L.F. amplification. A transformer having a ratio of 1 : 2 or 1 : 3 will be suitable, and several types of well-known make are now available. As you are using an " R " type valve in the first L.F. stage, a power valve of the D.E.5 or B.4 type will be satisfactory when used in the last stage. The normal grid bias of both valves should be carefully adjusted, and resistances of the order of 0·5 megohms may with advantage be connected across the secondary windings of each transformer.

"*B.J.S.*" (*Buxton*) **asks if it would be possible to control reaction by connecting a continuously variable resistance in parallel with the reaction coil.**

The degree of reaction coupling could be controlled by means of a variable resistance, but this method is not recommended, as it is doubtful if variable resistances are available, in which the resistance could be varied with sufficient precision.

"*H.R.W.*" (*Bridgewater*) **asks for a diagram showing how to add a note magnifier to the portable receiver described on page 40 of the issue of April 9th, 1924.**

A convenient method is indicated in Fig. 1. If you substitute the telephone jack specified in the original article by one of the type shown in the sketch, and if you employ a single filament jack in the plate circuit of the amplifying valve, you will obtain a very efficient method of switching off one or both valves. When the telephone plug is removed from the set, both valves will be automatically switched off. It will be necessary to use a separate H.T. battery for the L.F. valve.

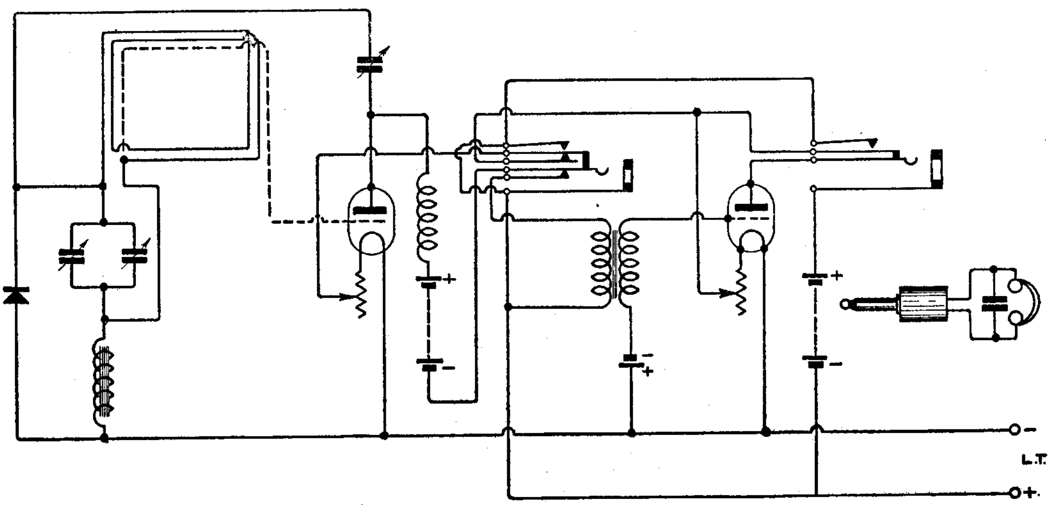


Fig. 1. "H.R.W." (Bridgewater). The method of adding a note magnifier to the portable receiver described in the issue of April 9th, 1924.

"*A.E.M.*" (*Kent*) **asks what advantage is to be gained by the use of a separate heterodyne when receiving C.W. signals.**

Continuous wave signals may be received either by making the receiver itself oscillate at a slightly different wavelength from that of the incoming signal, or by coupling a separate oscillator to one of the tuned circuits. The disadvantage of the "autodyne" method, in which the receiver itself is made to oscillate, is that in order to obtain oscillations of a different frequency from those of a signal, it is necessary to detune the receiver, with a consequent reduction in signal strength. With a separate heterodyne, the receiver itself may be tuned exactly to the wavelength of the signal, and the pitch of the beat note may be varied by altering the tuning of the heterodyne oscillator.

"*L.J.P.*" (*Dublin*) **asks if low frequency oscillation in a receiver is likely to cause interference with other receivers in the neighbourhood.**

The low frequency oscillations which often occur in the stages of note magnification in a receiver are not likely to cause interference with other stations. If the high frequency portions of the receiver are not oscillating at a frequency slightly different from that of the carrier wave of the broadcasting station, and if these oscillations are in any way transferred to the aerial, interference with neighbouring receivers will be caused through the production of a beat note of audible frequency. When receiving broadcast transmissions, the H.F. and detector valves should never be allowed to remain in a state of self-oscillation, and unless special circuits are arranged to prevent excitation of the aerial, a separate heterodyne oscillator very loosely coupled to the receiver should be used when receiving C.W. signals.

"*SQUARE LAW*" (*Peterborough*) **wishes to modify the shape of the moving vanes of a variable condenser, in order that the capacity may vary as the square of the condenser dial reading.**

It would not be possible to give an adequate treatment of the method of calculating the curvature of square law condenser plates in the short space at our disposal, as the method is somewhat involved. We would refer you to "The Calculation and Measurement of Inductance and Capacity," by W. H. Nottage, which gives an outline of the method used by Duddell to obtain the correct curvature for the moving vanes of a square law condenser.

The WIRELESS WORLD AND RADIO REVIEW

WHAT TO AIM FOR IN WIRELESS RECEPTION

By the EDITOR.

NO skill or ability is necessary in order that average results may be obtained in the reception of telephony from the local broadcasting station. Those who have passed the stage of obtaining results of some sort from their apparatus can turn their attention in three possible directions; firstly, to see how loud the signals can be reproduced; secondly, to find out what are the most distant stations which can be heard, or thirdly, they may devote their energies to improvement in the quality of their reception. There is, we believe, at the present time far too much attention paid to the endeavour to obtain great amplification and exceedingly loud signals which, in nearly all cases, results in a most unhappy mangling of the wave form of the speech or music which reaches the aerial of the receiver.

Again, in the reception of telephony, although it is of interest to endeavour to obtain telephony signals from very great distances, this often results in only poor results being received, whilst it is likely that when every effort is being made to obtain the greatest amplification with a most critical reaction coupling adjustment, the efforts of the amateur may produce a very poor result indeed, coupled with considerable annoyance to listeners in the neighbourhood.

We believe that the very first aim should be to tackle the problem of quality of reproduction and there is no doubt that practical experiment in this direction would do a great deal to increase the interest of the public in wireless, whilst at the same time it provides probably the most instructive channel for experimental research. The 1,600 metre experimental station of the British Broadcasting Company provides new opportunities for tackling the problem of improvement in quality of reception and we think it would be interesting to make comparative tests of quality of reception of this and the present short wave broadcasting stations.

If the amateur desires to test the range of his apparatus, the best opportunities are provided by the telegraphy stations at great distances, which can be heard on almost any wavelength at any time. Many of those who have only taken up wireless recently have not interested themselves in transmissions other than telephony for the reason that they have not taken the trouble to learn the morse code. After all, the morse code is not difficult to master and a knowledge of it will add enormously to the interest which can be got from listening in and especially is this the case where amateur transmitting stations in the United States and on the Continent are picked up. Nearly all of the transmissions which cover long distances are of course conducted by telegraphy and not telephony. As soon as the autumn arrives it is likely that there will be great activity between amateurs in communication over long distances, and for those who wish to take part in these, it is essential that the morse code should be learned. It is not by any means necessary to operate a transmitter in order to have an interest in two-way communication between amateurs say in this country and America. Such conversations conducted in morse can be listened-in to with just as much pleasure by those who are not able to join actually in the transmissions. Those who care to apply themselves to learning the morse code now would find that by the time the longer evenings arrive and transatlantic communication between amateurs starts again in earnest, they would be in a position to take part in what is probably the most fascinating branch of amateur wireless.

MORE ABOUT CRYSTAL RECEPTION.

The conditions necessary to produce maximum signal strength in a crystal receiving set are here discussed.

By F. M. COLEBROOK, B.Sc.

IN view of the interest which has been shown in the article on crystal reception published in *The Wireless World and Radio Review* of April 30th, it seems desirable to consider in somewhat fuller detail the theoretical basis of the measurements described and of the results obtained.

In the first place it will be well to enquire as to the real nature of the process of tuning an aerial to any given frequency. The writer attempted an analysis of this question on purely mathematical lines, and succeeded in obtaining an expression for the current at the base of an aerial in terms of the constants of the aerial and of the tuning circuit. The expression proved, however, to be quite unmanageably complicated and cumbersome. In default of this exact analysis, the following purely empirical account will be found to be in agreement with fact and will enable certain useful deductions to be made.

In order to tune a given aerial to a given frequency it is necessary to insert between the aerial and earth terminals a certain definite effective reactance. The magnitude of this effective reactance, which we will call X, will be found to be independent of the manner in which it is introduced, whether this be by pure inductance, an inductance in series or in parallel with a condenser, or by any combination of these. In addition it will be found that over the range of values likely to occur in practice the effective reactance required to tune the aerial to any given frequency is independent of the magnitude of the resistance associated with it. Further, at the same frequency, it will be found that the part of the aerial external to the aerial and earth terminals appears to have a definite effective resistance, R, the magnitude of which can be measured in the usual way by inserting known resistances and measuring their effect on the magnitude of the received current.

As far as the tuning conditions are concerned, therefore, it appears that the part of the aerial external to the aerial and earth terminals can be considered to be replaced by a simple circuit consisting of a source of high frequency e.m.f. of the given frequency in series with an effective resistance

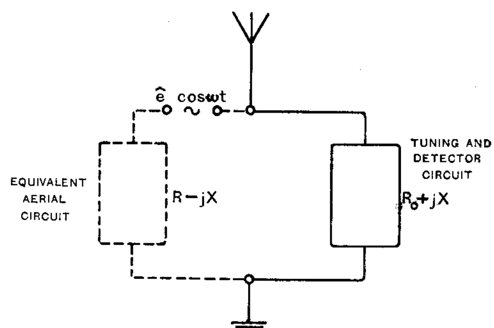


Fig. 1. A simple circuit equivalent to a broadcast receiving aerial.

R and an effective reactance X. This imaginary circuit, illustrated in Fig. 1, can be said to be equivalent to the actual aerial in the sense that it has the same effective resistance, and that an effective reactance X is required to tune it to resonance with the frequency of the e.m.f. The actual magnitudes of X and R will of course depend on the constants of the aerial and the frequency of the transmission. In the case of a standard P.O. aerial and the **2 LO** frequency R may be anything from 5 to 50 ohms, while X will usually be in the neighbourhood of 400 to 600 ohms, negative.

Coming now to the tuning circuit itself, this can in all cases be represented as an impedance of which the effective reactance must be X, in order to satisfy the tuning condition, and of which the effective resistance can be represented by a term R_0. This latter term must be understood as including both the wire resistance and

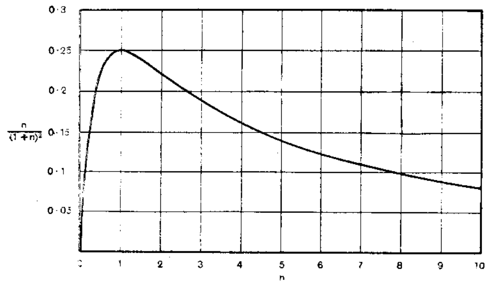


Fig. 2. Curve showing the relation between the efficiency of the aerial-detector circuit combination and the effective resistance of the detector circuit.

dielectric losses of the tuning circuit proper, together with the load effect of the detector. If the latter is a valve, its load effect will be comparatively small. By the proper use of reaction, it can even be made negative, thus compensating in part for the wire resistance and other losses in the aerial and tuning circuit. If, on the other hand, the detector is some form of crystal rectifier, the operation of which necessarily involves the consumption of power, then its load effect will be a very important factor. In all such cases the amount of sound energy emitted by the telephones is a certain definite proportion (depending on the efficiency of the telephone-detector combination) of the total energy consumed in the tuning circuit. The most efficient reception condition will therefore be that in which the latter is a maximum.

This condition can easily be deduced from the above representation in terms of a simple equivalent circuit. The current flowing through the tuning impedance is given in vector notation by

$$\mathbf{I} = \mathbf{E}/(R - jX + R_0 + jX$$

in which $\mathbf{E}$ is the vector representing the e.m.f. The tuning of the aerial is reflected in the fact that the reactive components of the equivalent aerial circuit and the tuning circuit are equal in magnitude and opposite in sign, so that the current is determined by the resistance factors alone, *i.e.*:

$$\mathbf{I} = \mathbf{E}/(R + R_0)$$

Since the vectors $\mathbf{I}$ and $\mathbf{E}$ are in phase we can substitute the R.M.S. values of these quantities, giving

$$I = E/(R + R_0)$$

The power consumed in the tuning circuit is given by I^2R_0, and, denoting this by $\mathbf{P}$ we have

$$P = I^2R_0 = E^2R_0/(R + R_0)^2$$

The important factor in this expression is the ratio of R_0 to R. Calling this n we have:

$$P = \frac{E^2R_0}{R^2\,(1 + R_0/R)^2}$$

$$= \frac{n}{(1+n)^2}\,\frac{E^2}{R}$$

The optimum condition is clearly determined by the variation with n of the factor $n/(1+n)^2$. It should be noted that this function is a perfectly general one, independent of any particular values of R_0 and R, and depending only on the ratio between them. It is, moreover, applicable to any case in which power is drawn from any source of electromotive-force with a definite internal resistance. The fact that the reception of wireless signals on an aerial by means of a power consuming detector is essentially similar to all such cases has probably not been very generally realised hitherto.

The curve showing the variation of $n/(1+n)^2$ with n is given in Fig. 2. It is seen to rise steeply to a maximum value of 0·25 when $n = 1$, after which point it falls more gradually as n increases.

The condition for maximum efficiency is seen to be $n = 1$, *i.e.*, $R_0 = R$. In other words, the maximum energy is dissipated in the tuning circuit when its effective resistance is equal to that of the aerial.

In order to relate this to an actual case we will consider the representative circuit illustrated in Fig. 3, in which the aerial is tuned by means of a pure inductance L of comparatively low resistance, the whole of this inductance being shunted by the detector circuit of which the effective high-frequency resistance is S. It can be shown that at a frequency $\omega/2\pi$, the effective reactance of the combination of tuning coil and detector circuit will be

$$\omega L\{S^2/(S^2+\omega^2L^2)\},$$

and that its effective resistance is

$$S\{\omega^2L^2/(S^2+\omega^2L^2)\}.$$

To bring these expressions down to concrete figures we will assume the following values, the reasonableness of which has been confirmed by the writer by actual measurement: X, 500 ohms; R, 30 ohms; S, 2,000 ohms. As a convenient approximation for the case of **2 LO** we will take $\omega = 5 \times 10^6$.

The tuning condition gives us

$$\omega L\left(\frac{S^2}{S^2+\omega^2L^2}\right) = 500$$

i.e.,

$$\frac{5 \times 10^6 \times L \times 4 \times 10^6}{4 \times 10^6 + 25 \times 10^{12}L^2} = 500$$

This can be simplified by measuring L in microhenries, giving

$$20 \times 10^6 L = 500\ (4 \times 10^6 + 25L^2)$$

This is a simple quadratic equation for L, and the relevant solution will be found to be

$$L = 105 \text{ microhenries.}$$

Knowing this value for L, we can now calculate the effective resistance R_0, for we have :—

$$\begin{aligned} \omega L &= 25 \times 105^2 \\ &= 0{\cdot}275 \times 10^6 \\ S^2+\omega^2L^2 &= 4{\cdot}275 \times 10^6 \end{aligned}$$

Therefore

$$\begin{aligned} R_0 &= \frac{0{\cdot}275}{4{\cdot}275} \times 2000 \\ &= 130 \text{ ohms approx.} \end{aligned}$$

This value for R_0 is very much in excess of the optimum value of 30 ohms. The corresponding value of n is 4·3, for which the corresponding efficiency factor is only 0·155, as compared with the possible maximum value 0·25, *i.e.*, only 60 per cent. of what it might be.

It is clear from the equations that the larger the value of the tuning reactance required, the larger will be the load introduced by the shunt detector. Thus, keeping the same values for R and S, but increasing X to 600 ohms (corresponding to an aerial somewhat smaller than that considered in the preceding example) it will be found that the equations give as solutions :—

$$\begin{aligned} L &= 135 \text{ microhenries.} \\ R &= 204 \text{ ohms.} \end{aligned}$$

For this value of R_0, $n = 6{\cdot}8$, giving an efficiency factor of 0·11, *i.e.*, only 44 per cent. of the possible maximum.

The remedy for these inefficient conditions is that already described in the previous article on the subject, namely, to shunt the detector circuit across a part only of the tuning reactance, the most favourable condition being found by trial. That this will decrease the load effect of the detector is clear from the expression given for R, *i.e.*,

$$R_0 = \left(\frac{\omega^2L^2}{S^2+\omega^2L^2}\right)S$$

which shows that a decrease in L will result in a decrease in R.

It should be pointed out that the lower the effective resistance of the aerial and earthing system, the more critical will be the selection of the correct tapping point for the detector circuit, and the smaller the proportion of the total reactance corresponding to the optimum condition.

Since the measurements recorded in the previous article were made, the aerial used for the reception has been considerably improved, and its resistance brought down to about 15 ohms. This improvement has resulted in a considerable change in the optimum detector conditions. The curves of Fig. 4 are included to illustrate this effect. Curve No. 1 shows the variation of the rectified current through the detector as the tapping point is moved up from the earthed to the aerial end of the tuning coil of 20 turns. Curve No. 2 of the same Fig. shows the corresponding result when

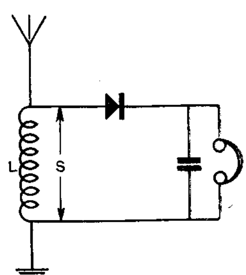


Fig. 3. A typical crystal receiving circuit.

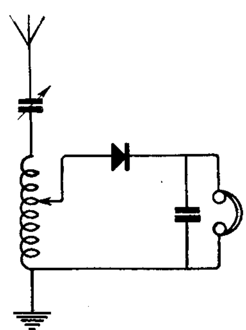


Fig. 5. A series condenser tuning circuit in which the load effect of the detector can be varied.

the aerial resistance had been artificially increased by 30 ohms. It will be seen that the curves give very good qualitative agreement with the above analysis. (It is also interesting to note the general resemblance between the first curve and the efficiency curve of Fig. 2. These two curves will not, of course, be of quite the same shape, since the scale of the former does not correspond to a uniform increase of R_0).

The comparative measurements described in the previous article pointed to the conclusion that the most efficient type of tuning for crystal reception consists of a simple low resistance solenoid with well spaced turns, and provided with two wandering contacts, one for the aerial and one for the detector.

Subsequent measurements carried out under improved conditions have confirmed this result, but have further indicated that the arrangement shown in Fig. 5 is only very slightly less efficient, provided the coil used be of low high-frequency resistance (not more than 5 or 6 ohms) and provided that the variable condenser setting does not fall below about 0·00025 microfarads. This alternative arrangement is easier to manipulate than the pure inductance circuit, and is more exact in its tuning. It is a convenient arrangement for demonstrating another considerable advantage to be obtained from the control of the load effect of the detector, namely, greatly increased selectivity. The curves of Fig. 6 show this very clearly. They represent the variation of the rectified current through the detector with the reading of the tuning condenser. Curve No. 1 corresponds to the optimum detector tapping, and curve No. 2 to the case in which half of the inductance is shunted by the detector circuit. The sharpness of tuning in the optimum case will clearly be a great advantage in districts which are subject to interference from other transmissions.

In a later paper the author proposes to describe a type of coil construction which, without being difficult to make or unduly cumbersome in size, will satisfy the requirements enumerated in this and the preceding article on crystal reception, and which will enable either the pure inductance or the series condenser tuned circuits to be adapted to any aerial up to or less than the standard dimensions.

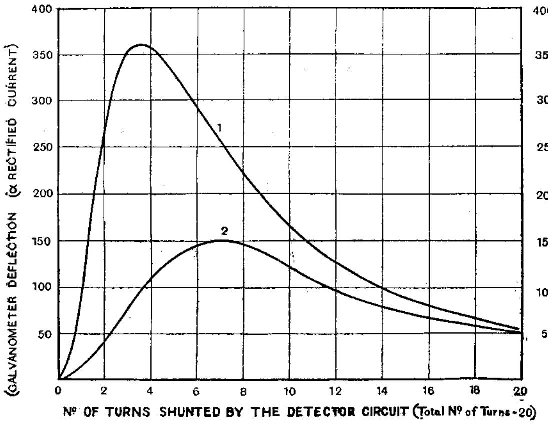


Fig. 4. Curve showing the reduction of the maximum signal intensity when the effective resistance of the aerial is increased.

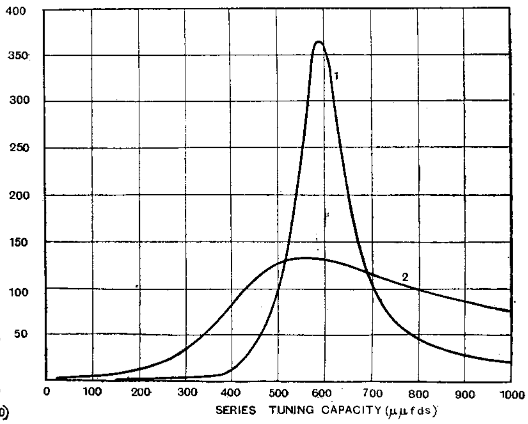


Fig. 6. Curve showing the decrease in intensity and in sharpness of tuning (i.e. selectivity) when the load effect of the detector circuit is increased beyond the optimum value.

A SHORT WAVE VARIABLE INDUCTANCE.

In this article the author suggests a convenient method of producing vernier control of wavelength or tuning on short wavelength ranges. The idea, whilst not of great value on long wavelengths, presents possibilities in short wavelength apparatus.

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

SINCE the inductance of a coil depends on the square of the number of turns per unit length, then the inductance of a coil made like a spring will vary accordingly as the coil is stretched or compressed.

The idea was tried out by winding a coil of springy brass wire and putting it in series with the A.T.I. The arrangement gave much the same results as a "vernier" condenser on 600 metres, which was considered a short wavelength at the time the experiment was first carried out.

It was not found practicable to make the whole A.T.I. in this manner as it would have to be very large and unwieldy, even for 600 metres, so that the arrangement was dropped, except for occasional use in fine tuning.

This method of tuning has recently been retried by the author for wavelengths of 100 metres and below and found successful.

The construction of such a coil can briefly be divided into two parts—the coil itself and the method of extending it.

THE COIL.

The wire for the coil must be springy and of high conductivity, so that phosphor bronze naturally suggests itself. For a coil of any length a heavy gauge of wire is necessary and No. 14 S.W.G. proves very suitable. Thicker wire would be better in some cases, but would be much harder to work, while finer wire would not make rigid coils—assuming the diameter of the coils to be the same in each case.

Several points should be noted before starting to make the coils :—

(1) The diameter of the former on which the coil is to be wound must be less than the final desired diameter of the coil, the amount depending on the gauge of wire used. This is because the coil will unwind a little when made and assume a larger diameter, with consequently fewer turns than originally put on.

(2) The coil must be wound at one operation and with constant tension on the wire while winding, as otherwise it will not expand evenly when extended.

It is advisable to wind on about 25 per cent. more wire than is necessary as the first few turns will not be even enough and should be cut out when the coil is wound.

(3) The following dimensions and turns only apply to 14 gauge wire. (It is obvious that a finer wire will spring out to a larger diameter than a thick wire if both are initially wound on the same former.)

The author has found it very difficult to make a satisfactory coil by hand. If a lathe is not available, it is probably better to try first to get the local garage man to wind the coils.

For a coil of the type illustrated, 1 lb. of 14 gauge phosphor bronze wire will be required and may be obtained from Messrs. Ormiston's, of 79 Clerkenwell Road.

For lathe winding a 2-in. diameter mandrel about 9 ins. long should be mounted in a chuck and a good fat screw carrying two washers screwed in at the chuck end to fix the beginning of the coil.

If the lathe is screw-cutting, some readers may prefer to use the screw-cutting device for feeding on the wire.

The author strongly advises the use of leather gloves when holding the wire in order to save the hands from being cut or blistered.

The wire should be fed on at an angle of, say, 20 degrees in order to get a tight-wound coil. If this is not done, the finished coil will be partly extended.

When the coil has been wound, and preferably left over night to "set," it should be held in the left hand and the wire cut close to the tool holder. The coil will try to unwind itself, and should be allowed to do so slowly, until it has finished, when it may be removed from the mandrel.

It is quite probable that the first coil made will not be successful owing to uneven winding. If this is the case, do not try and use the same wire for a new coil—or the results will certainly not be pleasing—but start afresh with more wire. The test for a good coil is to pull it out and see if the turns are evenly spaced.

When a satisfactory coil has been wound and removed from the mandrel, it should be lacquered and left to dry in a slightly extended position so as to prevent adjacent turns touching and being stuck together with the lacquer.

This lacquering must be done very carefully as it supplies the only insulation between the turns when the coil is closed up.

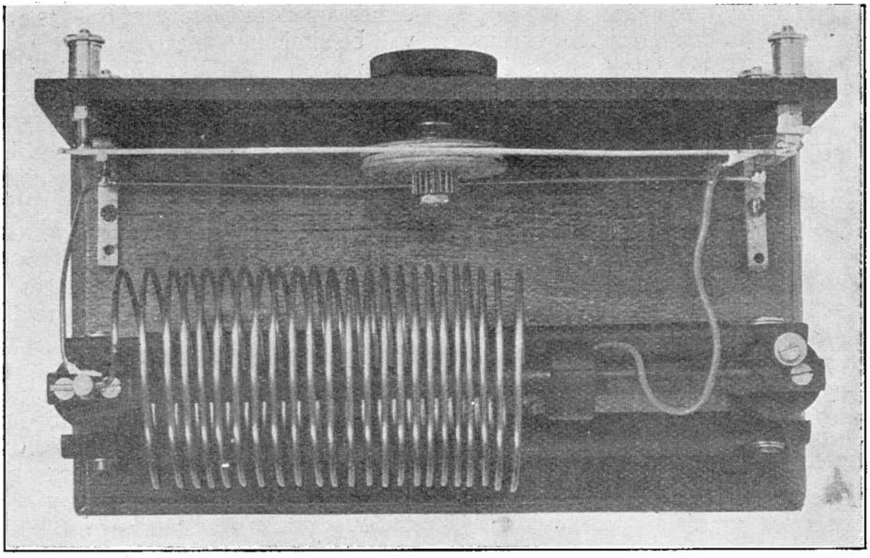
A suitable coil for short wave work consists of 32 turns on the 2-in. mandrel. When finished, the mean diameter should be 2½ ins. and the number of turns reduced to 23 (by expansion and removing the surplus). If less than 20 consecutive turns of the finished coil are evenly spaced it would be as well to make another coil.

COIL EXTENDING MECHANISM.

Several arrangements are possible for extending the coil but the author suggests two which have been found convenient, one being illustrated in the photograph.

One way would be to clamp one end of the coil and fix an ebonite rod to the other with a quick thread on it. To extend the coil the rod would be turned.

The chief drawback to this arrangement is the amount of space required for coil and rod.



An illustration of a variable inductance constructed and mounted in accordance with the ideas presented in this article.

The method used by the author is to fix the moving end of the coil to an ebonite collar sliding on an ebonite bar, and to extend the coil by turning a small drum and thus winding up a cord attached to the collar. A spring washer will suffice at the turning knob to hold the spring in the desired position, whilst the tension of the spring will serve to draw back the cord when the knob is turned so as to close up the turns of the coil.

FOUR-ELECTRODE VALVE RECEIVER.

It will be remembered that this receiver makes use of the four-electrode valve for the provision of efficient dual amplification. In this concluding article final constructional details are given and hints are offered on the operation of the set.

(*Concluded from page* 459 *of previous issue*).

Another item to be made or purchased is the condenser across the telephones to allow of the passage of the high frequency currents in the outer grid circuit. There is a simple and effective way of making condensers of fairly high capacity, where the exact value of the capacity is not important. A piece of lead, copper, or soft brass tube of about No. 20 gauge, and one inch long, is nearly flattened by a smart blow from a hammer. Inside the flattened tube are built up alternate layers of mica and copper foil; the mica being 1½ inches long, and just wide enough to go inside the tube. The copper foil should be rather narrower, as it should not be possible for it to touch the tube. The copper strips should project alternately towards each end of the tube, where they should be soldered together and to preferably short pieces of the same tube, flattened as before. This having been done, the flattened body tube can be finally clinched by further blows of a hammer or by screwing up in a vice, leaving a finished condenser the capacity of which will not have any exactly predetermined value, but which can be relied upon not to alter after it has been completed. The condenser can then be attached to the panel by bolts and nuts, gripping it by notches filed in the sides of the flattened tube.

The only remaining item is the three-coil holder, and this would require such a lot of careful fitting work and special sizes of tools that it is recommended that it should be purchased. The type shown is quite satisfactory, and can be bought for about 4s. and upwards. It is screwed to the side of the box, and holes for the passage of the wires are drilled through its base. Behind these holes the woodwork of the box is drilled out with clearance holes about ½ inch in diameter. The wires to the coil holder should be flexible, with a good class braided rubber covering.

After the various components have been made and fixed in place the wiring can be commenced. It is recommended that the flexible leads should be attached to the panel first, and then all the fixed wiring on the panel should be done before it is put into the box and the flexible wires attached to the coil holder. The wiring should be carried out with No. 18 tinned copper, either square or round section. Its appearance will be similar to that shown in Fig. 1.

As soon as the rigid wiring has been completed, the panel may be screwed into its place on the box, and the flexible leads to the coil holder passed through the sides of the box. They should be connected up temporarily in the first place until the set has been tested, and enough length should be left on each to allow of reversal of the connections if experiment shows them to be the wrong way round for correct reaction. With the exception of finally finishing off these leads, and fixing the bottom of the box, the set is now finished; but if desired name plates may be provided for the terminals on the deck. There are many types on the market. For instance, tabs bearing the desired name may be obtained to grip under the heads of the terminals, or transfer sheets of the more common names may be bought, the titles being transferred directly to the surface of the panel by means of gold size and a free application of cold water in the well-known manner. If this latter course is adopted, care should of course be taken that none of the water gets into the instruments.

The set may now be tested out. Firstly it should work quite efficiently as a three-electrode valve circuit without the use of the plate circuit with its throw back to the inner grid. To test this, no coil should be placed in the third coil holder. The connection of the middle coil holder may then be reversed if necessary, the correct one being, of course, that which allows the set to be brought up to oscillation when the coils are brought near to each other and the set tuned. No difficulty should be experienced in obtaining this result, and the plate circuit may then be introduced by putting in the third coil. If this circuit is all right, and the signals are not too strong, an increase of signal strength will probably be at once observed when the coupling is tightened up and the potentiometer adjusted. If this is not the case the connections of the last coil should be reversed. When the set is working properly it will be found that for each value of the coupling above a certain point, a setting of the potentiometer can be found at which the set goes into oscillation, and that near to this point good results are obtained. The coupling and potentiometer should then be jointly varied until the results are the best obtainable, during which process slight adjustments of the other controls of the set should be made as necessary.

On the aerial on which most of the work was done, which has a capacity slightly above that of an average "P.M.G.," No. 3 of a normal set of concert coils was found best in the aerial circuit, and another No. 3 or No. 4 for the plate, but these figures may vary somewhat under different conditions. The coupling between aerial and outer grid circuit should be quite loose, but that between the outer grid and plate must be fairly tight. Should any difficulty be found in getting sufficiently tight coupling here, the results would probably be improved by introducing a small condenser across the primary of the throw back transformer, but this was not found necessary under the conditions of test.

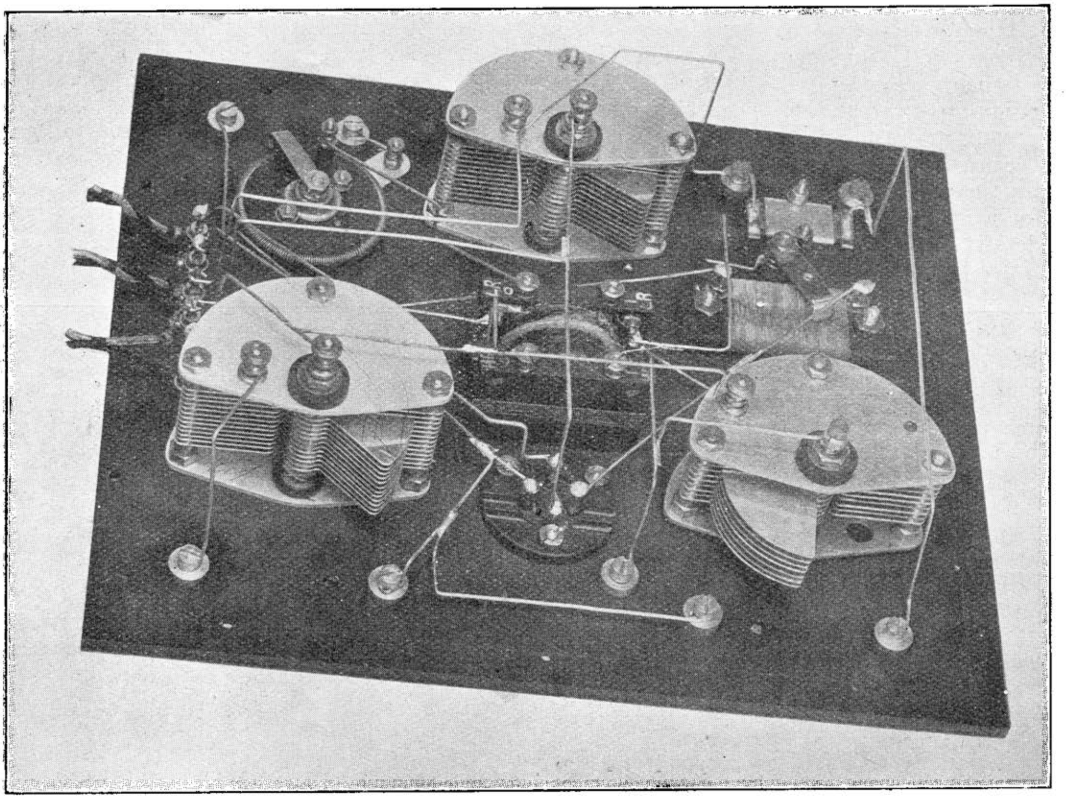


Fig. 1. The wiring of the receiver is clearly shown in this photograph.

In conclusion, the D.E.7. valve should not be used with more than about 40 volts of high tension, and it should be noted that on strong signals the set will work as well, or even better, with the plate circuit opened by removing the coil in it.

A. M. G.

AN EXPERIMENTAL CRYSTAL UNIT.

The author describes the construction of a useful instrument designed specially to allow of the rapid changes and adjustments necessary in experimental work.

IF serious experimental work is to be accomplished, using a crystal as a rectifier, the employment of an instrument capable of permitting several changes and adjustments, which are essential on such occasions, to be carried out with a minimum of time and labour, is almost a necessity.

Such an instrument has been constructed by the writer and it is thought that the following description and constructional details will be of interest to those experimenters having need of some such device.

The following are the arrangements catered for :—

(*a*) Employment of either of four crystal combinations ; *i.e.*, Crystal to catswhisker, steel plate, steel point, or crystal to crystal.

(*b*) Reversal of connections to crystal, and

(*c*) Application at will of a local battery potential.

The appearance of the finished unit may be seen from the photograph.

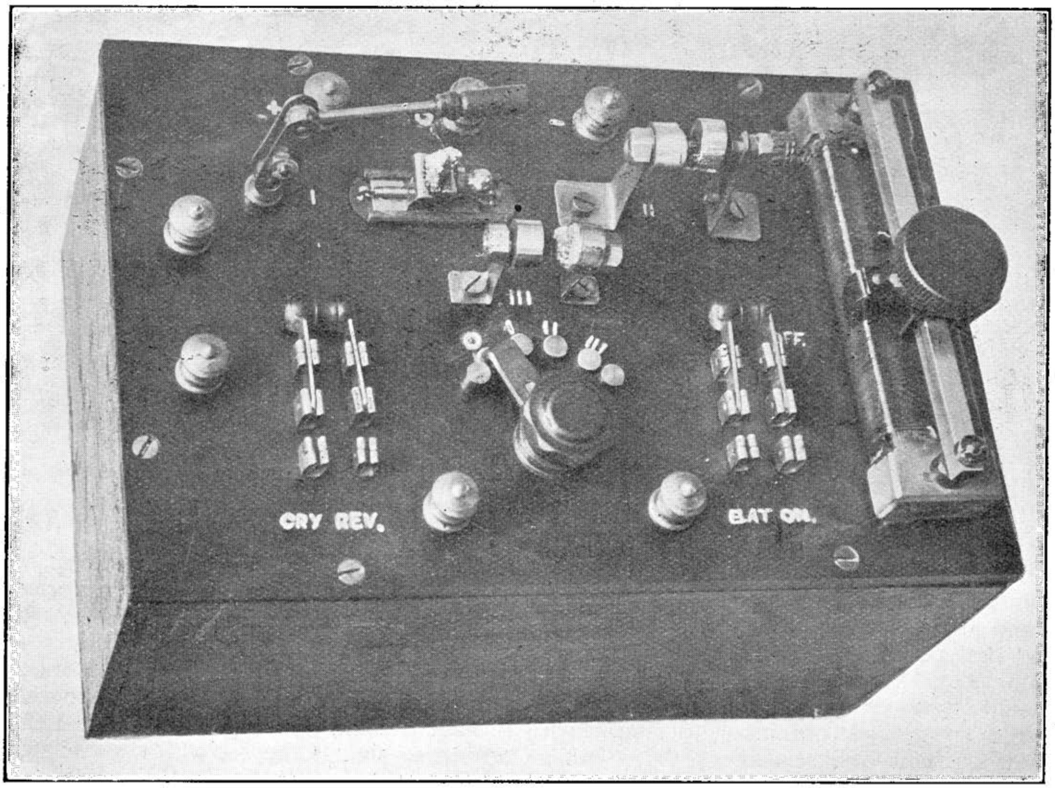


Fig. 1. The completed instrument. The design provides for instant changes and adjustments.

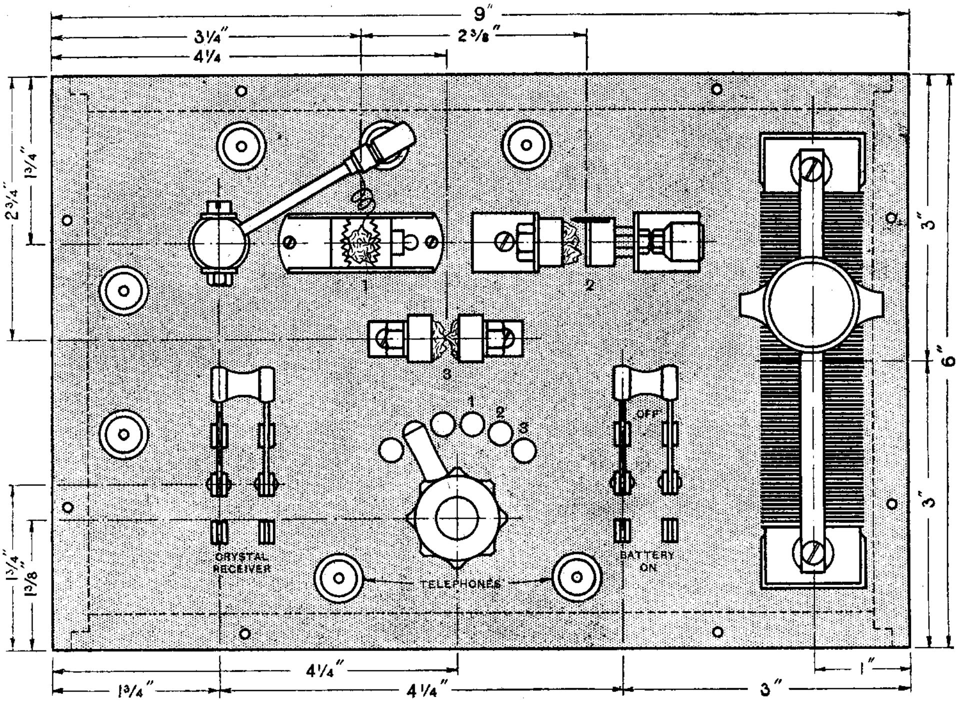


Fig. 2. The general layout of the experimental crystal receiver.

The general layout and dimensions are given in Fig. 2, while Fig. 3 shows the scheme of wiring.

The particular type of holder used in the No. 1 position (see Fig. 1) is not easily obtainable, and it is thought that anyone making up this instrument will prefer to fit one of the more familiar types at present on the market. One of modest dimensions should be chosen, and if the only connections needed are the usual one to the catswhisker and one to the crystal, the wiring will remain as given in Fig. 3.

The method of construction of holder No. 2 can be readily gathered from Fig. 2. The brass standard carrying the crystal is stationary, while the standard holding the steel plate and point possesses three movements, *i.e.*, rotation on its base, needle revolution, and the usual fore and aft tension movement. It will be found that these movements are quite sufficient to cover the surface of the crystal.

The steel plate comprises an empty crystal cup faced with a piece of an old "Valet" razor blade, while the point is part of a gramophone needle, likewise soldered in position.

The small knob may be cut from a piece of ¼ in. ebonite and given a finger-grip with a file, afterwards being fixed to the head end of a 6 B.A. brass bolt by means of a small nut. The free end of the bolt screws into the back of the cup carrying the plate and point. It is as well to fill the cup, before mounting the steel plate, with solder or Wood's metal to facilitate the drilling and tapping at the rear. The soldering of a small nut, bored clear, to the top of the standard, and drilling the standard to match, provides the necessary bearing for that part of the plunger spindle which has to be filed clear of thread to ensure smooth action.

The spring applying the pressure behind the plate is a short length of ¼ in. wide clock spring.

A hole is punched in one end for securing to the standard, while the other end should be given a small slot having a breadth slightly larger than the diameter of the spindle and about half again as long. The respective standards should be cut to convenient dimensions as shown in the photograph, and bent to a right-angle at the places indicated.

Holder No. 3 requires less attention. Two pieces of thin springy brass, or preferably phosphor-bronze, should be cut and bent to right-angles as shown in the photograph. A hole is drilled in each piece for the passage of the bolts which secure the standards to the panel, and another at the opposite ends to take the crystal cups. As this holder is used for crystal to crystal combinations the adjustments hold good for considerable periods, and therefore no elaborate movements need providing for.

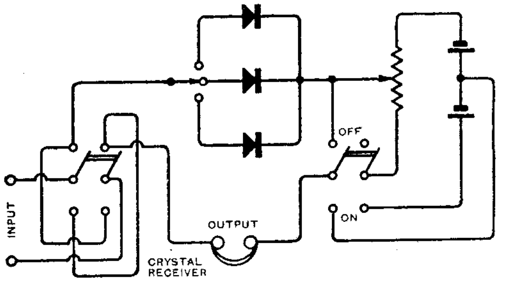


Fig. 3. The circuit diagram.

When setting, the nuts which secure the cups to the standards should be loosened and the crystals revolved until suitable bearing points are found, the nuts then being tightened.

The spacing of the components is given in Fig. 2 for cups ¼ in. deep, carrying crystals of average projection. If these dimensions are to be greatly exceeded it will become necessary to space the standard bases more widely. If this is not done undue tension will be placed upon the crystal owing to the resiliency of the springy metal.

The selector switch is of standard type with the exception of the knob. The potentiometer is of the type fitted to the Marconi crystal receivers, and was picked up second-hand. Should it be desired to fit some other type, one having a resistance of about 200-250 ohms would be found suitable. On the other hand, one can be made quite easily by cutting a piece of ⅝ in. ebonite to size 1¼ in. by 4¾ ins., bevelling the edges with a file, and then between points situate about ¾ in. from each end, winding about 200 turns of No. 36 S.W.G. "Eureka" resistance wire. The winding should be spaced by fine cotton, and then shellaced. When dry, remove the cotton winding and apply two more coats of shellac. The winding will then be found to retain its position quite firmly providing a smooth-acting slider is fitted.

The ¼in. square brass rod carrying the slider may be secured at each end by brass bolts of sufficient length to permit their passing through the panel and taking a securing nut on the under side, thereby fastening the component to the panel face. It is as well to insert a small piece of 1/16 in. ebonite, or a spacing washer, under each end of the potentiometer in order to keep the winding clear of the surface of the panel.

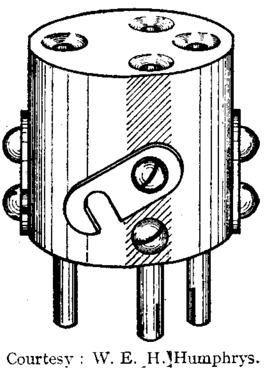
In practice this instrument is giving very satisfactory service. The dry cells used across the potentiometer do not run down quickly, and Siemen's "D" type should last a good six months even with constant usage. It should be remembered, of course, to have the battery switch in the "off" position when closing down.

The local potential is available for any crystal fitted into any of the holders; but it will be found to give the best results when applied to voltage operated crystals such as carborundum, zincite-bornite and silicon. The writer uses hertzite, carborundum, and zincite-bornite in holders 1, 2 and 3 respectively.

The outside dimensions of the case are: 6 ins. wide, 9 ins. long and 5 ins. deep. This instrument may, of course, be used in conjunction with any standard tuner.

S. A. C.

The valve is re-inserted into the socket holes and the links make it possible to introduce grid biasing cells, additional H.T. potential, grid condenser, reaction coil, tuned filter circuit or the fitting of shunt resistances.



Courtesy: W. E. H. Humphrys.

A RÉSUMÉ OF MODERN METHODS OF SIGNAL MEASUREMENT*

By J. Hollingworth.

AT the risk of being accused of being unpractical, I propose to deal with a subject which is possibly not of immediate importance to the radio amateur who merely listens-in, namely radio-telegraphic measurements. Beyond a few determinations of inductance and capacity, which, as a matter of fact, are usually carried out in such a way as to be eventually dependent on a time measurement (frequency) ; nothing more is needed for a great deal of reception work ; also the amount of apparatus and the facilities required are beyond the each of the average amateur. Like all other sciences, however, radio communication is fundamentally dependent upon such measurements for its systematic advance, and the study of them forms a subject of engrossing interest to those whose temperament inclines them to work of this nature ; though to the onlooker it may seem dull and uninteresting as the actual reception of signals occupies but a microscopic part of the time spent on the work.

The particular branch of the subject I propose to deal with here is the measurement of received field strength, which is, in practical terms, the determination of the actual voltage induced in a receiving aerial by a distant transmitter.

The well-known phenomena of fading and freak reception point directly to the need of such measurements for their explanation, which should also provide the answer to two questions of immediate importance. The first is a practical one. Given two places on the earth a certain distance apart, what power must be radiated from the one in order to ensure reception at the other under all circumstances ? This is the fundamental problem occuring to all those responsible for the installation of transmitting stations, and on these lines a great deal of work has been and is being done at the moment.

The second is more theoretical. Is it possible to determine the law of propagation of wireless waves to the same extent as the law of signalling along a long cable has been dealt with ? At the moment such laws as we have are admittedly empirical and only hold even approximately under very restricted conditions.

From the purely experimental point of view the difference between these two problems is slight.

In its essentials the problem is a very simple one. It merely involves the erection of a coil or aerial whose constants are known, and the measurement of the current produced in this circuit when tuned to the station of which the measurement is desired.

From this measurement the induced voltage and the electric field strength at the receiving station can readily be calculated. But in an actual case, unless the two stations are within a few wavelengths of one another the current is so small as to defy direct measurement. This will be appreciated from the general statement that in long distance reception the current is but a few microamperes, and the power available of the order of millionths of a microwatt. Such power cannot possibly operate any form of direct-reading instrument, and consequently elaborate methods have to be devised to make it measurable.

Before the days of the amplifier such distant measurements were, of course, impossible, the limit of distance being fixed by the sensitivity of the most delicate form of high frequency ammeter which could be obtained. Such instruments are the thermo-galvanometer of Duddell and the bolometer of Tissot. The former consists of a single loop of wire suspended in a strong magnetic

* A paper delivered before the Radio Society of Great Britain on Wednesday, June 25th, 1924, at the Institution of Electrical Engineers.

field, the bottom ends of the loop being joined by a tiny thermo-junction, and the whole hangs so that the junction is a few millimetres above a small resistance wire carrying the current and known as the heater. The bolometer is a Wheatstone bridge network, the unknown resistance being a wire carrying the current to be measured. This wire being heated by the current changes its resistance, and this change is measured by the bridge.

The former instrument was used by Duddell and Taylor in their experiments in 1905, the latter by Tissot in 1906, both over what would now be considered short distances, the maximum being apparently about 60 miles.

This method of measurement is still in actual use but for a slightly different purpose. It is now used for determining the " effective height " of an aerial, a figure which appears

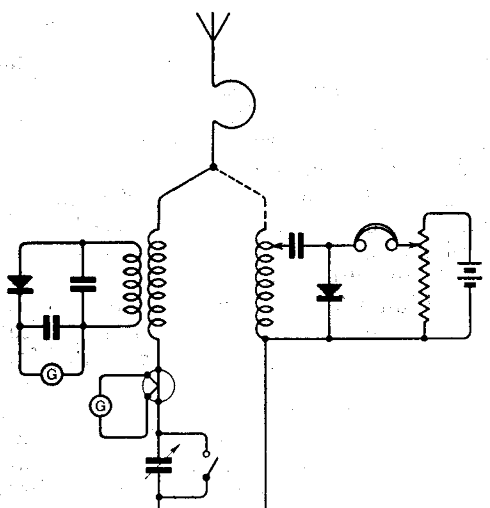


Fig. 1. *The circuit which produced the famous Austin-Cohen coefficient.*

in all transmission formulæ, and which may be described roughly as the height of the ideal aeral which would give the same radiation. For this purpose it is necessary to measure the intensity of the field at a distance of a few wavelengths from the aerial, at which distance the field is still so powerful that a comparatively coarse measuring instrument can be used.

The next stage in signal measurement was the use of a crystal as the detecting agent, which at once allowed a considerable extension of the range of measurement.

The classic experiments of this era were those of L. W. Austin and L. Cohen, resulting in the production of what is known as the Austin-Cohen coefficient, which forms the basis of most of the formulæ in use at the present day.

The experiments were mostly carried out between the station at Brant Rock and two boats, by means of which transmission was measured up to a distance of 1,000 miles, practically entirely over sea. The circuit used is given in Fig. 1. Three different methods of measurement were used, partly as a check on one another and partly depending on the distance. In the left-hand branch there is a thermal instrument on the aerial for use at short ranges, and also a crystal and microammeter in a loosely coupled secondary for measurements at greater ranges. On the right is a shunted telephone system. A loop was provided in the aerial coupled to a buzzer of known intensity, so that any of these methods could be calibrated.

Other workers at this period were Marconi, Max Reich and Dr. Marchant. In all these cases the general principles were the same, though the circuits differed in details.

Up to this time all experiments were, of course, carried out on spark stations, as there were no others, and in consequence many of the results were rather comparative than absolute; as any theoretical formula necessarily involved the decrement of the transmitting station, which is an extremely difficult quantity to determine.

With the advent of the thermionic v lve, with its capabilities as a generator of undamped waves, as detector and as amplifier, the modern study of signal measurements may be considered to commence; and as by this time there had been a considerable advance in the technique of measurements at radio frequency, attention was concentrated on the measurement of absolute values.

Although modern methods have been developed in many different ways they all possess a certain number of features in common dictated by the necessities of the case.

They all employ some form of amplification for the reason mentioned above, that the power available is far too small to operate directly any measuring instrument.

Now, in spite of the many virtues of the present-day amplifier, it can in no way lay claim to being an instrument of precision in the same way as we have a precision voltmeter or ammeter. In fact, its amplifying power is liable to vary very rapidly, and the more sensitive it is the more rapid may be the change; so that it is always necessary to provide some immediate method of calibration.

In theory no doubt it is possible to calculate the amplification of a multi-valve amplifier, given all the working characteristics, but in practice such efforts usually give ludicrous results as it is extremely difficult to take into account such quantities as inter-electrode and intervalve capacities which are nevertheless of vital importance in the amplification.

Consequently, all modern methods are what are known as substitution methods, *i.e.*, the effect produced by the incoming signal is not measured absolutely, but is balanced against a local source of C.W. under the control of the operator, which is constructed in such a way that the actual e.m.f. delivered by it can be accurately measured.

Under these conditions the value of this local e.m.f. is, of course, equal to that produced by the incoming signal; so that with the help of the known constants of the receiving circuit the field strength of the signal can be calculated.

Up to this point most methods possess a considerable degree of similarity, but from here they diverge considerably in details, the reason of which is interesting.

Like most other problems, this one produces a certain number of specific difficulties, the solutions of which are somewhat mutually contradictory, with the result that the arrangement finally selected will be in the nature of a compromise. Different observers will tend to compromise in different directions, depending on their particular views and requirements, and will thus produce methods which appear at first sight to be widely dissimilar.

Of these problems the following are some of the most interesting.

(*a*) Aerial *v.* Coil.

From the point of view of simplicity of reception and minimum amplification the aerial possesses great advantages. On the other hand the expression for its picking-up power has come in for a considerable amount of theoretical criticism, and its actual measurement is not an easy problem. The coil is far less efficient as a receiver, but its electrical constants are perfectly definite and capable of determination.

(*b*) Type of Signal Employed for Measurement.

While it is, of course, a great advantage to be able to take measurements on the ordinary routine of a station, it cannot in general be done without an increase in the complication of the apparatus. This is because at the time when the calibrating signal from the local source is being applied to the system, the outside signal must be inoperative. It is thus necessary either to have a pre-arranged routine between the signal and the local source so that they can be applied to the apparatus alternately, or else to have an aerial system which can be modified in such a way that while retaining its electrical constants it can be made blind to the incoming signal.

Various methods of doing this will be seen in the descriptions of the different systems.

(The conclusion of the paper, together with a report of the ensuing discussion, will appear in subsequent issues.)

Correspondence.

POZ Testing ?

To the Editor of The Wireless World and Radio Review.

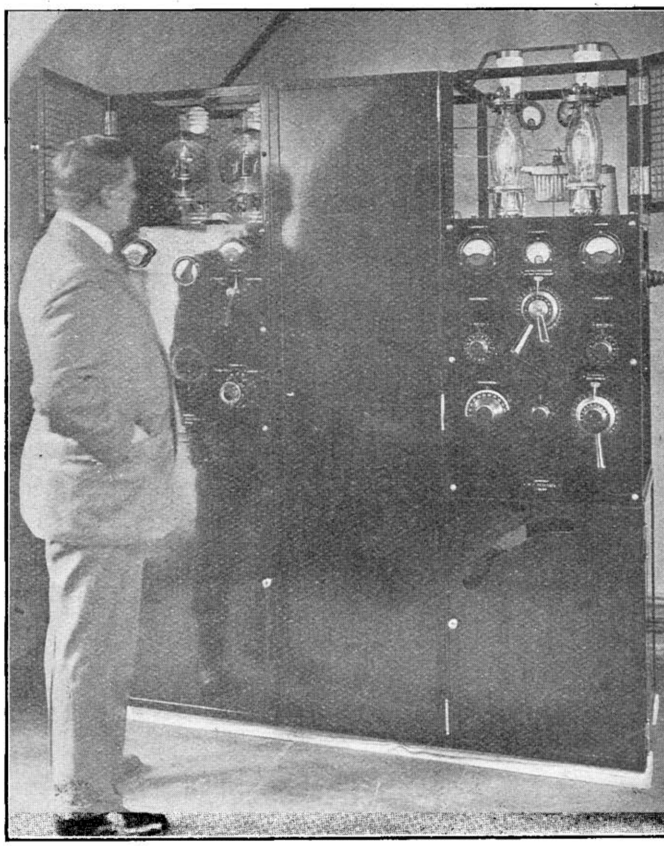
Sir,—On July 2nd, at about 11 p.m., B.S.T., on 95 metres, I heard a C.W. station sending V's and occasionally **POZ.** I presume that **POZ** (Nauen) is carrying out short wave tests, and would like to know if other amateurs have received this transmission. The strength was terrific; with detector and L.F., signals were audible with telephones on the table. The C.W. has a rather pronounced 25 cycle note in it.

B. J. Archer (**2 VJ**).

Wembley, Middlesex.

DANISH BROADCASTING DEVELOPMENTS

NEW STATION AT COPENHAGEN



The four-valve transmitter at the Copenhagen Broadcasting station.

As in most other countries, broadcasting has seized the popular imagination in Denmark. For several years a small number of enthusiasts have carried on wireless experiments but not until recently has official broadcasting been adopted.

The opening of the first wireless broadcasting station took place on July 3rd, when the first programme was broadcast from a large installation occupying the building of the Royal Danish Telegraph Service in Copenhagen. The opening ceremony was attended by a good representation of the press and prominent wireless amateurs.

For the convenience of the artists the studio is located in the centre of Copenhagen, in the same building as the transmitter. The two masts, 70 ft. high, are well situated on the roof of the building, and as some difficulty arose in obtaining a suitable earth connection, it has been found necessary to employ a counterpoise. The four-valve transmitter, which is entirely of Danish construction, can develop a power of 1 kW. Although owned by two Danish radio firms the station has been placed at the disposal of the Danish Radio Club, an active organisation representing amateur interests.

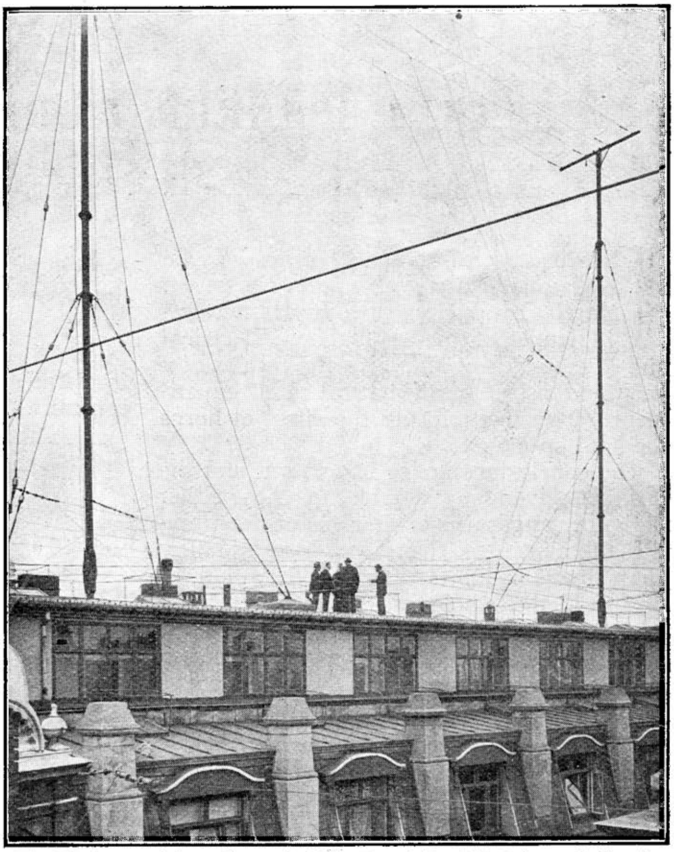
Musical items will predominate in the programmes, and it is hoped to provide a regular feature of broadcast opera as performed in the Royal Theatre, Copenhagen.

Every effort has been made to render the new station as efficient as those in neighbouring countries, and although Copenhagen's power falls somewhat short of that in general use, many British amateurs should be able to pick up the programmes without difficulty. At the moment of going to press we are without information regarding the wavelength of Copenhagen and the times of transmission, but hope to publish details in an early issue.

Up till recently the path of the amateur in Denmark has been by no means easy, and for a considerable time difficulty was experienced in inducing the authorities to grant experimental facilities. As a result of continued effort on the part of enthusiasts, however, anyone may now possess a wireless receiver, provided a declaration is filed at the local police station. While the Danish amateur has almost unrestricted facilities in the matter of reception, amateur transmission is unauthorised.

Preliminary broadcast concerts have been transmitted from the Government station at Lyngby; conditions there have not been entirely satisfactory, however, for this particular class of work and the establishment of the new broadcasting station in Copenhagen marks a great advance. New broadcasting stations will probably soon be erected in the provinces, as the amateurs in Denmark are to be found all over the country and their number, at present amounting to 10,000, shows signs of a steady increase.

The authorities at the Copenhagen station would doubtless welcome reports from British listeners who are able to pick up the transmissions. Such reports may be addressed to the station c/o the offices of this Journal. Particulars of the strength and quality of reception are of the greatest value.



The 70-foot aerial on the roof of the Royal Danish Telegraph Service in Copenhagen.

BROADCAST INTERFERENCE STATISTICS.

The complaints of oscillation and interference with broadcast programmes furnished to the Radio Society of Great Britain by the British Broadcasting Company during the period February to April, 1924, have been carefully scrutinised and the following is an analysis of them :—

Of the total number of 1,114 complaints received, 910 appear to be due to unintentional oscillation caused by valve receiving apparatus; 57 appear to be due to deliberate or intentional oscillation by valve receiving apparatus; 82 appear to be due to unintentional interference by amateurs holding experimental transmitting licences and mainly using telephonic communication; 3 appear to be due to deliberate and intentional interference by unauthorised transmitters, although in one case there is a slight doubt owing to the somewhat ambiguous form of the complaint; 26 appear to be due to commercial stations employing spark transmitters, although in one of these cases an arc station is clearly responsible; 36 appear to be due to various causes other than by radio apparatus used as such.

SUMMARY.	Per cent.
Unintentional oscillation	81·7
Intentional oscillation	5·1
Unintentional experimental transmission	7·4
Intentional unlicensed transmission	0·27
Commercial spark and arc stations..	2·3
Various causes other than radio ..	3·23

LOUD SPEAKER HORN DESIGN.

By CAPTAIN H. J. ROUND, M.C.

IN an article in the *Journal of the American Institute of Electrical Engineers*, March, 1924, Messrs. C. R. Hanna and J. Slepian, of the Westinghouse Electrical and Manufacturing Co., give the results of a very extensive mathematical and experimental investigation into the effect of horns for loud speakers.

The conclusions are so important, and the formulæ given so valuable to those either designing apparatus or desirous of determining the faults of their own loud speakers that, but for limits of space, it would be better if the whole article were reprinted here.

The authors investigate in general how a horn loads a diaphragm and they show how a correctly designed horn will not only give stronger signals than an incorrectly designed one, but will at the same time tend to minimise the resonances of the diaphragm.

Both mathematically and experimentally the exponential horn is shown to give a more uniform loading of a diaphragm down to a certain frequency than a conical horn.

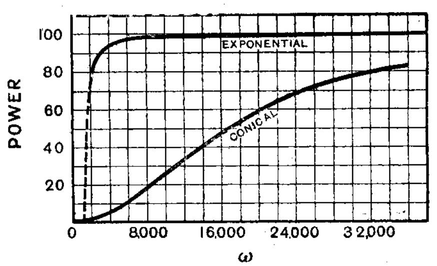


Fig. 1. Comparison of loading of exponential and conical horns.

Fig. 1 shows the loading given to a diaphragm by two similar sized horns, one in which the area of throat increases exponentially and the other in which a longitudinal section is a cone.

The writers then chiefly investigate the properties of the exponential horn in which

$$A = A_0 \, e^{Bx}$$

where A is the throat area at distance x from the small end and B is the exponential constant.

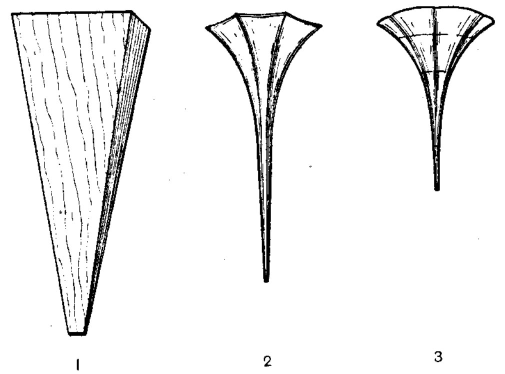


Fig. 2. Loud-speaker horns used for experimental comparison.

They investigate in general three points.

(1) The influence of B.

(2) The influence of A_0.

(3) The influence of the area of the open end.

Referring to the figure, the point P on the exponential horn loading curve is called the "cut-off" point, below which frequency the horn refuses to load the diaphragm.

They show that this point only depends on the value of B. The smaller B is the lower down in frequency this cut-off position is.

They determine that uniform loading will occur down to a point where :—

$$\omega/B = 2 \cdot 5 \times 10^4$$

They then determine that the amount of loading will be increased by a decrease of A_0 down to a point where air friction becomes important. This work has led them to use much smaller values of A_0 than are usually used, but, of course, with a corresponding increase of length of horn, and the result of this is to remove a great deal of the diaphragm resonance.

They show that the final orifice diameter determines the resonance of the horn, but very fortunately it turns out that in exponential horns the resonances are hardly noticeable above the frequency the horn begins to load, providing the diameter of the opening is above 14 ins. The dimensions of the air chamber next to the diaphragm are also discussed. The present writer has checked approximately the positions where the loading falls off on several exponential horns with different values of B, and they agree very fairly with the American writer's formula. In particular his horn gave very different tones to the same diaphragm—one has $B = 0{\cdot}25$ and the other $B = 0{\cdot}025$; the horns were not very different in length and of about the same large orifice. The input orifice of No. 1 was very much smaller than No. 2. For speech No. 1 was considerably stronger than No. 2, though not so natural, but for orchestral music No. 1 was thin and unsatisfactory, whereas No. 2 sounded wonderfully realistic and satisfying owing to the wealth of tone from the lower instruments.

Calls Heard

London, S.E.24 (May 18th to June 11th).
2 AIU, 2 AJA, 2 AJT, 2 BCF, 2 AU, 2 DY, 2 HS, 2 KF, 2 KV, 2 LT, 2 OM, 2 PX, 2 SX, 2 TI, 2 TQ, 2 VS, 2 WY, 2 XR, 2 XZ, 2 ZO, 5 AC, 5 BT, 5 DT, 5 FL, 5 LD, 5 MA, 5 OY, 5 PU, 5 WN, 5 XO, 6 AH, 6 DA, 6 BBC, 6 IT, 6 NF, 6 NH, 6 QB, 6 VR. French: **8 AÉ** (C.W.) (K. C. Wilkinson.)

London, N.1 (during May).
British: **2 ABR, 2 AC, 2 ACU, 2 AIU, 2 ARX, 2 DR, 2 GO, 2 LH, 2 LU, 2 MC, 2 MK, 2 OM, 2 TQ, 2 VJ, 2 VS, 2 VW, 2 WJ, 2 XO, 2 XR, 2 YR, 5 AC, 5 AI, 5 AS, 5 CF, 5 DN, 5 FL, 5 HN, 5 LZ, 5 MA, 5 MF, 5 OC, 5 OY, 5 PT, 5 PU, 5 QV, 5 SN, 5 UL, 5 UQ, 6 BO, 6 FG, 6 FJ, 6 GM, 6 HY, 6 IH, 6 QZ.** French: **8 BV, 8 DA, 8 DE, 8 DU, 8 LM, 8 SSU, 8 ZM.** Dutch: **0 PC, 0 MR.** Unknown: **GB 1.** (1—v—0, 1—v—1 and 1—v—2.) (Clemence Bradley.)

Marseilles, France (February-May).
2 AW, 2 CW, 2 GO, 2 JW, 2 KF, 2 KW, 2 KX, 2 LH, 2 NB, 2 NM, 2 PC, 2 RB, 2 TO, 2 TP, 2 UF, 2 VQ, 2 XG, 2 XY, 2 YQ, 2 ACU, 5 BT, 5 BV, 5 CX, 5 FD, 5 FS, 5 HN, 5 MO, 5 OC, 5 OX, 5 QM, 5 QV, 5 RZ, 5 SI, 5 US, 5 XF, 6 CV, 6 DW, 6 NF, 6 RY, 6 TM, 6 VP, 6 XG, 6 XX, 8 AAA, 8 AE, 7 AE 3, 8 AG, 8 AP, 8 AU, 8 BM, 8 BP, 8 BV, 8 CA, 8 CG, 8 CJ, 8 CM, 8 CT, 8 CZ, 8 DO, 8 DP, 8 DU, 8 DX, 8 DY, 8 EB, 8 ED, 8 EE, 8 EM, 8 JC, 8 MV, 8 OH, 8 RL 8 SSU, 8 WW, 8 XY, 8 YZ, 8 ZM, 0 AA, 0 AG, 0 BA, 0 FL, 0 FN, 0 KX, 0 MR, 0 NY, 0 PB, 0 PG, 0 XR, PCII, PCTT, NPCT, NAB 2, P 1, P 2, 1 AA, 1 ER, 1 JW, 1 ST, 1 SV, 1 VX, 1 XW, 1 AAA, 1 AAC, 1 ALL, 1 BCR, 1 XAH, 1 XAM, 1 XAR, 1 XBE, KDKA. (0—v—2.) (Mon. A. Sicard, **8 ÉN.**)

Leigh, Lancs (May 12th to June 8th).
2 AAC, 2 ADH, 2 AHT, 2 AJV, 2 AOI, 2 EB, 2 EF, 2 TR, 2 VF, 2 ZK, 2 ZU, 5 AY, 5 CL, 5 CR, 5 DC, 5 FW, 5 HG, 5 ID, 5 LB, 5 NX, 6 CF, 6 FV, 6 HS, 6 IK, 6 KK, 6 LF, 6 LY, 6 NI, 6 PQ, 6 SB, 6 YF. (1—v—1.) (O. Boydell.)

Kirby Muxloe, near Leicester (April 1st to June 10th).
British: **2 AAH, 2 AIT, 2 AK, 2 AOX, 2 BZ, 2 CC, 2 DR, 2 FY, 2 GO, 2 IF, 2 IX, 2 JX, 2 KW, 2 MO, 2 NO, 2 NW, 2 OD, 2 OF, 2 OQ, 2 RD, 2 RQ, 2 SX, 2 SY, 2 TO, 2 TU, 2 VG, 2 VQ, 2 VS, 2 XG, 2 XO, 2 ZU, 5 AS, 5 BP, 5 ID, 5 KO, 5 LZ, 5 MO, 5 OX, 5 QM, 5 QV, 5 RB, 5 RQ, 5 SI, 5 SW, 5 SZ, 5 TZ, 5 UL, 5 YW, 5 ZV, 6 AL, 6 BY, 6 FQ, 6 OF, 6 ST, 6 TD, 6 WH, 6 XJ, 6 YC.** French: **8 AG, 8 AQ, 8 BP, 8 CN, 8 DO, 8 ED, 8 JC, 8 JP, 8 RO, 8 RS, 8 SSU, 8 TK, 8 ZM.** Dutch: **0 BA, 0 FN, 0 HD, 0 MR, 0 MS, 0 NN, 0 PC, 0 PCC, PCRR, 0 ST, 0 XQ.** Miscellaneous: **W 2, 1 CF.** (1—v—1.) (F. H. Tyler, **2 ASH.**)

Bury St. Edmunds (during May).
2 AO, 2 DR, 2 FK, 2 IF, 2 II, 2 JV, 2 KT*, 2 LZ*, 2 MC*, 2 MG, 2 NA, 2 OD, 2 OF, 2 OQ, 2 PX, 2 SM, 2 SV, 2 TO*, 2 UV, 2 VI, 2 VJ, 2 WD*, 2 XR, 2 ZK*, 2 ZU, 2 ARX, 5 AI, 5 AS*, 5 CB, 5 CM, 5 DT*, 5 DY*, 5 GL, 5 HA, 5 JJ, 5 KO, 5 KW, 5 LY*, 5 MO*, 5 OX, 5 PD*, 5 QV*, 5 RF, 5 SI, 5 ST, 5 TG, 5 TJ, 5 TZ, 5 UD, 5 UL*, 5 WI, 6 AL, 6 BO, 6 BY, 6 CR, 6 CV, 6 DN, 6 EA, 6 HA, 6 IH, 6 IV, 6 LJ, 6 NN, 6 NO, 6 QB, 6 QL, 6 TJ, 6 TM, 6 TW, 6 VR, 1 CF, 4 BA, 4 QS, 7 EC, 8 DP, 8 DX, 8 ÉM, 8 ÉN, 8 EO, 8 TK, 8 TV, 8 ZM, 0 BA, 0 FN, 0 KX, 0 MR, 0 MS, 0 NN, 0 PC, 0 RB, 0 US, 0 XQ*, 0 ZW, W 2. *Telephony. (C. A. Jamblin, **6 BT.**)

London, N.W. (since April 9th).
Italian: **1 ER, 1 NA, 1 ST, ACD.** German: **1 CF.** Dutch: **0 HD, 0 NJ, 0 NN, 0 PC, 0 PT, 0 ST, 0 XQ, PCRR.** Luxembourg: **0 PG.** Belgian: **4 C 2, 4 CVB, 4 GZ, 4 HA, 4 QS, 4 YZ, 4 ZZ, P 1.** French: **8 AE 3, 8 AG, 8 AH, 8 BL, 8 CK, 8 DD, 8 DI, 8 DN, 8 DP, 8 ÉO, 8 ÉQ, 8 ÉT, 8 GG, 8 HR, 8 IP, 8 JC, 8 JD, 8 JZ, 8 PD, 8 PN, 8 QW, 8 RL, 8 RO, 8 RCN, 8 TK, 8 TV, 8 ZM, 8 CA, 8 ÉN.** Argentine: **CB 8** (**R 2** on 0—v—0). ?: **H—9 AA (ACCW, QSA, QRA** ?) (0—v—1). (S. K. Lewer, **6 LJ.**)

Enfield Wash, Middlesex (during May), telephony.
2 AU, 2 ABJ, 2 ABR, 2 AKS, 2 ASU, 2 CT, 2 DV, 2 DY, 2 FA, 2 FF, 2 FK, 2 FM, 2 IL, 2 JM, 2 JX, 2 KF, 2 KT, 2 KV, 2 LZ 2 MC, 2 MK, 2 QD, 2 QF, 2 QZ, 2 TI, 2 VY, 2 WD, 2 WJ, 2 XD, 2 XO, 2 XR, 2 XZ, 5 AI, 5 AS, 5 CF, 5 DT, 5 DY, 5 FL, 5 IF, 5 LN, 5 LP, 5 MA, 5 OA, 5 OY, 5 PU, 5 PZ, 5 QV, 5 TR, 5 UL, 5 YX, 6 BBC, 6 BY, 6 HP, 6 HY, 6 JT, 6 NH, 6 PD, 6 QO, 6 QV, 6 VX, 6 WX (1—v—0). (D. W. Crocker.)

Cowes, I. of W. (during May).
2 CA, 2 GO, 2 KF, 2 OF, 2 QT, 2 RB, 2 US, 2 XR, 2 YY, 2 ZU, 2 ZZ, 5 AD, 5 AW, 5 BP, 5 BV, 5 FD, 5 IC, 5 IO, 5 JJ, 5 PY, 5 QN, 5 QV, 5 TN, 5 US, 5 WI, 5 YI, 6 OU, 6 FQ, 8 AE, 8 BY, 8 CZ, 8 OA, 7 DU, 8 DX, 8 EB, 8 JL, 8 RI, 8 UU, 8 VW, 1 MT, 0 KN, 0 AA, 0 LA, 0 SA, 0 NN, 0 XX, 0 ZZ. (W. G. Sherratt.)

Cambridge (during April and May), telephony.
2 DT, 2 ET, 2 MP, 2 MX, 2 QQ, 2 QT, 2 SP, 2 ST, 2 WD, 2 XI, 2 YX, 2 ZI, 2 ZO, 5 AY, 5 BT, 5 LY, 5 OY, 5 PT, 5 PU, 5 WO, 5 WX, 6 BBC, 6 MX, 6 PO. (0—v—0.) (B. M. Sendamore.)

Harrogate (May 25th to June 8th).
British: **2 GO, 2 UV, 2 VI, 2 XY, 5 CU, 5 NW, 5 MO, 5 SZ, 5 WI, 6 NI, 6 UD.** French: **8 EN, 8 LMT**(?), **8 RM, 8 SSU.** Dutch: **0 BA, 0 KN, 0 KX, 0 NY.** Danish: **7 EC, 7 ZM,** and **W 2, 4 C 2.** (0—v—0 and 0—v—1.) (W. Hartley.)

Wigan (May 25th to June 10th).
2 AAC, 2 AHT, 2 ALF, 2 AMS, 2 AOJ, 2 ASZ, 2 AVH, 2 FU, 2 HD, 2 HS, 2 KY, 2 LM, 2 RB, 2 RT, 2 SO, 2 TO, 2 TR, 2 XB, 2 ZK, 2 ZÜ, 5 AY, 5 BG, 5 CR, 5 CU, 5 DC, 5 HG, 5 ID, 5 MA, 5 KB, 5 SW, 5 VN, 6 BBC, 6 FV, 6 IK, 6 KK, 6 LC, 6 NI, 6 RW, 8 BA, 8 GM. (1—v—1.) (G. W. Hall, **6 LF.**)

CONVERTING BROADCAST RECEIVERS TO RECEIVE ON 1,600 METRES.

The simple modifications are here described for adapting broadcast receiving sets to bring in the transmissions now carried on by **5 XX** on high power with a wavelength of about 1,600 metres,

CRYSTAL RECEIVERS.

RECEIVERS making use of crystal only may be divided into two classes, depending upon the method of tuning.

(1) The variometer tuned set, in which the wavelength is changed by altering the relative position of two inductances. One inductance may rotate inside or swing over the other.

(2) The tapped coil tuned set, employing either a slider or switches with a number of contacts.

(1) THE VARIOMETER SET.

This is probably the most difficult type of crystal receiver in which to provide an extension of wavelength. It may be thought at first that all one has to do is to connect a variable condenser across the aerial and earth terminals and so increase the capacity of the circuit and thus add to the wavelength

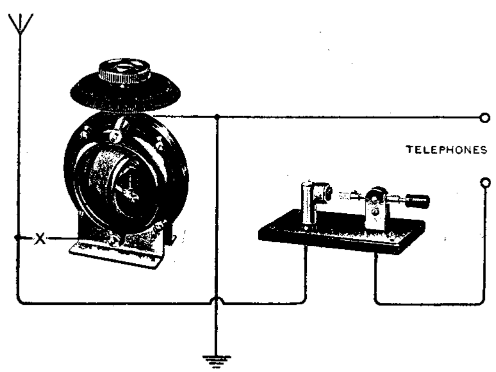


Fig. 1. Position (X) for connecting a loading coil for extending the wavelength of a variometer-tuned crystal set to 1,600 metres.

to which the set will respond. True, the wavelength will be increased, but to produce a change from 400 to 1,600 metres a condenser having a capacity of almost 0·003 mfds would be needed. Such a variable condenser is practicably unobtainable, and were it employed the resulting signals would be

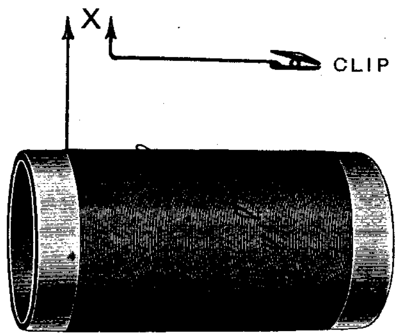


Fig. 2. Loading coil for extending the wavelength of crystal set to 1,600 metres. It consists of 300 turns of No. 26 D.C.C. on a cardboard former 3 ins. in diameter and 9 ins. in length. Tappings are made by means of twisted loops at the 100th, 110th, 125th, 145th, 170th, 200th and 240th turns.

exceedingly weak and the range of reception very limited because the action of this large capacity would be to considerably reduce the potential set up across the ends of the tuning coil.

A loading coil of one of the many forms needs to be connected between the aerial terminal and the lead to the variometer at a point in the circuit lower than that to which the lead to the crystal detector is joined, and shown at X in the accompanying diagram (Fig. 1). The method of building a suitable coil is also given (Fig. 2), and this may consist of about 300 turns of No. 26 double cotton covered wire on a cardboard former 3 ins. in diameter and 9 ins. in length. It is most essential to thoroughly dry out the former before attempting to wind on the wire. Not only will moisture impair the insulating properties of the cardboard, but should the tube become drier subsequent to winding, it will contract and the turns of wire will become loose and loop off. Tapping points are made by means of

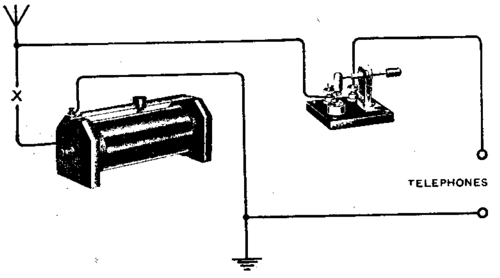


Fig. 3. *Position of connecting loading coil in simple crystal set for extending the wavelength to* 1,600 *metres.*

twisted loops at the 100th, 110th, 125th, 145th, 170th, 200th and 300th turns and contact picked up by means of a clip. It is not considered advisable to varnish the winding when completed, for although it may be rendered more durable by such treatment, the self-capacity of the coil, an undesirable property, will be appreciably increased.

The difficulty with regard to increasing the wavelength of a variometer tuned set by means of a loading coil is that only a very limited tuning adjustment is provided in the variometer itself. For this reason the loading coil has been provided with a liberal number of tapping points.

(2) Sliding Contact Tuned Set.

As a large wavelength change is provided in a set of this type when the point of contact is moved one can, for neatness and compactness, fit a socket to take a plug-in coil on the panel or base of the instrument. The size of the coil should be a No. 150, or, in the case of a small or single wire aerial, a No. 200, having an inductance value of about 2,000 microhenries as stated in data tables supplied by the coil manufacturers.

The loading coil described above may, of course, be used, and whatever type of loading coil is decided upon, is connected in the circuit at the point X.

VALVE SETS.

There are not many single valve receivers of commercial manufacture and designed for short wave broadcast reception on the market at the presen time, and this is due, of course, to the regulations which were at one time in force prohibiting the coupling of a reaction coil on to an aerial coil on the grounds that such an arrangement would cause interference by oscillation. True, it does cause interference, but almost equally can a wo-valve set in which reaction is arranged on to the anode coil. It thus transpires that most single valve sets are of amateur construction, and invariably embody the circuit shown in Fig. 4. A variable aerial tuning condenser is indispensable in this circuit, and is usually connected in series in the aerial lead so as to produce a maximum signal potential across the inductance and to stimulate some degree of oscillation—that desirable condition that brings about great receiving range.

Modifications Necessary.

The tuning range of two circuits has, in this case, to be altered. The aerial inductance will now need to consist of about 350 turns of No. 26 D.C.C., 3 ins. in diameter, and these may be inserted as a loading coil at the point marked X in Fig. 4,

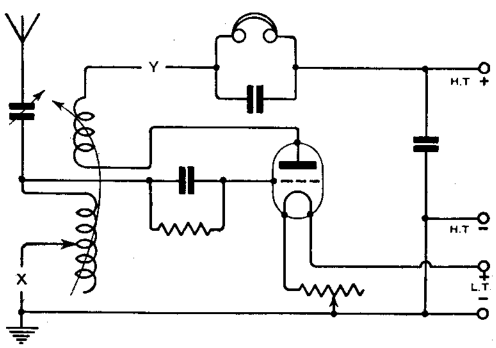


Fig. 4. *Typical amateur single-valve set. Both aerial and reaction inductances need to be loaded as shown at the points X and Y.*

providing that it is found that the reaction coupling is sufficiently tight to still maintain oscillation. The reaction inductance will also need to be loaded, and a coil should be inserted at the point Y, consisting of about

120 turns of No. 28 enamelled wire, 1¾ ins. in diameter. The enamelled wire wound coil, having moderately high self-capacity, will possess the useful property of fairly flat tuning, and will thus operate smoothly over a

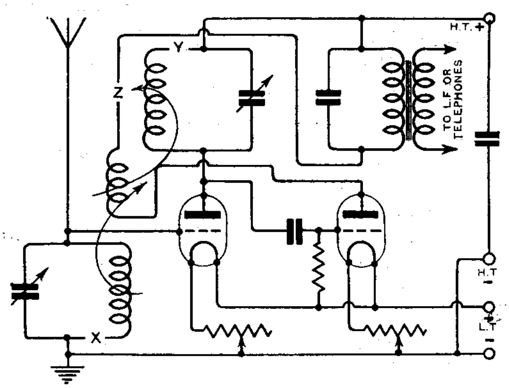


Fig. 5. Increasing the tuning range of set fitted with H.F. amplification.

wide tuning range. The other change that is necessary is to connect the aerial lead to the top of the aerial inductance and the condenser in parallel across the ends of the inductance.

Where plug-in coils are made use of for the purpose of tuning, one only has to select a pair with a suitable number of turns, such as a No. 150 in the aerial circuit and a No. 75 to No. 200 in the reaction circuit. The amateur will probably immediately appreciate the necessity for fitting a series-parallel switch for connecting the aerial tuning condenser in series or parallel across the aerial inductance, and the connections are repeatedly given in the Questions and Answers section of this journal.

SETS WITH HIGH-FREQUENCY AMPLIFIERS.

Most high-frequency amplifier sets on the market are capable of extension of wavelength range by the tuning adjustments with which they are provided. Plug-in coils are so often used, while, of course, tapped and interchangeable H.F. couplings are often fitted. In sets embodying high frequency amplification it is common practice to connect the aerial tuning condenser in parallel with the aerial tuning coil so as to provide smooth oscillation adjustment, and a typical H.F. circuit is shown in Fig. 5. If the variable tuning inductance is a tapped coil of limited wavelength range, and in which case the reaction coil will probably be a wound ball or cylindrical coil coupling, then the best course to adopt is to fit a three-coil holder on the face of the panel or to the side of the containing cabinet, and wire it up in the circuit to the points X, Y and Z. Plug-in coils, No. 150 or 200, will extend the wavelength to the required degree.

* * * *

The simple methods described here cannot necessarily be applicable to every type of broadcast receiver, but the general principles remain the same, and the details mentioned should give the beginner confidence in carrying out the necessary changes.

The new high-power station, with its wavelength of 1,600 metres, will bring about modifications in the types of sets obtainable. The use of plug-in coils for tuning purposes will, without doubt, become universal, and in tuning to the required extended range of wavelengths the listener will be afforded an opportunity of tuning to certain of the European transmissions to be found on settings a little above the wavelength of **5XX**. It is to be hoped that the high power employed will not entirely eradicate the fitting of a single stage of tuned high frequency amplification to amateur receiving sets. Admitted, it may no longer be necessary, but on the other hand high frequency amplification functions much more efficiently on 1,600 metres than it does on 400 metres. It would therefore seem that had the B.B.C. been allowed to arrange its low-power transmissions on the longer wavelength, permitting of the use of good high frequency amplification, and its high power transmission on the shorter wavelength, where high frequency amplification is neither efficient nor required, the work of the designer of broadcast receiving apparatus would have been simplified.

PATENTS AND ABSTRACTS

Improved Means for Reproducing Sound.*

The object of this invention is to provide a sound reproducer in which the distorting effects due to the natural frequency of a diaphragm may be substantially eliminated. One method consists in employing a plurality of diaphragms of different pitches, each with its own electro-magnet, the coils of the magnets being connected together, preferably in series. A shunt is connected across one or more of the magnets.

Referring to Fig. 1A. A, B and C are three receivers with their coils connected in series, and with adjustable resistances, a, b and c, arranged across the coils. When currents due to found are led through the coils of the magnets, the amplitude of the vibration of any particular diaphragm can be adjusted at will by adjusting the shunts.

Fig. 1B shows a form of magnetophone especially suitable for use in carrying out the invention. D is a heavy rigid case, in the front of which is mounted a diaphragm E, behind which is a pole piece F, surrounded by the coil G, and a polarising coil H, the case acting as the return circuit. J are pads of rubber, which can be pressed by means of screws K, working in brackets L, against the diaphragm to damp it. In cases where sufficient damping cannot be obtained, capacity, resistance and inductance can be connected in the circuit for the purpose of weakening the effect of the diaphragms at their resonant points.

Fig. 1C shows such an arrangement, where M-N are two rejector circuits placed across a combination of two receivers A, B.

It is said that very good reproduction of the human voice can be obtained by employing two diaphragms, one having a natural frequency of about 6,000 per second, and the other of about 600 per second. For the reproduction of music in which bass is present, a suitable combination consists of

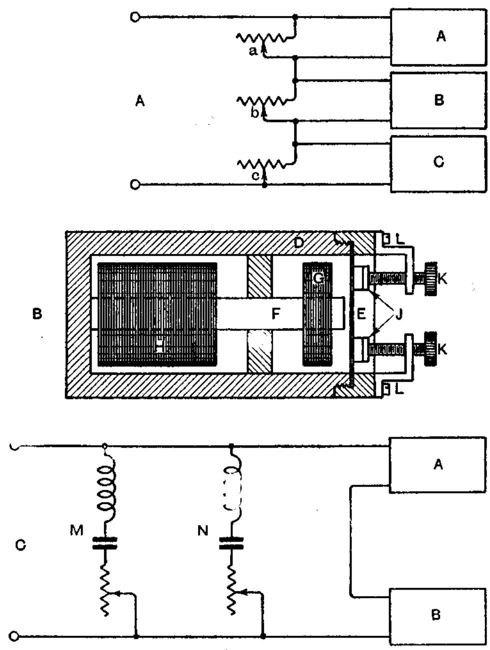


Fig. 1.

three diaphragms, whose natural frequencies may be 200, 900 and 6,000.

Other arrangements are described in the patent specification.

* British Patent No. 215,104, by H. J. Round.

BOOKS RECEIVED.

The British Empire Exhibition, 1924, edited by G. C. Lawrence (Fleetway Press, Ltd., High Holborn, W.C.1). 128 pages. Price 1s.

Librairie de l'Enseignment Technique. Catalogue of Works on Industrial and commercial subjects, including wireless. (Léon Eyrolles, 3 rue Thénard, Paris). 150 pages.

"The time is not far distant when special programmes will be transmitted regularly from America for the benefit of British listeners."—Mr. J. C. W. Reith.

* * * *

The total amount payable to the British Broadcasting Company in respect of licences issued up to March 31st last was £432,000.

* * * *

A wireless "pedlar" has made his appearance in Manchester. He undertakes to repair broadcast receivers, and carries a selection of spare parts.

* * * *

5 XX, the new Chelmsford broadcasting station, is reported to have been heard on a crystal set in Dumfrieshire, 270 miles distant.

* * * *

The broadcasting of sermons and church services has been prohibited in Breslau, according to a Berlin message.

Swedish SMZS.
Mr. Torsten Elmquist, of Helsingborg, Sweden, sends particulars of his experimental transmitting station, which should prove of interest. Transmissions take place on 120 metres every Wednesday and Saturday night. The power used at present is 10 watts but this is shortly to be increased to 50 watts. Our correspondent would be glad to arrange tests with English amateurs and would particularly welcome reports of his transmissions. His address after August 15th will be, Jakobnilsgatan 23, Malm, Sweden.

Broadcasting Marathon Race.
The Olympic Games Marathon Race on Sunday, July 13th, was followed by a motor car containing a broadcasting set. All the principal features of the race were immediately transmitted to a receiving station at the Colombes Stadium for the benefit of the many thousands there assembled.

The Leeds-Bradford Broadcasting Sta ior.
Reports on the transmissions from the newly opened Leeds-Bradford station are distinctly favourable and there is a marked increase in the number of aerials in the two cities. The station actually has two transmitters connected with the studio in Leeds, the transmitters being situated in Leeds and Bradford respectively. Reception has been reported good at Selby and even as far as Hull, but at the moment the guaranteed radius is 5 miles.

Short Wave Work in France.
A French amateur, Monsieur Laborie, has just completed the construction of a transmitter for use on a wavelength of 55 metres. His call sign is to be **8 BB.**

German Enthusiasm.
Popular enthusiasm in Germany over the introduction of broadcasting seems to be reaching a somewhat advanced stage. The latest evidence of this is the vogue of the floating radio set, to be found in many swimming baths. To add to the seductive charm of the arrangement, beer is served from the same float.

Wireless in Empire Pageant.
Early transatlantic experiments will feature in one of the most interesting scenes in the "Pageant of Empire" at the Wembley Exhibition. In this episode, Senatore Marconi will appear in person, taking part in a Newfoundland scene with the actual wireless apparatus on which he secured his early success in long-distance wireless signals. We understand that as far as possible the same assistants who were present on the memorable occasion referred to will take their part in the pageant.

New Zealand's Broadcasting Plans.
If the ambitions of New Zealand in the matter of broadcasting are realised, the country should possess one of the most efficient broadcasting systems in the world. A company is being formed to control broadcasting and will begin by establishing four 5,000 watt stations—two in each island (north and south).

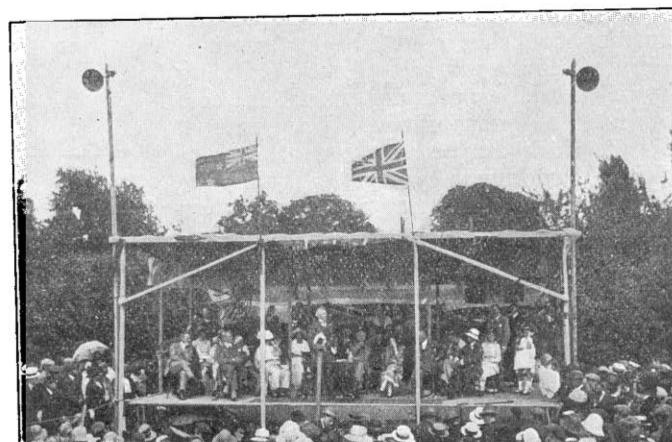
The Government has given a sympathetic hearing to a deputation of the promoters of the company, which will comprise the wireless trade and listeners-in, besides a representation of the Government.

New York's Broadcasting Station.
The City of New York, on July 8th, opened its new wireless broadcasting station, which has been installed in the Municipal Building at a cost of £10,000. The call sign is **WYNC** and transmissions are carried out on a 526 metre wavelength.

Programmes from the station will consist chiefly of municipal information in a popular form previously accessible only in statistical reports. In addition, assistance will be given to the work of the police, fire and health departments, and concerts will be transmitted.

Wireless in German Aerodromes.
The provision of wireless apparatus in every aerodrome in Germany is rendered imperative by an act recently passed in the Reichstag. Installations must be capable of receiving meteorological bulletins from all parts of Europe and must be suitable for communication with passengers in flight.

Wireless in Schools.
The experiences of a headmaster in the introduction of wireless in a rural school are interestingly related in the current issue of the *Teacher's World.* The writer is Mr. A. S. B. Minhinnick, Headmaster of Polchampton Boys' School,



Loud speakers were used with great success at an open-air political meeting held at King's Langley recently. In the photograph the Rt. Hon. Lloyd George is seen speaking before the microphone. The technical arrangements were supervised personally by Captain H. J. Round.

The well-equipped stand of Messrs. Radio Instruments, Ltd., at the recent Brussels Wireless Exhibition.

Twyford, Berks. The necessary funds for the construction of the receiver were raised by subscriptions from scholars, parents, old boys, school managers, and a few members of the outside public. Twyford being outside the crystal range of London, a valve set had to be employed, but it is hoped that with the opening of the new high-power station at Chelmsford, it will now be possible for the boys to construct crystal sets during the handwork science lessons.

Writing of the value of broadcast lessons, Mr. Minhinnick states that it has been found advisable to select pupils for these studies; some boys are not capable of giving the necessary voluntary concentration to an unseen speaker. Generally speaking, however, the pupils appreciate the opportunity of listening to the living voice of some eminent scholar, actor, musician or traveller, and it is the writer's opinion that such training will foster a desire in after-school life to continue the improvement of the mind with this direct contact with master minds.

Dutch PCII.

Many amateurs may have noticed that the transmissions from the well-known Dutch Experimental Station **PCII** ceased some time ago. The reason for this is now explained in our Dutch contemporary the "Radio Wereld," in which it is stated that the station was closed down by order of the authorities, pending a charge of transmitting without proper authority. The owner of the station is Mr. H. J. Jesse, Jnr.

For the defence it was contended that the wireless telephone had never been used by **PCII** and that the Government monopoly over commercial wireless had not been violated. Furthermore, **PCII** operated on short wavelengths with low power and at no time interfered with Government or commercial stations.

It was also urged that it was practically impossible to use a permit as outlined in the law for the purpose of the experiments carried out at **PCII.**

At the conclusion of the evidence the Clerk of the Open Ministry began his summing up of the case by congratulating Mr. Jesse on his success in communicating with America. At this point, the prosecutor arose and objected. The Clerk added, however, that the words of the law did not apply to the case in question and the matter could only be considered from the possibility of using the station for spy communication. As the results of the tests were published in the press, however, it was plain that no attempt was made to deceive the Government. The Clerk further suggested an early judgment, a levy of a small fine and the restoration of the confiscated apparatus.

The attorney for the defence thanked the Open Ministry for the very lenient decision and remarked that it was not often that the Court addressed the accused with a good-luck wish. He also said how bad it would appear if, while France gave a gold medal to the first French amateur to work across the Atlantic, the Netherlands brought its amateurs into court and hindered scientific progress and experimental work in radio. It was decided that the defendant had not transgressed the law and the case was dismissed.

We hope that **PCII** will again be working in the near future.

Radio and Crime.

Among the features of the daily programmes sent out by the Reich-Telegraph Administration in Berlin will be descriptions of wanted criminals. It is also announced that broadcast programmes have been instituted in certain German prisons for educational purposes.

New Premises.

To cope with increased business Messrs. The Peto Scott Co., Ltd., have taken new premises at 77 City Road, for their registered offices and works. The company is also opening a new shop at 62 High Holborn, which will contain a comprehensive display of Peto Scott products.

Amplion Loud Speakers at Wembley.

Messrs. Alfred Graham & Co. have had their attention drawn to the fact that statements have been made not only in the press, but elsewhere, that the loud speakers used at the B.B.C. kiosk at Wembley are of some other make than Amplion.

In contradicting this impression the Company states that the instruments in use are Amplion loud speakers, type A.R.49, and are standard productions in every respect.

New Australian Broadcasting Regulations.

The Australian Government's new broadcasting regulations completely alter the existing scheme, which is based on sealed receiving sets, each set sealed with a particular wavelength allotted to the broadcasting company to which the purchaser subscribes. The new scheme adopts the principle of the open set, and charges a licence fee ranging from 25s. to 30s., according to the radius of the broadcasting station. Two classes of station are authorised, one mainly devoted to advertising, and the other to entertainment. The latter receives revenue licence fees, less 5s., retained by the Government. This scheme limits the number of broadcasting stations in each State. The uncertainty of the Government regulations has hitherto considerably restricted the popularity of broadcasting in Australia, for the sealed set, designed to prevent monopoly and ensure revenue to the broadcasting companies, never had a chance to prove itself, although an excellent service was operating in New South Wales for several months. Experimental licences for bona-fide investigators are provided under the new scheme, and the Government collects the revenue.

Radio Association of Ireland.

At a special meeting of the Association held in the Municipal Technical Schools, Kevin Street, Dublin, on Thursday, June 19th, 1924, Mr. E. R. Jones gave an interesting lecture and demonstration on wireless reception with telephones and loud speaker, employing a Brown microphone amplifier.

Mr. Jones demonstrated with a three-valve straight circuit tuned anode, which he had constructed himself.

After appealing to amateurs to do all they could to stop interference by oscillation, Mr. Jones spoke of loud speakers and said that the distortion so often evident with loud speakers was mainly caused by bad amplification, consequent on inefficient design of the transformers used; a warning was also given against the too common custom of forcing the loud speaker beyond its natural capabilities.

After a general discussion, the Chairman said that Mr. Jones had kindly offered a prize of a pair of Brown's 4,000 ohm adjustable headphones, for the best three-valve set constructed by a member of the Association who has never yet made up a valve set. This competition is open to new members who join before the closing date, which will be announced in due course. Intending competitors are asked to forward their names to the Hon. Secretary, Radio Association of Ireland, 20 Harcourt Street, Dublin.

Mr. Marshall Harriss in conclusion said that he was glad to be able to announce that an agreement had been concluded, giving the Association possession of a fine room in No. 20 Harcourt Street. Regular weekly meetings would be held there, which he hoped would be as well attended as the present one.

Hon. Sec., J. P. Murphy, 20 Harcourt Street, Dublin.

The Birmingham Wireless Club.

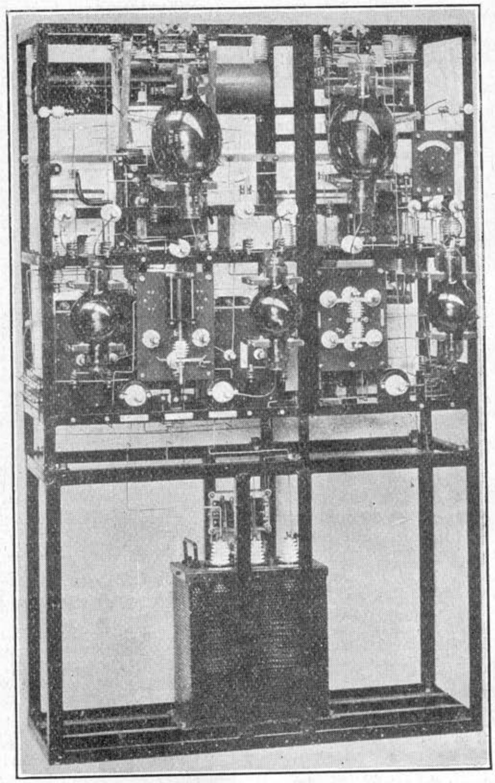
On Friday, June 27th, Mr. H. E. Payton delivered an interesting lecture on "Telephones." In spite of a very small attendance, a most informative discussion followed.

Hon. Sec., H. G. Jennings, 133 Ladywood Road, Birmingham.

The Leicestershire Radio and Scientific Society.*

The Society met for the last time prior to the midsummer vacation on Tuesday, July 1st. Several visitors were present. Mr. Cyril T. Atkinson, in an elementary paper, dealt with reaction and its effects.

It is hoped to hold at least one open air function before the Autumn and details will be published shortly. The Society again wishes to draw to the notice of all concerned the desirability of becoming a member. Particulars of membership will be gladly furnished on application to the Hon. Sec., Jos. W. Pallett, 111 Ruby Street, Leicester.



Courtesy: Marconi's Wireless Telegraph Co., Ltd.

Suitable for either telegraphy or telephony, the Marconi Type U transmitter, seen above, operates on a power of 3 kilowatts.

The loud speakers in use at the B.B.C. kiosk at Wembley are of the Amplion A.R. 49 type, of which the above is an example.

RADIO SOCIETY OF GREAT BRITAIN

The Radio Society of Great Britain is in touch with the Postmaster-General regarding the restrictions relating to transmissions to the Dominions and foreign countries recently introduced into the Experimental Transmitting Licences now being issued. It is hoped that an official announcement may be made at an early date.

(Signed) W. H. ECCLES, President.

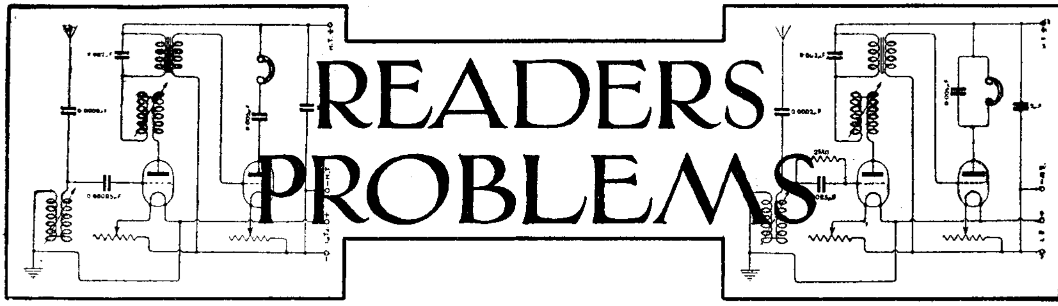
Forthcoming Events.

On Thursday, July 24th, Captain P. P. Eckersley, Chief Engineer of the B.B.C., will visit the Wireless Society of Hull and District. The meeting, which will be open to the general public, will be held in the Owen Hall, Baker Street, Hull, and will commence at 7.30 p.m.

On the same evening Mr. C. C. Phillips will lecture before the Hackney and District Radio Society on the subject of "The Calibration of Condensers."

Members of the Golder's Green Radio Society will at 11 a.m. on Sunday, July 27th, pay a visit to **6 XX**, the experimental transmitting station of the Radio Society of Great Britain.

READERS PROBLEMS



1. *All questions are answered through the post. A selection of those of general interest is published.* 2. *Not more than four questions may be sent in at any one time.* 3. *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* 4. *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

" *J.B.*" (*Milan*) **asks for a diagram of a four-valve receiver for broadcast reception in which only one variable coupling is used, and with a reaction coil used in such a way as to reduce as far as possible radiation from the aerial.**

The diagram is given in Fig. 1. As you intend to receive over a band of wavelengths between 250 and 600 metres, the A.T.C. may be connected permanently in series with the aerial circuit, and may be given a capacity of 0·001 μF. Tuned anode coupling is employed between the H.F. and detector valves, and the single variable coupling permissible is between this anode coil and the reaction coil. With this arrangement, the risk of radiation from the aerial will be considerably less than if the reaction coil were coupled directly to the A.T.I.

" *W.D.*" (*Liverpool*) **sends a description of a three-valve receiver, and asks why he is unable to eliminate the transmissions from the local broadcasting station.**

The receiver is directly coupled to the aerial

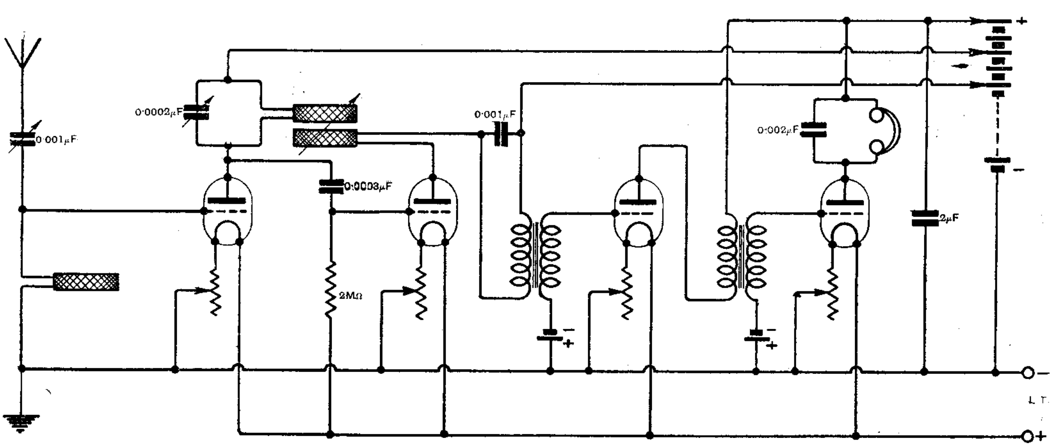


Fig. 1. " J.B." (Milan). A four-valve receiver with one stage of H.F. and two stages of L.F. amplification.

circuit, and a high degree of selectivity cannot therefore be expected. A coupled tuning circuit consisting of a tuned secondary circuit coupled to the A.T.I. should be used if possible. Without adding a tuned secondary circuit, the selectivity could be improved by connecting the tuning condenser in series with the aerial circuit. The aerial itself should not be longer than is necessary to obtain the required signal strength, and should be erected well clear of partial conductors, such as trees or the walls of buildings.

" *R.W.*" (*Bramley*) **wishes to use two pairs of telephones with a valve receiver, and asks if they should be connected in series or in parallel.**

Of the two alternatives, the better method to use will depend upon the resistance of the telephones and the plate-filament impedance of the last valve. If high resistance telephones are used in conjunction with a low impedance valve, best results will be employed, and if the anode current flows through the telephone windings, care should be taken that the connections are such that the polarity of the magnetic field produced by the steady current coincides with that of the permanent magnet.

" *F.M.D.*" (*Bristol*) **asks for a diagram of a three-valve receiver (1-V-1) suitable for the reception of C.W. transmissions on wavelengths between 10,000 and 30,000 metres.**

A diagram of a suitable circuit for this purpose is given in Fig. 2. The H.F. valve is resistance capacity coupled to the detector. Although the degree of H.F. amplification obtainable with resistance coupling is not so high as with other methods, its use is justified on long wavelengths, because of the difficulty and cost of making suitable anode inductances or H.F. transformers. A further advantage of this method is that it is aperiodic, and the whole of the operator's attention may be given to the adjustment of the tuner. In order that the well known makes of plug-in tuning inductance may be used in the secondary circuit of the tuner, two coil holders connected in series have been indicated. The largest plug-in coils available will require a very large tuning capacity in parallel in order to reach a wavelength of 30,000 metres, and it is therefore advisable to use two coils in series in order that a smaller tuning capacity may be employed. One of these coils may be coupled to the A.T.I. and the other to the reaction coil. A potentiometer is provided to control the grid potential of the H.F. valve, and separate condensers are connected between each H.T. tapping and −H.T. The use of a separate heterodyne in conjunction with this receiver is strongly recommended, as the efficiency of the autodyne method of C.W. reception, in which the receiver itself is made to oscillate, is not very high on long wavelengths.

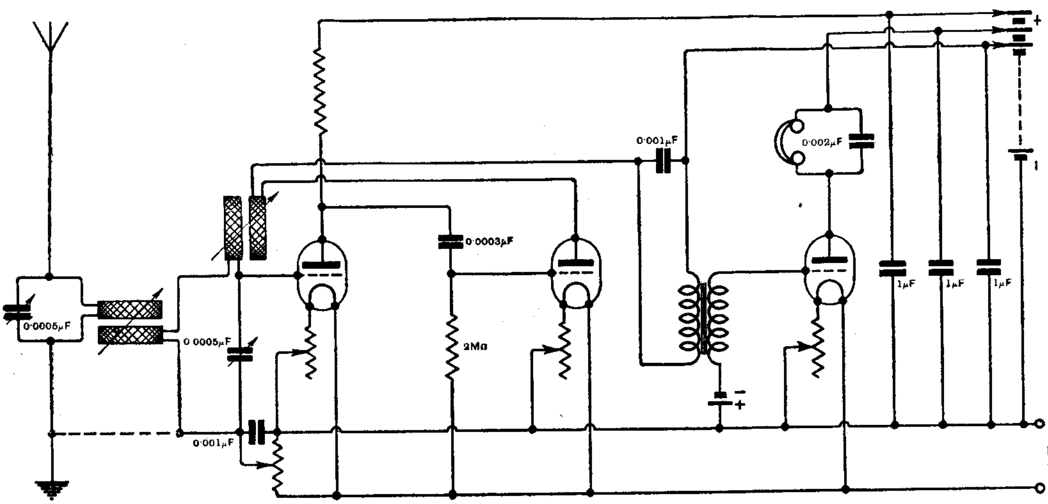


Fig. 2. " F.M.D." (Bristol). A three-valve receiver designed for long wave reception.

obtained with the telephones connected in parallel. If you are unable to find the best method of connection before building the set, fit only one pair of telephone terminals; series or parallel connections can easily be made externally with the aid of connector terminals.

" *R.S.*" (*Colne*) **asks if it is absolutely necessary to use a low resistance loud speaker or telephones when power valves are employed for L.F. amplification.**

Although some high resistance loud speakers and telephones are capable of carrying steady current of the order of 10 milliamperes, it is better to eliminate the steady anode current if possible. This may be done by using either a filter feed circuit consisting of low frequency choke coil and condenser in conjunction with a loud speaker with H.R. windings, or by means of a telephone transformer and low resistance windings. If these methods are not

The WIRELESS WORLD AND RADIO REVIEW

METRES OR KILOCYCLES.

FROM the time of the introduction of communication by ether waves, it has been the practice to refer to transmitters as operating on wavelengths expressed as so many metres, or when speaking of a receiving set to state that it is designed to receive over a particular wavelength band.

In the early days, when a limited number of stations were in operation, the allocation of wavelengths to the various services for the purpose of preventing interference was an easy matter, but now almost every band of wavelengths is overloaded. In giving consideration to the allocation of wavelength bands it has become apparent that they can be more accurately pictured when expressed in terms of oscillation frequency rather than in terms of wavelength. The simple formula showing the relationship between frequency and wavelength is well known and the frequency of oscillation is obtained when the velocity of ether waves (300,000,000* metres per second) is divided by the wavelength.

The determination of the separation of wavelengths required between transmitting stations for non-interference cannot be seen from wavelengths expressed in metres, but only by a consideration of difference of frequency expressed in cycles. To illustrate this point, 50 transmitters can operate simultaneously on wavelengths between 150 and 200 metres, for the difference of frequency is 2,000 to 1,500 kilocycles or a separation of 500 kilocycles. On the other hand only one station can operate at a time between 1,000 metres and 1,050 metres, for the difference here is only 14 kilocycles.

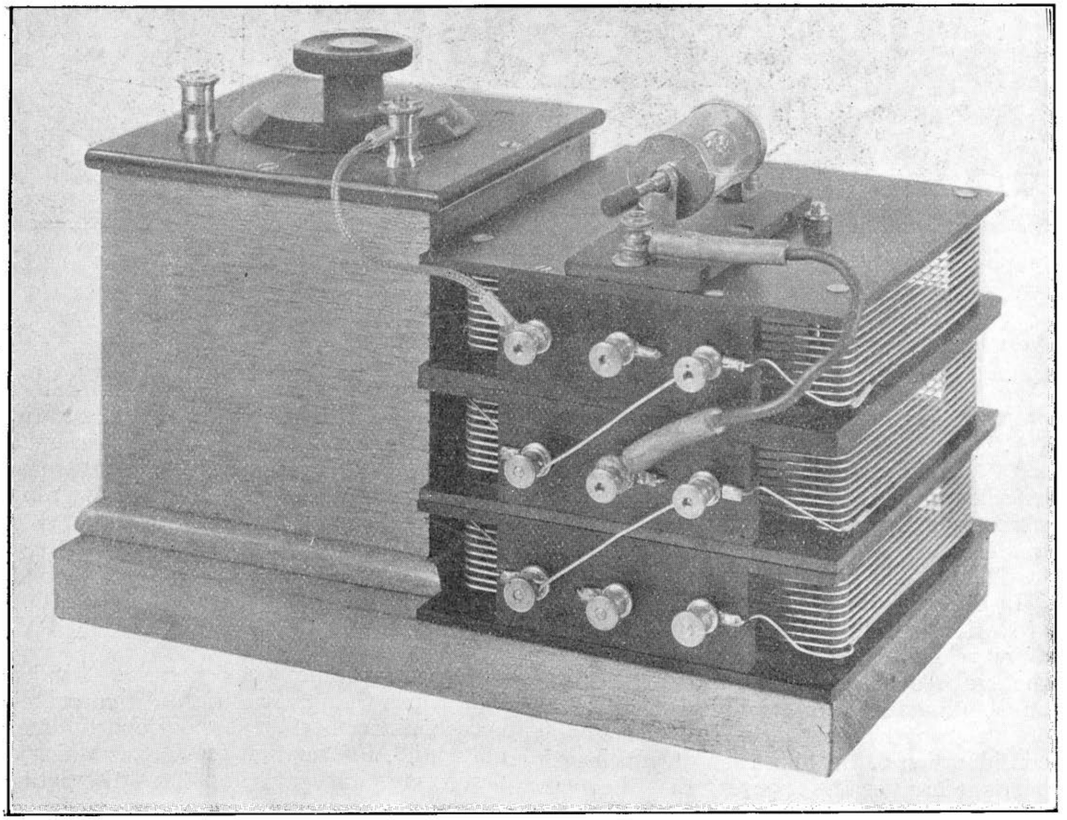
One of the merits of short wave working is apparent from this, in that when operating on wavelengths below 200 metres interference is reduced and the amateur is fortunate in the allocation to him of such an extensive range of kilocycles as is covered by the short wavelengths.

* Velocity is more accurately 299,820,000 metres per second, which figure is used when converting wavelengths to frequencies.

BY WHOSE AUTHORITY?

Just at a time when there are evident indications that the position of the amateur is becoming consolidated and proportionately influential, information reaches us which at first may appear somewhat disquieting. We refer to a printed circular recently forwarded to transmitting amateurs announcing the proposal to form a new society for transmitters. Some of the objects of the proposed scheme, which goes by the name of "Radio Corporation," are to bring all transmitters in England under one head, to obtain necessary freedom for transmitters, and to promote harmony between the various departments engaged in wireless telegraph and wireless telephone work. The scheme certainly sounds ambitious, as does also the name, but although reference is made to "The Executive of the Scheme," no names appear on this circular beyond that of the "President" over whose signature the letter is sent out.

We think that before considering the advisability or otherwise of supporting a new enterprise of this nature at such a juncture in amateur affairs it would be well to ascertain who are the members of the "Executive" and whether the "President" is an individual elected to that office or self-appointed.



Crystal receiver designed for extreme efficiency.

COIL DESIGN FOR CRYSTAL RECEPTION.

The author of this article has carried out some very conclusive determinations on the conditions necessary to bring about maximum signal strength in crystal receiving sets. He here interprets the observations made in his experiments in designing a crystal set of extreme efficiency.

By F. M. COLEBROOK, B.Sc.

IN an article published in *The Wireless World and Radio Review,* April 30th, 1924, the writer described a series of experiments in which it was shown by objective measurements that in order to obtain the most efficient reception of wireless telephony by means of a crystal or similar power operated detector it is essential that there shall be some means of controlling the load imposed on the aerial by the detector. In a second article, published in last week's issue, a theoretical analysis of reception conditions was given, and it was shown that the maximum signal intensity will be obtained when the effective resistance of the tuning circuit-detector combination is equal to that of the remainder of the aerial.

The object of the present article is to

describe a type of coil construction which has been found by the writer to be very satisfactory for the practical realisation of the theoretically best reception conditions.

For various reasons, the chief of these being general adaptability, it was decided to adopt a unit system, the unit chosen being a ten-turn coil with three terminals, one at either end of the winding, and one tapped to the centre.

The component parts of a single unit are illustrated in Fig. 1. In the models constructed by the writer, the large end plates were cut from $\frac{1}{8}$ in. ebonite sheet. This was perhaps an extravagance, since these plates play no part in the insulation of the coil. The flatness of this material, however, and its excellent dielectric properties make it very suitable for this purpose.

The cross pieces are cut from ebonite tube, the external diameter being $\frac{3}{8}$ in. and the central hole $\frac{1}{8}$ in. The grooves are easily cut with a tool shaped for the purpose, their width and depth being such that a No. 20 bare copper wire will bed down in them, the sloping sides ensuring the centreing of the wire. In two out of each four of these cross pieces the last grooves should be cut slightly deeper than the others. A single turn of No. 20 wire is laid in these larger grooves and soldered, as shown in Fig. 2.

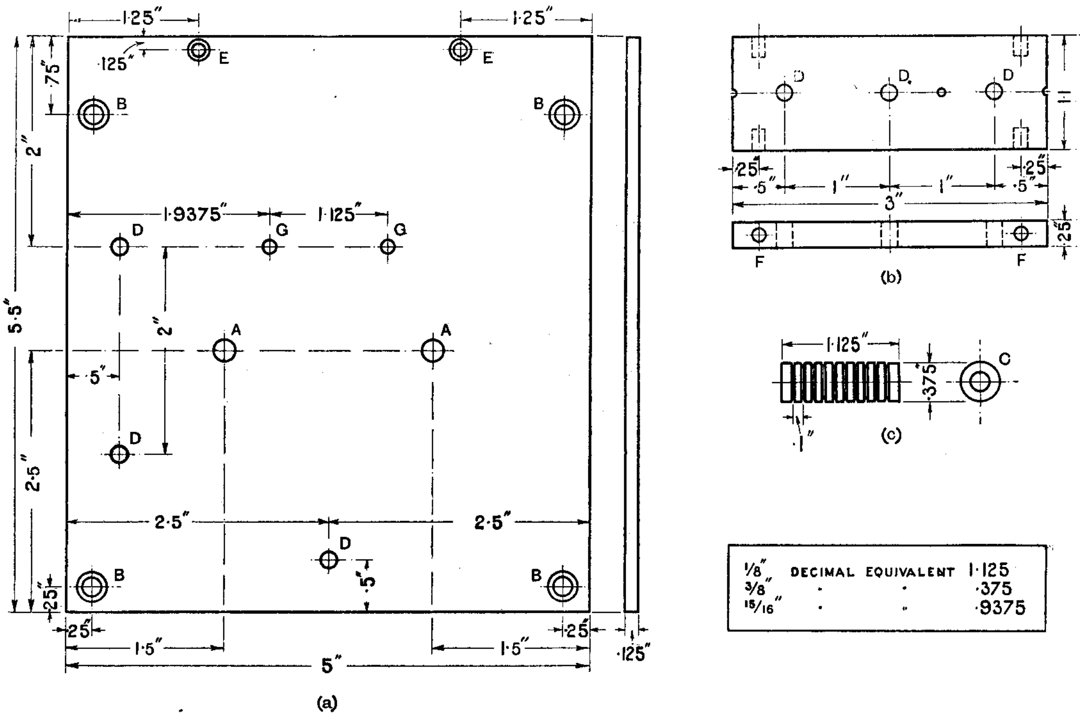


Fig. 1. Component parts of the inductance unit. Decimal dimensions are shown for uniformity and fractional equivalents are given. Sizes of holes : A, Drill 7/32″ dia.; B, Drill 3/16″ dia. and countersunk on topside for No. 3 B.A. screws ; C, Tapped No. 3 B.A. ; D, Drill 5/32″ dia. ; E, Drill 1/8″ dia. and countersunk on topside for No. 6 B.A. screws ; F, Tapped No. 6 B.A. × 3/16″ deep ; G, Tapped No. 4 B.A.

Having assembled the two end plates and four cross pieces, the winding will be found a very simple operation if carried out as follows. One end of an 18-ft. length of the wire is clamped in a vice or otherwise

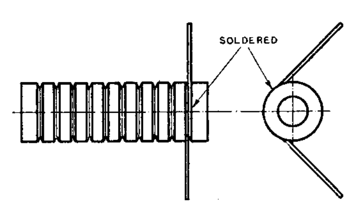


Fig. 2. Method of terminating the winding.

securely held. The other end is held with pliers and the wire strained so as to give it an extension of an inch or so in length. This process will straighten the wire very effectively. The free end of the wire is now soldered to one of the terminal wires, the other end being left clamped as before. The wire should not be handled at all in laying it round the frame, as this will inevitably give rise to small bends. This can be avoided by taking the frame away to the full length of the wire from the clamped end and rotating it, laying the wire in the grooves prepared for it, a light tension being maintained as the frame moves towards the clamped end. When the whole ten (or 9¾ to be exact) turns have been wound the clamped end can be freed and a soldered connection made to the remaining terminal wire. Finally a short length of the same wire is soldered on to the middle of the top centre turn for connection to the centre terminal of the terminal block. The latter can now be fastened in position by means of four 6 B.A. screws (countersunk) the wires for connection to the terminals being threaded through holes prepared for them. These wires are then cut short and soldered to small copper tags of the usual eyelet form which are clamped on to the top face of the terminal block by means of the 4 B.A. terminals. This completes a single ten-turn unit. Five, or at most six, such units will probably be sufficient with most forms of aerial.

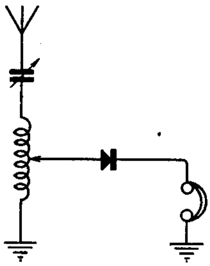


Fig. 3. Crystal receiver circuit to give maximum signal strength.

The actual number required will of course depend on the type of tuning adopted. As stated in the article on this subject in the previous issue, series condenser tuning is only very slightly less efficient than pure inductance tuning provided the coils used are of fairly low high-frequency resistance and small self-capacity, both of which conditions are satisfactorily fulfilled by the construction described above, and provided the tuning capacity does not fall below about 0·00025 microfarads. For this circuit, illustrated in Fig. 3, it will be found that four or five coils give an inductance of

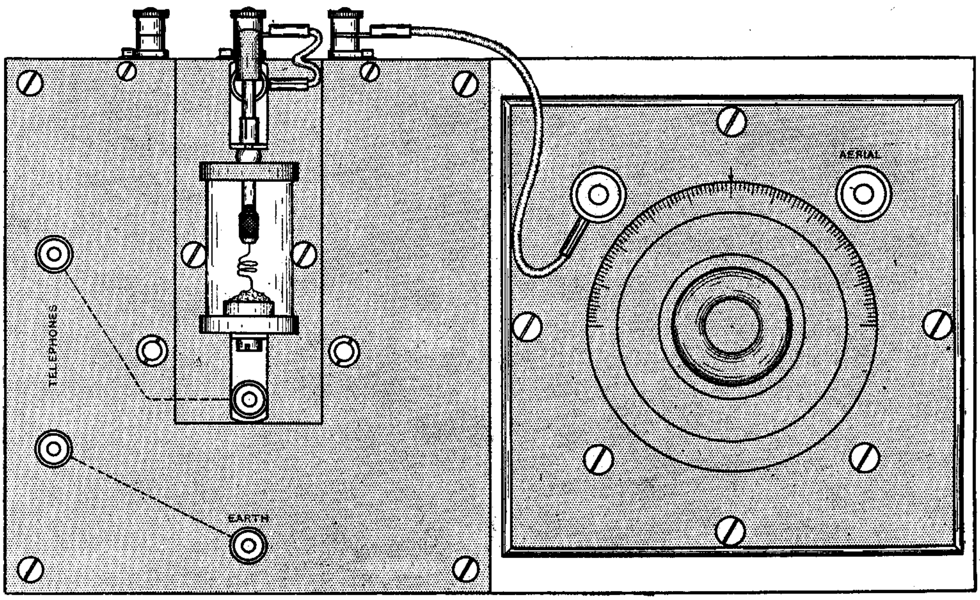


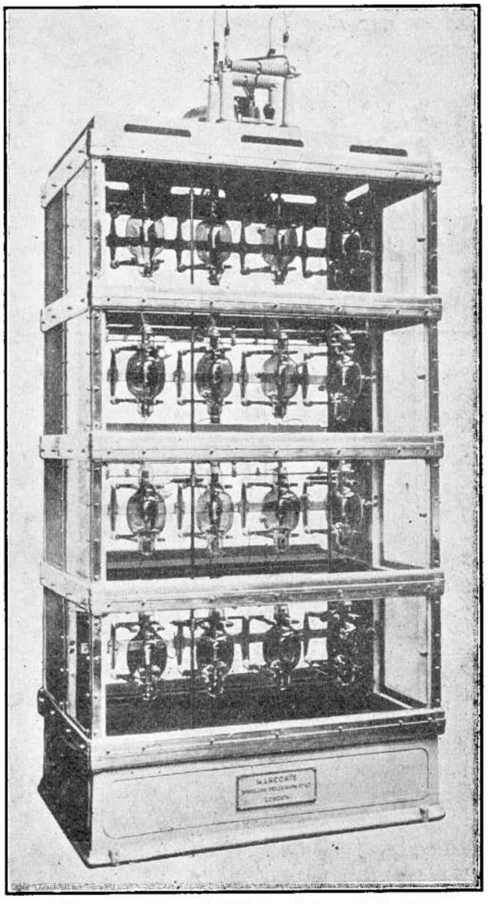
Fig. 4. The arrangement of inductances, detector and tuning condenser.

suitable value for an aerial of approximately standard dimensions. The centre terminal of the coils permits of the variation of the detector tapping by five turns at a time, the best position being found by trial. In all cases except those in which the resistances of the aerial and the detector circuits are very high, it will be found that the telephone intensity rises as the number of the turns included in the detector circuit increases from zero, reaching a maximum value at about fifteen or twenty turns, after which point there will in general be a perceptible diminution of intensity. Each variation of the tapping point will require a slight alteration of the tuning condenser. The right tapping point is of course that which gives the maximum intensity. In cases where this maximum is flat, there being very slight variation of intensity over a wide variation of the tapping point, the smallest number of turns which will give this maximum should be used, for reasons explained in the previous article.

It may be of interest to point out that if a comparison is made between two circuits, one of which contains a larger inductance than the other, an apparent paradox will be revealed. It will appear that the tuning, judging by the effect of equal small variations of the tuning condenser, is considerably sharper in the second case than in the first, in spite of the fact that the total aerial resistance is larger in the second case. This greater sharpness of tuning is, of course, only apparent, and is due to the fact that a small variation of a small capacity produces a greater change of reactance than an equal variation of a larger capacity, since the reactance of a condenser at any given frequency is inversely proportional to its magnitude, *i.e.*, for a condenser of magnitude C and a frequency $\omega/2\pi$ the reactance is $1/\omega C$, so that for a small variation δC we have $\delta X = -\delta C/\omega C^2$, which increases as C decreases. Of the two circuits considered above that which has the larger inductance will have a slightly greater decrement than the other, but its tuning will actually appear to be sharper because the value of the tuning capacity will be correspondingly smaller.

The requisite number of ten-turn units for a complete receiving set can be assembled in any convenient manner. That shown in Figs. 4 and 5 is a suggested form. The wooden baseboard used should be large enough to take the coils and a variable condenser of, say, 0·0005 or 0·001 microfarads. The coils can be secured to the baseboard by means of two long pieces of 2 B.A. studding which pass through the two central holes in the side plates of the coils. If the detector and additional terminals are mounted as shown on the side plate of the top coil, then this side plate should be of ebonite, whatever material has been used for the other coils, and the necessary marking out and drilling should be done before the coil is assembled and wound.

(To be concluded.)



Courtesy: Marconi's Wireless Telegraph Co., Ltd.

Mounting for high power oscillating and rectifying valves. The frame is of angle-aluminium with sliding glass windows. The valves can be rapidly replaced.

PLOTTING VALVE CURVES AUTOMATICALLY

Valves are designed to operate on particular settings of grid and plate voltage and good amplification is only obtained when these values are applied and makers of valves indicate the H.T. potentials which should be used. The characteristic curve of a valve shows the best operating conditions, and in this article an instrument is described which plots the curve automatically.

By W. BAGGALLY.

It is the purpose of the writer to describe in the following article an apparatus designed by him which reduces the plotting of valve characteristics to a purely automatic process, and which therefore may be handled by unskilled operators if necessary.

Let us consider the nature of the problems involved in the design of such an instrument.

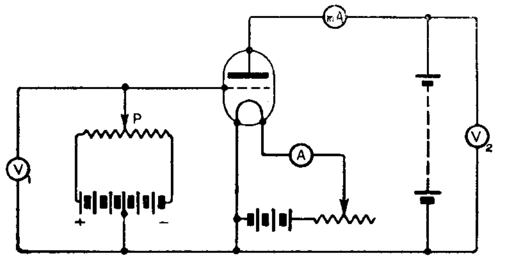


Fig. 1. *Circuit for plotting grid voltage—anode current characteristic. The potential applied to the grid is varied by means of the potentiometer P and indicated by the voltmeter V_1 while the plate current is read off on the milliammeter mA. Filament current and plate voltage remain constant.*

Fig. 1 shows the circuit employed in plotting the grid voltage-anode current characteristic of a triode, the method of procedure being, as is well known, to adjust the slider of the potentiometer P so as to obtain successive convenient values of grid potential from the maximum negative value, through zero to the maximum positive value as shown on the voltmeter V_1, and to observe the corresponding values of anode current by means of the milliammeter mA, keeping the filament current and anode voltage constant, as shown on the ammeter A and voltmeter V_2 respectively.

A graph is then drawn to a convenient scale, taking the values of the grid potential as abscissæ and anode current as ordinates, the graph usually working out somewhat as Fig. 2, which shows a curve taken on the "Charactograph" or automatic curve plotter to be described.

It occurred to the writer that if an instrument were constructed in such a manner that the distance moved along a straight line by a tracing point was made proportional to grid potential, and a movement at right angles to the first was made to vary as the anode current, the resultant path traced out would constitute the grid voltage—anode current characteristic of the triode under observation to rectangular co-ordinates, the motion being obtained by causing the independent variable, which is in this case grid potential, to successively pass through all values from the maximum negative to the maximum positive value, a paper chart placed directly beneath the path of the tracing point having the characteristic drawn upon it.*

In practice, the chart itself moves under the pen, being mechanically geared with a

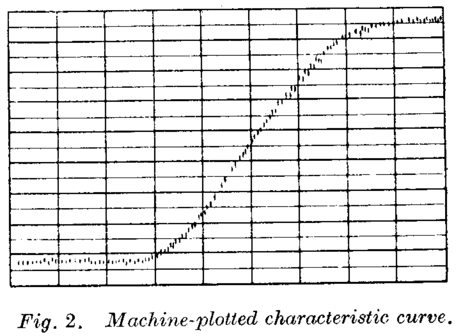


Fig. 2. *Machine-plotted characteristic curve.*

switch arm passing over 140 contacts connected with a potentiometer-like arrangement in the grid circuit of the valve, the whole apparatus being driven by clockwork, strict proportionality between grid potential and abscissæ on the chart being thus secured.

The tracing point takes the form of the needle of a suspended coil galvanometer in

* Provisional Patent No. 21632/23.

the anode circuit, shunted so as to have a suitable range, and arranged to move across the chart and in a line at right angles to the movement of the latter.

This galvanometer corresponds to the milliammeter mA of Fig. 1, its deflection being proportional to the current flowing in the anode circuit.

The needle of the galvanometer cannot be in continuous contact with the paper owing to friction impeding its free motion, and it is necessary to make use of a thread recorder mechanism.

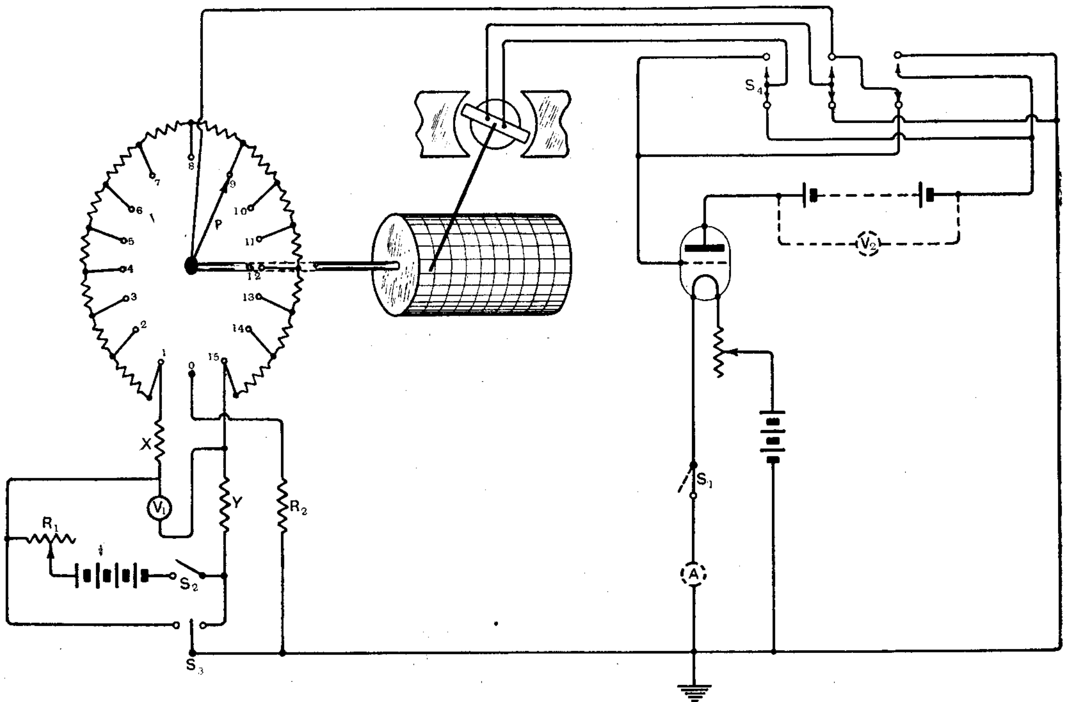


Fig. 3. Diagram showing the operation of the instrument.

This consists of an inked thread similar in composition to a typewriter ribbon, which is slowly moved along its length between the needle and the paper, and a "chopper bar," running the width of the paper and suspended over the thread, which periodically descends, forcing the needle, wherever it may be, down on to the thread and the thread on to the paper, thus impressing a dot on the latter, then rising, leaving the needle free to swing into its next position.

The graph plotted therefore consists of a series of dots, and as the chopper bar is geared so as to descend once for each stud passed over by the potentiometer arm, it will be seen that each dot is, in reality, an accurately plotted point on the characteristic curve.

An electrical diagram of the instrument used in the writer's laboratory is given in Fig. 3, in which several special points require explanation.

The switch S_4 is for the purpose of transferring the galvanometer from the anode circuit to the grid circuit, so making the instrument available for taking grid voltage —grid current, as well as grid voltage—anode current characteristics, the galvanometer usually being used unshunted for grid current work.

This switch also affords a simple means of checking the accuracy of the instrument as a whole, for when the galvanometer is in the grid circuit position, the valve removed and a resistance connected across grid and filament terminals of the Charactograph, a straight line graph is obtained by which the calibration of the instrument may be effected if the value of the resistance is known.

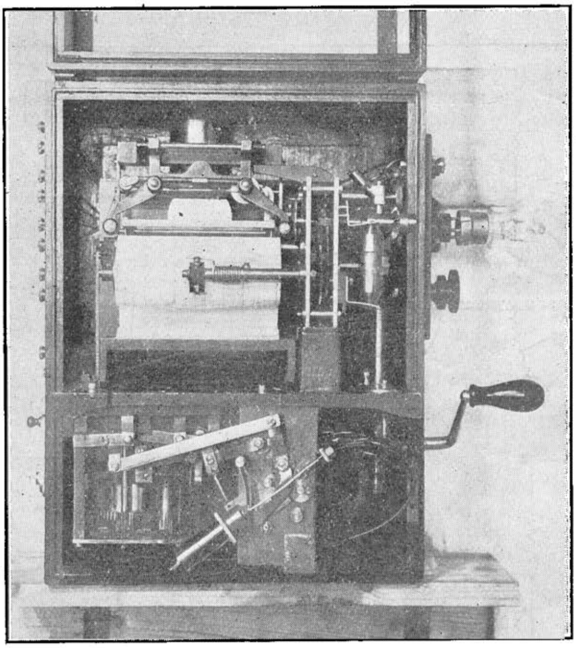
In the second place it is to be noted that only half the number of cells in the grid battery are required for the Charactograph as compared with the orthodox circuit of Fig. 1.

This is arranged for in the following way :—

The switch S_3, together with S_1 and S_2, which latter two switches control filament and grid potentiometer current respectively, are operated automatically by means of cams in such a manner that on pressing the starting lever, S_1 and S_2 are closed, S_3 being thrown into the left-hand position, thereby connecting the positive of the grid battery to the valve filament and earth. The clockwork drive is started, and the chart commences to move forward, also the contact arm P rotates over the studs (only 15 are shown for clearness), commencing at No. 15 (maximum negative), and working downwards over 14, 13, 12—2, 1, in which last position the potential drop down X is applied to the grid.

It is to be noted that the arm must always make contact with at least one stud, that is to say, it must pass on to the next before coming off the previous one, otherwise there would be a period of zero grid voltage between each pair of studs which would cause the anode galvanometer to swing about, and so necessitate running the Charactograph very slowly, so as to give the needle time to settle down before each descent of the chopper bar.

Simultaneously with the transfer of the contact arm from stud 1 to stud 0, S_3 changes over to the right-hand position, earthing the negative of the grid battery.



Machine for automatically plotting valve characteristic curves. Several of the components referred to can be identified.

With the arm on stud 0, the grid is earthed through R_2, the object of this resistance being to prevent the grid from assuming a negative charge when on this stud, at the same time avoiding the shorting of the grid battery which would take place when passing from stud 1 to stud 0 if the latter were directly earthed.

The arm has now completed one complete revolution, and we have that half of the characteristic drawn which lies to the left of the grid zero perpendicular, and it will be seen that as the arm makes its second complete revolution, the grid potential will rise from zero to its maximum positive value, *i.e.*, when the arm is on stud 1 again and the graph will be completed.

Upon the arm reaching stud 0, the switch cams again come into play, opening S_1 and S_2, and changing S_3 over to the left once more in readiness to plot the next characteristic.

The position of the voltmeter V_1, which indicates the maximum voltage to be attained by the grid with a given battery, is of interest, the object of not connecting the voltmeter across both X and Y being that the potentials set up down X and Y are never simultaneously applied to the grid, but only one at a time—X for the first revolution and Y for the next.

This will be seen to be the case if the cycle of operations be studied carefully.

The rheostat R_1 is a fine adjustment device, and is used to set the grid voltage range to a convenient round number.

THE IMPORTANCE OF THE GRID LEAK

AND ITS PURPOSE IN REACTING CIRCUITS

By C. HANDFORD.

How often does one hear the statement made that a particular set works well without a grid leak. This article describes the practical results obtained by using grid leaks of unsuitable value and draws attention to the necessity of correctly adjusting the grid circuit.

Most experimenters must have experienced that annoying property possessed by some sets in which critical reaction control is unobtainable, and in which the circuit drops in and out of oscillation in a most erratic manner. This condition is traceable to the grid leak, and the way to overcome the difficulty is explained.

THE use of a leak in conjunction with a condenser to produce rectification on the grid of a valve is familiar to most users of valves for wireless reception, but it does not appear to be generally known that the value of this leak affects to a marked extent the manner in which the set responds to the reaction adjustment, when it is used in a set where critical reaction is required to bring in faint signals.

The value of the grid-leak in non-regenerative circuits is in general not at all critical. With an "R" valve in the possession of the writer, variation of the grid-leak between the value of 0·9 and 8 megohms produced less than 5 per cent. change in signal strength as measured by an audibility meter. This amount is quite inappreciable in ordinary reception.

In the case of a circuit where reaction is used, however, when the leak is below a certain fairly critical value, the phenomenon known in the days of the soft valve as "floppiness" makes its appearance. As the reaction coupling is increased, the signal becomes progressively louder, till, at say, 60 degs. of coupling, the set bursts suddenly and with a dull "plop" into strong oscillation. The character of telephony or spark is, of course, entirely lost. On reducing the coupling, oscillation does not stop till a lesser coupling than that began the oscillation, say one of 56 degs., is reached. This is a very uncomfortable kind of adjustment and it is impossible to get the most out of the reaction adjustment, as if the coupling is left at, say, 59 degs., where regeneration is approaching closely to its maximum, the least electrical disturbance will destroy the apparent state of equilibrium, and the set will burst into violent oscillation. The tuning of a set in such a condition must, by reason of the strong oscillations necessary to pick up a carrier wave and the continued going into and coming out of oscillation necessary to find the maximum coupling at which it is possible to leave the reaction coil, give strong radiation and disturbance to other listeners, if reaction into the aerial, secondary or anode tuning arrangement is employed.

If the leak is above the value below which "floppiness" occurs, a new defect which can be described as "fluffiness" appears. As the reaction coil is approached to the grid circuit, signals become louder as before, but before the signals reach the maximum which they reached when the leak was lower in value, the set begins to oscillate. It does not immediately go into powerful oscillations as before, but the character of telephony and spark is lost. If the reaction coil is more tightly coupled the oscillations increase in strength, and a carrier wave or C.W. signal will come to a maximum strength when the reaction coil is a certain distance inside the point at which oscillation starts. Even this maximum, however, is less than that obtained when the most suitable value of grid-leak is used and the reaction coil adjusted to just within the oscillation point, so that for the autodyne reception of C.W. telegraphy, as well as for spark and telephony, the set is in a poor condition.

Between these two extremes lies a value of grid-leak which produces neither of these defects. When it is in use, as the reaction coil is coupled more and more tightly to the appropriate grid circuit, signals get louder and louder but retain their character in its entirety up to the very point at which oscillation starts. When oscillation does start, it does so quite crisply but not with a dull "plop," and there is no "overlap" or "backlash." Just within the oscillation point will be found the loudest position for C.W. signals. When the set is adjusted to this point, the local oscillations are the correct strength for efficient reception, but are not nearly as strong as when the grid-leak is too low and "floppiness" prevails, so that if reacting into the aerial, radiation and interference are low. All states of regeneration with this value of leak are quite stable and the fullest advantage may be taken of the reaction adjustment. A well-made fine adjustment becomes of the greatest value and reaction may, with its help, be pushed to the very limit without causing appreciable distortion in *faint* telephony.

The particular value of leak which gives this desirable condition is fairly critical and varies not only with the valve in use, but to a small but important extent with the conditions prevailing in the circuit, so that some form of variable grid-leak or a means of obtaining the same effect must be used. If a really good leak is available, this offers no difficulty, but many of the variable leaks now on the market, in which the requisite variation is obtained by compressing carbonaceous material or containing semi-conducting liquids, give crackling or rustling noises which become objectionable when used before low frequency amplifiers. Others have the parts of the leak or accessory connections so arranged as to have considerable capacity to each other. This does not matter when the leak is connected directly across the condenser as in Fig. 1, but when a stage of tuned anode high-frequency amplification is used before the detector this cannot be done, and the leak must go straight from grid to filament. Any self-capacity across the leak will then tend to earth the audio-frequency changes in the potential of the grid. If the self-capacity is a fair proportion of the capacity of the grid condenser, these losses will be serious.

An alternative to the use of a variable leak which avoids these possibilities is to be found in the use of a fixed leak, of which there are several good makes on the market, and a potentiometer. The effect of the grid leak on the steady voltage of the grid will obviously vary with the potential of the point to which its lower end is connected. If the leak goes to the negative end of the filament, the "R" valve before mentioned requires a leak of $1\frac{1}{4}$ megohms to secure smooth and efficient reaction. If the leak goes to the positive leg of the filament the required value is 10 megohms, so that using the arrangement shown in Fig. 2, when the potentiometer slider is to the negative end and a 2 megohm leak in use, the leak is of too high a value. When the slider is at the positive end the leak is too low. The arrangement gives practically all the effects of a leak, varying from 0·6 to 6 megohms, connected to the negative of the filament.

As stated, the value of leak required to obviate "floppiness" and "fluffiness" varies with the conditions obtaining in the circuit.

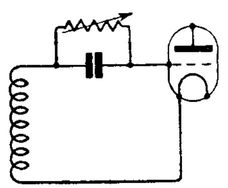


Fig. 1.

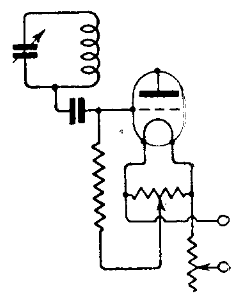


Fig. 2.

Increase in the plate voltage tends towards "floppiness." Increase in the filament current tends towards "fluffiness." Greatly increasing the ratio of inductance to capacity in the grid circuit, such as occurs when a 300 turn coil is substituted for a 30 turn one, leaving approximately the same condenser in circuit, causes "floppiness." Any decrease in the decrement of the grid circuit gives "floppiness." This is noticed when the series condenser of an aerial tuning arrangement is made very small, or in the case of a tuned anode stage into which reaction is being carried, when the high frequency valve is dimmed. Since as the plate-filament resistance of this valve can for purposes of high-frequency currents be regarded as being in shunt to the tuned circuit, any increase in its value, as occurs on dimming, will lower the decrement of this circuit.

In all these cases appropriate adjustment of the leak or potentiometer will correct the fault.

In the case of a set having a fixed leak where it is not desired to make alterations, use can often be made of the effects of varying plate and filament voltages to get rid of " floppiness " or " fluffiness."

The explanation of these effects is to be found in the shape of the grid and plate characteristics and in the fact that in condenser rectification the grid acquires a negative charge.

When a valve is lighted, some of the emitted electrons will fall on to the grid. If the grid is well insulated, a strong negative potential will result, but if it has a leak connected to it, electrons will leak away at a rate dependent on the resistance of the leak and the potential of the point to which its lower end is connected. The resultant steady potential of the grid can be conveniently found by a graphical method.

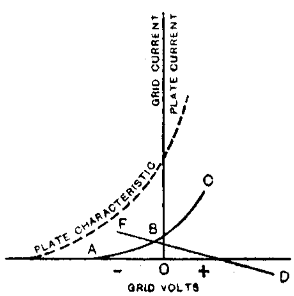


Fig. 3.

In Fig. 3, ABC is the grid-volts, grid-current characteristic and DBF is the graph of the variation in voltage of the top end of the grid-leak with variation of the current passing through it. It is calculated from Ohm's law, and at zero current must pass through the potential of the point on the filament to which it is connected, on the horizontal line. Since the grid-leak and grid-filament are in series the current through them must be the same, and since the top end of the leak is connected to the grid, their potentials must be the same. Hence the point B where they intersect gives the grid potential and current. This will be found to correspond to a gently curved portion of the grid characteristic, and a point slightly off the straight portion and just on the beginning of the bend at the foot of the plate characteristic. (This is not drawn to scale in Fig. 3.) If the reaction coil of a circuit containing such a leak is closed till oscillation just begins, rectification of the local oscillations in the grid circuit will cause the grid to acquire a more negative potential. This will tend to two opposing effects.

In the first place, since the operating point on the grid-current curve is one at which the current is less, the damping of the grid circuit is less. The amount of energy fed back from the reaction coil is now therefore more than is required under the new conditions to just maintain oscillation, strong oscillations are built up, and it is possible to reduce the reaction coupling somewhat without stopping oscillation. This tends, then, to " floppiness."

In the second place it moves the working point on the anode characteristic to a point where it is less steep so that the energy delivered from the plate and fed into the grid circuit is less. Thus the oscillations tend to remain very weak if the minimum coupling necessary to start oscillation is not exceeded. This then tends towards " fluffiness."

At one critical value of leak and of consequent initial grid potential these two opposing tendencies will counter-balance each other; lower values of leak will move the initial grid-potential to the right where the grid-current being large and the anode characteristic more nearly straight, the effect of the change in grid-current will predominate and " floppiness " result, while higher values will move it to the left where the grid-current is smaller and the curvature of the anode characteristic more pronounced, causing " fluffiness."

The effects of circuit changes on these two phenomena can also be seen to be rational. When the anode voltage of the valve is raised, the straight portion of the anode characteristic is moved to the left, and a higher value of grid-leak giving a more negative initial grid-potential is necessary to preserve the balance of the two opposing effects. When the filament temperature is raised the grid-current is raised and a lower value of leak is required. If the decrement of the grid circuit is high apart from the grid-current, the effect of small variations in the grid-current will be small, the effect of moving to a less steep part of the anode characteristic will prevail, and a lower value of leak is called for.

VALVE TESTS.

THE MARCONI-OSRAM D.E. 5.

The valve dealt with this week is of comparatively recent introduction. It should claim the attention of the amateur as it is a general purpose valve with a dull-emitting filament and in addition is designed to operate as a power amplifier.

THE American U.V. 201A class is exemplified in this country by a B.T.H., Marconi-Osram and Mullard product.

This type of valve is extremely popular in America, where it is used in either a low frequency or high frequency circuit.

We have already, under this heading, described our tests on the B.4, the B.T.H. product, and this week the subject of our review is the Marconi-Osram D.E.5.

The filament of this valve is very efficient, as is shown by Fig. 1, for with a filament wattage of 1.15 (5 volts, 0·23 amps), the most liberal emission of 26 milliamps is obtained, and when the filament voltage

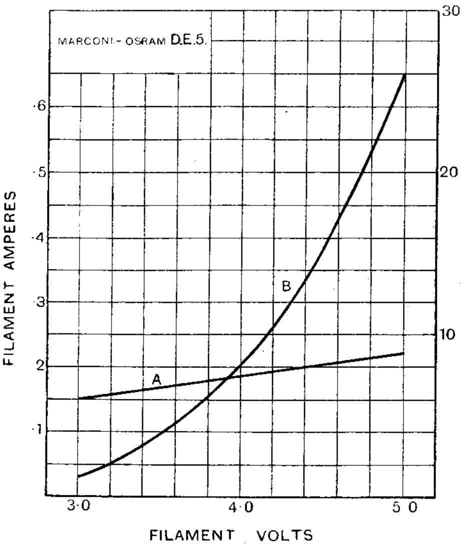


Fig. 1.

is reduced to 4, the emission is just over 8 milliamps, quite ample for all ordinary work.

The advantage of the greater emission obtainable at normal filament voltage becomes apparent when the valve is used as a

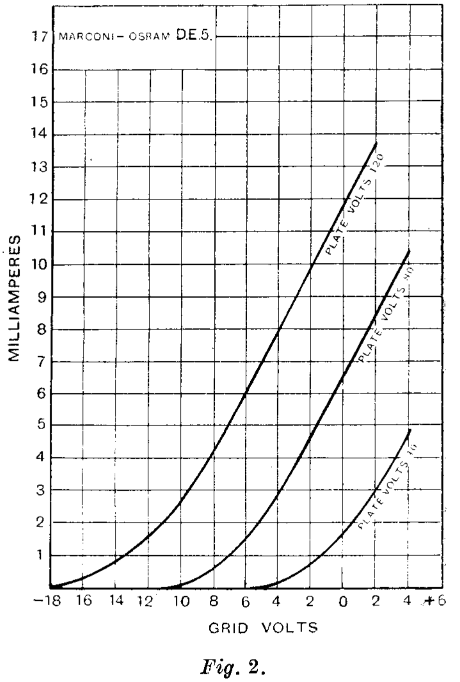


Fig. 2.

power amplifier, and the great point about this type of valve is that the emission is there if and when required. The plate current-grid volts characteristics at normal filament voltage, and for three values of plate potential, are given in Fig. 2. At the higher potentials these curves give promise of excellent low frequency amplification, the distortionless range being exceptionally long even at 80 volts.

The magnification and impedance curves are shown in Fig. 3, and with 100 volts on the plate the "*m*" value is seen to be a fraction over 7, with an impedance of 7,500 ohms, a particularly good ratio which is brought about by the shape and design of the electrodes, small clearance and large areas.

The interpretation of the curves in Figs. 1 to 3 leads us to the conclusion that the D.E.5 should give a reasonably good performance in any part of the receiving circuit but should prove particularly good as a low frequency amplifier.

We first tried the valve as a detector and obtained excellent results with a plate potential as low as 30 volts and with less than 4 across the filament: the usual 0·0003 grid condenser was employed with a 2 megohm leak, the bottom of which was connected to the + of the low tension accumulator. As a high frequency amplifier a filament potential of 4 and anything between 30 and 40 volts on the plate produced good results. With this type of valve the set is easy to handle and reaction control is delightfully smooth.

On the low frequency side the advantage of the high emission became apparent and plenty of power was given to the loud speaker without the slightest trace of distortion. For the first stage 80 volts on the plate, backed off with about − 3 to − 4 on the grid, is suitable; and when used in the second stage the plate potential can be increased to 120 with advantage, at the same time putting up the grid bias to about minus 6.

Valves of this type are of particular interest to the experimenter as they are capable of handling a comparatively large

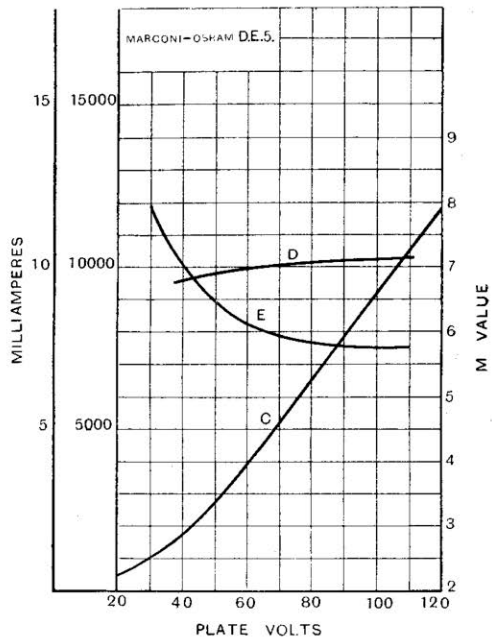
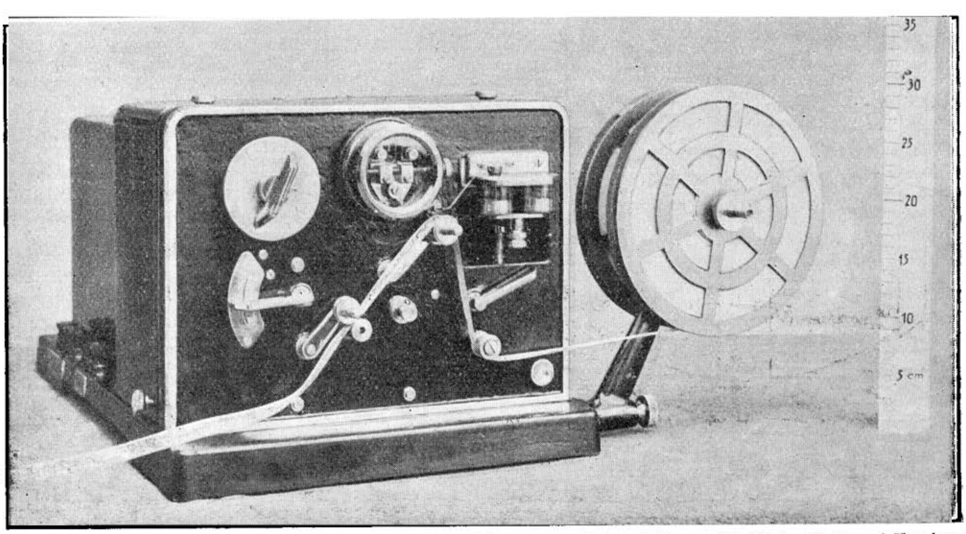


Fig. 3.

amount of power with a filament input of about one-half that of the bright emitting R.



An ingenious inker of German manufacture, making use of the Johnsen-Rahbek effect. ***Adhesion*** *between a metal plate and semi-conductor holds the needle over when a potential is applied.*

IMPROVEMENTS TO VARIOMETERS.

Important details of design in the method of mounting variometer rotors are here dealt with and many useful suggestions put forward.

By W. J. JOUGHIN, F.R.S.A.

WHERE a relatively small band of wavelengths has to be covered, the variometer offers the most compact arrangement. It is proposed to discuss here one aspect of a particular type of variometer, the moulded case pattern. It is obviously impossible to give details of alterations to the multitudinous types constructed with cardboard or ebonite tubing, and it is safe to assume that the moulded pattern far exceeds all other patterns in popularity. As with many other components it is possible to effect slight alterations which make it just that little bit better to work, an advantage which is soon appreciated and looked for.

To begin with, little can be done without

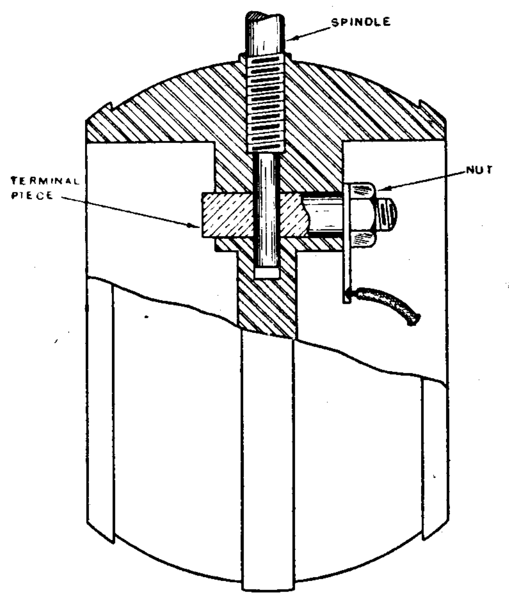


Fig. 1. Here the terminal piece is clamped up on to the spindle.

removing the spindles, as they are usually the source of two or three slight errors. The spindles rotate between the two stator halves, and are screwed into the rotor, passing through the brass locking device in the rotor as shown in Fig. 1. It may be seen that

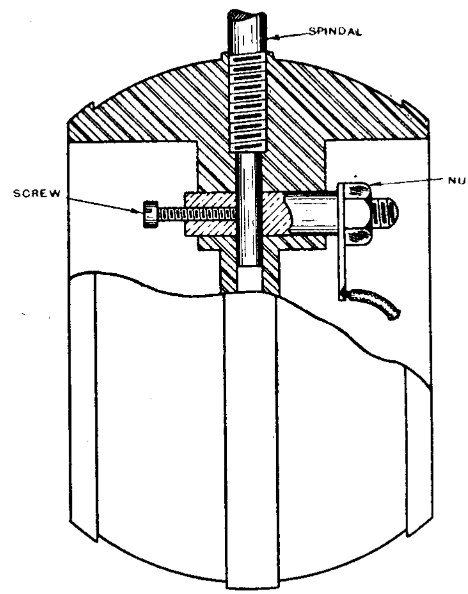


Fig. 2. A set screw is here introduced to prevent the spindle from being pulled out of alignment.

when either spindle has been screwed in sufficiently to ensure the rotor being centrally mounted, the tightening of the nut pulls the terminal piece until the spindle becomes securely gripped. Loosening the nut enables one to unscrew the spindle, although it may be a little tight due to the moulding setting to the brass.

This is one type of spindle fixing, and some manufacturers have introduced an improvement, since the clamping action bends the spindle slightly and causes the dial to rotate unevenly. To obviate this trouble, the form of floating terminal piece shown in Fig. 2 has been adopted. The nut here merely holds the solder tag in position against a shoulder on the terminal piece, the latter being just free in its hole in the rotor moulding. The steel screw at the other end of the terminal piece is tightened into the spindle end, thus ensuring rigidity without distortion. Thus to remove the spindle of this pattern, it is only necessary to loosen the screw and unscrew the spindle from the rotor. This detail is a marked improvement, as it will be found much easier to set the dial to rotate squarely.

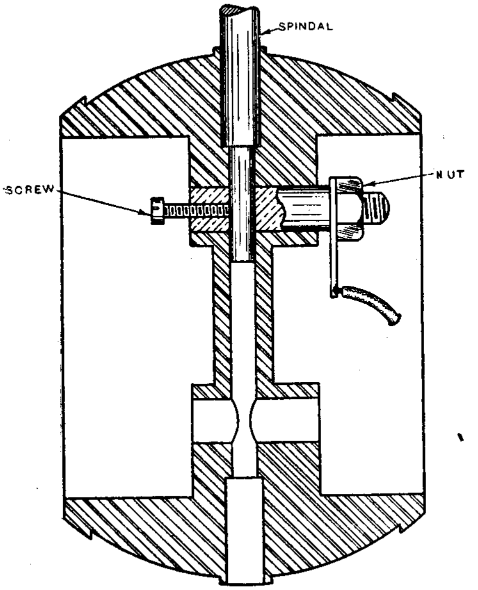


Fig. 3. The threaded portion of the spindle is omitted, which facilitates withdrawal.

A still further modification has been brought out which is shown in Fig. 3. The only difference here from Fig. 2, is that the threaded portion of the spindle and rotor moulding has been omitted, both being plain and a good fit on each other. Removal of the spindle here is still further facilitated since it is only necessary to loosen the screw, when the spindle may be straightway withdrawn.

The spindle to which the dial is screwed needs but little attention other than seeing that the dial is square and tight. Nothing is more annoying than to turn the knob to no effect at a critical moment owing to the dial becoming loose. In this case it is advisable to remove the spindle, and holding it securely with pliers or in a vice, tighten the dial on. Should it not be true when replaced and tightened, loosen the clamping nut or screw and give the spindle a slight rotation in the rotor, when it will probably be found much better. In this matter it is advisable to point out that perfect rotation of the dial is not always possible, due to reasons for which no remedy is available. As long as the difference between the high and low positions on rotation does not exceed 1/16th inch, exception may be permitted.

The spindle at the other end has a cheese head slotted for screwdriver, and carries a spring washer to ensure smooth rotation. This particular item is the cause of a fair amount of trouble and warrants some comment. These washers often have sharp ends to the coil, and working between the spindle head and the connecting stamping, cause an abrasive effect which if left will cause a small deposit of brass dust to collect beneath the variometer. It has been noticed that this trouble is occasionally so bad as to cause a squeak on rotation, which is sufficient warning that immediate attention is advisable. It is an easy matter to file off the sharp edge as shown in Fig. 4, even to the extent of rounding off the ends of the coil, which will do away with the trouble entirely, and will ensure a much sweeter working variometer.

Fig 4. The ends of the spring washers are rounded to prevent abrasion.

When replacing the spindles after examination, it is essential to adjust each so that the rotor is situated exactly in the centre of the stator mouldings, and also that the spring washer is only half compressed. If it be left fully stretched its value is entirely lost, and if tightened nearly or completely up, stiff working will result. The necessity of centreing the rotor correctly is due to the close proximity of the rotor and stator windings which otherwise are liable to catch up on each other and pull the stator winding away from the moulding.

If and only when it is essential to open up the variometer halves, remove the spindles first, take off the nuts from the four securing bolts and remove same, and carefully open up the two halves. It will be found that a small screw in one side of the stator is for connecting up the two stator winding halves, and great care must be taken to see that this is not strained sufficiently to break the wire or pull it away from the thin paper clamps fixed round the coil.

SIMULTANEOUS BROADCASTING FROM 5XX.

At the invitation of the B.B.C. a visit was paid to the new station on the occasion of the song recital given by Dame Clara Butt which was retransmitted by all stations.

Photo : Barratt's.

Dame Clara Butt before the microphone at **5 XX** *(Chelmsford).*

OWING to the distortion which is bound to occur when broadcast transmissions are relayed by landline connections, attempts have been made to provide wireless links between stations transmitting the same programme simultaneously. Making use of the new high power broadcast station **5 XX**, the many stations and relay stations of the British Broadcasting Company have been equipped with receiving apparatus on which reception on a wavelength of 1,600 metres can be carried out, so that the transmissions from Chelmsford may be re-radiated from all broadcasting stations throughout the country and on their respective wavelengths. The advantage of this system is that not only can simple receiving sets listen-in to the transmission as re-radiated from the broadcasting stations, but also, owing to the high power employed at Chelmsford station, it becomes possible to use crystal receivers over a very considerable area.

On July 21st an experiment was carried out, the high power station being put into operation to provide items for re-broadcast from the stations and relay stations of the B.B.C. In an improvised studio at the Chelmsford high power station (**5 XX**), Dame Clara Butt sang a number of songs and the transmission was picked up by some fourteen main and relay broadcasting stations. Captain Eckersley, speaking on this occasion, said that the object of the experiment was to serve all those areas not hitherto served by main or relay stations and in addition the long wavelength solved the difficulty of ship interference with broadcast transmissions, inasmuch as, where jamming occurs by spark stations, reception can be carried out direct from the high power station by tuning to 1,600 metres. In this respect the high power station has already proved itself to be of great benefit.

Reports received after the transmission showed that results were generally excellent, though unfortunately atmospheric interference interrupted to some small extent reception at London, Cardiff and Newcastle. It is gratifying to note that in these preliminary experiments very successful retransmission was carried out by the broadcasting stations located in Scotland, and listeners have reported very favourably upon the results obtained.

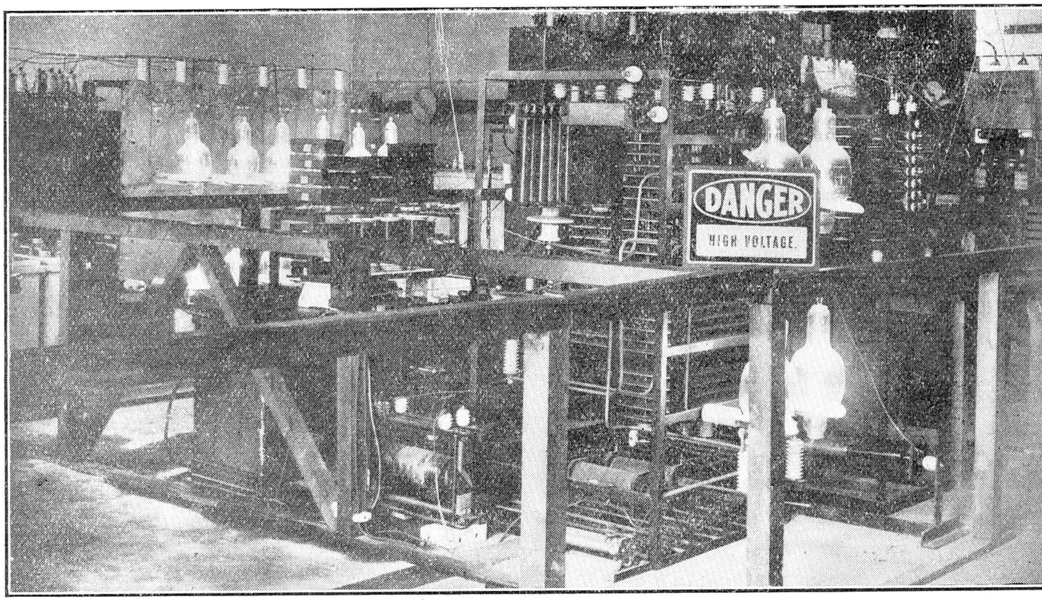


Photo : Barratt's.

A corner of the transmitting equipment. The valves on the left are the rectifiers employed after the step-up transformer for the purpose of producing the plate potentials for oscillator and modulator valves. The our valves on the right are in the master oscillator circuit, whilst the small boxes in the centre of the picture are part of a 1,150 *volt battery connected in the grid circuit of the modulator valves.*

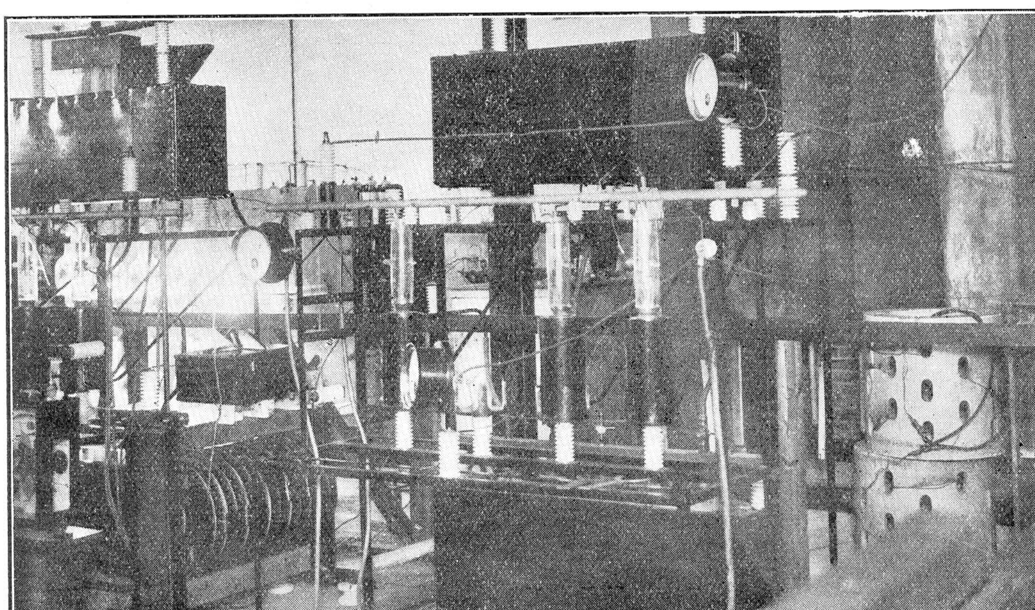


Photo : Barratt's.

This view shows the three main oscillator valves, which are of the water-cooled type, and each handles 5 *kW. Four somewhat similar valves are used as modulators, and operate on a potential of* 9,000 *volts. The modulation choke can be seen in the foreground on the left, whilst the large plates at the back form a portion of the closed circuit condenser.*

A RÉSUMÉ OF MODERN METHODS OF SIGNAL MEASUREMENT*

By J. HOLLINGWORTH.

(*Continued from page 487 of previous issue,*)

Having now given a general sketch of the principles involved and the problems arising from them it is possible to describe a certain number of systems in detail.

The "Aldebaran" Tests were a series of measurements carried out by Lieuts. de Bellescize and Guierre under the auspices of the French Navy on the ship *Aldebaran*, during an extended cruise. The general principle is shown by the diagram in Fig. 2.

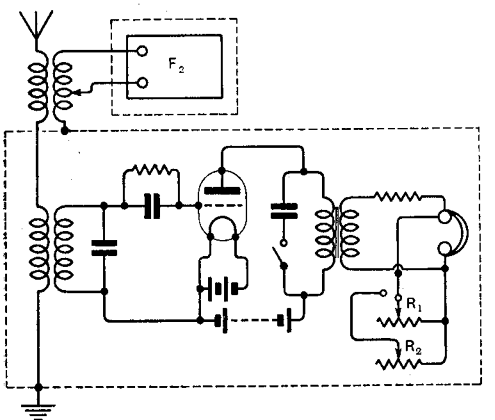


Fig. 2. *Diagram showing the general principles adopted in measuring experiments carried out by the French navy.*

The aerial is coupled to a local source of calibrated e.m.f. F_2, which is screened, and then passes to the receiving apparatus, which is also screened. Here it is coupled in the usual way to a secondary circuit with a valve detector, which is again coupled to a circuit containing a shunted telephone system. A heterodyne is also provided, and the measurement consists in adjusting the telephone shunts in such a way that equal intensities are obtained from the incoming and local sources. For this purpose a special signal was sent consisting of 10 secs. dashes followed by 10 secs. silences, and the switching gear at the receiving end was operated by a chronograph which was carefully synchronised with the incoming signal.

The system at present in use in France is shown in Fig. 3. It was produced by MM. Jouaust and Mesny, by whom a full description is given in *L'Onde Electrique*, Vol. I.

In brief the action is as follows :—

The signals are received in the coil A, tuned by the condenser B and applied to the amplifier C, D being a heterodyne.

The rectified signals from the amplifier are again tuned by the note resonator E, which is a circuit capable of oscillating at the beat note frequency, and then applied through a transformer to the Abraham multiplying voltmeter F. The telephones are provided for preliminary listening. G is the local source of e.m.f., the signals from which pass through the tuned filter circuit H and the adjustable mutuals J and K and so into the receiving coil. G, H, J and K are heavily screened, and the various earth connections made so as to eliminate stray induction.

It is operated as follows :—

The coil is tuned to the incoming signal and the beat note produced by the heterodyne D again tuned by E until the galvanometer gives a maximum deflection.

D is then extinguished, and G switched on so as to heterodyne the incoming signal, and tuned to it by adjusting to the silent interval. At the end of the special signal, D is switched on again (the coil being turned to the zero position if the station is still working) and E and F again adjusted until the galvo deflection is again a maximum. The variable mutuals are then adjusted until the deflection is the same as that given by the signal, when the intensity can be calculated from the positions of these and the reading of the thermo-ammeter.

In the present American system due to Dr. Austin, no special aerial circuits are employed. The incoming signal is received

* A paper delivered before the Radio Society of Great Britain on Wednesday, June 25th, 1924, at the Institution of Electrical Engineers.

on an ordinary autodyne valve circuit in a normal aerial. The resulting beat note in the telephones is then balanced against a local audio frequency oscillation of the same pitch, produced by an apparatus known as the telephone comparator, which is based on a vibrating tuning fork, this oscillation being induced at will directly into the telephones. The comparator is then itself calibrated by means of a radio signal sent from an adjacent aerial of known effective height, the few milliamperes of current in this latter aerial being measured. One of the special features of this method is its use in connection with atmospherics. Every wireless man knows now that the limiting factor in transatlantic transmissions is not necessarily actual strength of received signal, but often rather the ratio of average atmospheric strength to signal strength.

This ratio cannot, of course, be measured purely instrumentally; it is carried out on this set by the operator moving the telephones forward on his head until the atmospherics are only just audible, and then finding the strength of the signal from the comparator which is also just audible with the telephones in the same position.

Measurements have also been made by Prof. Vallauri on the signal strength of Annapolis at Livorna.

He used for reception a large coil pointing in the direction of Annapolis, and for calibration switched over to an exactly similar one at right angles to the first and containing the local source.

Balance was obtained by switching from one coil to the other, and varying the coupling of the local source until equal intensity was obtained in the two positions, from which the incoming intensity could be calculated.

The Marconi system was devised by Eckersley and Lunnon and is described in the *Journal I.E.E.*, Vol. 59, p. 685.

It is an ordinary injection system using either a coil or an aerial. The local source is contained in a single highly screened copper box. Internally this box is divided into three compartments, the first of which contains the source. The second compartment contains a tuned filter circuit and a device known as the "slide-back" method due to Capt. Round for measuring the current. The basic idea of this is to measure the voltage across the tuning condenser by connecting its terminals to the grid and filament of a valve whose anode circuit contains a galvanometer and H.T. battery.

A potential divider with a voltmeter across it allows a negative bias to be given to the grid, and from the readings of the galvanometer and voltmeter the current in the

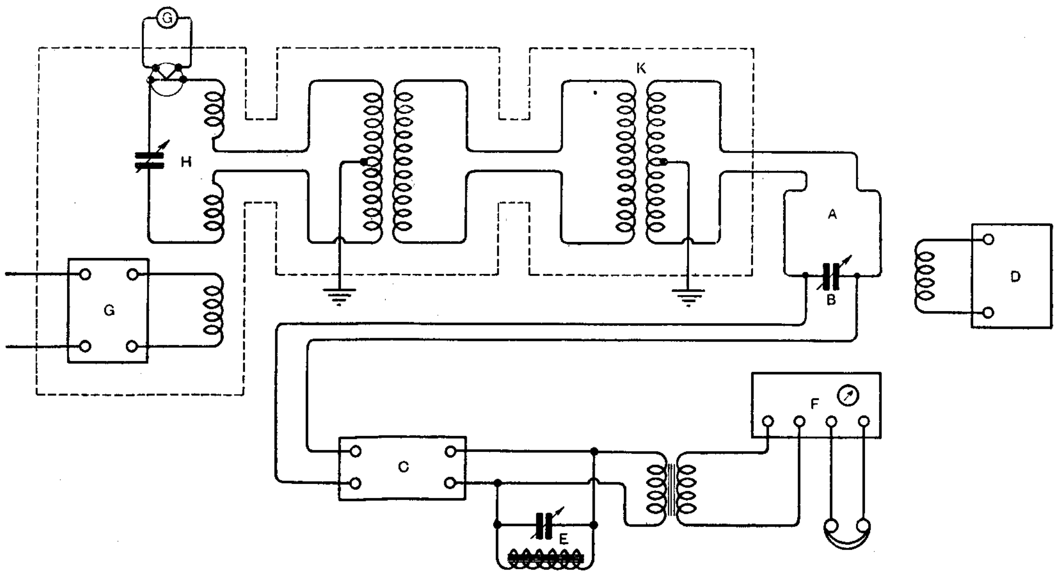


Fig. 3. Showing the principles embodied in the present measuring system used in France.

oscillating circuit can be calculated. The third compartment contains a variable mutual inductance, the secondary of which is connected to the receiving circuit.

The National Physical Laboratory's system* has recently been developed for the measurement of the URSI signals now sent from various European stations. It chiefly differs from other systems in that the calibrating oscillation is applied direct to the amplifier terminals, the tuned receiving circuit being disconnected. This avoids any necessity of screening as no dummy circuit is required, but involves the measurement of the effective high frequency resistance of the receiving set, for which a switch is provided. No heterodyne is used and consequently no audio frequency amplification, the signal being measured by means of a micro-ammeter in the anode circuit of the last valve. The normal anode current through this micro-ammeter is balanced by a potential divider, so that the micro-ammeter normally reads zero. An incoming signal polarises the grid of the last valve, making it negative and so reducing the anode current, this reduction being measured on the micro-ammeter. The latter can, if necessary, be replaced by a Salamson string galvanometer, when measurements can be taken on the ordinary routine of a station.

Another very interesting system which works on an entirely different principle has been suggested and used by Dr. Appleton, but its use is confined to strong signals. It depends on the well-known fact that if a powerful oscillation be induced into a feebly self-oscillating circuit and the two be slowly brought nearly into tune with one another the beat notes heard will not gradually fall in pitch to silence but will cease abruptly at a definite point owing to the powerful oscillation forcing the weaker one into step. By noting the point at which this occurs it is possible to calculate the intensity of the incoming signal; but it is, of course, essential that the incoming signal should be considerably more powerful than the local source.

In conclusion a few words may be said as to the theoretical side of the problem.

The formula in most general use for calculation is that known as the Austin-Cohen formula.

It is

$$E_g = 120\pi \frac{Ih}{\lambda d} e^{-\frac{\cdot 000045d}{\sqrt{\lambda}}}$$

E_g is potential gradient at receiving station.
I current in transmitting aerial.
h effective height of transmitting aerial.
λ wavelength.
d distance between stations.

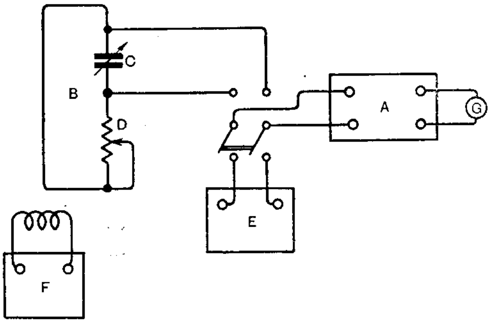


Fig. 4. The National Physical Laboratory System. A = amplifier, B = receiving coil, C = tuning condenser, D = known variable resistance, E = local calibrated source, F = uncalibrated C.W. source for testing, G = galvanometer.

As this formula is based on the following assumptions :—

(*a*) Air a perfect dielectric.
(*b*) Earth perfectly conducting.
(*c*) Plane earth.
(*d*) A purely empirical factor,

the results, although at times surprisingly accurate, cannot represent actual conditions. It also appears to give entirely inaccurate results on short waves.

Much mathematical work has been done on the subject, and the well-known Heavyside layer theory has been introduced, but the chief difficulty arises from two facts. The first is that wave-propagation over the earth's surface under actual conditions is an infinitely more complex action than it was originally imagined to be; and the second is that if the attempt be made to allow mathematically for the known facts, the resulting equations are so elaborate as to make the practical arithmetical use of them an extremely difficult problem.

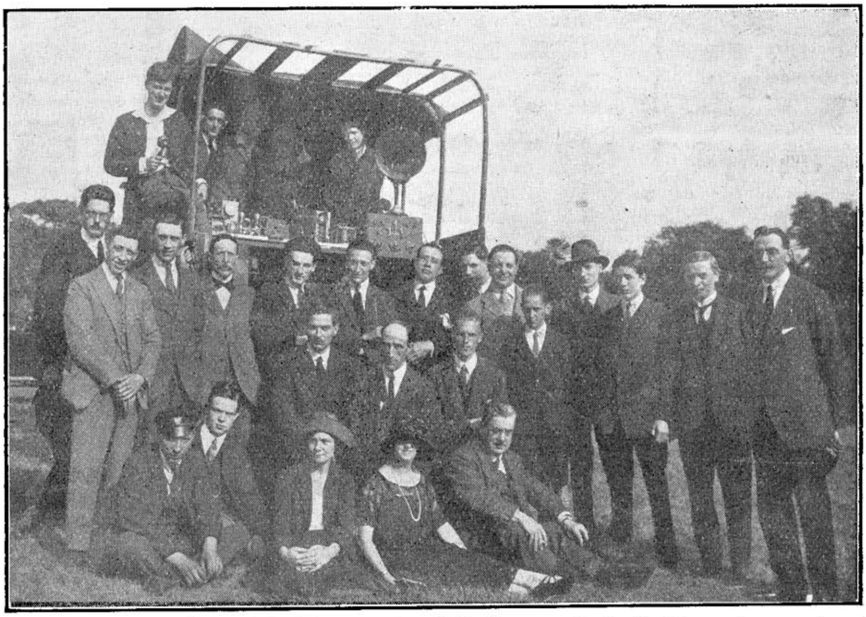
(A report of the ensuing discussion will appear in a subsequent issue.)

* Proc. I.E.E., Vol. 61, No. 317.

A CLUB OUTING.

DURING the summer months most wireless societies endeavour to arrange some outdoor function in order to maintain a continuity of their meetings and also avail themselves of the good weather for the purpose of carrying out certain experimental work. Such an outing was carried into effect by the Hampstead and St. Pancras Radio Society on Saturday, July 19th, when experimental transmission and reception was effected from a mobile equipment carried in a light motor lorry.

Experiments showed that good working could be obtained on about 140 metres, and this was employed throughout the afternoon's tests. The circuit employed for transmission was a typical Hartley oscillator with a loose-coupled aerial circuit. The aerial was a single wire "T." The valves used were A.T. 40 X type and power was derived from H.T. batteries, taking about 15 mA. at 600 volts, representing something under 10 watts. The mobile set (**2 DZ**) operated in the neighbourhood of Mill Hill and,



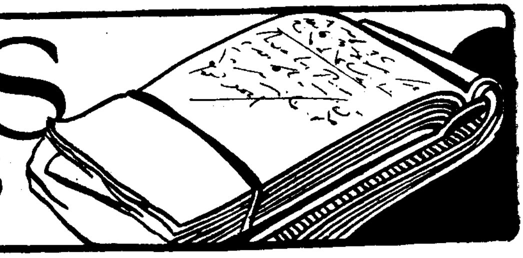
A group of the members of the Hampstead and St. Pancras Radio Society on the occasion of their successful field day.

using telephony, communicated with **5 SU**, **2 TA** and **5 CF**, the first mentioned station being operated by Capt. Ian Fraser and the other stations by members of the Radio Society of Highgate, who kindly co-operated.

The receiver was identical with the three-valve short wave set recently described in this journal, and gave readable loud-speaker results on these short wavelengths, whilst many members brought telephone receivers and connected them in circuit, so that the replies received from the communicating stations could be followed.

Events of this kind must necessarily take place on Saturday afternoon to suit the convenience of members, and it will be found that B.B.C. transmissions leave very little time for amateur work on the fixed wavelength of 440 metres. Consequently transmission must be undertaken on a wavelength below 200 metres. On the afternoon in question a special S.B. transmission was taking place and in order to avoid interference, it was decided to adopt as short a wavelength as possible for working from the mobile set.

NOTES & CLUB NEWS



As a result of recent experiments, the German Government has decided to introduce a regular wireless communication service on certain trains.

* * * *

The St. Gall Radio Association (Switzerland) has decided to construct a wireless receiving station at the Saentis Observatory, which is 8,300 feet above sea level.

* * * *

Wireless loud speakers are being installed on the Nord-Sud Railway in Paris to announce the next station to passengers.

* * * *

Complaints are being made by a number of French listeners-in that the transmissions from the Chelmsford broadcasting station are interfering with the reception of Radio-Paris, on 1,780 metres.

* * * *

Thirteen observation cars on the Canadian National Railway have been equipped with receiving sets.

* * * *

Senatore Marconi.
Senatore Guglielmo Marconi, G.C.V.O., has been elected Chairman of the Council of the Royal Society of Arts for the year 1924-5.

Ecole Superieure de P. & T.
The Ecole Superieure de P. & T. Broadcasting Station, Paris, has again changed its wavelength, reverting to the original 450 metres. We understand that the question of a further change to 500 metres is under consideration.

Broadcasting from Vienna.
A new broadcasting station has been opened in Vienna, known as the "Radio Hekaphon," and concerts are transmitted on Mondays, Fridays and Saturdays, on a wavelength of 600 metres.
The transmissions, which are only of half-an-hour's duration, commence at 8 p.m.

An International Relay Club.
Under the comprehensive title of "The Franco-Anglo-American Radio Club," a new organisation has been formed in Paris with the object of extending international wireless relay work.
The President is Mr. Reginald Gouraud, a young American radio engineer, and he is issuing an invitation to membership to amateur transmitters of all countries. His address is 20, Rue Vineuse, Paris.

Moving Pictures and Wireless.
A device which, it is claimed, succeeds in synchronising radio and cinematograph pictures, has been evolved by M. Charles Delacomme, a French engineer. A series of public demonstrations has been given with educational films, and favourable results are reported. The inventor hopes to introduce his apparatus in America during the autumn.

French Plea for Parliamentary Broadcasting.
The Compeigne Radio Club has passed a resolution urging the Government to arrange for the regular broadcasting of performances from State-controlled theatres. The Government is also asked to install a microphone in the Chamber of Deputies. Up to the present no action has been taken by the Government.

Remarkable Low Power Transmission.
A Luxembourg transmitter, M. Anen, is reported to be in regular communication with a Finnish amateur, M. Leo Lindell, at Turku, Finland, on 95 metres, with only 0·25 ampere in the antenna.

New Spanish Wireless Regulations.
Under new wireless regulations, private transmitting stations in Spain will be subject to governmental control and inspection. The General Director of Communications reserves the right to grant transmitting facilities in accordance with definitely fixed conditions.
With regard to reception, permission to erect a receiving station will be granted to all Spanish subjects at an annual fee of five pesetas. For apparatus installed in hotels and other public places an annual fee of 50 pesetas will be charged.
Should the new system fail to function satisfactorily a special committee will be created, on the petition of more than one half of the total licence holders, to reorganise the scheme as required.

Successor to the late Dr. Walmsley.
The vacant Principalship of the Northampton Polytechnic Institute, Clerkenwell, caused by the tragic death of Dr. R. Mullineux Walmsley, in June, has been filled by the appointment of Mr. S. C. Laws, M.A. (Cantab.), M.Sc. (Lond.), Principal of the Wigan Mining and Technical College for the past nine years. The appointment is subject to the approval of the London County Council.

Venetian Wireless Serenades Forbidden.
For some time the Government has extended a ban on private receiving sets in Venice, and although this measure has only served to stimulate secret listening-in, it has put an end to wireless serenades on the famous Lagoon.
At the Feast of Il Redentore, however, held on Saturday, July 19th, several bold souls equipped their gondolas with receiving sets, well disguised by flowers, and towards evening, broadcast music was received from Paris on loud speakers. Later, music was tuned in from the Savoy Hotel, London, and was made clearly audible above the other sounds of the festival. At midnight a small motor launch, decorated like the others, suddenly appeared, and from it there stepped a Venetian officer, who quickly clipped the wires of the aerials and hove the receiving sets into the water. The occupants were warned that, but for the festive nature of the occasion, heavy fines would have been imposed.

Submarine Broadcasting.
Broadcasting from the ocean bed is to be attempted at Atlantic City, N.J., in a few days.
Messrs. Gimbel Bros., prominent American merchants, who own a broadcasting station, have arranged for a deep sea diver "with a descriptive and literary gift" to go down to the ocean bed about a mile out and "deliver the goods." Through the heavy glass windows of his helmet he will see and describe the formation of the ocean bed, marine flora, strange fish and everything likely to interest his hearers.

Wireless Telegraphy to the Dominions.
Replying to Sir W. de Frece (Ashton-under-Lyne, U.), on July 22nd, Mr. Hartshorn said that an average of 40,000 words of Press traffic was transmitted weekly by wireless telegraphy to Halifax (Nova Scotia). In addition, it was understood that parts of the British official wireless messages, which were transmitted *via* Leafield at 8 p.m. and midnight, G.M.T., daily, were picked up in India and in certain of the Dominions whenever conditions were favourable, although they were not intended specifically for reception in the Dominions. There was no information as to what proportion of these messages, which averaged 9,000 words a week, was picked up regularly.

That Aerial Deposit Problem.
A stubborn war is being waged at West Bromwich between the Corporation and tenants who have refused to pay deposits in respect of their wireless aerials. The defaulting tenants, who have now been served with notices to quit, describe this latest move as "pure intimidation." Preparations are being made for a legal conflict.

Wireless and the Boy.
What the modern boy has done for radio was recently discussed by Mr. Pierre Boucheron, Chairman of the Boy Committee of the American Associated Manufacturers of Electrical Supplies.
"Radio this summer," said Mr. Boucheron, "has taken the American boy off the street corner and placed him in his home-made laboratory. Instead of lurid novels, he now reads the radio magazines and the radio sections of the newspapers. . . . ."
"It was the boy who first sold the idea of radio to the entire family. It is the boy who keeps the older folks informed of developments; it is the boy who determines very largely the type and character of radio equipment which the family shall buy; and it is the boy who this summer is making a radio set a year-round necessity."
Very much the same can be said, we feel, of the British boy, and it is probably true that many of our most prominent experimenters can date their first allegiance to wireless to the days when they wore knickerbockers.

Preparing for the Winter Session.

Mr. L. F. Fogarty, A.M.I.E.E., Vice-President of the Radio Society of Gt. Britain, speaking from **2 LO** on behalf of the Society on July 17th, reminded club secretaries that the time is now ripe for the preparation of next season's programme.

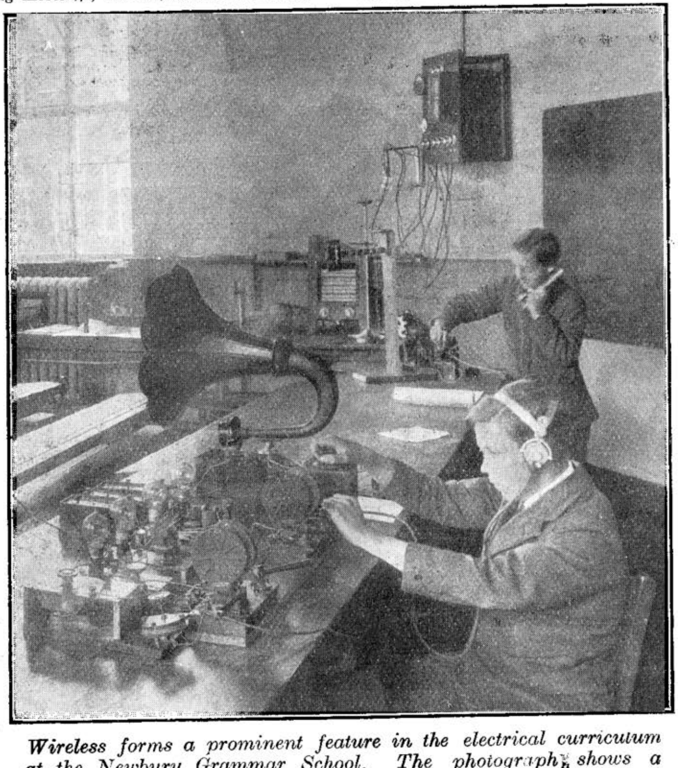
"The work of preparing a series of interesting events," said Mr. Fogarty, "involves a good deal of forethought and correspondence, but these duties must be faced in the interest of the Societies, for in the absence of an interesting and instructive series of visits, lectures, and demonstrations, the members' interest is prone to wane, with the result that the income suffers and the Society's welfare rapidly deteriorates.

"Experience shows that when an application for a renewal subscription is accompanied by a programme of interesting meetings, the response is invariably good, with the result that the Committee's worries in regard to finance are greatly reduced and the stability of the club or society is enhanced."

Subject to the approval of the House of Commons the Marconi Company will erect, as contractors, a "beam" station in this country, adapted for communication with Canada, and capable of extension to provide similar communication with South Africa, India and Australia. Under the conditions of the contract payment will be made to the Company on the station fulfilling certain minimum guarantees, which are as follows:—

Communication at 100 five-letter words per minute (exclusive of any repetitions necessary to ensure accuracy) for the following average number of hours daily throughout the year:—

	Hrs.
Between Great Britain and Canada	18
Between Great Britain and South Africa	11
Between Great Britain and India ..	12
Between Great Britain and Australia	7



Wireless forms a prominent feature in the electrical curriculum at the Newbury Grammar School. The photograph shows a wireless lesson in progress.

It must be remembered that at present communication by this system is only possible during the hours of darkness, and during one or two hours before and after twilight.

Government and the "Beam" System.

The Postmaster-General announced on July 23rd that the Government had decided to adopt in the main the recommendations of the Donald Committee on Imperial wireless services, which provide for State ownership of Empire wireless stations in Great Britain. In the meantime, however, the Marconi Company had put forward proposals with regard to short wave directional or "beam" stations, and definite arrangements had been made for the erection of a beam station in Canada for communication with this country.

"Short Wave" Transmitter at Nauen

According to a Berlin message, the Nauen wireless station has succeeded with a new short wave transmitter in sending messages to Buenos Aires, a distance of 7,500 miles. The tests were carried out at night.

An Amplion Warning.

The attention of Alfred Graham & Co., makers of the Amplion Loud Speaker, having been drawn to the fact that a number of their instruments from which the name plates have been removed are now being sold to the public, wish to advise prospective purchasers to see that any Amplion offered to them bears the well-known "Amplion" name plate as the Company cannot accept any responsibility for instruments from which the name plates have been removed or defaced in any way.

Standard List of Electrical Definitions.

The British Standard List of Terms and Definitions used in connection with Telegraphs and Telephones, just published by the British Engineering Standards Association, forms one of a series of eleven sections devoted to a Glossary of Terms used in Electrical Engineering. Definitions of about 230 terms are supplied in this section (No. 204—1924), which can be purchased from any bookseller or at 28 Victoria Street, London, S.W.1, price 1s. post free 1s. 2d.

A Mystery Programme.

At the next regular meeting of the Golder's Green Radio Society, to be held on Wednesday, August 6th, at the Club House, Willifield Way, N.W.11, Mr. Reed (**5 XH**) will speak on a subject which is to remain secret. Visitors are cordially welcomed to attend and share with the members the delights of a mystery programme.

How we get our Condensers.

Members of the Radio Society of Great Britain were afforded an unusually clear insight into modern radio manufacturing methods on July 19th, when at an informal meeting at the Institution of Electrical Engineers, Mr. Philip R. Coursey, B.Sc., F.Inst.P., delivered an illustrated lecture on "The Manufacture of Condensers."

After dealing briefly with the history of the condenser, touching upon its earliest form in the shape of a Leyden jar, and enumerating the properties of the ideal condenser, the lecturer emphasised the importance of a good dielectric. Various kinds of dielectric were in use, including glass, air, oil and mica, and it was to the last-named that Mr. Coursey chiefly directed attention.

Mr. Coursey began his interesting story of the manufacture of the present-day mica condenser by taking his audience to the mica mines in India. A number of excellent slides portrayed the excavation of the mica in the raw state by native labour and its shipment to England and the factory of the well-known Dubilier Condenser Company. Here the mica was seen undergoing the process of splitting into thicknesses of a few thousandths of an inch. A certain amount of mica has to be rejected on account of flaws, such as air bubbles and foreign particles, and an ingenious method of testing was shown, whereby the surface was submitted to a spray of electric sparks at high voltage, any hidden faults being at once revealed. After the assembling and testing of fixed capacity condensers had been studied, the lecturer dealt with the construction of variable air condensers, to which a large section of the company's works is devoted. An interesting comparison was afforded at the conclusion of the lecture when a large condenser, specially constructed by the Dubilier Company for use at voltages of 40,000 at the Northolt wireless station was seen in relation to a small fixed condenser produced by the same firm.

In the brief discussion following the lecture, interest was shown in the question of dielectric losses and the relative values of different dielectric materials.

Wireless and Experimental Association.*

The Association had an enjoyable afternoon outing at Sevenoaks on Saturday, July 5th. Forty-eight members, including 13 ladies, attended. Summer radio was the excuse, and strawberries and cream was the achievement. **2 LO** was also received.

Hon. Sec., Geo. Sutton, 18, Melford Road, S.E.22.

Hackney and District Radio Society.*

On Saturday, July 12th, a party of members visited the ss. "Patricia" at Millwall Docks. A most enjoyable time was spent in the wireless cabin, the concert from **2 LO** being received.

On Thursday, July 17th, Mr. Toye gave a very instructive lecture entitled "Crystal Set Construction." Mr. Toye described several standard methods of tuning, and finished by demonstrating a unique crystal set, aptly named by him "The Millionaire's Own."

Hon. Sec., Geo. E. Sandy, 70 Chisenhale Road, E.3.

The Woolwich Radio Society.*

On June 15th a field day was held at Chislehurst Caves. Assembling there at 3 o'clock, the party was taken round the caves by the guide and left in the deepest part to test wireless reception. Though several sets had been brought, including some very powerful ones using as many as six valves, it was surprising to find that it was impossible to obtain any wireless signals whatever. It would appear that the caves are absolutely shielded, and are therefore an ideal spot for any experimenter who wishes to carry out experiments free from any type of interference.

A pleasant tea on the lawn and a demonstration of wireless outside the caves in the evening ended a very enjoyable day's outing.

On June 18th Mr. Houghton, a vice-president, gave a demonstration of a capacity bridge. He first sketched the circuit employed, and then demonstrated the ease with which measurements of capacity could be made. Many members having brought condensers, Mr. Houghton was kept busy till 10 o'clock testing capacities.

During the month several new members have joined. All wireless enthusiasts in the district are welcomed to the meetings.

Meetings take place every Wednesday evening at the Y.M.C.A., Thomas Street, Woolwich, at 7.30 p.m.

Hon. Sec., H. J. South, 42 Greenvale Road, Eltham, S.E.

The Leeds Radio Society.*

The following lectures have been delivered recently before the Society at its weekly instructional and general meetings: "A One to Five-Valve Receiver," Part II, Mr. D. E. Pettigrew, Hon. Sec.; "Design and Construction of Valve Receiving Stations," Mr. A. F. Carter, Vice-President; "Methods of Rectification of Radio Frequent Currents," Mr. D. E. Pettigrew, Hon. Sec.; "Potentiometers and their Function," Mr. W. G. Marshall; "Some Radio Principles," Mr. T. Brown Thomson.

The Society is now in recess, the next meeting being fixed for September 12th. In the meantime it is hoped to arrange a visit to the relay station.

Applications for membership for the session 1924-25 will now be welcomed. It is highly probable that the Society will continue to be engaged on strictly technical and experimental interests during the approaching session.

Hon. Sec., D. E. Pettigrew, 37 Mexborough Avenue, Leeds.

Tottenham Wireless Society.*

A discussion on "Valves" was opened by Mr. Holmes on Wednesday, July 16th. The various types of valves on the British market were classified according to their impedance values, after which members gave their experiences with valves of different makes and their use in various circuits. The discussion was followed by a demonstration of an American Westinghouse receiver using U.V. valves. The set consisted of detector and 2 L.F. amplifying valves. Excellent reception of broadcasting was obtained on an Amplion Concert Grand loud speaker.

The next meeting of the Society will take place on Wednesday, August 6th.

Hon. Sec., A. G. Tucker, 42 Drayton Road, Tottenham, N.17.

North Middlesex Wireless Club.*

On July 9th a very interesting lecture was given by Mr. W. A. Saville, Hon. Treasurer of the club, on "Valves Used in Wireless." The lecturer had brought with him, by kind permission of Mr. C. Wright, a very complete collection of valves of all sorts. Among these were bright emitters and dull emitters, large valves and small valves, valves that could be operated by a couple of dry cells, and valves which would make the plates of an ordinary amateur's accumulator curl up and perish. In cost they varied from five shillings to as many pounds. Mr. Saville explained clearly the characteristics of each valve, indicating the purpose for which it was most suited. Some that were good amplifiers were not so good as detectors, and others which operated well in the second stage of L.F. amplification were unsuitable for the first stage, and so on. At the conclusion of his instructive lecture Mr. Saville was congratulated on the success of his efforts to secure a really representative collection of valves.

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

Halifax Wireless Club.

The new headquarters of the club are now at Tower Chambers, Halifax.

At the annual meeting held on July 16th, the following elections were made: President, Mr. W. Emmott, M.Inst., C.E.; Hon. Treasurer, Mr. G. F. Greenwood; Hon. Secretary, Louis J. Wood. A committee was also appointed consisting of Messrs. Brennan, Holroyd, Bentley, Town, Allott and Jowett.

An excellent year of progress was reported, and members are looking forward to the coming session with great enthusiasm.

Hon. Sec., Louis J. Wood, 35 Commercial Street, Halifax.

BOOKS RECEIVED.

British Engineering Standards Association (28 Victoria Street, London, S.W.1). Lists Nos. 206, 207, 208, being respectively British Standard Specification for Silver Solder (Grades A and B); Special Brass Ingots for Castings; and Special Brass Castings. Price 1s. each, post free 1s. 2d.

CATALOGUES RECEIVED.

Radio Components, Ltd. (19 Rathbone Place, London, W.1). A loose leaf illustrated list of wireless components of all descriptions.

J. Macdonald & Co. (2 High Street, Camden Town, N.W.1). Illustrated price list of guaranteed wireless components and "Maxone" receivers.

C. A. Vandervell & Co., Ltd. (Acton, W.3). Folder "O," describing the C.A.V. Loud Speaker and supplying details of C.A.V. wireless batteries.

Houghtons, Ltd. (88-89 High Holborn, London). "Houghtons' Radio News," Vol. I, No. 1. Deals with prominent manufacturers' latest products.

Calls Heard

Stockton-on-Tees (May 10th to June 4th.)
British: **2 CC, 2 FN, 2 YT, 5 DN, 5 IK, 5 JX, 5 KO, 5 MO, 6 CV, 6 OU, 6 UD.** French; **8 BN, 8 BX, 8 DC, 8 DN, 8 ER, 8 GG, 8 JL, 8 RO, 8 TK, 8 ZM.** Dutch: **0 XQ.** Luxembourg: **1 JW.** Italian: **1 ER.** Misc.: **1 CF.**
J. W. Pallister.

Perry Barr Birmingham (Sunday, June 1st.)
2 AK, 2 HF, 2 KO, 2 KQ*, 2 LX, 2 OQ*, 2 OX, 2 QR, 2 SY*, 2 TN, 2 VI, 2 YC, 2 YV, 2 YX, 2 ADX, 2 AFS, 2 AIT, 2 AOX, 5 DW, 5 FI, 5 KD, 5 KO, 5 NH, 5 RD, 5 WD, 5 YD*, 5 YS, 5 YW, 6 HU*, 6 MJ, 6 NI, 6 NQ*, 6 RH, 6 UR*, 6 UK, 6 XJ*. * Morse.
A. E. Edwards.

Leigh, Lancs. (May 26th to June 15th.)
2 AOI 2 ATS, 2 EF, 2 VG, 2 TR, 2 QR, 2 WH*, 5 CH, 5 HM, 5 LB, 5 YD, 5 YS, 5 SW, 6 DS, 6 GR, 6 KK. * Morse. (o—v—1.)
W. R. Stainton.

Rock Ferry, Cheshire (May 1st—31st).
2 ABW, 2 ADP, 2 ALX, 2 ATI, 2 ATX, 2 TRC, 2 CC, 2 DF, 2 DR, 2 FU, 2 JW, 2 KW, 2 NA, 2 PY, 2 SF, 2 TR, 2 VJ, 2 WY, 2 YQ, 2 YX, 2 ZU, 5 AT, 5 BS, 5 BV, 5 DN, 5 FT, 5 IK, 5 KO, 5 PU, 5 SI, 5 SZ, 5 WM, 5 XI, 6 FG, 6 GB, 6 OM, 6 RY, 6 SN, 6 TD, 6 UD, 6 XN, 6 XG, 6 XX, 6 YA, 6 YB, 8 AB, 8 AG, 8 BA, 8 BN, 8 BV, 8 CC, 8 CF, 8 CM, 8 CN, 8 CT, 8 DA, 8 DE, 8 DP, 8 DT, 8 DU, 8 DV, 8 ÉM, 8 ÉU, 8 QA, 8 RO, 8 TV, 8 ZM, 0 BA, 0 MR, 0 NY, 0 PC, 0 SS, 0 XF, 0 XP, 0 XW, 0 ZM, 1 CF, 7 EC, MW, All below 200 metres. (o—v—o.)
Edw. T. Salmon, **6 RW.**

Harbourne, Staffs. (since March 14th).
2 AK, 2 AT, 2 DU, 2 FY, 2 HF, 2 IB, 2 IX, 2 IY, 2 JR, 2 KO, 2 KQ, 2 KR, 2 NC, 2 NP, 2 NV, 2 OP, 2 OQ, 2 OX, 2 QG, 2 QR, 2 RD, 2 RG, 2 RH, 2 RQ, 2 VB, 2 VG, 2 WQ, 2 YB, 2 YC, 2 YU, 2 YX, 2 AAD, 2 ADM, 2 ADS, 2 ADX, 2 AHH, 2 AMJ, 2 AIT, 2 AOX, 2 ARS, 2 STA, 2 STV, 5 AA, 5 FI, 5 HG, 5 IY, 5 KD, 5 TW, 5 VB, 5 VT, 5 WO, 5 WP, 5 MV, 6 AG, 6 MG, 6 MJ, 6 NQ, 6 NZ, 6 OU, 6 KRG, 6 ZX. (Flewelling single-valve.)
T. S. Calder.

Bristol (May 12th to June 21st).
British: **2 AKG, 2 CW, 2 DF, 2 FU, 2 GO, 2 IN, 2 KF, 2 MP, 2 NO, 2 PC, 2 UV, 2 XY, 5 FH, 5 FS, 5 KO, 5 MA, 5 MO, 5 NW, 5 TZ, 5 UG, 5 WK, 6 BY, 6 JG, 6 RS, 6 RY, 6 TH, 6 TN, 6 UD.** French: **8 BA, 8 CN, 8 DA, 8 DP, 8 GG, 8 MN, 8 ON, 8 RN, 8 TV, 8 ZY.** Dutch: **0 MS, 0 NY, 0 XP, 0 ZN.** Belgian: **4 C 2, W 2.** Danish: **7 EC.** Spanish: **3 XY.** Unknown: **1 BD.**
Frank Wilson, **2 AMG.**

Smethwick, Staffs.
2 AC, 2 AEX, 2 AFL, 2 AHH, 2 BS, 2 HF, 2 HV, 2 HA, 2 KO, 2 KF, 2 KQ, 2 LV, 2 LT, 2 NV, 2 NM, 2 OX, 2 OP, 2 OM, 2 PV, 2 QR, 2 SY, 2 SV, 2 SH, 2 TR, 2 YD, 5 FH, 5 FI, 5 NH, 5 KO, 6 MJ, 6 PW, 6 MQ, 6 UC, 6 UU, 8 AB, 8 AS. (1 to 4 valves.)
Ralph H. Parker, **2 AQB.**

Northampton (May 26th to July 6th)
2 AIP, 2 AOX, 2 DU, 2 FL, 2 GG, 2 HF, 2 IL, 2 JR, 2 KO, 2 KV, 2 LX, 2 MK, 2 NP, 2 NV, 2 OX, 2 QR, 2 QQ, 2 VG, 2 WA, 2 WD, 2 WM, 2 WN, 2 XG, 2 XH, 2 YV, 2 YX, 5 BP, 5 CU, 5 DO, 5 FL, 5 IY, 5 OY, 5 PU, 5 SZ, 5 UF, 5 VP, 5 YS, 5 YW, 6 MJ, 6 NQ, 6 ZX. Morse: British, **2 AC, 2 DR, 2 FN, 2 FU, 2 GO, 2 HD, 2 KF, 2 KZ, 2 OD, 2 OF, 2 ST, 2 UG, 2 VJ, 2 WY, 2 XM, 2 YQ, 5 CC, 5 DN, 5 FS, 5 HW, 5 JH, 5 JX, 5 KO, 5 LS, 5 MO, 5 OT, 5 QV, 5 RB, 5 SI, 5 TT, 5 WR, 5 YI, 6 NF, 6 RW, 6 RY, 6 TD, 6 TM, 6 TX, 6 UD, 6 XJ, 6 XX, 6 XY, 6 ZZ, ACS, AGG.** French: **8 AE 3, 8 AQ, 8 AU, 8 BA, 8 BG, 8 BN, 8 BP, 8 BS, 8 BU, 8 BV, 8 CF, 8 CM, 8 CN, 8 CT, 8 CZ, 8 DA, 8 DO, 8 DP, 8 DU, 8 DY, 8 ER, 8 EU, 8 GG, 8 KP, 8 LMT 8 LO, 8 MF, 8 ML 8 MM, 8 MN, 8 PP 8 PX, 8 SR 8 TK, 8 TV, 8 WZ, 8 YR, 8 ZM, FL.** Dutch: **0 AB, 0 BA, 0 GC, 0 MR, 0 MS, 0 NN, 0 NY, 0 PI, 0 XF, 0 XP, 0 XQ, P 2, NAB 2.** Belgian: **W 2, 4 WR, 4 RS.** Danish: **7 EC.** Luxemburg: **1 JW, 0 AA.** Italian: **1 HT.** Rhineland: **1 CF, 8 SSU.** Finland: **1 NA.** Unknown: **3 XO, 4 TU, 4 EUEU.**
P. H. Brigstock Frasler.

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

CHELMSFORD 5 XX, 1,600 metres. Weekdays, 11.30 a.m. to 12.30 p.m., 4.30 to 5.30 p.m., 7.30 to 8.30 p.m. Tests. **ABERDEEN 2 BD,** 405 metres; **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5C** 420 metres; **NEWCASTLE 5 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 351 metres; **PLYMOUTH 5 PY** (Relay), 335 metres; **EDINBURGH 2 EH** (Relay), 325 metres; **LIVERPOOL 6 LV** (Relay), 318 metres; **SHEFFIELD 6 FL** (Relay), 303 metres; **LEEDS-BRADFORD 2LS** (Relay), 346 and 310 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3 to 7.30 p.m., 8 to 11.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m. Weather Forecasts, 11.0 a.m. (Sunday); 10.45 a.m., Cotton Prices; 12 noon Market Report; 12.15 to 12.30 (Weekdays), Time Signal and Weather Forecast; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 8.0 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), Concert; 10.10 p.m., Weather Forecast.

PARIS ("Radio Paris"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.30 p.m., Exchange Prices; 4.30 p.m., Financial Report; 5.0 p.m., Concert; 8.30 p.m., News and Concert.

PARIS (Ecole Superieure des Postes et Telegraphes), 450 metres. 3.45 p.m. (Wednesday), Talk on History; 8.0 p.m. (Tuesday), English Lesson; 8.30 p.m., Concert; 9.0 p.m., Relayed Concert or Play.

PARIS (Station du Petit Parisien), 340 metres. 8.30 p.m., Tests.

BELGIUM

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 265 metres. Daily, 5 p.m. to 6 p.m., Concert; 8 p.m. to 8.15 p.m., General Talk; 8.15 p.m. to 10 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9.0 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday, 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9.0 a.m. and 5.0 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m. (Weekdays), 8.0 to 9.0 (Sunday), Concert.

SWEDEN.

STOCKHOLM (Telegrafverket), 440 metres. Daily, 12.45 to 1.0 p.m., Weather Report and Nauen Time Signal; Monday, Wednesday and Saturday, 8.0 to 9.0 p.m., Concert and News; Sunday, 11.0 a.m. to 12.30 p.m., Divine Service from St. James' Church.

STOCKHOLM (Radiobolaget), 470 metres. Tuesday and Thursday, 8.0 to 9.30 p.m., Concert and News.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7.0 to 8.0 p.m.

BODEN, 2,800 metres. Tuesday and Friday, 6.30 to 7.30 p.m., Sunday, 5.30 to 6.30 p.m., Concert and News.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,370 metres (Sunday), 10.40 a.m. to 11.45 a.m., Orchestral Concert. 4,000 metres, 7.0 to 8.0 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1.0 to 2.0 p.m., Address and Concert; 6.0 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 430 metres. 11.0 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7.0 p.m., Concert; 7.0 to 8.0 p.m. (Sunday), Concert.

BRESLAU, 415 metres.

HAMBURG, 392 metres.

STUTTGART, 437 metres.

KONIGSBERG, 460 metres.

FRANKFURT AM MAIN, 467 metres. 7.30 to 10.0 p.m., Tests, Gramophone Records.

LEIPZIG (Mitteldeutsche Rundfunk A.G.), 452 metres.

MUNCHEN (Die Deutsche Stunde in Bayern), 485 metres.

AUSTRIA.

VIENNA (Radio-Hekaphon), 600 metres.

CZECHO SLOVAKIA

PRAGUE, PRG, 1,800 metres. 8.0 a.m., 12.0 a.m., and 4.0 p.m., Meteorological Bulletin and News: 4,500 metres, 10.0 a.m., 3.0 p.m., and 10.0 p.m., Concert.

KBELY (near Prague), 1,150 metres. Weekdays, 7.15 p.m. and 10.0 p.m., Sundays 11.0 a.m. to 12.0 noon, Concert and News.

BRUNN, 1,800 metres. 10.0 to 11.0 a.m., Concert; 2.30 p.m., News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8.0 p.m., Concert or Lecture.

LAUSANNE, HB 2, 850 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 6.0 to 8.0 p.m. Tests.

MADRID (Radio Iberica), 392 metres. Daily (except Thursdays and Sundays), 7.0 to 9.0 p.m. Thursdays and Sundays, 10.0 to 12.0 p.m., Concerts.

MADRID, 1,800 metres. Irregular.

CARTAGENA, EBX, 1,200 metres, 12.0 to 12.30 p.m., 5.0 to 5.30 p.m., Lectures and Concerts.

PORTUGAL.

LISBON (Aero Lisboa), 370 to 400 metres. Wednesdays and Fridays, 9.30 to 12.0 p.m., Irregular Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12.0 a.m. 1,800 metres, 4.0 p.m. and 8.30 p.m., Tests, Gramophone Records.

CORRESPONDENCE.

Spark Interference.

In view of the many complaints made from time to time on the subject of interference from spark stations, the following reply to a letter on the subject, addressed to the Postmaster-General recently by the Radio Association, is of general interest.

General Post Office,
London, E.C.1.
July 8th, 1924.

SIR —With further reference to your letter of the 16th June, I am directed by the Postmaster-General to say that he is anxious to do everything he can to minimise interference with the broadcasting service, and in this connection he is making efforts to secure the discontinuance of the use of the 450 metres wavelength for certain maritime services.

The use of spark transmission on the 300 and 600 metre waves for ship and shore services is permitted by the International Convention governing the radiotelegraphic services, and, so long as a large number of ships—both British and foreign—are equipped only with spark apparatus, the maintenance of suitable spark stations on shore for the purpose of communicating with ships is imperative. The Postmaster-General regrets that it would not be practicable at present to secure a general international change to continuous wave working. The cost involved would be considerable ; indeed, it has been estimated that for British ships alone such a change would involve a capital expenditure of about £2,500,000.

At the same time, a large and increasing number of the more important liners are transmitting all their traffic by continuous wave to the Post Office station at Devizes and other similar stations on the Continent. The Devizes station is working on the 2,400 and 2,100 metre waves, and its transmissions should not therefore interfere with programmes transmitted on the band of waves allotted to broadcasting.

While a large number of British and foreign ships using the main sea routes to and from the British Isles continue to use spark apparatus, there must necessarily be great congestion of spark traffic on the chief routes, such as the English Channel, and it would, it is feared, be impracticable to insist that such traffic should not be sent during broadcasting hours. Such a curtailment of facilities would seriously impair the efficiency of the ship and shore services, and could not be carried out without international consent, which there would be no likelihood of obtaining.

The Postmaster-General thinks it right to add that he has good reason for assuming that a large amount of interference with reception is due to the use of widely tuned receiving apparatus, and that a great improvement could be effected in this respect by the use of selective apparatus suitably adjusted.

(Signed) F. J. BROWN.

The Transmitting Licence Regulations.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was interested to see in the June 25th issue of *The Wireless World and Radio Review* that in an editorial you bring into notice the methods adopted in granting transmitting licences. As a keen experimental licence holder since pre-broadcasting days, I applied about 12 months ago for a transmitting licence, detailing experiments in a system of simultaneous transmission and reception which, in conjunction with a friend, I proposed to conduct. I explained that the data which an artificial aerial could supply was already in our possession and asked for permission to use an open aerial for advanced experiments. I gave evidence that I was a qualified telegraphist, which could have been proved if necessary, and furnished particulars of experience in the use of wireless apparatus in the army. Permission to use anything but an artificial aerial was refused and the refusal was upheld on appeal. In the meantime the system on which we were working has been patented by a commercial concern who were evidently working on the same lines. So that's that ! As a consolation we are privileged to listen any Sunday to transmitters whose experiments appear to consist of continuous endeavours to ascertain whether their microphones are working, or whether they are louder on 400 metres than on 450 metres. This sort of thing is absurd and I think that any serious experimenter who has listened in to the babel on Sundays will agree that nine of every ten experimental transmitters are out for amusement rather than work.

I would suggest that the G.P.O. provide a number of district inspectors to *personally* investigate each application for permission to transmit, and also to check the amount of serious experimental work done by holders of open aerial transmitting licences. After all, the permission is given for serious experiments, and not for the purpose of jamming the ether with badly modulated reproductions of second-rate gramophone music.

"BIRMINGHAM."

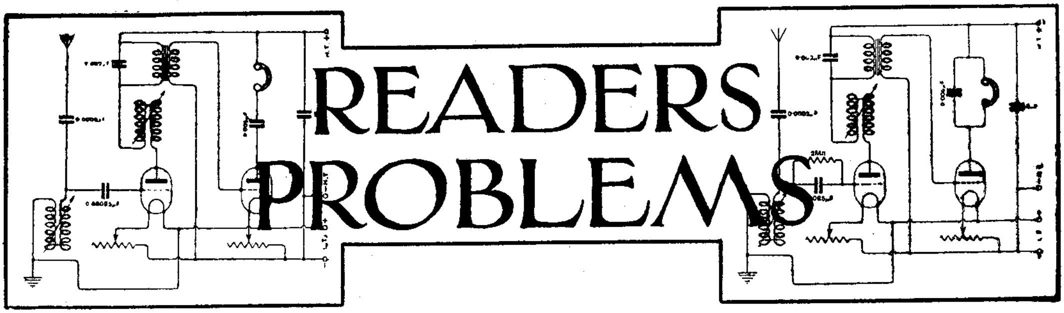
Crystal Detectors.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—Will you kindly publish the following correction in my article " On the Design of Crystal Detectors." Fig. 3 is a new detector of German design (not French as stated on p. 464). Further, this detector does not suffer from the fault of capacity. The French detector referred to here is a well-known make in which two massive brass fittings are separated by a space of about 2 millimetres only.

In reply to Mr. Wallace (p. 431) I am quite aware of the old use of oil in various detectors. One of the oldest coherers, in fact, consisted of a steel disc running in oil and touching a mercury surface. The improved detector I refer to uses a plastic or solid dielectric at the loose contact, thus preventing vibration as well as oxidation.

Aberdeen. J. STRACHAN.



1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for 1/-, or 3/6 for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.

" *W.E.T.*" (*Merthyr Tydfil*) **finds that no difference in signal strength is obtained when the telephone condenser in his receiver is removed, and asks if this condenser is necessary.**

The use of a fixed condenser across the telephones is not a necessity, but often brings about an improvement in the quality of speech or music received. This condenser has the effect of correcting faults in the acoustic characteristic of the telephones. It therefore follows that the value of the telephone condenser should be found by trial, as its value will depend upon the particular type of telephones which you are using. The 0·001 μF condenser across the primary winding of the intervalve transformer is important. The purpose of this condenser is to by-pass the H.F. currents from the plate of the detector valve, and to prevent their passage through the transformer winding primary.

" *F.R.R.*" (*London, S.E.*6) **sends particulars of the formers of a variometer, and asks how many turns to put on each winding for wavelengths between 250 and 600 metres when connected to a standard 100-ft. single wire aerial.**

The stator, which is 3¼ inches in diameter should be wound with 50 turns of No. 22 D.C.C., and the rotor, 2⅝ inches in diameter, with 60 turns of the same gauge of wire. To increase the efficiency on short wavelengths, a fixed condenser of about 0·0003 μF capacity should be connected in series with the aerial. A switch should be provided to short circuit this condenser on the longer wavelengths.

" *R.T.C.*" (*Swindon*) **asks how a two-valve receiver (H.F. and detector, tuned by means of cylindrical coils) may be modified for the reception of wavelengths in the neighbourhood of 1,600 metres.**

The wavelength range may be increased by connecting plug-in coils in series with the existing cylindrical coils, as indicated in the diagram in Fig. 1. The coil A in series with the A.T.I. may be an Igranic No. 150 coil, and a No. 400 coil may be connected in the anode circuit, at the point B in the diagram. Reaction effects could be obtained by coupling together coils A and B.

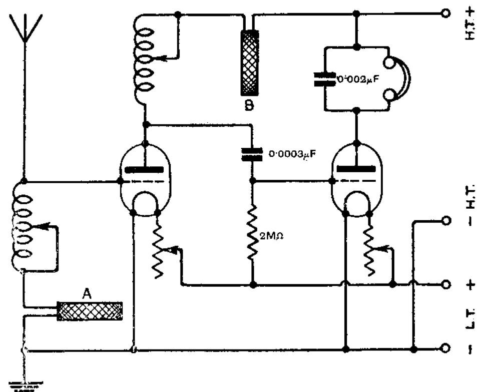


Fig. 1. " R.T.C." (Swindon). Circuit showing the addition of load coils to a two-valve receiver.

" *H.K.*" (*London, N.W.*3) **asks for a diagram of a four-valve receiver with three stages of H.F. amplification employing the resistance capacity method of coupling. The receiver is**

required for the reception of the B.B.C. stations, and must have a high degree of selectivity.

The only B.B.C. station which you would be able to receive satisfactorily with a resistance capacity coupled H.F. amplifier would be the high power broadcasting station on 1,600 metres. The resistance capacity method of H.F. coupling is not suitable for reception on wavelengths below 1,000 metres. This method of coupling is aperiodic in its action, and the selectivity of the instrument would not be very high. You would be able to receive on short wavelengths if semi-aperiodic anode coils were substituted for the anode resistances, and the necessary selectivity could be obtained by the use of a loose-coupled tuner.

by several well-known manufacturers. The latter transformers are convenient where it is desired to cover a wide band of wavelengths, and it is often an advantage to use one of these transformers in conjunction with a stage of tuned H.F. amplification, as it will be found that the aperiodic transformer will tend to give the H.F. portions of the circuit stability. The connections for the reaction coil when passing through the H.F. panel are crossed over. By these means the reaction coil is automatically reversed in direction when an H.F. panel is added to or removed from the circuit. In the detector unit the 2 megohm grid leak is shown connected in parallel with the grid condenser, as it is possible to purchase units of this type from several manufacturers. It is often advantageous

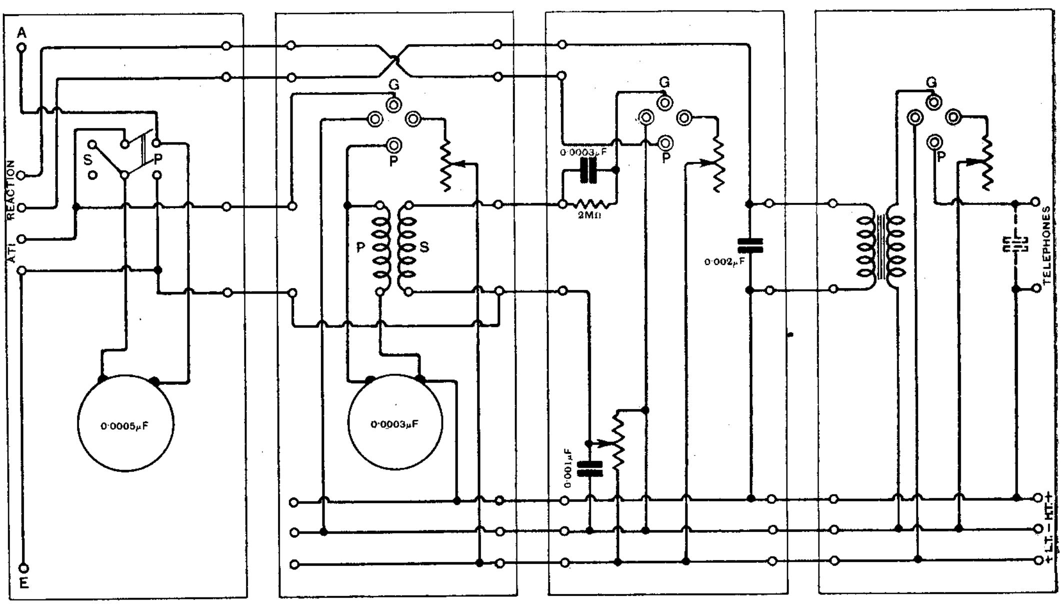


Fig. 2. "K.D.C." (London, S.W.16). A three-valve receiver built on the unit system.

"*K.D.C.*" (*London, S.W.*16) **asks for a diagram of a unit receiver consisting of four panels (tuner, H.F., detector and note magnifier).**

A wiring diagram of the panels is given in Fig. 2. In the tuner a reaction coil is coupled directly to the A.T.I., no secondary circuit being used. A series-parallel switch is provided for use in connection with the 0·0005 μF tuning condenser. Transformer coupling has been used in the H.F. panel, since with this method there is no difficulty in duplicating the wiring should it be necessary to add a further stage of H.F. amplification at a future date. When tuned anode coupling is used it becomes necessary to provide two types of panel, one for use immediately preceding the detector valve, and the other type for the remaining panels. The H.F. transformers may be of the four-pin plug-in type, or the semi-aperiodic type marketed

to connect the grid leak between the grid and +L.T., but in general the difference between the results obtained by the two methods is not very great. If the use of a telephone condenser is found to be desirable, this may be connected across the telephone terminals outside the set.

"*F.H.W.*" (*Folkestone*) **asks if an old ignition coil might be used as a low frequency choke coil in a filter feed circuit for use with high resistance telephones.**

Provided that the insulation resistance of the secondary winding of the coil is in good condition, the ignition coil will make an excellent telephone choke. It will not be necessary to provide a closed core for the choke coil as it is often found an advantage from the point of view of freedom from distortion to use an open core.