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THE
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On Heterodynes

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

(*Continued from p. 255.*)

IT was pointed out in the last instalment of this article, that the action of the two condensers in series across the ends of the tuning coil could be looked upon as analogous to that of a potentiometer—the connection of the valve filament to the common mid point of the condensers providing a means of dividing the total potential difference across the oscillation circuit into two parts, one of which is joined across the anode circuit, while the other is applied to the grid. This being the case one might enquire whether it would not be possible to apply such an electrostatic or condenser potentiometer to the ordinary oscillation circuit of Fig. 13,

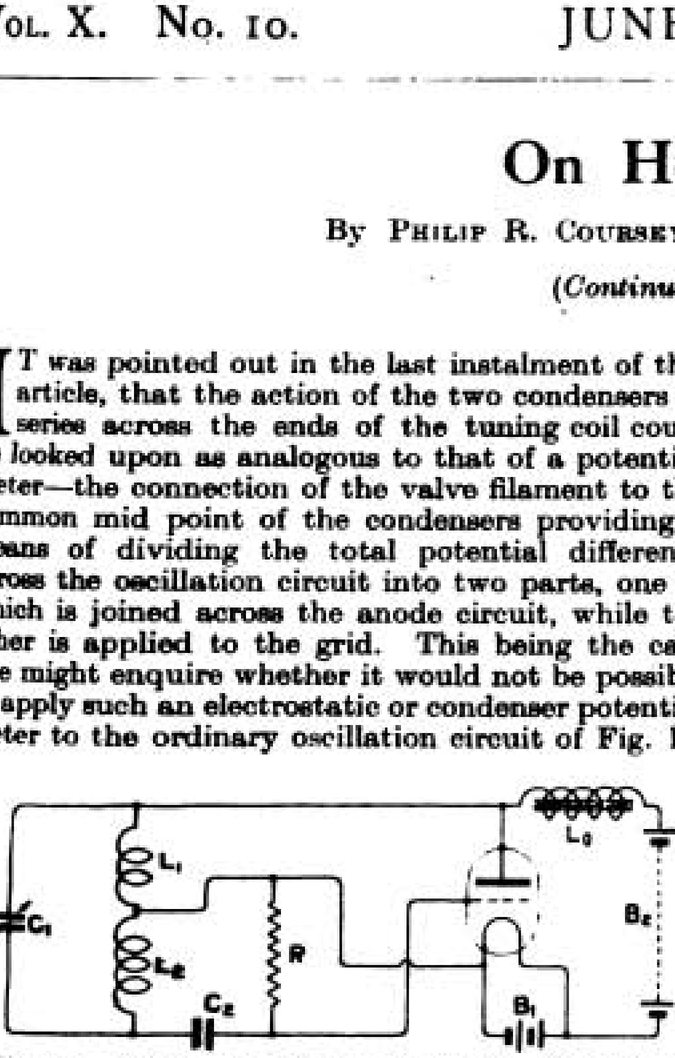


Fig. 13. (Repeated from last issue.) Heterodyne Oscillator with Magnetic Coupling.

(which is reprinted here for convenience in reference) so as to provide a means of electrically obtaining the tapping point shown near the centre of the coil L in that diagram, without actually making a tapping on to the coil itself. The use of an actual tapping on the coil implies that if it is desired to change the coils by means of a plug socket as in the previously described arrangements, provision must be made for the fitting of a special three-pin or four-pin socket on the instrument, and for the mounting of all the coils that are to be so used on special three-pin or four-pin plugs. By making the tapping electrostatically in the manner to be described below this disadvantage is eliminated and the use of a single standard two-pin plug socket retained.

The circuit arrangement is shown in Fig. 19, in which L and C are the main tuning coil and condenser respectively, the ends of which are joined to the anode and grid of the valve in a similar manner to that already described, a stopping condenser C_3 being inserted in the grid lead, with a leak resistance R between the grid and the filament. Across the oscillation circuit LC, is joined the "electrostatic potentiometer," formed by the two condensers C_1 and C_2 in series, and the connection to the filament of the valve is made to their centre point in a similar manner to that described in connection with the instrument using the double variable condenser (Figs. 14 and 16).

The wavelength of the oscillation circuit can thus be loaded up by means of the single variable condenser C—which may, if necessary, as in the case of the magnetically coupled instrument, be made up of a variable air condenser in conjunction with one or more fixed condensers connected in parallel with it by means of the range switch. The capacity of the two condensers C_1 and C_2 in series will, however, be additive to the capacity of the variable tuning condenser C, and needs to be taken into account when predetermining the wavelength range of the circuit.

It is found in practice that the ratio of the capacities of the two condensers, C_1 and C_2, requires to be changed somewhat as the wavelength is altered in order to obtain the most stable oscillations. This effect is doubtless due to the fact that one of the condensers (C_1) is shunted, not only by the valve itself, but also by the telephones T and battery B_2, whereas the other (C_2) is shunted by

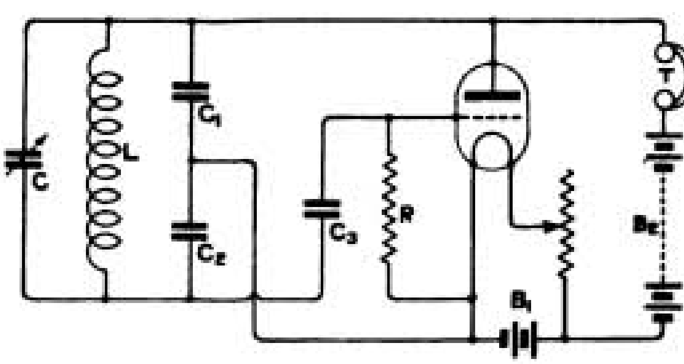


Fig. 19.

the condenser C_3 in series with the resistance R, which is in shunt to the grid-filament path in the valve. The shunting impedance of these two paths will depend upon the wavelength of the oscillations, so that the relative voltages tapped off by the ratio condensers C_1 C_2 and applied to the anode and grid of the valve will also vary. Altering the ratio of their capacities as the wavelength is increased (by means of the condenser C) enables this variation of effective ratio to be overcome and stable oscillations to be produced over the whole tuning range of wavelengths.

Using a set of Burndept tuning coils for the coil L (Fig. 19), and a variable air condenser of maximum value = 0·0005 microfarad, the condenser C_1 can be fixed at about 0·00040 μF, and C_2 made about 0·00025 μF for coils Nos. 50 to 200, and increased to 0·0005 μF for coils 300 to 1,000.

The tuning range of the set under these conditions is about 400 to 17,000 metres.

The condenser C_3 shown in the grid circuit of the valve in Fig. 19 is necessary merely to insulate the grid from the high positive voltage that would otherwise be impressed upon it from the H.T. battery. Provided, therefore, that its insulation resistance is high, its capacity value is not very important as long as it is kept large enough not to oppose any serious impedance to the passage of the high frequency pulses from the oscillation circuit. Since the frequency of the oscillations set up by the valve used in this instrument can be varied over a wide range, it is desirable to employ a fairly large capacity, such as 0·01 μF for this condenser. The leak resistance R has its usual function —that of maintaining the proper grid potential relative to the filament, but at the same time it has some effect upon the strength and stability of the oscillations. While the ordinary values of grid leak resistance—of the order of 2 megohms—can quite well be employed here, somewhat improved results are obtainable with a lower resistance value, such as 60,000 ohms, as thereby the changes of frequency of the oscillations due to changes in the filament current or H.T. voltage are much reduced. For example, with one particular V.24 valve, and associated circuits built up in the manner here outlined, and using the above values of resistance and capacities, neither a change in the filament battery voltage of nearly 1 volt, nor a 25 per cent. change of H.T. battery voltage produced much effect upon the frequency of the oscillations, as indicated by the beat note obtained with another valve which was maintaining steady oscillations. Even at the highest frequencies, *i.e.*, at the shortest wavelengths to which the heterodyne would tune, these large changes in the operating conditions only altered the beat note by a very few cycles, while ordinary battery variations that are likely to be experienced produced no appreciable effect. The position of this leak resistance R, *i.e.*, joined directly between grid and filament should be specially noted, as in this case it must *not* be connected across the grid condenser C_3 in the usual way.

The general arrangement of an instrument built upon these lines is shown in Fig. 20, which gives the leading dimensions and location of the parts. For the sake of uniformity the outside dimensions of the containing box have been made the same as those of the instruments that have already been described in the earlier parts of this articles, viz., 9¾ ins. by 6 ins. by 4½ ins. high when completed. The ebonite top, details of which are shown in Fig. 20, should be ¼ in. thick. Details of the valve-holder springs remain the same as those already described, Figs. 4 to 7. The complete valve holder also is mounted in the same position, with one of the filament springs clamped under the LT terminal. The position of the coil holder is shown in Fig. 20, one only being required. The variable condenser

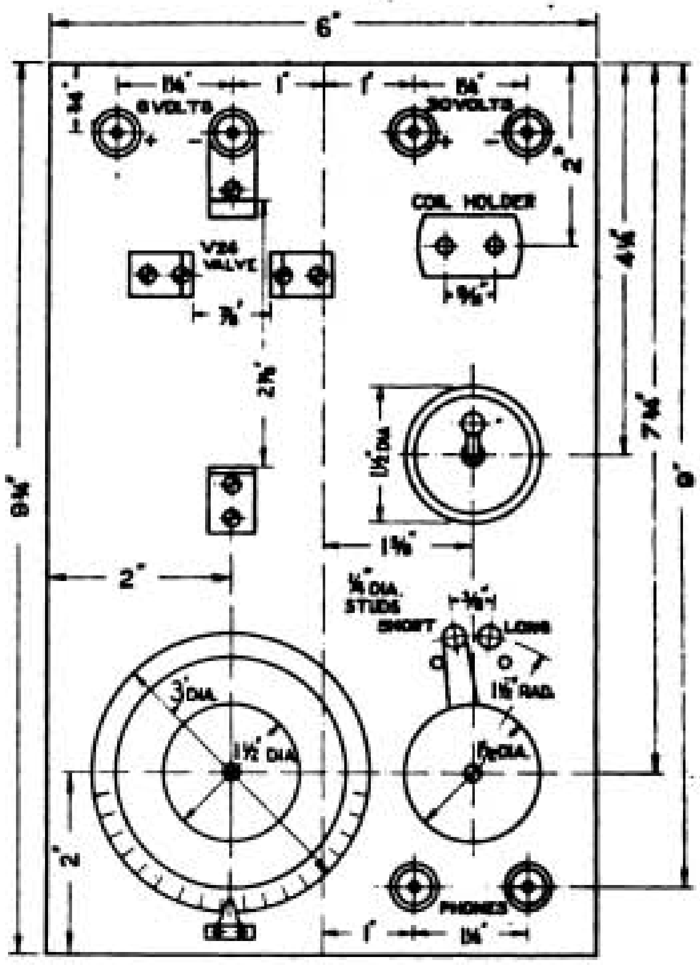


Fig. 20.

is also of the same type as used in instruments (1) and (2) described above, except that its maximum capacity need not exceed 0·0005 μF.

The range switch in this instrument is fitted with two contacts only, as it does not here perform the same function as it does in the instruments already described. It is used here solely to add additional capacity in parallel with one of the "e.s. potentiometer" condensers for the longer wavelengths for the reason that has already been described. It does not serve as a "range switch" in the sense in which that term has been used in the earlier parts of this article, since all the tuning is here done with the single variable condenser. The switch itself can be built up on the lines shown in Fig. 9 (page 195), and its detailed connections are given in Fig. 21, which also shows the mode of interconnecting the other parts of the set. The condensers forming the electrostatic potentiometer can be mounted in any convenient position on the under side of the top of the instrument. They may conveniently be fixed near to the "range" switch, or between that switch and the coil plug socket, since they have to be connected to both those parts. The resistance in the filament circuit of the valve, shown in the circuit

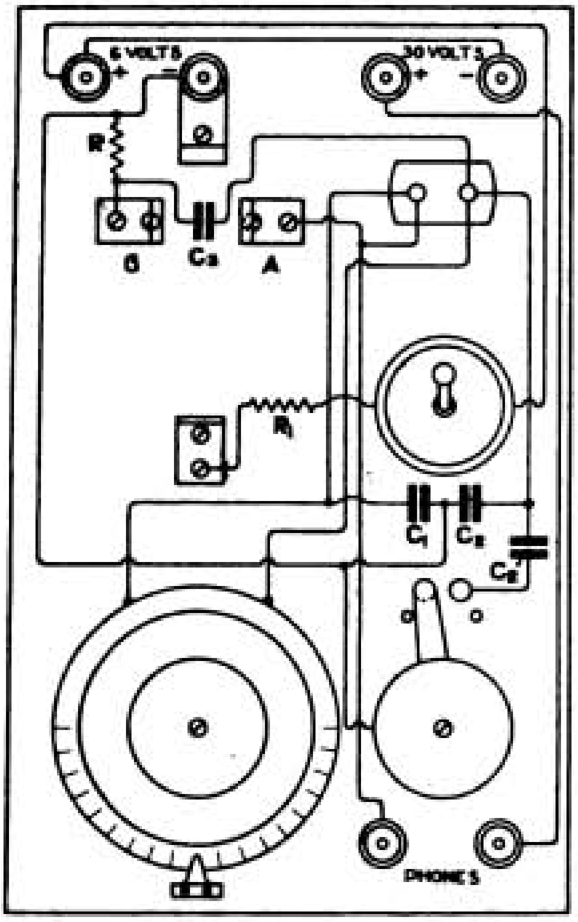


Fig. 21.

diagram, Fig. 21, may be made on the lines already described in an earlier part of this article, and may be given about the same resistance value.

Using a V-24 valve with the capacity values, etc., here described, Table VI shows approximate wavelength ranges obtainable with the coils, of which the numbers are given in column 1. The figures given are for Burndept coils. Column 2 indicates whether the "range switch" should be on stud 1 or on stud 2, in order to secure the proper working of the instrument and to give the wavelength values tabulated.

Other intermediate coils can, of course, be employed if desired in order to get any particular wavelength range nearer to the centre of the condenser scale. For this purpose it is evidently not essential to retain the use of standard plug-in coils, since any

TABLE VI.

Coil No.	Position of "Range-Switch."	Approximate Wavelength Range (metres).	Coil Inductance μH.
50	1	380—600	135
75	1	550—910	305
100	1	740—1,160	535
150	1	1,020—1,650	1,120
200	1	1,450—2,460	2,240
300	2	2,420—3,650	4,600
400	2	3,440—5,200	9,600
500	2	5,000—7,850	20,500
750	2	7,800—11,800	48,900
10,000	2	11,300—17,000	101,500

coil can be connected into the circuit by providing it with the appropriate plug connection. To facilitate the choice of extra coils for this purpose, the inductances of the coils listed in Table are also given. The necessary inductance value to be given to a coil for use in any particular part of the wavelength range of the instrument can thus be obtained approximately by inspection with little trouble.

A heterodyne of this type using only one coil for each wavelength range is capable of retaining a much more rigid calibration that the types described in the earlier parts of this article in which two coils are used (one serving as reaction) since it is not easy to obtain rigidity of these coils, and absolute constancy of their relative position when in use, and still to retain ease of replacement. Greater rigidity can, of course, be obtained when the tuning and reaction coils for each range are built up rigidly together, and provided with four connecting pins or contacts, but such an arrangement entails the use of specially constructed coils, whereas with the instrument just described any coil is suitable provided that it is rigid in itself—*i.e.*, that its tunes are rigidly mounted so as to eliminate individual movement among themselves.

(To be continued.)

An American Short Wave Receiver

By FREDERICK J. RUMFORD, A.M.Am.I.E.E.

AMATEURS have long needed a cheap but efficient short wave receiver. The set described is easily made up and requires but very few parts, and is so assembled that it is easily accessible at all times for the changing of circuits, if so desired. It is designed along the lines of the famous "Paragon" short wave regenerative receiver, and will give results unexpectedly good. While it has not been put to any extensive test, it has worked on 100 to 400 metres with very good results, and I feel sure that the builder could get still better results by further experimentation.

I will now describe the parts needed for making the set. Two 3-inch dials, engraved as shown on the drawing, and one 2-inch dial, also engraved, will be required. These dials must have knobs attached to them. Eight brass terminals are also needed, and one complete variable switch with five contact studs, their necessary nuts and washers. The switch lever should swing within a radius of 1 inch. This switch is for the purpose of tapping the primary of the loose coupler. One of the contacts on this switch is left idle.

Fig. 1 shows the front of the panel, with the necessary components mounted in place, and Fig. 2 represents the rear view, showing the variometers and loose coupler and the method of mounting them.

Fig. 3 shows a side view of the loose coupler, with the method of mounting it 3 inches from the back of the panel, as well as the method of placing the bracket for the coil former. Fig. 4 shows the method of wiring, including internal and external circuits.

The panel may be of Bakelite, or ebonite. It should be 12″ long, 6″ wide and from ⅛″ to ⅜″ thick. All the measuring and drilling for the necessary holes should be done first, after which the panel should be sand-papered. For the shafts on the variometers there should be ¼″ holes drilled. The binding-posts and switch contacts should have 3/16″ holes and the switch lever a ⅜″ hole. After this is done the panel is ready to be engraved. The different symbols appearing on the front of the panel should be engraved upon it with some sharp-pointed tool.

For the coils six formers must be procured, two of 4″ in outside diameter by 2″ long and with a thickness of ⅛″; one 3″ in outside diameter, each of these coils, with suitable nuts and washers to attach the wire on the starting and finishing of the winding of these coils. This also provides means of joining the primary and the secondary in series. There will be about 42 turns in all on the primaries of variometers Nos. 1 and 2.

As the reader will note, on Fig. 2 the coils are all wound in two sections. The primary for variometer No. 2 is wound just as the primary on variometer No. 1. When both primaries are wound they should be given a good coat of shellac and allowed to dry.

We will now pass to the making of the secondaries for variometers Nos. 1 and 2. These coil formers are 2¾″ in outside diameter and 2″ long. The winding starts ⅛″ and continues for ¾″, leaving a ¼″ space. It again continues over ¾″, leaving ⅛″ at the end. These coils are fastened at both ends in the same way as the primaries, and should be shellaced as before.

We will now start on the loose couplers. The

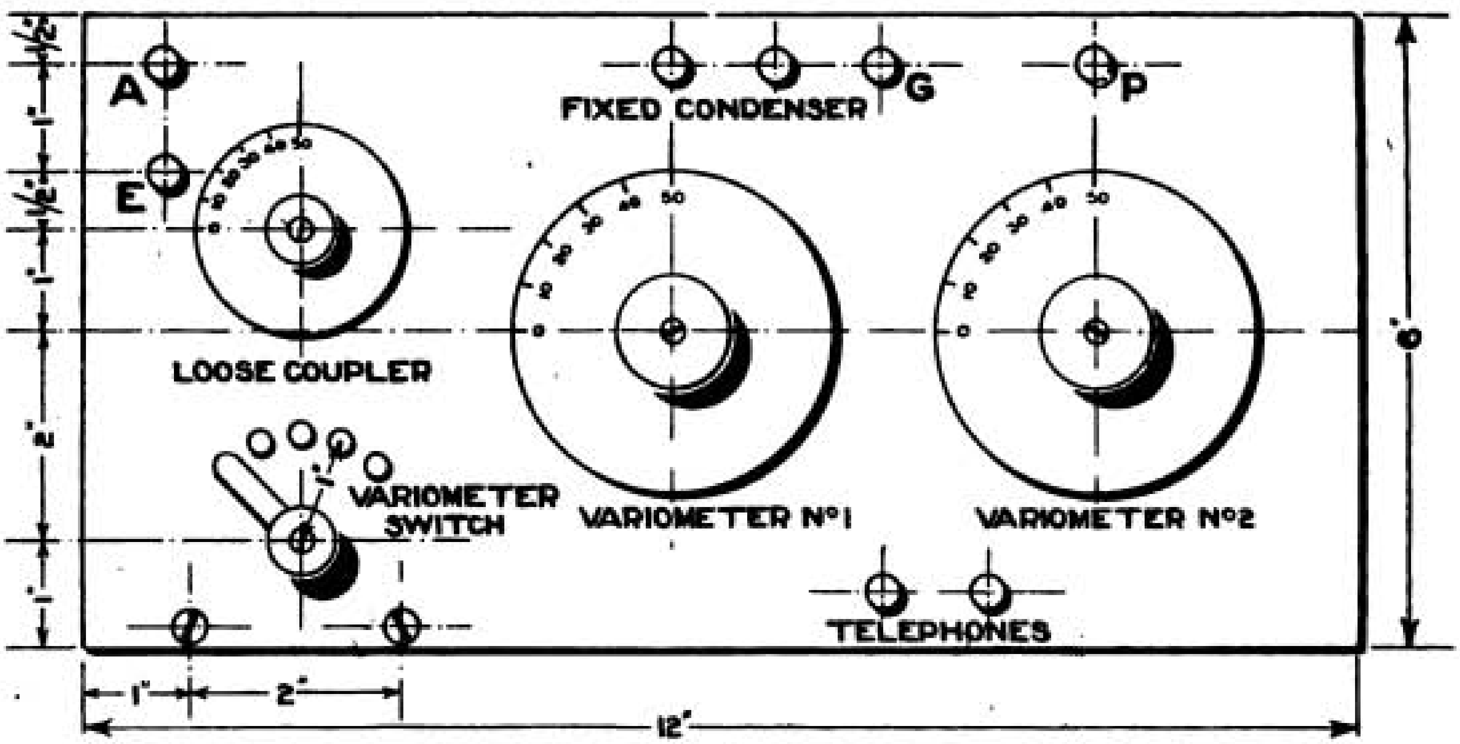


Fig. 1.

2″ long and ⅛″ thick; two 2¾″ in outside diameter, 2″ long and ⅛″ thick; one 4″ outside diameter, 3½″ long and ⅛″ thick. All formers that are 4″ in outside diameter are for the primaries of the variometers, and the formers smaller in outside diameter are for the secondaries. The two primaries that are 2″ long must be drilled in the centre with holes to allow a loose fit of a ¼″ shaft. This shaft is the means by which the secondary is revolved within the primary, and the hole to be drilled in the secondary formers should be small enough to allow for a snug fit on the same shaft. After this has been done the four coil formers should be given a couple of coats of some good insulating varnish.

In this instance the writer has used No. 24 D.C.C. wire. On the primary former of variometer No. 1 the winding should start ⅛″ from the end and continue for ¾″. A space of ¼″ is then skipped, and the winding continued to ⅛″ from the end. It is advisable to fit small screws on the ends of primary is 4″ outside diameter, 3½″ long and ⅛″ thick. The primary should have a projection on it, as shown in Fig. 2. The purpose of this projection is to provide a means of fastening the shaft. This former should be shellaced as before. After it has dried, the winding will start on the projection, and by attaching the wire to a screw, as mentioned above. It should be wound 2″ down with No. 24 D.C.C. wire—in fact, all the coils are wound with this size wire. From this coil four taps are taken off. All the coils, by the way, must be wound in the same direction. As the 2 inches of winding will equal 66 turns of wire, the taps should be taken off on the 16th, 33rd, 49th and the 66th turn. A good way to take them off is to scrape the insulation off the wire for a short distance and solder short pieces of No. 24 bare copper wire upon the scraped section of wire, these being in turn connected to the different contacts on the switch. We are now ready to make up the secondary coil for the loose coupler. This former is 3″ in outside diameter

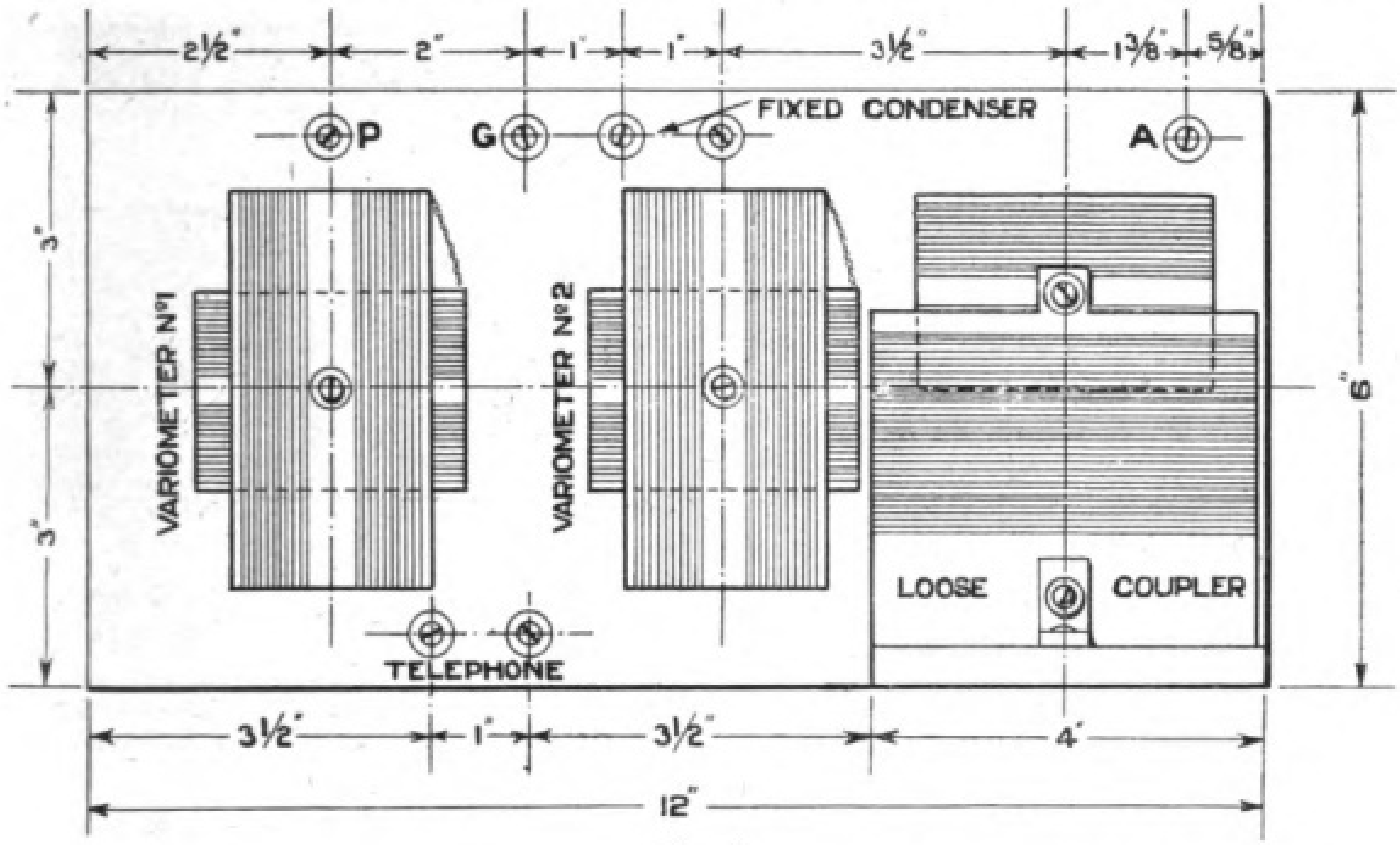


Fig. 2.

and 2″ long, with a wall ⅛″ thick. It should have a hole drilled in the centre of it to allow a ¼″ shaft to fit snugly. This shaft serves to revolve the secondary coil within the primary. The primary of the loose coupler should also be drilled for the shaft. The beginning of this coil will be fastened as was done in the case of the other coils, and the winding will continue for ¾″, will skip a space of ¼″ and continue again for ¾″ more, the end being secured for a screw. The secondary is now ready for its coat of shellac.

The primaries of variometers Nos. 1 and 2 will have 42 turns upon each (21 turns per section), which will total about 45′ of wire to each primary. The two secondaries of variometers Nos. 1 and 2 will have 50 turns each, with 25 turns to a section. Each coil would take about 36′ of wire. The loose coupler primary has 66 turns of wire—equal to about 71′ of wire. The loose-coupler secondary is 3″ in outside diameter and has 50 turns of wire (25 turns to a section), which would equal about 40′, with a grand total of 273′ of wire in all, or about ⅜ to ½-lb. of the size given.

We are now ready to assemble the outfit. We will mount the primaries of variometers Nos. 1 and 2 by four little wood screws (two to a coil), which will screw in through the coil former into the back of the panel, so that the shaft hole on the coil former will come in line with the hole in the panel. After this we will get the necessary shafts, which should be threaded for their whole length. Each of these shafts should be 5″ long and ¼″ in diameter. One end of these shafts should be screwed up into the knob of the dial and pinned so that it won't work loose. It is then pushed through the panel from the front, through the primary coil, and nuts run on it so that there will be a nut on the front and back of the secondary at each end, and on the inside and outside of the primary, which when screwed up tight against the formers will hold them securely. The above operation will be executed on both variometer assemblies respectively, No. 1 and No. 2. In joining the primary and secondaries in series, connection should be made by taking pieces of flexible lamp cord of sufficient length and connecting the ends to the screws that have already been provided.

We will now pass on to the assembling of the loose coupler. We require a base for this 8″ long, 4″ wide and ⅜″ thick, which in turn is secured to the back of the panel by two wood screws, which go through the panel from the front. This base will support the primary of the loose coupler. The primary is mounted upon the base and held there by four little brackets, two of angle form and the other two straight. These brackets can be of either copper, brass or iron. The builder must bear in mind that between the back of the panel and the front of the primary coil former there must be just 3″ of space. This is absolutely essential, or otherwise, when the secondary or variometer No. 1 is rotated, it will rub against or strike the primary of the loose coupler. After the primary has

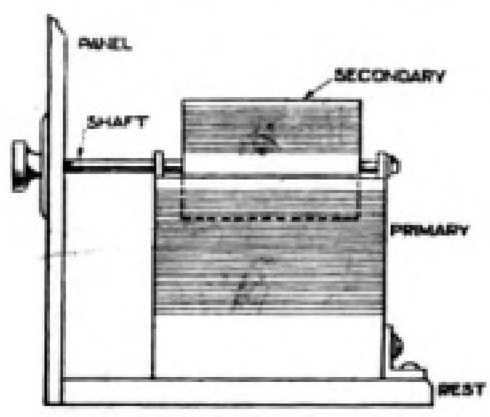


Fig. 3.

been fixed the secondary of the loose coupler is mounted in the same manner as the secondaries of the two variometers. The wiring for the back of this panel is done with No. 18 stiff bare copper wire, which will be bent into the different shapes desired. Fig. 3 shows the true method of mounting the primary of the loose coupler. The taps on the primary are joined to their respective contacts on the panel. Fig. 4 shows the method of wiring, and Fig. 5 shows the simplifier circuit diagram. This set can be mounted in cabinet form or upon a pair of brackets.

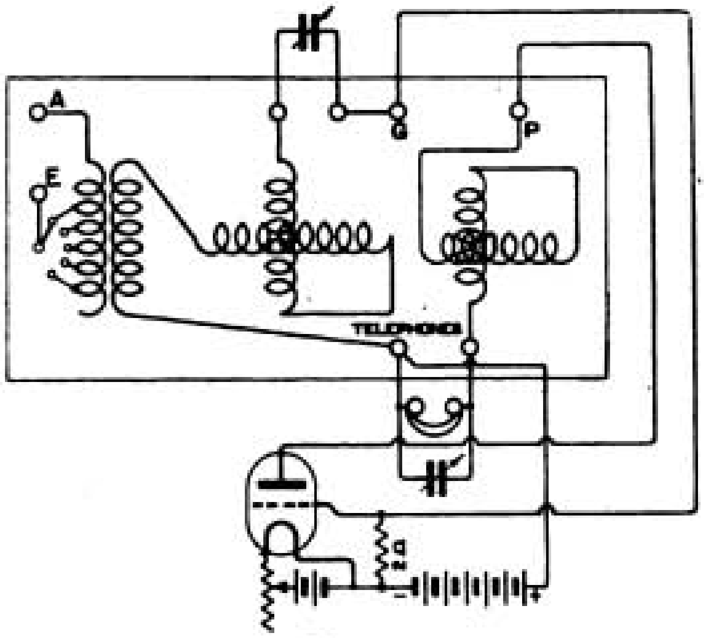


Fig. 4.

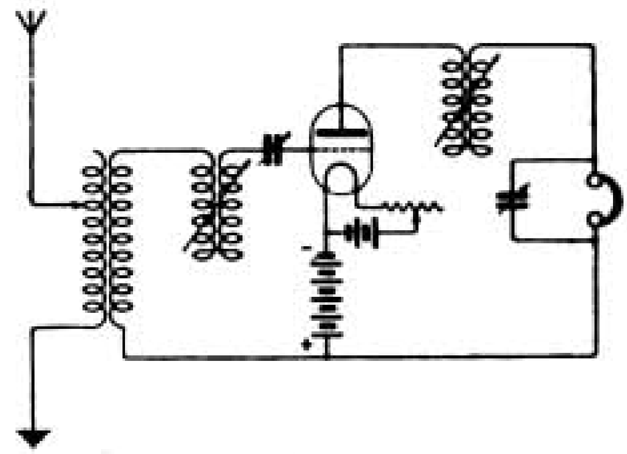
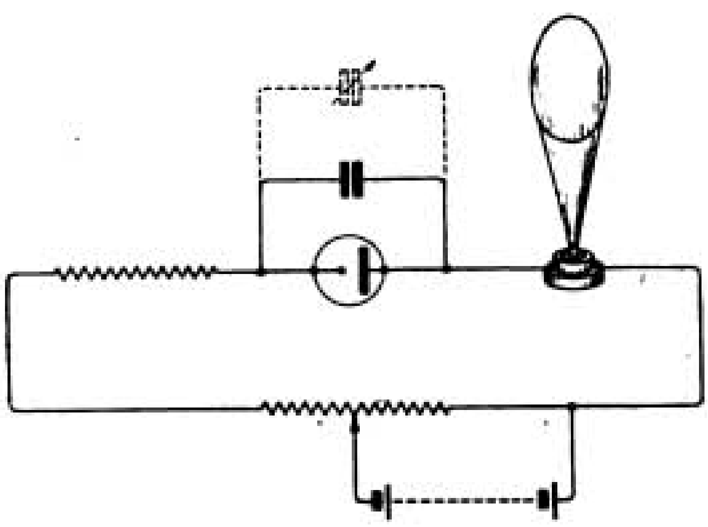


Fig. 5.

The Production of Electrical Impulses by the Neon Tube

At a recent meeting of the Physical Society, Mr. S. O. Pearson, B.Sc., gave an interesting demonstration of the production of electrical impulses by means of neon gas-filled lamps.

He first drew attention to the small current controlling resistance which is to be found in the socket of the neon lamp of the type recently introduced for low candle power lighting. It was shown that a very critical voltage was required to set up the glow, and how, when once established, it could be maintained on a lower voltage. Curves were given to show the potentials at which the glow was established, and at which it disappeared. From this it is interesting to consider the effect of shunting the tube with a condenser, as shown in the accompanying circuit diagram. On applying the potential to the lamp and condenser an interval will elapse during which the voltage across the condenser will build up as it acquires a charge. On reaching the critical voltage the lamp glows and the energy required to maintain the glow will be drawn partly from the charged and partly from the charging supply depending upon the resistance in circuit. When the condenser voltage has dropped below that required to continue the glow, the resistance across the lamp electrode is restored and a re-charging of the condenser immediately commences. This cycle gives rise to a flashing of the lamp and with suitable values of resistance and capacity, flashing at intervals as long as one minute can be obtained. A reduction of the capacity of the shunt condenser or an increase in the value of the series resistance increases the rapidity of the impulses which can then be detected by telephone receivers connected either in the lamp and condenser circuit or in the battery leads.



The demonstrator gave much data on the determination of the frequency and equations, showing the relationship between the governing factors. Apart from the many other applications of the neon gas-filled lamp, the property opens up a very extensive field for research and there is little doubt that before long it will find a place in wireless equipment.

Static Interference as a Function of Wavelength*

By H. T. FRIIS and L. J. SIVIAN.

INTRODUCTORY.

The purpose of this note is to comment upon a recent theoretical investigation by M. Abraham† of the relative immunity from atmospheric disturbances in closed loop and open aerial forms of receiving antennæ, and upon a subsequent paper by L. B. Turner‡, on the signal-static ratio as a function of wavelength. The calculations in the latter paper are based on Abraham's results, which are believed to be in error due to Abraham's incomplete circuit equation for the loop aerial, and due to his choice of initial conditions for both the loop and capacity aerial equations.

In the present state of our knowledge regarding the nature of atmospheric disturbances any quantitative discussion of their effects in receiving aerials is necessarily largely speculative. The importance of the subject, however, is evident to anyone acquainted with the operation of long-distance stations at the present day, and warrants closer examination of the assumptions underlying its discussions.

As the receiving aerial is tuned to longer and longer wavelengths the static disturbances steadily increase with no indication of a maximum corresponding to a definite frequency. The general trend of the phenomenon may be judged from L. W. Austin's§ static-wavelength curves. It appears plausible to assume, therefore, that static is due to strongly damped non-oscillatory pulses. Evidence from other sources‖ points to the same general conclusion with regard to lightning discharges. Turner‡ states that "lightning fields are known to die away in 1/1,000 to 1/10,000 second, corresponding to (say) $\alpha = 5{,}000$ to 50,000, and are almost certainly non-oscillatory." It is simplest to represent the field due to these "dead-beat" pulses by $E\epsilon^{-\alpha t}$. This is the assumption made by Abraham in his paper in the *Jahrbuch*, and is adopted as typical of static in what follows.

Response of Tuned Circuit to Static Pulse.

Let a circuit of inductance L, capacity C, and total resistance R be subjected to the e.m.f. shown in Fig. 1, which may be expressed as :—

$$\left.\begin{array}{ll}\text{e.m.f.} = E\,\epsilon^{-\alpha t}, & t > 0 \\ \text{e.m.f.} = 0\quad, & t < 0\end{array}\right\} \quad . \quad . \quad . \quad (1)$$

The circuit equation is :

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{C}q = E\,\epsilon^{-\alpha t} \quad . \quad . \quad . \quad . \quad (1a)$$

where $$I = \frac{dq}{dt}.$$

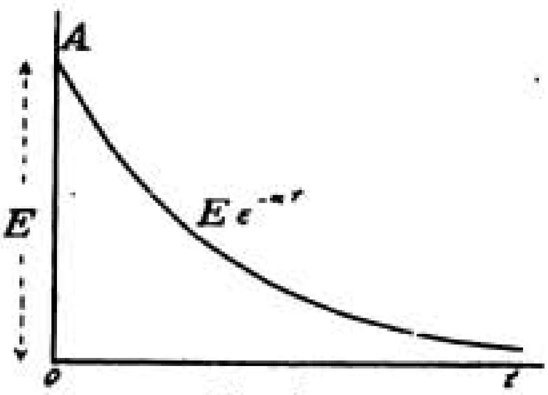


Fig. 1

For the initial conditions $t = 0, q = 0, i = \frac{dq}{dt} = 0$, the solution is

$$i = \frac{E}{L[b^2 + (\alpha - a)^2]} \cdot \left[-\alpha\epsilon^{-\alpha t} + \frac{\sqrt{a^2 + b^2}\;\sqrt{b^2 + (\alpha - a)^2}}{b}\,\epsilon^{-\alpha t}\cos(bt + \Theta)\right] \quad . \quad . \quad (1b)$$

where $a = \frac{R}{2L}$, $b = \sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$, $\Theta = \tan^{-1}\left[\frac{a(\alpha - a) - b^2}{b\alpha}\right]$.

Abraham's choice of initial conditions is

$$t = 0, \qquad i = 0, \qquad \frac{di}{dt} = 0,$$

and accounts for the discrepancies pointed out below. The total energy, Q_0, delivered to the circuit

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* Received March 6th, 1922.

† M. ABRAHAM, "Die Spule im Strahlungsfelde, verglichen mit der Antenne." (*Jahrbuch der drahtlosen Telegraphie und Telephonie*, 14, pp. 259-269, August, 1919).

‡ L. B. TURNER, "Optimum Wavelength and Atmospherics." (*Radio Review*, 2, pp. 524-534, October, 1921.)

§ L. W. AUSTIN, "The Relation between Atmospheric Disturbances and Wavelength in Radio Reception." (*Proceedings of the Institute of Radio Engineers*, 9, pp. 28-40, February, 1921.)

‖ Eg., Humphreys' "Physics of the Air," and C. T. R. WILSON, Investigation of Lightning Discharges and the Electric Field of Thunderstorms. (*Philosophical Transactions of the Royal Society*, 211A, pp. 73-115).

is $Q_i = \int_0^\infty i^2 R dt$. Assuming now, as Abraham does, that $a << b$, and $a << \alpha$, it readily follows that

$$Q_i = \frac{E^2}{2L(\omega^2 + \alpha^2)} = \frac{E^2}{2L} \cdot \frac{\lambda^2}{4\pi^2 c^2 + \alpha^2 \lambda^2} \quad \ldots \ldots \ldots \ldots \quad (2)$$

where $\omega = \frac{1}{\sqrt{LC}}$, c = wave velocity, λ = wavelength.

If now Q_i be taken as a measure of the static intensity in a tuned aerial, and plotted as a function of ω and λ, curves of the general character indicated in Figs. 2(a) and 2(b) are obtained. Thus on the assumption that E and L are constant, the change in tuning of the aerial being accomplished by varying

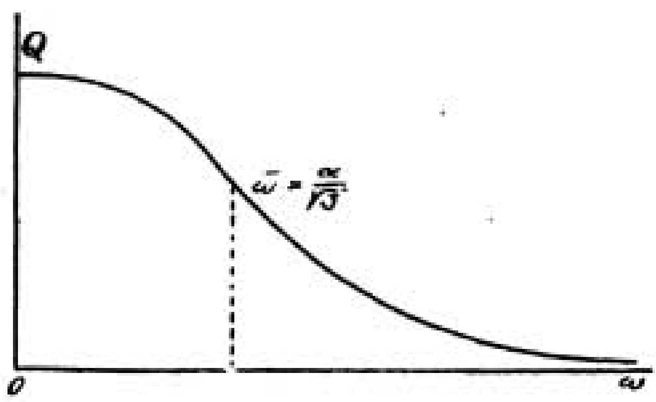

Fig 2a.

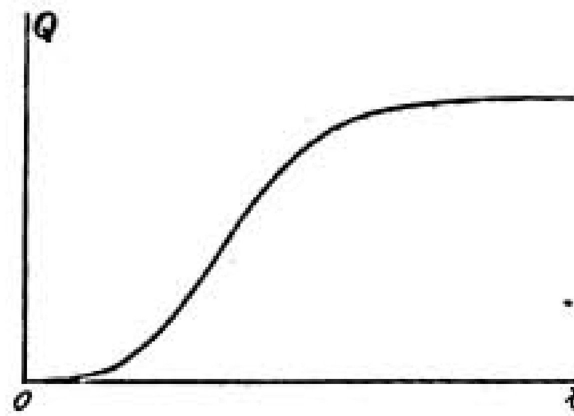

Fig 2b.

its capacity C, the inflection point on the Q_i, ω curve is given by

$$\frac{\partial^2 Q_i}{\partial \omega^2} = -\frac{E^2}{L} \cdot \frac{\alpha^2 - 3\omega^2}{(\omega^2 + \alpha^2)^3} = 0$$

whence $$\bar{\omega} = \frac{\alpha}{\sqrt{3}}.$$

The general shape of the Q_i,λ curve bears considerable resemblance to that of Austin's curves. No quantitative conclusions, however, can be drawn from the latter in view of the way they were obtained, under experimental conditions widely different from those assumed here.

A nearer approach to actual conditions is to assume the ratio $\frac{L}{C} = k^2$ to remain constant as the aerial wavelength is being varied. We then have

$$Q_i = \frac{E^2}{2k} \cdot \frac{\omega}{\omega^2 + \alpha^2}.$$

The general shape of Q_i as a function of ω is shown in Fig. 3. The inflection point is given by

$$\frac{\partial^2 Q_i}{\partial \omega^2} = \frac{E^2}{k} \cdot \frac{\omega(\omega^2 - 3\alpha^2)}{(\omega^2 + \alpha^2)^3} = 0$$

whence $$\bar{\omega} = \alpha\sqrt{3}.$$

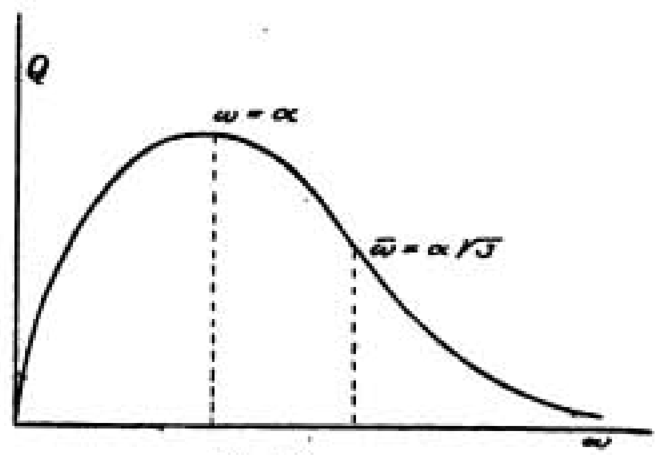

Fig. 3.

It must be emphasised that this result is only qualitatively related to data on static audibility obtained with regenerative or heterodyne methods of reception. It would be interesting to have *simultaneous* measurements of the intensity of static impulses made in aerials tuned to distinct frequencies. If the measuring device obeys a square law so that its reading is proportional to Q_i then α could be obtained graphically as above or from

$$\frac{\omega_2^2 + \alpha^2}{\omega_1^2 + \alpha^2} = \left(\frac{Q_{i_1}}{Q_{i_2}}\right) \left(\frac{E_2}{E_1}\right)^2 \left(\frac{L_1}{L_2}\right).$$

Static Immunity of Capacity Aerial.

Let $E_s \cos \omega t$ represent the electric field due to a sustained C.W. signal. The energy, Q_s, supplied by it to the aerial during the time T seconds $\left(T >> \frac{2\pi}{\omega}\right)$ is :—

$$Q_s = \frac{h^2 E_s^2}{2R} \cdot T$$

and that due to the static impulse :

$$Q_i = \frac{h^2 E_i^2}{2L\,(\omega^2 + \alpha^2)}$$

where h = height of the aerial in cms. Defining the interference immunity as $S_m = \frac{Q_s}{Q_i}$ we find for the capacity aerial :—

$$S_m = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \left(\omega^2 + \alpha^2\right) \cdot T \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Abraham's result for this case is

$$S_m = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \frac{\omega^2}{\alpha^2} \cdot \left(\omega^2 + \alpha^2\right) \cdot T \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4a)$$

The additional factor, $\frac{\omega^2}{\alpha^2}$, is introduced through the choice of initial conditions referred to above.

If now Table II in Turner's paper be recomputed on the basis of equation (4) rather than (4a) the following is obtained (on Abraham's additional assumption $\alpha^2 << \omega^2$) :—

TABLE I.

Range X in km.	Optimum Wavelength in km.	
	Austin-Cohen.	Fuller.
	Capacity Aerial.	Capacity Aerial.
3,000	2·25	6·06
4,000	4·0	7·35
5,000	6·26	8·65
10,000	25·0	14·1

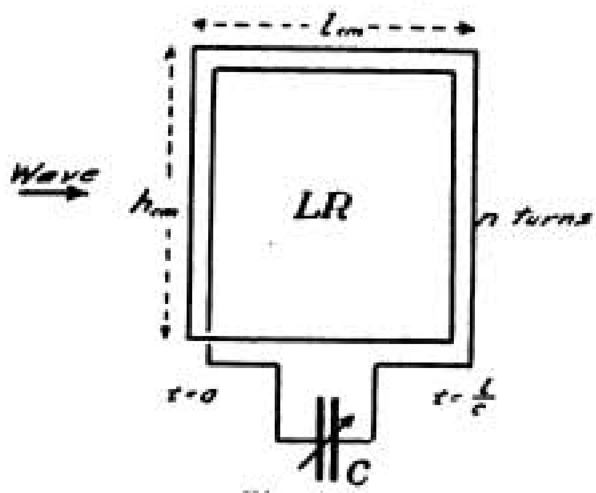

Fig. 4.

For purposes of comparison the corresponding table based on Abraham's result, is reproduced :-

TABLE II.

Range X in km.	Optimum Wavelength in km.			
	Austin-Cohen.		Fuller.	
	Loop.	Capacity Aerial.	Loop.	Capacity Aerial.
3,000	0·40	0·81	3·3	4·2
4,000	0·71	1·44	4·05	5·1
5,000	1·10	2·25	4·8	6·0
10,000	4·4	9·0	7·8	9·8

Interference Immunity of Loop Aerial.

Abraham's solution for the loop assumes the same initial conditions as in his treatment of the capacity aerial. In what follows the initial conditions $t = 0$, - - - $q = 0$, $i = \frac{dq}{dt} = 0$, will be used. Another modification also appears necessary in order properly to represent the history of the transient e.m.f. acting in the loop.

Regarding the loop (Fig. 4) as two vertical aerials, h cm high and l cm apart, the e.m.f. due to a sustained signal is given by

$$E_s.n.h \cos \omega t - E_s.n.h. \cos \omega\left(t - \frac{l}{c}\right),$$

where c = velocity of wave propagation.

Assuming $\frac{\omega l}{2c} << 1$, this becomes

$$E_s.n.h. \frac{\omega l}{c} . \sin \omega\left(t - \frac{l}{c}\right).$$

The energy supplied to the loop circuit during the time T, $(T >> \frac{2\pi}{\omega})$, is given by $\int_0^T i_s^2 R \, dt$

which is: $$Q_s = \frac{E_s^2 n^2 h^2 l^2 \omega^2}{2 R c^2} . T.$$

Let the static impulse again be of the type given by equation (1). The two e.m.f's. acting in opposite directions are ABE and GH (Fig. 5). The resultant e.m.f. acting in the loop is given (in absolute value) by ABCD, where

$$|ICD| = |FGH| - |ABE|. \text{ (Fig. 5).}$$

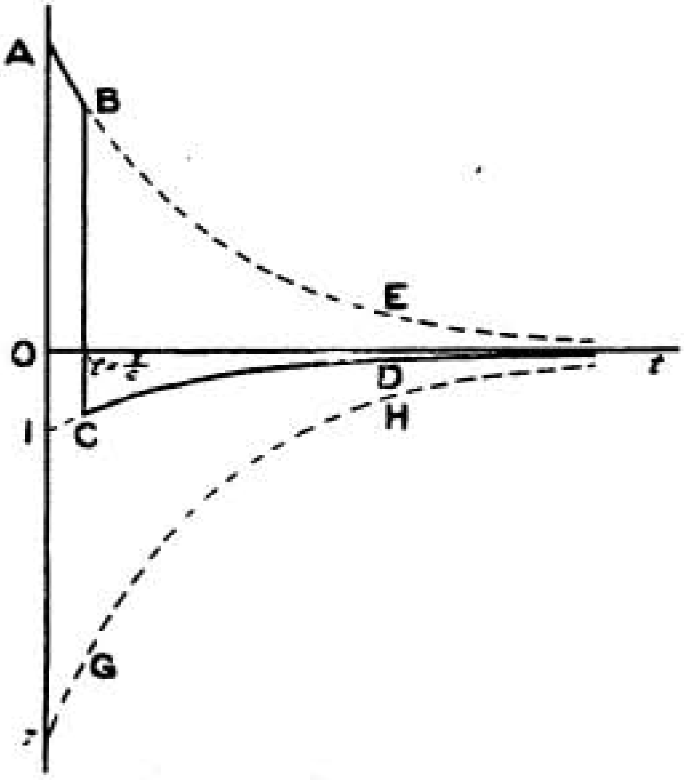

Fig. 5.

or by

$$E_1 + E_2 = E_i nh \left[\epsilon^{-\alpha(t-l/c)} - \epsilon^{-\alpha t} \right]_{0<t<\infty} - E_i nh \left[\epsilon^{-\alpha(t-l/c)} \right]_{0<t<\frac{l}{c}} \quad . \quad (5)$$

In Abraham's solution the ICD curve is taken to represent the e.m.f. acting throughout, the second term, E_2, in equation (5) being neglected. The exact evaluation of the energy delivered by $(E_1 + E_2)$ to the loop circuit leads to a rather complicated expression. If, however, Abraham's assumptions of $a << b$, $a << \alpha$, $\frac{\alpha l}{c} << 1$, and $\frac{\omega l}{c} << 1$ are adhered to, the calculations become simple. In that case the method used in deriving equation (2) from (1b) is directly applicable whence

$$Q_i = \frac{E_i^2 n^2 h^2 \omega^2 l^2}{c^2} \cdot \frac{1}{2L(\omega^2 + \alpha^2)}$$

and for the loop aerial interference immunity

$$S_L = \frac{Q_s}{Q_i} = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \left(\omega^2 + \alpha^2\right) \cdot T$$

which is the same as was found for the interference immunity of the capacity aerial. Abraham's result for this case is

$$S_L = \left(\frac{E_s}{E_i}\right)^2 \cdot \frac{L}{R} \cdot \frac{\omega^4}{\alpha^4} (\omega^2 + \alpha^2) . T.$$

It follows that the "best wavelength" values in Tables II and IV of Turner's paper are replaced by those in Table I above for loop and capacity aerial alike. Of course, the directive properties of the vertical aerial and of the loop were not taken into account in the computation of their interference immunities. Their effect will depend on the spatial distribution of the atmospheric disturbances but can not appreciably modify the above conclusions in so far as wavelength is concerned.

RESEARCH LABORATORIES OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, AND THE WESTERN ELECTRIC COMPANY, INC.

October 17th, 1921.

Fine Adjustments of Tuning for Telephony

By G. P. KENDALL, B.Sc.

SUCCESS in the reception of telephony depends to a very great extent upon the use of the minimum amount of amplification necessary to give signals of fair strength; in this way alone can one secure any degree of freedom from interference by Morse signals, atmospherics, induction from power mains, radiating valve circuits, and all the other things which the learned call "extraneous noises," but which the harassed owner of a seven-valve set is apt to describe much more forcibly when he has to snatch the telephones from his deafened ears on nights when Mars is coming in particularly well. Since, then, as few stages of amplification as possible are to be used it is obvious that the tuned circuits must be operated with the greatest possible efficiency, and devices for fine adjustments of inductance and capacity become essential. When reaction is used, of course, a further device is needed for giving fine adjustments of the degree of coupling. A good method was described in *The Wireless World* for November 26th, 1921.

ADJUSTMENTS OF INDUCTANCE.

Since the inductance changes required on telephony wavelengths are fairly small, the variometer probably offers the best solution of the problem. As, however, it is usually convenient to design one's short wave tuner to cover, say, 300 to 1,500 metres, this statement must be modified, for a variometer to cover that range would have to be capable of giving such large variations of inductance as to rule out the possibility of fine adjustment (unless, of course, it were fitted with some form of general slow motion, which is beyond the powers of most amateurs, since it has to be of great mechanical perfection to be any use). A very satisfactory tuner to meet the aforementioned requirements may be made by combining the tapped form of inductance with a small variometer in some such way as this:—Wind a 12 × 3 inch, or an 8 × 4 inch tube, with a single layer of No. 22 D.C.C. wire, taking a tapping from every fifteenth or tenth turn respectively, to a stud of a switch; this gives the rough variation of inductance. For its finer adjustment, arrange inside one end of the tube (the end which remains in circuit on minimum adjustments) a small coil of about ten turns on a spindle, to which is fixed a long handle of the usual anti-capacity type. This little rotary coil, being connected in series with the main coil, provides by its variometer action a very fine inductance adjustment, which should comfortably cover the gaps between tappings.

With a tuner of this type a variable condenser is not really necessary, but is nevertheless desirable, to enable the operator to make wide sweeps when searching for a station, and consequently to pick up that station quickly, which is of great importance in telephony.

It should be noted that this tuner does not lend itself to having a reaction coil combined with it, because the magnetic fields of the variometer and reaction coils must necessarily interlink, and hence every slight adjustment of the one will upset that of the other in a vexatious manner. For this reason and others it is much better to use a separate reaction coupler whose aerial circuit coil has a fixed value. A suitable design follows for a coupler to cover the same range of waves as the tuner previously described:—

Aerial coil: 20 turns of No. 22 D.C.C. wire (*i.e.*, about 2 cms. of winding) on a former of about 3 inches diameter, mounted on a spindle (with anti-capacity handle) so as to rotate within the plate coil.

Plate coil: a single layer of No. 30 D.C.C. wire upon a 4 × 8 inch tube, with six equal tappings taken to studs of a switch. A small variable condenser should be placed across this coil for the purpose of tuning the plate circuit more or less exactly to the received wavelength, since somewhat better results are obtained in this way. Fig. 1 shows how these components may best be arranged in circuit so as to minimise capacity effects from the hand.

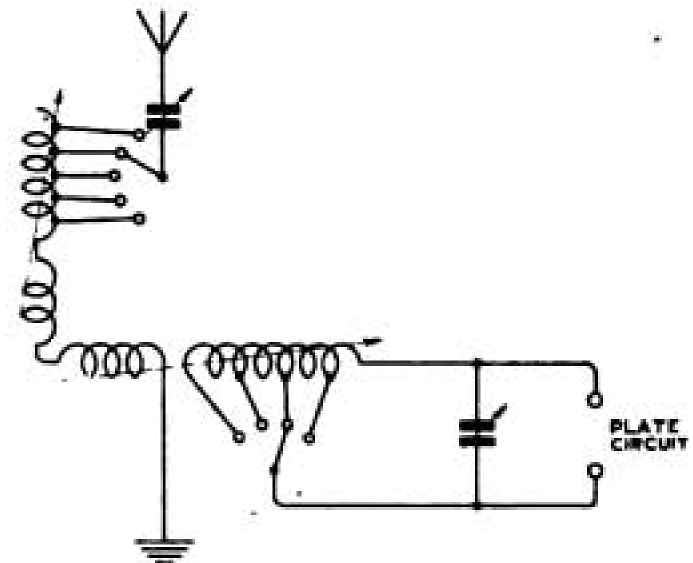

Fig. 1.

It should be noted that the reaction coil here specified is intended to be used for purposes of amplification only, and *not* for the production of heterodyne current. (The man who operates such a circuit in the self-oscillating condition on telephony wavelengths would have his licence suspended in a world wherein everyone got his deserts.) When a heterodyne current is required for searching for carrier-waves or the reception of C.W., it should be provided by a separate heterodyne set and introduced into the amplifier at a point as remote from the aerial circuit as possible. For example, if a transformer-coupled H.F. amplifier is used, the heterodyne set should be coupled into one of the inter-valve transformers. This is really the only considerate method, but since it can be used with H.F. amplifying sets only, it is out of reach of the numerous amateurs who are limited to a single valve, with reaction, possibly followed by L.F. amplification. The proper course in this case is to employ two tuned circuits, as loosely coupled as possible, and to react into the secondary, NOT the aerial circuit. The only alteration required to make the previously described reaction coupler suitable for this purpose is to wind the rotary coil (which is now to be placed in series with the secondary of the loose-coupler) with 30 turns of No. 28 D.C.C. wire. Fig. 2 shows how the components should be arranged in circuit to minimise objectionable capacity effects. An improvement is shown in Fig. 3, where the coupling of aerial and secondary circuits is done by means of a small fixed aerial coil mounted on a spindle inside the secondary coil, tuning of the aerial circuit being

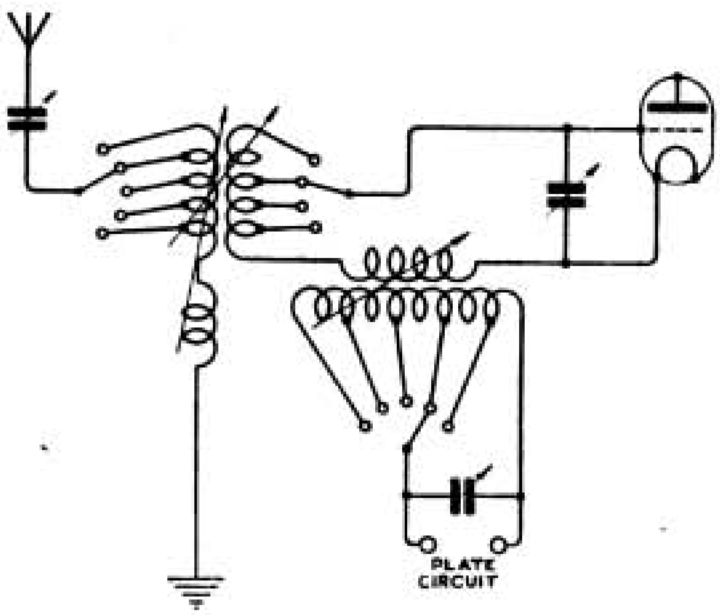

Fig. 2.

done with the tuner already described. In this way tuning and coupling are kept separate and distinct, so that one can adjust the one without upsetting the other. The additional complication of the set which results, objectionable though it may seem, is well worth while from the point of view of the amateur who aims at getting the best possible results from his set. Suitable dimensions for the loose coupler follow :—

Aerial coil : 15 turns of No. 22 D.C.C. on a 3 inch rotary former inside one end of the secondary.

Secondary coil : single layer of No. 28 D.C.C. on a 4 × 9 inch tube, with about six tappings, the actual number depending upon the capacity of the variable condenser which is to be used.

The reader will have observed that I specify double cotton-covered wires for all windings ; this is done advisedly, in order to draw the attention of those amateurs who use silk-covered wire to the advantages of the former type of covering. A good deal of experience has led me to the conclusion that double cotton is much the best covering for wires for almost all types of tuning coils, since it is both cheaper and more efficient than silk. Its greater efficiency is due to the fact of its greater thickness, giving a better spacing of adjacent turns, and a correspondingly reduced internal capacity, this being especially noticeable in any type of multi-layer coil. Of course, the resulting coil is more bulky, but every amateur of any experience knows that he must not expect a really efficient set to be suitable for the waistcoat pocket.

As for insulation, the relative insulating and hygroscopic properties of silk and cotton are of little importance, since the finished winding will in any case be thoroughly dried and then impregnated with shellac varnish or paraffin wax. The last-named is perhaps the best insulator for the purpose, because both the coil and the former upon which it is wound can be soaked in the melted wax until thoroughly impregnated (*i.e.*, until air-bubbles cease to rise). The result, when the coil is taken out, drained of superfluous wax as completely as possible and allowed to cool, is a perfectly permanent and damp-proof impregnation of the highest insulation.

ADJUSTMENTS OF CAPACITY.

The ordinary type of rotary variable condenser does not give a sufficiently gradual variation for telephony purposes, and some form of fine adjustment is extremely desirable, although it can be dispensed with if really good variometer tuning is employed. Many amateurs, however, prefer to use merely a tapped inductance and to get their fine adjustments of wavelength with the condenser.

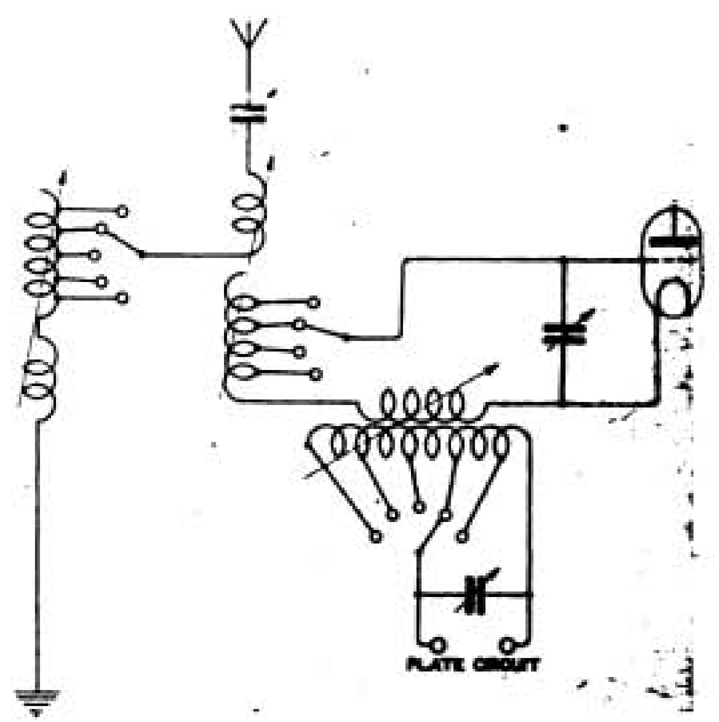

Fig. 3.

There are three principal methods of attaining the desired end, two of which are in common use, while the third, which I have found to be decidedly the best, seems to be very little known. The first method is that known as the Vernier condenser; this, correctly, means that an ordinary tuning condenser is fitted with a geared slow motion, by means of which the rotary plates may be very gradually turned, and a vernier scale to indicate their position with great exactitude. This is quite a good method, but it is really only suitable for the amateur with a pocket of considerable depth, since the gearing must be of the highest possible quality to ensure that there shall be no "back-lash" or looseness in its working, the slightest trace of which would be sufficient to render the condenser useless for the purpose for which it is intended.

The most popular method is one depending upon the use of a very small variable condenser.

(sometimes erroneously called a vernier condenser), having, say, three fixed and two moving vanes; this condenser is connected in circuit in a variety of ways, and provides a fairly satisfactory method of fine tuning. When connected in parallel with the inductance it may be used either alone or in parallel with a larger condenser, both arrangements having drawbacks. The defect of the first is that it is incapable of giving those wide sweeps which are essential to picking up stations quickly, while the second is objectionable on the score of expense. It is, however, very convenient to work with, the large condenser being used for rough adjustments and the small one for fine tuning. When working with the capacity in series with the inductance the small condenser cannot, of course, be used alone, but must be placed in parallel with a larger condenser, which may be either fixed (say, 0·001 mfd.) or variable (preferably). The reader will see that the same objections apply to these two arrangements respectively as to the preceding two.

The third method is simplicity itself. It is based upon the fact that if two condensers are placed in series the resulting capacity in circuit is less than that of either of the two separate condensers (actually, it is the reciprocal of the sum of the reciprocals of the separate capacities). Now, if one wishes to connect an ordinary variable condenser of, say, 0·0005 mfd. capacity in circuit in such a way that the total capacity shall have a maximum value of about 0·00005 mfd., and be very gradually variable between that value and a very small minimum, all that is necessary is to place in series with the variable condenser a fixed condenser of suitable (very small) capacity. Since the whole scale of the condenser then only represents a variation of zero to 0·00005 mfd. it is evident that we have here the desired fine adjustment. The method has many advantages, of which the following are the chief ones:—

(1) Cheapness. Total cost is perhaps sixpence.

(2) Capacity effects from the hand are much reduced, provided that the fixed condenser is put on the *aerial* side of the variable condenser, and not the earth side.

(3) The insulation of the variable condenser (a doubtful quantity in many cases) is increased by that of the fixed condenser, which is easily made very high.

(4) When using the tuning condenser in parallel with the inductance, the device automatically ensures that only small values of capacity are used, thus compelling one to keep to an efficient ratio of inductance to capacity.

(5) Only one variable condenser is needed to give either rough or fine adjustment. Fit a two-point switch to put the stopping-down condenser in or out of circuit as required; signals can then be picked up in the ordinary way, inductance increased and capacity decreased until they are heard near the zero end of the condenser scale, and then the stopping-down condenser inserted and final exact adjustments made.

What has been said so far about this method applies mainly to its use when the capacity is in parallel with the inductance. When the condenser is to be in series it is evident that some modification is required, since a capacity in that position must be large. What is needed is another fixed condenser of about 0·001 mfd., in parallel with which is to be placed the variable condenser with its stopping-down condenser and two-stud switch as before. Coarse and fine adjustments can then be obtained, and tuning in be done, exactly as already described. Fig. 4 will make the arrangement clearer than a detailed description.

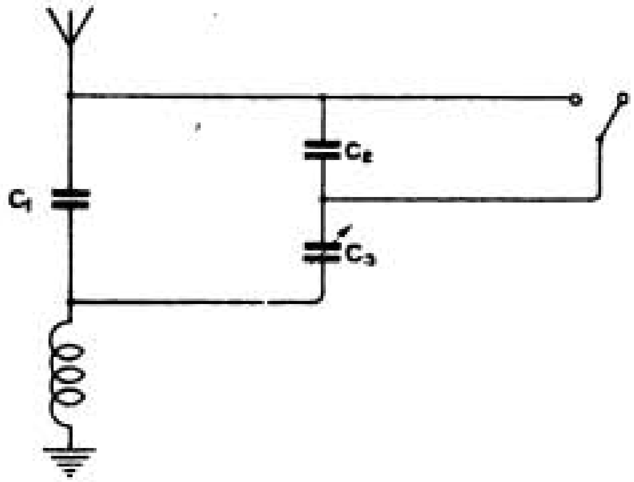

Fig. 4.

C_1 is the large fixed condenser (0·001 mfd.), C_2 the stopping-condenser (0·0001 mfd.), and C_3 is variable (0·0005 mfd. max.). The values given are probably about the best to work with, since they give somewhere about the right degree of fine and rough adjustment. Although this arrangement seems a little complicated, it is really only so on paper; once connected up it is perfectly simple and satisfactory to use.

A practical point to note is that mica is not a desirable dielectric for the small fixed condenser, because it necessitates the use of such small plates that exact calculation becomes impossible, and one has to trust to luck in hitting the right capacity. The best materials for the purpose are, I suggest, copper foil and thin sheet ebonite (1/64th inch is the best).

The actual capacity of the stopping-down condenser may be suited to such individual requirements as the amount of capacity variation needed to cover the intervals between studs on one's tuner. A good general value is that already mentioned, namely, 0·0001 mfd.

The Wireless Society of London.

The last Meeting of the Session will be held on Wednesday, June 14th, at 6 p.m., at the Institution of Electrical Engineers, when an address will be given by Sir Oliver Lodge, F.R.S.

A Simple C.W. and Telephony Transmitter

BY B. J. AXTEN.

THE following is a description of a C.W. and telephony transmitter which can be built very easily and has given the writer great satisfaction. It is both simple and inexpensive to make and maintain, and most of the components are to be found in any amateur station.

The set takes small power, which although not giving a long range, keeps the cost of construction and maintenance low; also, for the purpose for which it is designed (*i.e.*, to give a practical knowledge of transmission to amateurs with little previous experience), high power and long range are unnecessary. Instructive, useful and interesting experiments and tests can be carried out with this set with the co-operation of local amateurs, and when the owner is tired of the limitations of the set, he will be in a suitable position to work a more powerful set. Yet another advantage of commencing operations on low power is that any interference the owner may cause by his ignorance will be far less serious than if he started right away with considerable power.

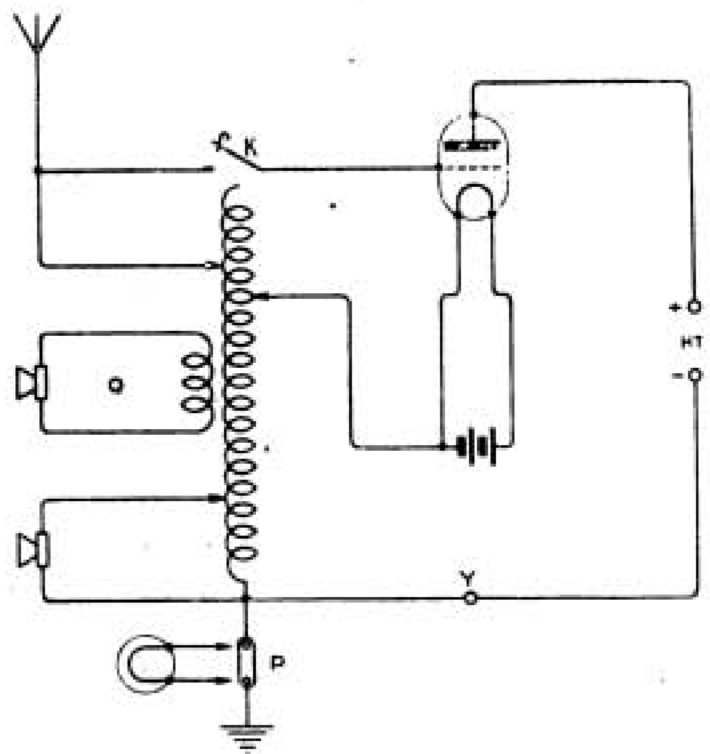

Fig. 1.

Fig. 1 shows a diagram of the transmitting circuit proper. The inductance consists of a former (diameter 3") wound for 13 centimetres, with No. 26 S.W.G. enamelled wire. This will give well over 1,000 metres, but the actual wavelength will depend upon the capacity of the aerial in use. Cardboard or wooden formers will be quite satisfactory if well soaked in paraffin wax or shellaced. Ebonite is preferable, of course, but is more expensive and, in the writer's opinion, its use for the purpose in hand does not warrant the extra cost.

The original coil was fitted with three sliders, one for regulating wavelength, one for adjusting the position of the centre tapping and one for adjusting the position of the microphone contact. I would advise other amateurs to profit by my experience and use tappings instead of sliders, as the latter do not work satisfactorily. In constructing my second tuner I took tappings at every ten turns.

As will be seen from the diagram, the key, K, is inserted in the grid circuit, being connected between grid and aerial.

The valve used is an ordinary receiving valve ("R" type), with about 4 volts on the filament, although 5 volts can be used safely. The application of more than 5 volts to the filament, whilst giving a greater plate current, tends to decrease the length of life of the valve. However, it is desirable to use as much filament current as safety will allow to avoid saturation-point effects, because it is useless to increase the H.T. voltage beyond the voltage at which saturation point is reached, *i.e.*, when all electrons from the filament are attracted to the plate. The increase of filament current produces a greater emission of electrons, thus causing a greater current to flow in the anode circuit.

The microphone is a watch-case type instrument, with replaceable inset, and was obtained for the modest sum of 2s. 6d. through advertisement in *The Wireless World*. Good speech has been obtained with it, although one inset is often decidedly better than another. One connection is made to the metal case and the other to a contact inside the case. The lead from the metal case should be the earthed one, to avoid capacity effects of the hand when speaking. The other lead, from the microphone, goes to one of the inductance sliders, adjustment of which is necessary to obtain the best speech. Different type microphones have different resistances, and it is therefore necessary to experiment with the position of the slider for each type of microphone tried. The microphone can also be tried in series with the earth lead by inserting it at P, or by coupling it inductively to the main inductance, as at Q.

In wiring up the set the various components should be mounted reasonably close together. The microphone leads should be kept short, to minimise the capacity between them.

With regard to the high-tension supply, a battery of dry cells of about 120 volts can be used very satisfactorily. Any other D.C. supply, of course, will be suitable if above about 100 volts.

An important feature of the set, however, is that it can be used with great success when the plate voltage is derived from A.C. mains. Results are very good and this source of H.T. supply is cheap.

The A.C. mains in my locality are 240 volt, 50-cycle, 3-wire system. To use them for H.T. supply the addition of the apparatus shown in Fig. 2 is necessary.

Another "R" valve is needed, of ordinary receiving type, to rectify the A.C., and a 3 mfd. condenser to smooth out the rectified current.

The plate and grid of this rectifying valve are connected together, thus the valve functions purely as a 2-electrode valve. The anode is connected to one lead of the A.C. mains, the other lead going to the negative H.T. terminal of the transmitter proper. The positive H.T. terminal of the transmitter is connected to the + side of the rectifier valve's filament battery.

The smoothing condenser is connected in parallel with the H.T. terminals of the transmitter. In the original set a 3 mfd. Mansbridge was used, and worked perfectly well, being obtained for 1s. 6d. from a well-known dealer. This condenser smooths out the A.C. hum excellently, enabling telephony to be carried out. If the condenser is diconnected tonic-train transmission is obtained.

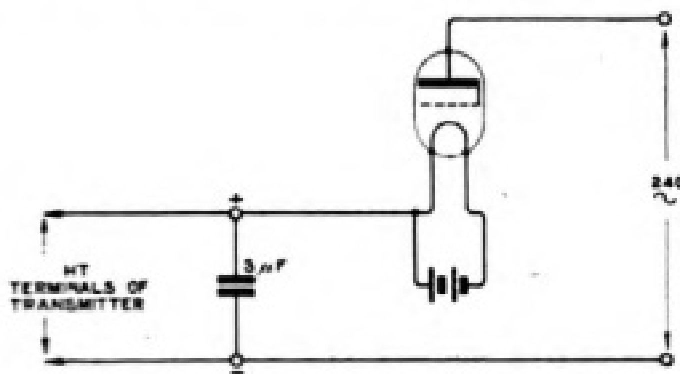

Fig. 2.

In my district the supply is on the 3-wire system, one wire being earthed. Unfortunately the same wire is not always the earthed one. Now, when A.C. mains are used for the H.T. supply, the A.C. lead connected to the negative H.T. terminal of the transmitter goes to earth, as will be seen from the figures. This is all right if one happens to connect up the A.C. leads the right way round, but if the unearthed A.C. lead is connected to the negative H.T. terminal it short-circuits, and the fuse goes. One can find out the right way round by experiment, but in my district even this is of no use, since the A.C. leads may change their connections to earth without warning. This difficulty was overcome by inserting an ordinary lamp in the point marked Y (Fig. 1). If the A.C. lead to the + H.T. becomes the earthed one, instead of a short-circuit and consequent blowing of fuses taking place, the lamp lights up, indicating that the A.C. leads must be reversed, which will put matters right. It will be seen that the lamp is always in the anode circuit. This does not matter, however, as the lamp's resistance is of about 800 ohms, whereas the rest of the anode circuit's resistance is about 20,000.

Separate accumulators must be used for the power and rectifier valve filaments, otherwise the centre tapping of the inductance would become connected to the positive H.T. terminal, which would short-circuit the plate-to-filament circuit of the power valve.

I hope later to give some figures showing the distances at which the above transmitter has been heard. I shall be interested in the results obtained by anyone making up a set as described above.

Home-Made Three-Valve Set

BY G. T. SINDALL.

ALTHOUGH nothing unusual is claimed in the construction or design of this set, it is thought it may be of interest to amateurs in the early stages of their progress in wireless.

The apparatus consists of one H.F. resistance coupled, one rectifying and one L.F. valve, and is entirely home-made, with exception, of course, of the telephones, valves and transformer (L.F.). The whole is mounted at the back of an ebonite panel of a cabinet, 18″ × 9″ × 5″ (Fig. 1).

The anode resistance is made from a piece of ebonite 3″ × ¾″, with a groove cut in it 1½″ long, into which graphite was rubbed until a suitable value was obtained, and is as near to 80,000 ohms as possible, as the writer was afterwards able to have it tested. The grid leak is about 3 megohms and was made in the same manner as the anode resistance. The filament resistance was reconstructed from an old pattern, which had the knob at the front, and was reversed to allow of mounting at rear of panel. The coupling condenser, C_1, is composed of three strips of tinfoil 2½″ × ½″, with 1″ overlap, interleaved with waxed paper and clamped between ebonite plates. The condenser, C_2, is the same size, but with six strips of tinfoil. By adding this, condenser signals were found to be better. The variable condenser (A.T.C.) is entirely home-made and has 14 moving vanes and 15 fixed, cut from sheet zinc 1/64″ thick, with snips and holes for supporting rods of fixed vanes

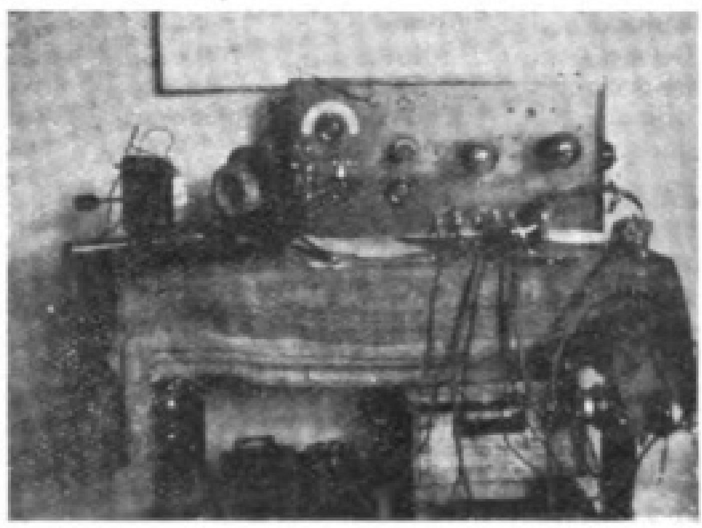

Fig. 1.

drilled out whilst held firm in vice. The square holes for spindle of moving vanes were drilled ¼″ diameter and afterwards filed square. The spacing washers were cut from brass tube and are ⅛″ thick. To obtain the vanes perfectly flat they are slightly heated, being the while firmly held in a vice and allowed to cool off before being taken out. The internal connections, shown in Fig. 2, are made with No. 16 S.W.G. enamelled wire, thus ensuring stiff connections, as the writer has found that loose and flapping wires are most conducive to a silent set. The condenser, C_3, across A.T.C. is switched in or out by the switch seen in photograph under the variable condenser.

The inductances are honeycomb and made from instructions given in a recent article by Mr. Philip Coursey in *The Wireless World*, connection to panel being by means of flex and plugs. The tuning stand in photograph is arranged so that reactance coil is moved to and fro from A.T.I. by means of knob on extreme left of photograph. The first valve is an E.S.2, the second and third French "R" type. The knob under first valve is the filament resistance controlling rectifying valve filament. The switches on right of the cabinet being for H.T. and L.T. current.

The set is fairly silent in working, and most Continental stations are audible with telephones (8,000 ohms) on table, Paris and Leafield being easily read on next floor. Croydon telephony is quite loud here in the Midlands, and the Dutch Concert quite clear and about half the strength of Croydon. The circuit is given in the accompanying diagram.

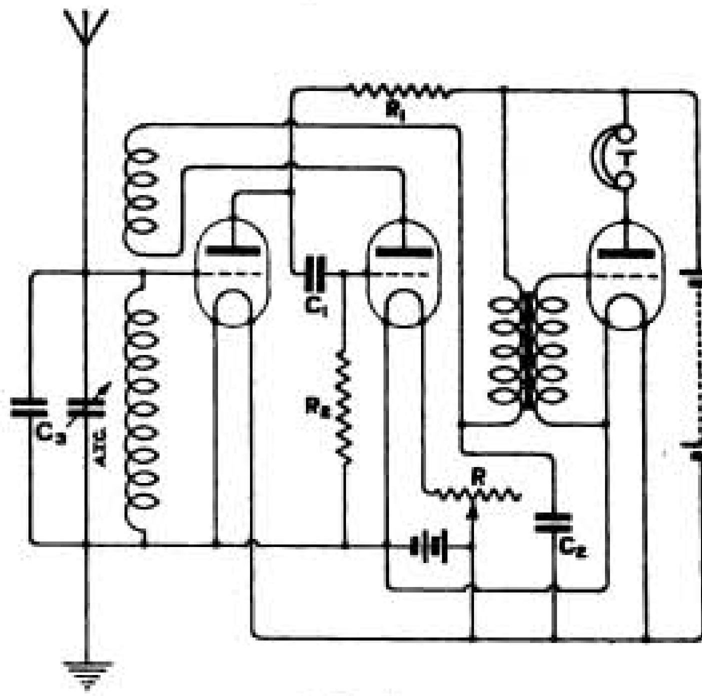

Fig. 2.

Wireless Societies of the United Kingdom

(Continued from last issue.)

Leamington Spa and Warwick Wireless Society, 13, Archery Road, Leamington Spa.

Leeds District Wireless Society, 37, Mexborough Avenue, Leeds.

Leicestershire Radio Society, 269, Mere Road, Leicester.

Lincoln and District Wireless Society, 168, West Parade, Lincoln.

Liverpool Wireless Association, Avondale, Knowsley Road, Cressington Park, Liverpool.

Loughborough College Wireless Society, The College, Loughborough.

Lowestoft and District Wireless Society, "Gouzeacourt," Chesnut Avenue, Oulton Broad.

Luton Wireless Society, Hitchin Road Boy's School, Luton.

Manchester Wireless Society, 2, Parkside Road, Moss Side, Manchester.

Radio Scientific Society of Manchester, 16, Todd Street, Manchester.

Merchant Taylors' Wireless Scientific Society, Merchant Taylors' School, Charterhouse Square, E.C.1.

Middlesborough and District Wireless Society, Borough Road East, Middlesborough.

Newcastle Wireless Association, 51, Grainger Street, Newcastle-on-Tyne.

Newark-on-Trent Wireless Society, 6, Beach Avenue, Hawtonville, Newark-on-Trent.

The Newbury and District Wireless Club, 86, North Brook Street, Newbury.

North Essex Wireless and Scientific Society, 15, Rayne Road, Braintree.

North London Wireless Association, c/o Superintendent, Peabody Buildings, Essex Road, N.

North Middlesex Wireless Club, Nithsdale, Eversley Park Road, Winchmore Hill, N.

North Staffs Railway Electrical Department Wireless Society, 87, Spencer Road, Shelton, Stoke-on-Trent.

Nottingham and District Radio Experimental Association, 22, Cranmer Street, Nottingham.

Radio Experimental Association (Nottingham and District), 157, Trent Boulevard, West Bridgford, Notts.

N.S. Railway Wireless Society, 87, Spencer Road, Shelton, Stoke-on-Trent.

Oldham Lyceum Wireless Society, Oldham Lyceum, Union Street, Oldham, Lancashire.

Paddington Wireless and Scientific Society, Paddington Technical Institute, Saltram Crescent, W.9.

Plymouth Wireless and Scientific Society, 9, Ryder Road, Stoke, Devonport.

Portsmouth and District Wireless Association, 34, Bradford Road, Southsea.

Preston Scientific Society, 119a, Fishergate, Preston.

The Dick Kerr Wireless Society, Ashton Park, Ashton-on-Ribble, Preston.

Reading Radio Research Society, 73, London Street, Reading.

Redhill and Reigate Wireless Society, 111, Station Road, Redhill.

Richmond and Kew Wireless Society, 14, Forest Road, Kew.

Rugby and District Wireless Club, 3, Charlotte Street, Rugby.

The Border Wireless Club, The Square, Kelso, Scotland.

Sheffield and District Wireless Society, 156, Meadow Head, Norton Woodseats, Sheffield.

Slough, Windsor and District Wireless Society, Caversham House, Dolphin Road, Slough.

South Hackney Wireless Society, 48, Dagmar Road, South Hackney, E.1.

Southport Wireless Society, 5, Tower Buildings, Leicester Street, Southport.

Sussex Wireless Research Society, Technical College, Brighton.

Stockport Wireless Society, Mersey Chambers, King Street East, Stockport.

Sunderland and District Amateur Radio Society, 15, Ridley Street, Southwick-on-Wear.

Scarborough and District Wireless Club, School House, Snainton, Scarborough.

Smethwick Experimental Wireless Club, Radio House, Wilson Road, Smethwick, Staffs.

Southend District Wireless Club, 21, Oakleigh Park Drive, Leigh-on-Sea.

Southampton and District Wireless Society, 24, Floating Bridge Road, Southampton.

South Woodford Radio Society, 190, Hermon Hill, South Woodford, Essex.

Southwark and District Wireless Society, 178, Walworth Road, Walworth, S.E.17.

St. Austell Wireless Club, 26, Fore Street, St. Austell, Cornwall.

Stoke-on-Trent Wireless and Experimental Society, 360, Cobridge Road, Hanley.

Sutton and District Wireless Society, Elmwood Lodge, Benhill Avenue, Sutton.

The South London Wireless and Scientific Society, St. John's Institute, Larcom Street, S.E.17.

The Borough of Tynemouth Y.M.C.A. Radio and Scientific Society, Eynesbury, Cleveland Road, North Shields.

Tunbridge Wells and District Wireless Society, 4, Vale Avenue, Tunbridge Wells.

Borough of Tynemouth Y.M.C.A. Amateur Wireless Society, Y.M.C.A. Buildings, Bedford Street, N. Shields.

Walthamstow Amateur Radio Club, 23, Ardliehg Road, Walthamstow.

Walsall Amateur Radio Club, 17, White Street, Walsall.

The Wallasey Wireless and Experimental Society, 11, Stoney Hay Road, New Brighton, Cheshire.

Wandsworth Common Wireless Club, 9, Birdhurst Road, Wandsworth.

Wandsworth Wireless Society, Technical Institute, High Street, Wandsworth.

Westcliff and District Wireless Club, Devon Lodge, Lydford Road, Westcliff-on-Sea.

Wimbledon and District Wireless Society, 48, Warren Road, Merton, S.W.19.

Wireless Society of London, 32, Quex Road, West Hampstead, N.W.6.

Worcester and District Radio Association, 59, Waterworks Road, Worcester.

Wolverhampton and District Wireless Society, 8, Roseberry Street, Wolverhampton.

West London Wireless Association, 19, Bushey Road, Harlington, Middlesex.

The Willesden Wireless Society, 87, Mayo Road, N.W.10.

Wireless and Experimental Association, 18, Melford Road, S.E.22.

Woolwich Radio Society, 42, Greenvale Road, Eltham, Kent.

York Wireless Club, 16, Wentworth Road, York.

Amateur Transmissions

REVISION OF POST OFFICE REGULATIONS.

The following letter has been received from the Postmaster-General by the Wireless Society of London, in reply to Recommendations of the Committee of the Society,* made to the Postmaster-General as a result of the resolutions passed at the third Annual Conference of Affiliated Wireless Societies, held on January 25th, 1922 :—

To The Hon. Secretary, THE WIRELESS SOCIETY OF LONDON.

SIR,—With reference to your letter of March 3rd, addressed to Captain Loring, I am directed by the Postmaster-General to say that he has carefully considered the recommendations of the Committee of the Wireless Society of London regarding the regulations governing amateur transmission, and, in reply, to say that, after consultation with the other Government Departments concerned, he agrees that the following modifications shall be made, viz. :—

(1) The restriction that transmission must be confined to five other stations will be withdrawn, on the understanding that the matter transmitted will be confined to communications relating to the experiments in hand and intended solely for the stations actually co-operating in those experiments. The broadcasting of general calls, news, or advertisements, or of matter similar to that which will be transmitted from the proposed broadcasting stations, will be expresaly forbidden.

(2) Transmission will be permitted for an aggregate maximum of two hours in each 24 hours provided—(*a*) that no transmission shall commence without previous listening-in on the wavelength which is to be used in order to ascertain whether the proposed transmission is likely to interfere with any other station which may be working, and (*b*) that no single transmission shall last more than 10 consecutive minutes, and each transmission shall be followed by a period of not less than three minutes listening-in on the wavelength used for transmission.

(3) The following wavelengths will be allocated for amateur transmission, viz :—

150 metres to 200 metres inclusive (spark, c.w. and telephony).

440 metres (c.w. and telephony only).

The fixed wave of 1,000 metres will be withdrawn.

A circular letter on the subject will be sent from this Office to all the licensees concerned.

General Post Office, London, I am, Sir, Your obedient Servant,

May 19th, 1922. (Signed) F. J. BROWN.

* See page 108 of the issue of April 22nd, 1922.

A Hint to Wireless Traders.

An extension of business which will very soon assert itself will be the demand for efficient and rapid accumulator charging and electricians who lay themselves out to do this will, no doubt, build up a wide connection among wireless enthusiasts in their district.

A brief survey of the numbers interested in the science at the moment and the enormous increase that will without doubt take place in the immediate future indicates that a big business is to be done in satisfying the public wants, and retailers who provide a reliable accumulator charging service will find it thoroughly worth their while and will show their enterprise in keeping abreast of the times.

It behoves every enterprising trader to carry a stock of first-class wireless gear and he should waste no time in rigging up a complete receiving outfit in order that he may demonstrate the reception of the broadcasted telephony and in satisfying the public demand for a knowledge of the subject, he will be establishing himself in the field as a factor of wireless apparatus and will achieve no small amount of notoriety and advertisement.

Notes

The Institution of Electrical Engineers.

The result of the ballot for the election of Officers and new Members of Council for 1922-23 is as follows :—

President, Mr. F. Gill ; Vice-Presidents, Dr. W. H. Eccles, F.R.S., Mr. A. A. Campbell Swinton, F.R.S. ; Hon. Treasurer, Sir James Devonshire, K.B.E. ; Ordinary Members of Council : Mr. J. W. Beauchamp, Mr. R. A. Chattock, Mr. F. W. Crawter, Mr. D. N. Dunlop, Major K. Edgcumbe, Mr. A. F. Harmer, Mr. W. R. Rawlings.

The Council of the Institution of Electrical Engineers have made the following award of premiums for papers read during the session 1921-22, or accepted for publication :—

THE INSTITUTION PREMIUM, Mr. J. G. Hill; AYRTON PREMIUM, Mr. L. H. A. Carr ; DUDDELL PREMIUM, Mr. T. L. Eckersley ; FAHIE PREMIUM, Mr. E. S. Byng ; JOHN HOPKINSON PREMIUM, Mr. F. P. Whitaker ; KELVIN PREMIUM, Mr. R. Torikai, PARIS PREMIUM, Mr. J. A. Kuyser ; EXTRA PREMIUMS, Mr. J. Anderson, Mr. F. J. Teago and Mr. W. Wilson ; WIRELESS PREMIUMS, Mr. E. B. Moullin, Mr. L. B. Turner and Mr. C. S. Franklin ; WILLANS PREMIUM (awarded triennially alternately by the Institution and the Institution of Mechanical Engineers), to Mr. K. Baumann.

Wireless Society for Dublin.

Mr. H. L. Fletcher, of School House, Oundle, Northants, is anxious to get into touch with readers of *The Wireless World and Radio Review* who are resident in Dublin and area with a view to forming a Wireless Society at some future date. Mr. Fletcher would be glad if the following who have made use of the Questions and Answers columns would communicate with him :—

W.B.B., P.Y.D., W.Mc.N., Prospective, Crystal, and **Anxious**, all of Dublin.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with interest Mr. Kendall's article on "Faults in Valve Circuits," in the April 22nd issue.

I would like to point out a small error which crept in. On page 96, par. 4(*a*), he said that to test a condenser put some telephones in series with a battery and the condenser, and a faint click should be heard at make and break.

In the case of a perfect condenser there should be a click at make, due to the charging current. When the condenser is charged the current stops and there is *no* click when the circuit is broken. If the circuit is again made there should be no click unless the condenser was discharged in the interval between break and remake.

In most condensers there is some leakage, and therefore there is a faint click at break and also a louder click on remaking the circuit, but the loudest click is heard on making the circuit after completely discharging the condenser.

P. G. A. H. VOIGT.

"Bowdon Mount,"
121, Honor Oak Park,
London, S.E.23.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The publication of Mr. P. R. Coursey's articles on the construction of long-wave heterodynes, together with the increasing appreciation of accuracy of tuning shown by the wireless fraternity, suggest to me that with the co-operation of the more advanced amateurs a useful method of calibrating receivers could be devised.

At the present time the amateur who wishes accurately to calibrate a heterodyne or a receiving set is faced with several difficulties. The number of calibration waves sent out is small. Regular readers of *The Wireless World and Radio Review* are acquainted with these stations from particulars published in your columns, and will agree that such waves are insufficient to provide means of preparing calibration curves. At the same time few amateurs have access to an accurately calibrated standard wavemeter, and many sold are useless for fine work.

My suggestion is that the Wireless Society of London form a committee of voluntary workers who will undertake to measure the wavelengths radiated by those stations easily audible on the average station, and having agreed amongst themselves on the actual wavelengths received, the results of their work should be periodically published in the journal. In this way a large number of accurate readings would be available and any listener could prepare curves for his own coils and condensers with a minimum of trouble. The present published wavelengths are generally given in round figures and form only the roughest guide.

Perhaps other readers will express their opinions on this matter.

REDAX.

Book Reviews

DIE DRAHTLOSE TELEGRAPHIE UND TELEPHONIE. By Dr. P. Lertes. (Pp. xi + 152, 8½" × 6", with 45 Figs. *Steinkopff*, Dresden and Leipsig, 1922. Price, unbound, 4s.)

This is Volume 4 of a series of "Wissenschaftliche Forschungsberichte," which are being issued under the supervision of Dr. Liesegang, of Frankfort. According to the introduction, the object of the volume is to give students and others an insight into the manifold developments which have taken place during and since the war, descriptions of which are so scattered throughout various transactions and periodicals that it is difficult to obtain a comprehensive conception of the whole.

To do this satisfactorily in 150 pages, many of which are taken up by lists of references, it would be necessary to assume that the reader already had a good knowledge of the principles of the subject. The author does not make this assumption, but explains with diagrams the difference between a damped and an undamped oscillation; neither does he confine himself to recent developments, but deals with coherers, electrolytic detectors and such-like. The result is that everything is dealt with very superficially and not always clearly. The treatment of coupled circuits, on page 14, is especially vague and misleading. The author gives a fairly unbiased account of the historical development of the subject, except that he follows the usual German custom of comparing the Marconi, or plain aerial, with the Braun, or coupled aerial, with the implication that one company used one type and the other company the other. One excellent feature of the book is the comprehensive alphabetical bibliography at the end of every chapter; this alone is worth the price of the book.

G. W. O. H.

Calendar of Current Events

Saturday, June 3rd.

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

Half-day visit to Aerodrome and Wireless Station, Croydon, by kind permission of the Air Ministry.

Sunday, June 4th.

Transmission of Telephony at 3 to 5 p.m., on 1,070 metres by **PCGG**, The Hague, Holland.

Tuesday, June 6th.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

6 *p.m.*—At Savoy Place, Victoria Embankment, W.C.2. "The Performance of Radiotelegraphy Transmitters with Special Reference to the Installation at the North Foreland," by Captain Norman Lee. Also a demonstration of a Dynamic Model of Tuned Circuits, by Professor C. F. Jenkins.

THE WOLVERHAMPTON DISTRICT WIRELESS SOCIETY.

8 *p.m.*—At 26, King Street, Wolverhampton. "The Electron Theory," by Mr. Blakemore.

Transmission of Telephony at 8 *p.m.* on 400 metres by **2 MT**, Writtle, near Chelmsford.

Wednesday, June 7th.

NORTH ESSEX WIRELESS SOCIETY.

At the Technical Exhibits Tent, Essex Agricultural Show, Chelmsford. Demonstration of Wireless. (Also on the 8th).

Thursday, June 8th.

THE DEWSBURY AND DISTRICT WIRELESS SOCIETY.

7.30 *p.m.*—At Society's new Club Rooms, in South Street, Dewsbury. "Amplification on Short Wavelengths," by Mr. H. F. Yardley.

THE LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"The Thermionic Valve," by Mr. J. F. Turner.

Friday, June 9th.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part I, by Mr. J. Stanley.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—"Reception of Wireless Telephony," by Captain F. A. Whitaker, R.E.

Sunday, June 11th.

Transmission of Telephony from The Hague, **PCGG**, as above.

Monday, June 12th.

WIRELESS SOCIETY OF HULL AND DISTRICT.

7 *p.m.*—Committee Meeting.

7.30 *p.m.*—Lecture by Mr. W. J. Featherstone.

Tuesday, June 13th.

Transmission of Telephony from Writtle, **2MT**, as above.

Wednesday, June 14th.

WIRELESS SOCIETY OF LONDON.

6 *p.m.* (tea 5.30 *p.m.*)—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Address by Sir Oliver Lodge, F.R.S.

NORTH MIDDLESEX WIRELESS CLUB.

8 *p.m.*—At Shaftesbury Hall, Bowes Park. "The Townsend Wavemeter and How to Use It," by Mr. L. C. Holton, followed by a Demonstration of the Reception of Telephony for Beginners.

Thursday, June 15th.

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Interpretation of Wireless Circuits," by Mr. F. E. Strudt.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, "Continuation of A.C. Experiments in Relation to W/T.," by Mr. E. F. Clarke.

Friday, June 16th.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part II, by Mr. J. Stanley.

Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.—[ED.]

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

Wireless Society of London.

The Forty-Eighth Ordinary General Meeting was held on Wednesday, May 24th, at the Institution of Electrical Engineers at 6 p.m.

After the minutes of the previous meeting had been approved and signed the **President** read a letter from the Postmaster-General which had been received in reply to a recommendation from the Society regarding the regulations governing amateur transmission.†

The President then called upon Mr. J. H. Reeves to give his lecture on "Some Effects of Capacity on Mutual Induction, with special reference to their application to the Elimination of Jamming." (For full report see next issue.)

After the discussion which followed the lecture the President announced that the following had been duly elected to membership of the Society:—Robert Donald Spence, Hubert James Powditch, Boirl Thomson Wilson, Lionel Jackson Hughes, Colin Hamilton Gardner, W. Bissett (formerly Associate), to be full Members, and Walter Seppings Tearle to be Associate.

The President announced that the following Societies have been approved by the Committee for Affiliation:—Sunderland Wireless and Scientific Association, Guildford and District Wireless Society, Reading Radio Research Society, Wolverhampton and District Wireless Society, and Stoke-on-Trent Wireless and Experimental Society.

At the close of the meeting the President welcomed the attendance of Signor Bianchi, President of the Radio Club d'Italia, who expressed his appreciation of the reception given him.

The meeting adjourned at 7.30 p.m.

Willesden Wireless Society.*

The Society met at 25, Station Road, Willesden Junction, on May 16th, when Mr. Mann exhibited a 3-valve low-frequency receiver capable of being used either as a single valve, two-valve or three-valve receiver, the connections being changed for the various adjustments by means of a rotary switch fitted in a very novel and ingenious manner into a small box, the whole being a triumph of workmanship and efficiency. **2FQ** was heard during the earlier part of the evening, and music from **2UV** was picked up on an indoor aerial at the close of the meeting. Gentlemen wishing to join the society are asked to write to Mr. F. A. Tuck, 87, Mayo Road, Willesden, N.W.10, for membership form. All are welcome.

The Gloucester Wireless and Scientific Society.*

Hon. Secretary, Mr. G. T. Peck, 45, Denmark Road, Gloucester.

The Annual General Meeting of the above Society was held at the Physics Laboratory of Sir Thomas Rich's School on March 20th. A considerable discussion took place regarding the future policy of the Society. The following officers were then elected: President, Mr. C. J. Scott; Hon. Treasurer, Mr. H. Hine; Hon. Secretary, Mr. G. T. Peck. A vote of thanks was passed to the retiring officers for their valuable services in the last two years.

A General Meeting of the Society was held at headquarters on April 3rd, when Mr. C. Minchin gave a lantern lecture on "Dynamo Design." The lecturer, who is a member of the designing staff of a well-known dynamo works, showed himself very familiar with his subject, and demonstrated clearly the principles underlying the designing of a modern dynamo. The Society is promised in the near future a further and deeper lecture on the same subject.

Meetings are held on the first Monday in the month, at 7 p.m., when prospective members are cordially invited to attend.

The Wireless Society of Hull and District.*

Before an excellent attendance of members, at the meeting of this Society held on April 24th, Major F. Holman gave a demonstration of winding duo-lateral inductance coils by machine. Members were much interested in this piece of apparatus, which has been both designed and constructed at home by Major Holman. A number of coils were neatly and rapidly wound, and the working carefully explained. This gentleman has kindly offered to wind coils of any size for members if they will supply the necessary wire. Mr. G. H. Strong (President) occupied the chair, and at the conclusion of the demonstration proposed a vote of thanks to the Major, which was ably seconded by Mr. J. Nicholas.

Mr. Henry Strong (Vice-President) presided over a fair attendance of members at a meeting on May 8th, when Mr. T. Forster gave an interesting paper on "Some Experiences of a Novice." In the course of his remarks Mr. Forster touched upon some debatable points, such as single layer coils, insulation of aerials, directional effects, etc., which gave rise to much discussion, to which Messrs. J. Nicholson, C. S. Snowdon, W. J. Featherstone and the Chairman ably contributed; and altogether an instructive evening was spent, the only fault being that the lecturer's remarks were far too brief, although, as he explained, the paper had been compiled at very short notice. Mr. Forster was accorded a vote of thanks for his trouble.

A small library of technical works is being formed, and already a number of volumes have been promised by different members. This matter will be dealt with by the Committee at their next meeting. "The Handbook of Wireless Telegraphy and Telephony, 1922," has now been added to the list of volumes in the Reference Department of the Central Free Library, and can be consulted by any persons interested in these subjects. Will all members please note that during the summer months the meetings of the Society will be held on the *second Monday in each month*, at 7.30 p.m., buzzer practice for those desiring same at 7 p.m.

†A copy of the letter appears on page 295.

The Society continues to make progress, and the membership is now over forty. Any enquiries *re* membership should be addressed to Mr. H. Nightscales (Hon. Secretary), at 16, Portobello Street, Hull, who will be only too pleased to supply full particulars of the Society.

Luton Wireless Society.*

The Second Annual Exhibition was held on Saturday, May 13th, at the Hitchin Road Boys' School, and attracted a large number of visitors. At the opening, at 3 p.m., the President (Mr. W. H. Cooke, A.M.I.E.E.) gave an account of the development of the Society.

Among the professional exhibits were a display of apparatus and accessories by Mr. W. R. H. Tingey, Radio Constructa goods demonstrated by Mr. Ed. McT. Reece (of Messrs. Butler & Co.), apparatus by Mr. Peto Scott, and a bookstall by the Wireless Press.

The amateur section of the exhibits included multivalve sets by Messrs. Wilding, L. Bird, F. Halstead, A. Tearle, E. A. Mander, G. White, E. Porter, G. Brown, J. Wells, J. Stiles, F. Bonner, and W. F. Neal. Much ingenuity and skill were apparent from their construction.

The club set, a multi-valve instructional set, was an object of admiration. Demonstrations of X-rays were given by Mr. H. S. Shoolbred, A.M.I.E.E., with apparatus kindly loaned by the Bute Hospital. These proved to be very popular items.

Various objects of scientific interest were exhibited, among others being a working scale model of a Vauxhall chassis by Mr. E. W. Fraser, which won the Championship at the recent Model Engineer Exhibition and some excellent working models of engines by Mr. Palmer. Parties were conducted round at intervals by the Hon. Secretary.

At 6 p.m. telephony was received from Paris, to the delight of a large audience, and at 7 p.m. a popular demonstration and lecture was ably given by Mr. Tingey. A short address was given by the Mayor of Luton, and signals and telephony from a London station provided interesting entertainment until the close.

Leeds and District Amateur Wireless Society.*

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

A General Meeting was held at the Leeds University on Friday, May 12th, Captain F. A. Whitaker, R.E. (Vice-President) taking the chair at 8 p.m. The Chairman called upon Mr. H. F. Yardley, A.M.I.R.E., to deliver a paper on "The Principles of Tuning."

Mr. Yardley described the term "tuning," and laid emphasis on the fact that it is essential for a beginner to learn to appreciate the use of the $885\sqrt{LC}$ formula at the outset of an amateur wireless career. The majority of beginners pay too much attention to their filament resistances and such like, and only turn their attention to the inductance and capacity of their circuits when absolutely forced. He described the value of resonance curves, and gave blackboard sketches of these curves with their circuits to which they are due. After describing the double-humped wave effect of tightly coupled circuits, he showed how a similar effect was being produced by many receivers, the operators of which were working their reaction too strongly. This gives rise to radiation of aether waves from the aerial circuit, which is picked up on other amateur and commercial aerials, resulting in interference. By means of the pendulum analogy the effect of tightly-coupled circuits and the necessity for the transmitter and receiver to be in tune, were well illustrated. The lecturer recommended the use of loose-coupled two-circuit receivers for reception of the short amateur wavelengths and broadcasting waves. He mentioned various means of tuning such circuits, and paid particular attention to the use of the variometer.

A lengthy discussion took place at the close of Mr. Yardley's remarks. A hearty vote of thanks was accorded to Mr. Yardley in the usual manner. The meeting terminated at 10 p.m.

The Hon. Secretary recommends W. H. Nottage's book on the "Calculation of Inductance and Capacity" (The Wireless Press, Ltd.), to those who desire to become more familiar with these all-important electrical properties that determine "tuning."

Edinburgh and District Radio Society.*

Hon. Secretary and Treasurer, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

General Meeting held on May 12th, when six new members and two Associate Members were elected. This was followed by a sale of second-hand apparatus, which again proved very successful, a percentage of the amount realised going to the Apparatus Fund of the Society.

Shortly we hope to remove our headquarters to 117, George Street. Members will be notified of the definite date, and strangers or others who may wish to visit the Society on meeting nights should first communicate with the Hon. Secretary.

It has been decided to fix one evening per week for a "work" night, when certain definite experimental work will be undertaken by volunteers. The day and time will be fixed in due course.

Although our membership is increasing rapidly, we are still open to receive new members, as our new headquarters will be considerably larger and meetings will not be so overcrowded as they have been recently.

Sunderland Wireless and Scientific Association.*

A General Meeting of the Association was held on Saturday, April 8th, at the Technical College, when Mr. Marcus G. Scroggie, of the Edinburgh and District Radio Society, gave a most interesting lecture on "Inductances." The lecture was illustrated by some interesting slides and demonstrations.

A General Meeting was held on Saturday, April 22nd, when Mr. A. F. Stafford gave an interesting lecture on "Aerial Design," which was followed by a brisk discussion. Mr. Stafford then gave a demonstration on his five-valve receiving set.

On Saturday, April 29th, under the auspices of the Association, Mr. T. Brown Thomson, of Messrs. Burndept, Ltd., gave a public lecture on Telephony, illustrated by a demonstration on an Ultra IV receiver.

On Thursday, May 11th, and Tuesday, May 16th, a number of members visited the Radio Communication Co's. offices at Newcastle-on-Tyne, where they were shown a ship's cabin fitted with ½ and 1½ kilowatt sets.

The Association is now affiliated with the Wireless Society of London, and the present membership is 110.

Hon. Secretary, Mr. H. G. MacColl, 1, North Elms, Sunderland.

The West London Wireless and Experimental Association.*

Club Rooms: Belmont Road Schools, Chiswick, W.4.

A meeting was held on Thursday evening, May 4th, when Mr. Oswald Carpenter, Associate I.R.E., gave an interesting lecture on "Short Wave Reception, and various Circuits in connection therewith." After two hours continuous speaking the lecturer finished at 10 p.m. Members and their friends turned up strongly and accorded the lecturer a very hearty vote of thanks for his "yarn," as he himself described it. After the lecture a large number of pictures were shown on the screen—photographs of various large stations, aerials, and apparatus which have been built or fitted throughout by the Marconi Scientific Instrument Co. A vote of thanks was also accorded the Company for the use of the slides.

Meeting held Thursday evening, May 11th.—Another very fine lecture and demonstration given by Mr. Edward McT. Reece, of Messrs. H. Butler & Co., on "Transformer Coupled H.F. Amplification." Great interest was shown in this lecture and the diagrams placed on a blackboard by the lecturer. As the result of the Great Fight at Olympia was to be broadcast by 2 LO (Marconi House, Strand) Mr. Reece arranged his apparatus ready for the reception of the telephony that was to be sent out.

Owing to the Club's Brown's Relay being under repair we were unfortunate in not being able to use the loud speaker with any great success, and Mr. Reece kindly read aloud all the messages as they were received, and great excitement prevailed until the message that the first round was to start. Hardly had the words been repeated aloud when there was a hush, and the thrilling announcement "Carpentier has won" was made. The lecturer was accorded a very hearty vote of thanks for his detailed account of his subject, and the members left for home at 10.20 p.m.

Members are particularly requested to scan the Calendar of Current Events column each week.

The Secretary will have much pleasure in forwarding particulars of the objects of, and particulars respecting membership of the Association upon application from any gentleman interested in Radio Telephony, etc.

Hon. Secretary, Mr. Horace W. Cotton, 19, Bushy Road, Harlington, Middlesex.

Radio Experimental Association* (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

An interesting event in the history of this Association occurred on Thursday, May 11th, 1922, when we were very fortunate in securing Mr. Carpenter as lecturer on "Wireless during the War." The attendance exceeded all expectations, and it was a very gratifying result for those who worked hard to make the evening a success.

We were also very fortunate in having Mr. L. O. Trivett, J.P., our President, with us for the occasion.

In his remarks Mr. Trivett expressed the opinion that the amateur wireless movement was a great national asset. He was also very pleased, he said, to see the youth of to-day engaged in the very useful scientific research of radio telegraphy.

The lecturer had a very good collection of slides, some belonging to himself and others very kindly loaned by Major Stanley, and also the Marconi Company. Mr. Carpenter took us through from the beginning of the war when spark sets were the only ones in use, and when aerials had to be of considerable height and length in order to secure results, to the closing stages of the war when with the development of the thermionic valve, aerials were reduced to a minimum in order to obtain greater facility in transport. He also illustrated by means of slides the conditions under which the wireless work was carried out, and in his opinion he thought no service deserved greater praise than the Signal Section of the Royal Engineers. Mr. Carpenter also presented diagrams showing how power buzzer work was carried on, and also illustrated the use of listening sets. Unfortunately the time did not permit of too detailed an explanation of C.W. work, this Mr. Carpenter has promised for a later date.

In his concluding remarks the President voiced the opinion of the audience when he said that they were fortunate to have in the lecturer a member who evidently had a practical knowledge combined with ability in a marked degree to impart that knowledge to others. Mr. Carpenter put this down entirely to his long association with Major Stanley, the Chief Instructor on Wireless to the B.E.F. in France.

The meeting closed with hearty votes of thanks to the lecturer for his very interesting entertainment, to the Marconi Company and Major Stanley for the loan of some of the slides, and also to the President for officiating during the evening.

Full particulars of the above Association will be supplied on application to the Hon. Secretary.

North Middlesex Wireless Club.*

Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The 91st meeting of the Club was held on Wednesday, May 17th, the Chair being taken by the President at 8.30 p.m. The minutes having been read, and some announcements having been made by the Secretary, the Chairman addressed the meeting, and more particularly those who were new members, or prospective new members. His remarks were as usual, witty and to the point, and members were pleased to see him back in his old form after his indisposition, which has kept him from taking an active part in the Club's affairs recently.

He then introduced to the meeting Mr. Ed. McT. Reece, who had kindly come down to lecture on "The Advantages of Sectional Wireless Sets."

Mr. Reece said that in addressing this Club, he was faced with the difficulty that although it was one of the oldest clubs, and had many advanced experimenters, yet he gathered from the Chairman's opening remarks that there were present that night a number of beginners. He therefore asked the advanced workers to forgive him if he went over ground which was already familiar to them.

He said that his lecture would be like the set he had brought to the hall with him, viz., in sections. In the first place, he showed what advantages there were in being able to connect up the instruments in different ways. The instruments on the table were made by Messrs. Butler & Co. with that end in view, and the base-board was pierced with holes spaced equidistantly, and the instruments could be removed and refixed with the greatest ease, the holding-down screws being the terminals.

The next section dealt with the meanings of the terms "capacity" and "inductance," and Mr. Reece explained these in a very clear manner by diagrams on the board, and mechanical analogy. This explanation was of great interest to the beginners, and several new points were brought out which had not been clear before.

Mr. Reece said that he felt a certain regret that the coming of the valve had made such a revolution in Wireless that signals could be obtained even if the apparatus was carelessly made, whereas in the days of crystals all connections had to be good, and the adjustments accurate, and the general efficiency had to be high before signals could be heard. Nowadays, if the signals were not as loud as desired, there was a tendency to add more valves rather than to look for the real cause of the trouble. Personally, he said, he was very fond of crystals, and advocated using one crystal and one valve, particularly for beginners. This combination was both efficient and cheap.

The next section of the lecture was of a more advanced nature, and several questions were dealt with by Mr. Reece. Mr. Dixon had a lot to ask regarding grid leaks, and grid condensers, one of his favourite subjects, and ten o'clock came and members still had questions to put. At the close of question time, the Chairman thanked Mr. Reece in a few well-chosen words, and the applause which followed left no doubt as to the way in which the lecture had been received.

During the evening nine new members applied for election.

Glasgow and District Radio Club.*

Hon. Secretary, Mr. Robert Carlisle, 40, Walton Street, Shawlands, Glasgow.

The increased attendance at recent meetings and a considerable influx of new members are gratifying indications of our progress in the world of wireless. The publicity which has been given recently to the scheme for broadcasting wireless telephone messages, outlined by the Postmaster-General, will lead many to study wireless work and stimulate their interest in the subject. The knowledge that one of the proposed transmitting stations will probably be located at Glasgow has caused no little excitement and enthusiasm among local amateur wireless men and the public generally. There is nothing that popularises wireless more than a concert by a famous singer. Glasgow is a musical community, if the Musical Festival recently held is any criterion, and the opportunity of enjoying first-class music in the comfort of one's own home, at no expense, should cause a very large increase of recruits to the ranks of radio amateurs in Glasgow and District. The novice in wireless matters reaps an advantage by becoming a member of a wireless club. He will meet others keen on the same work, and obtain the benefit of his fellow workers experiences and profit by his mistakes. This, at any rate, is the spirit that animates the Glasgow Club, and the reason we mention it is because it may not be realised by other radio enthusiasts who are plodding away by themselves, and not connected with any organisation devoted to the subject of their pastime.

At a recent meeting held in temporary premises at 11, Elmbank Street, we had a very fine lecture from Mr. A. F. Stevenson, on "Cable Engineering." It was fully explained how the various types and grades of cable were manufactured and tested. Mr. Stevenson exhibited numerous samples of the cable about which he lectured, and made clear the intricate processes involved in the making of each kind. Mr. Stevenson held the attention of his audience throughout, and after answering some questions, at the close he was accorded a hearty vote of thanks for his instructive and interesting lecture.

At the two last meetings held we had a lecture on "Capacity and Inductance," from Mr. A. McLennan. The lecturer divided his subject into two parts and gave one at each meeting. With the aid of blackboard diagrams and some figures in simple arithmatic Mr. McLennan made the subject clear to those members of the audience who had only a very elementary knowledge of electricity. Some clever analogies were introduced, but the outstanding feature was the particulars given with Part 2 of the lecture of how to make sets capable of receiving waves from 200 to 20,000 metres. The details given included dimensions of formers, gauge of wire, capacity of condensers, etc. The information imparted to members in this respect was such as could not be gained by a perusal of many volumes of technical literature on Wireless work, and was therefore of a more or less exclusive nature. Mr. McLennan appeared to have devoted much time to the numerous calculations involved in the preparation of such a wealth of detail. To our personal knowledge he is a rather busy man, and we are just afraid he must have encroached upon his usual hours for sleep. The lecturer then answered a number of questions, after which he was accorded a very hearty vote of thanks.

Owing to the removal of the N.B. Wireless Schools to another address, the Club has had to look for new premises. We enjoyed the hospitality of the Wireless Schools at 206, Bath Street, and a long period, where everything possible was done for our assistance and comfort, and at a recent meeting they were, through Mr. W. K. Dewar their representative, thanked for their kindness to the Club.

A sub-Committee, consisting of Mr. A. Pick and Mr. A. Hood was appointed to look out for new premises, and after much trouble these have been found at 200, Buchanan Street, where the Club meetings will be held, commencing in October. During next session meetings will be held weekly, on Thursday nights, and the Hon. Secretary will be pleased to have the names of any gentlemen who are willing to give a paper on wireless or allied subjects, during the coming winter.

The following sub-Committee has been appointed for renovating the Club's receiving gear.—

Mr. D. B. Wright (convener), Mr. D. J. Carmichael W. G. Corner, J. R. McCulloch, A. Pick.

Intending members should apply to the Hon.

Secretary, who will give all required information. The annual subscription is 10s., with an entry fee of 5s.

The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. **Hamilton, 24,** Vaughan Road, Wallasey.

On Thursday, May 18th, some members entertained their colleagues with descriptions of their sets.

Many interesting points were raised and discussed, and numerous difficulties encountered by members were explained.

Mr. Martin gave a short discourse on the construction of a four-valve set.

Several new members were elected, and three proposed as members.

General business followed, the meeting closed after a most enjoyable evening. Intending members should write to the Hon. Secretary as above.

Bristol and District Wireless Association.*

Hon. Secretary, Mr. E. C. Atkinson, 5, Pembroke Vale, Clifton.

The Annual General Meeting was held on December 16th, 1921, the following Committee being elected: Professor A. Tyndall (President), Mr. G. Marcuse (Chairman), Rev. H. W. Jukes (Hon. Treasurer), Mr. E. C. Atkinson (Hon. Secretary), Mr. A. E. Mitchell and Mr. L. F. White. Mr. A. C. Davis and Capt. C. Thomas were appointed Auditors.

Between January and April, 1922, ten new-comers have brought the membership above the 50 line.

Other meetings have been held: on January 20th, February 24th, March 31st and April 28th. In addition to buzzer practice and general conversation, proceedings have included the following items: "The Ultra-Micrometer," by Mr. W. Sucksmith; "Resistance in Wireless Circuits," by Mr. L. W. J. Silcocks; "A Home-made Receiving Set," by Mr. J. S. Hobbs; "A Self-contained Portable Receiver," by Mr. L. F. White: "High-frequency Experiments," by Mr. A. E. Siddons-Wilson, and "Short Wave Oscillations (Wavelength Measurement and Meter Calibration)," by Mr. H. E. George.

Much to the regret of the Association, the Chairman (Mr. G. Marcuse) has migrated to London. Recently he supplied the wire for a new aerial at the University. His enthusiasm and his telephony will be missed by many.

Richmond and Kew Wireless Society.

A meeting of the above Society was held on Thursday, May 11th, with Mr. W. H. Lloyd (President) in the chair.

Mr. G. G. Blake, A.M.I.E.E., A.Inst.P., delivered a most excellent lecture on the "Working of Modern Wireless Apparatus." The lecturer commenced with the elementary principles of atomic theory, leading on to the nature of electrons and their functions in connection with the three-electrode valve.

Mr. Blake, who had kindly brought along a splendid assortment of apparatus, demonstrated throughout the lecture. The experiments with the electroscope and those demonstrating some of the properties of the ultra-violet rays being particularly interesting. With the aid of lantern slides he then explained the characteristic curves of the valve at varying grid voltages; diagrams of receiving and transmitting circuits; and passed round for inspection a very neat, compact and efficient receiving set.

Later Mr. F. Hope-Jones (Chairman of the Wireless Society of London), who was present, demonstrated with slides the motion of wave trains of wireless waves, which was very interesting. Mr. Hope-Jones wished the Society every success in its objects, and proposed a vote of thanks to the lecturer. The President, in seconding Mr. Hope-Jones, expressed his thanks on behalf of the Society to Mr. Blake for his very interesting lecture, and demonstrations.

During the lecture an operator was on duty to "listen in" for the result of the Carpentier-Lewis fight.

The meeting adjourned at 10.30 p.m.

Hon. Secretary, Mr. A. J. Richardson, 14, Forest Road, Kew.

Ilford and District Radio Society.

The Society departed somewhat from its customary programme on Thursday, May 11th, when Mr. H. B. Adams, F.R.A.S., late of Greenwich Observatory, honoured us with a lecture on "Astronomy."

Mr. Adams brought with him a large number of lantern slides, and led us with great clarity through a maze of star clusters, sun spots, eclipses and the like, backed up with figures and statistics, the enormity of which made the hearer gasp, until we began to realise what a tiny, insignificant spot is our own earth. His description of the light rays and of their minute wavelengths was particularly good.

Many of us, with thoughts of the new spring hat now on its way to America, moaned in sympathy when Mr. Adams deplored the fact that owing to financial stringency Great Britain was far behind America in astronomy, especially as regards the size of the telescope available for observation purposes. The lecture closed with a brief but none the less lucid description of the method employed at Greenwich for observing and recording correct time.

The Grimsby and District Radio Society.

At a meeting of the above Society, held on May 16th, it was decided owing to the greatly increased membership that the present clubroom and the room adjoining be combined as one, assuring greater accommodation for its members, who are at great advantage being able to gain access on any and at any time in the day.

It was also intimated that a public lecture will be given at an early date by Mr. I. Brown Thompson, of Messrs. Burnham & Co., on "Telephony" in the showrooms, kindly lent by The Lincolnshire Motor & Electric Traction Co.

Two very interesting lectures were given during the last month, which were:—April 4th, "A Three-Valve L.F. Amplifier for All Waves," by the President, Mr. C. Hewins, who demonstrated one of his own construction, it giving quite excellent results. April 25th, "American Amateur Sending Stations for the Transatlantic Tests," by Mr. P. H. Shephard (Chairman): and on May 9th, "Resistance Capacity Amplifiers," by Mr. Garthwaite (Treasurer). Some very interesting points were gained by the discussion following.

Hon. Secretary, Mr. J. H. Perkins, 35. Hare Street, Grimsby.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only: Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"W.D." (Huddersfield) *asks* (1) *For diagram of four-valve receiver for frame aerial.* (2) *What must be the capacity of accumulators to supply filament current for four valves.* (3) *If necessary to have transformers between all the valves.*

(1) For this purpose it will be advisable to have two H.F., one rectifier and one L.F. valve, used with a 4′ or 6′ frame aerial. For a suitable diagram see Fig. 1. (2) Four valves will require 3 amperes total filament current. It will be necessary to use a 6-volt 30 or 40 ampere hour accumulator. (3) It is essential to have some method of coupling between the valves. Transformers are better on short wavelengths, while resistance capacity coupling may be used for long waves.

"P.O." (Aber) *asks* (1) *For criticism of two-valve diagram.* (2) *If he should hear* **2MT** *Concert on small aerial.* (3) *What coils do we recommend.* (4) *If 15-volt valves may be used.*

(1) This circuit is quite O.K. as a rectifier and one L.F. combination, but is not sufficiently sensitive for **2MT**. The "R" valves will require 6-volt filament battery as a resistance is used. There should be a small fixed condenser across the telephones. Crackling noises are probably due to bad connections. (2) The aerial is on the small side, and for it to be of any use the strands should be more than 1′ apart. (3) For a commencement single-layer coils should be used. Your slab coils may be suitable, but you do not give any particulars of them. (4) If these valves with 15 volts H.T. give good magnification, they are quite all right to use, but we do not know of any such valves at present.

"ARIEL" (Reigate) *asks* (1) *which of two single-valve circuit arrangements is the more useful.* (2) *If vulcanite is as good an insulator as ebonite.* (3) *Whether* **PCGG** *will be heard on either of above arrangements.*

(1) The second arrangement, with tuned reaction coil, will be the most efficient, but is more difficult to handle until one is used to it. (2) Vulcanite is an elastic term often misapplied to ebonite. For receiver panels it is just as effective as ebonite. (3) With arrangement No. 2 you may hear it, but it will not be very strong.

"T.G." (Tamworth) *is making a set for 180 to 30,000 metres, and asks* (1) *If honeycomb coils joined in series by a switch for cutting off dead-ends are as effective as coils plugged in singly.*

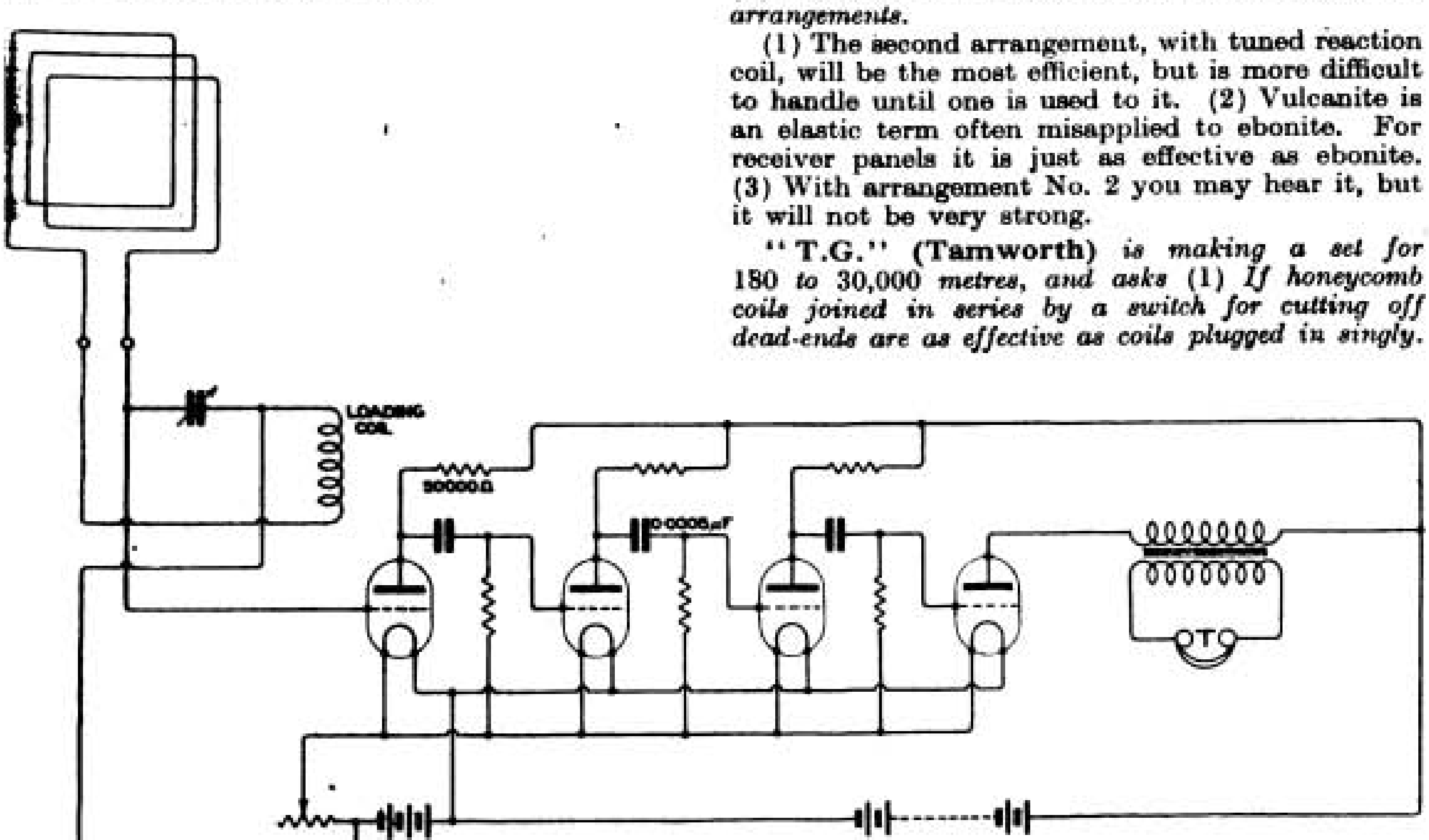

Fig. 1.

(2) *Whether a 0·0015 mfd., or 0·0005 mfd., series-parallel A.T.C. is most efficient.*

(1) On wavelengths above about 2,000 metres either method may be used, but for wavelengths below this idle coils should not be placed near the coil in use. (2) On short waves the 0·0005 mfd. condenser will give better tuning in series with the A.T.I., while for long waves the larger condenser in parallel with the A.T.I. is better.

"BEGINNER" (Chester) *wishes to make a simple single-valve set with certain apparatus, and asks* (1) *What additional apparatus will be required.* (2) *Type of valve to use.* (3) *For diagram of suitable circuit.* (4) *Range of set and if suitable for telephony.*

(1) You will be well advised to make a single-valve reaction set, for which the following additional apparatus will be required: reaction coil (to slide in and out of A.T.I.), one valve, 6-volt battery, filament resistance (5 ohms), H.T. battery (30 to 50 volts), grid condenser (0·0003 mfd.) and leak (2 megohms), and telephone transformer. The size of reaction coil cannot be given without knowing the size of A.T.I. (2) "Ora" or "R" valve. (3) The apparatus should be connected as shown in Fig. 3, page 90. The aerial and earth should be joined across the grid inductance, and not as shown. (4) We cannot estimate wavelength range, and therefore do not know from how far the set will receive. You will probably not hear much telephony owing to your situation.

be used. (4) *For diagram to add additional H.F. valve to circuit 2.*

(1) We do not think it advisable. Signals with crystal and L.F. mag. should be weaker than those given by a valve and L.F. mag. (2) The reaction coil should be connected as shown in the diagram referred to. (3) The German amplifier should be inspected to see if it has a transformer in the circuit of first grid. If there is one, there is no necessity to use an external transformer. (4) These circuits were recommended for telephony, and we therefore advise a transformer coupled valve, diagram of which is given. (Fig. 2.)

"ANCHOR-GAP" (Hornsey) *asks* (1) *For the capacity of a given condenser.* (2) *The wavelength range of his tuning coil, which is 6" long and 3½" in diameter, and wound with No. 22 S.W.G.* (3) *Whether his variable condenser is suitable for fine tuning.* (4) *Whether a given crystal circuit is suitable for the reception of near-by telephony.*

(1) Impossible to say, without knowing thickness of plates, but if of No. 20 gauge the value would be about 0·0002 mfd. (2) Range without parallel condenser up to 900 metres. (3) Yes. (4) Yes, but it is doubtful whether the station will prove to be sufficiently strong unless, of course, it is very near.

"L.H.I." (Leicester) *asks* (1) *If any other type of vernier condenser is suitable for use with the pocket receiver, described on page 747, March*

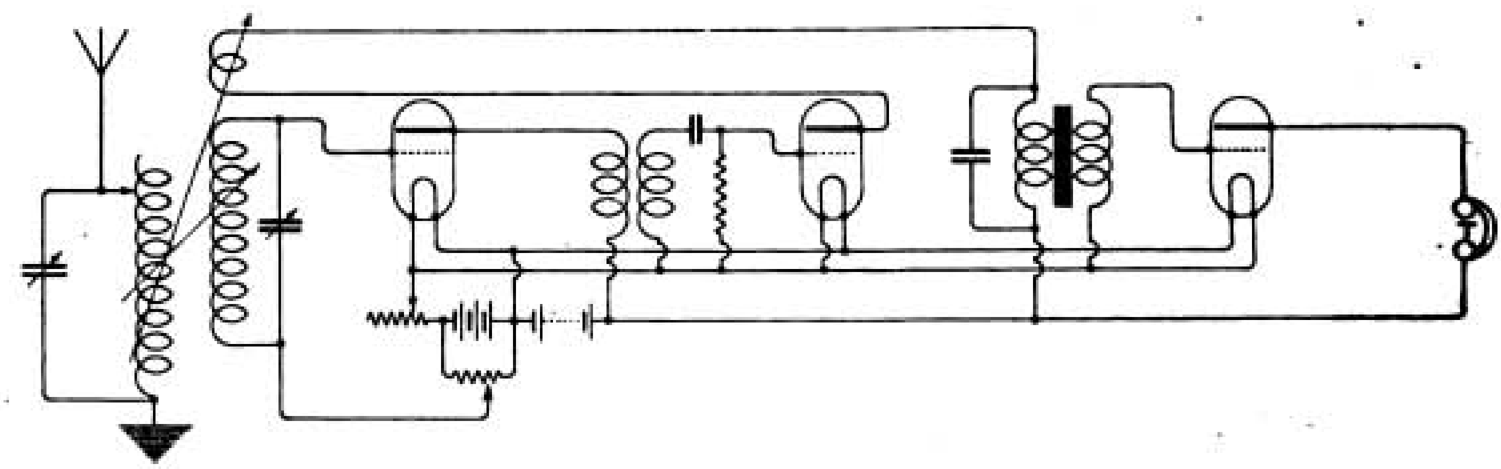

Fig. 2.

4th issue. (2) *If a single wire aerial, 20′ high and 140′ long, is suitable.* (3) *What to use for an earth where there is no water-pipe.* (4) *Whether the set can be used for the recepion of* **FL, 2MT** *and* **PCGG.**

(1) Any moving plate air dielectric condenser having capacity up to 0·0005 mfd. may be used with the set. (2) Fairly good, provided there is not too much sag. (3) Bury a piece of fairly heavy copper wire beneath your aerial and running the full length of it, or, if you can, dig into damp soil and bury an old galvanised iron bath or dustbin surrounded with fine coke. Make sure that you have a good connection to this buried conductor. (4) You should get **FL** easily, and possibly **2MT**, but for **PCGG** it is advisable to add one H.F. or L.F. amplifier.

"FREQUENCY" (Southampton) *asks* (1) *How many turns of No. 36 to wind an eight-groove ormer for a 300 to 3,000 metre transformer.* (2) *If method shown of connecting the transformer between the two valves is correct.*

(1) This type of transformer is not very suitable for such short wavelengths as 300 metres. For 300 to 1,000 metres, transformers in the form of single-layer windings should be used. If each groove is filled with wire the resultant wavelength would probably be between 2,000 to 3,000 metres. (2) This is correct.

"FLUX" (Clerkenwell) *is using C Mark III tuner and German L.F. amplifier, and asks* (1) *Whether to use a transformer between crystal telephone terminals and amplifier input terminals.* (2) *Referring to circuits, page 529, November 26th issue, asks if reaction coil may be taken from primary instead of secondary.* (3) *When using circuit 2 with German amplifier if the coupling transformer should*

"A. McD" (Edinburgh) *asks* (1) *For a diagram of a 3-valve set for reception of* **PCGG.** (2) *For dimensions of a loose coupler suitable for wavelengths of 300 to 5,000 metres.* (3) *Whether* *a stranded wire aerial will give better results than his present aerial of No. 16 copper for reception.*

(1) *See* Fig. 1, page 37, April 8th issue, but use A.T.C. at smaller value and connect it in series in the aerial circuit. (2) Aerial circuit 8″ of windings of No. 28 D.C.C. on a 6″ former, 19 tappings, making the final ones step over bigger portions than those at the beginning. Secondary (or reaction) circuit, 4″ of winding of No. 32 S.S.C. on a 4½″ former with four tappings at ½″, 1″, 2″ and end. (3) Very little would be gained.

"2.59" (Burnham-on-Sea).—(1) Your circuit is quite correct. It is better to put the A.T.C. across the entire inductance in the aerial circuit. (2) The values would appear to be correct, excepting, perhaps, the grid condenser, which is a little low, but the value is best determined by the results it gives. (3) The only improvement that can be suggested is that you provide a double pole two-position switch to connect A.T.I. in series or parallel in the aerial circuit.

"H.J.B." (Derby) *asks for a diagram of a 4-valve set suitable for reception of telephony, with particulars as to gauges of wire and dimensions of inductances.*

See paper read by Mr. Campbell Swinton before the Wireless Society of London, which appears in the issue of June 25th, 1921. As a beginner we would recommend you to commence with simple single valve circuits. The instrument described on page 202 of the issue referred to is quite good for the reception of 1,000 metre telephony.

"C.R.S." (Colombo) *wishes to know (1) Which is the best theoretical ratio of inductances for use in aerial and reaction circuits. (2) Whether it is better to use a separate reaction unit. (3) Inductance values of secondary coils in reaction unit. (4) Whether statement made on page 724 of the issue of February 18th, with regard to the efficiency of the circuit given in Fig. 2 on wavelengths over 7,000 metres, is correct.*

(1) It is impossible to state definitely the best combinations of inductance values from a theoretical point of view. One might deduce that certain arrangements will give better results, but experimenting is the best guide. Generally speaking, the arrangement that provides for loosest coupling of reaction or secondary circuit is the most efficient. (2) We presume you mean the use of a separate heterodyne, the merits of which have been discussed from time to time in this journal. The advisability of adopting such an arrangement depends entirely upon the signals it is intended to receive. If separate heterodyne is used it is advisable to leave in your receiving circuit some feed-back arrangement, such as inductive or capacity reaction. Ratios between anode and secondary coils cannot be definitely stated, but as a general rule should be approximately equal. (4) Articles that appear in this journal must be taken as expressing only the opinion of the author, and we cannot undertake to criticise the merits of circuits given in replies in these columns. The height of the curve in Fig. 3, page 724, must not be regarded as a direct factor of efficiency, but more as a measure of advice in adopting circuits for particular wavelengths. The circuit is not the popular one, as you will see that tuning is effected by stepping out a portion of the coil and short circuiting it, a practice that is often adopted for tuning to short wavelengths.

"E.R.N." (Accrington) *asks (1) If circuit Fig. 8, page 100, April 22nd issue, is suitable for the reception of spark, C.W. and telephony. (2) Windings for inductances L1, L2 and L3 and capacities of C1, C2, C3 and C4 for 4,000 metres. (3) Which is better, H.F. or L.F. amplification.*

(1) Yes. (2) L1 and L2 to be each of 4″ of winding of No. 26 S.S.C. on 6″ formers; L3, 3½″ of winding of No. 34 S.S.C. on 4½″ former; C1, 0·0003 mfd.; C2, 0·002 mfd.; A.T.C. maximum, 0·0015 mfd.

"H.H." (S.W.1) *asks (1) If it is possible to amplify the Dutch Concert to such an extent that it can be heard 50 ft. from the loud speaker. (2) For a suitable circuit for this purpose.*

(1) We do not recommend you to attempt this with **PCGG**, although it might be successfully accomplished with **2MT** or any other high-power British broadcasts. (2) Use the circuit shown in Fig. 1, page 199, issue of June 25th, 1921. You may omit condensers C2, C3 and C4 and make transformers of precise values to suit wavelength, which are best found by experiment.

"G.G.F." (Newcastle-on-Tyne) *asks (1) For dimensions of plates for making 0·001 mfd. fixed condenser. (2) Wire for step-down telephone transformer. (3) If it is possible to employ an H.F. transformer for 300 to 30,000 metres with switch and condenser. (4) Windings for L.F. transformers.*

(1) Use seven tinfoil strips with overlap ⅜″ × 1″ and six pieces of mica dielectric 0·002″ thick. (2) 1½ ozs. No. 44 S.S.C. for primary and 1 oz. No. 36 for secondary. (3) No. Use H.F. transformer coupling by means of intervalve coils for wavelengths up to 1,500 metres. Beyond this range use capacity coupling. See article page 133, issue of April 29th. (4) See page 52, issue of May 28th, 1921.

"F.D.P." (Stourport) *asks (1) For diagram of wavemeter for wavelengths 180 to 2,000 metres. (2) Constructional details for same.*

(1) and (2) See issue of October 15th, page 444, and October 29th, page 461, and November 12th, 1921, page 493. The approximate windings can be obtained from the latter article, but the actual windings must be found by calibration with a standard wavemeter. See also May 6th issue, page 161.

"D.C.M." (Southsea) *submits circuit and asks (1) Why his valve howls. (2) What additional apparatus is required for reception of* **PCGG** *and* **2MT**. *(3) For a revised diagram of connection with additions.*

(1) Your aerial inductance is bridged with two variable condensers. We presume that one is a vernier for fine tuning. Omit the leads between L.T. minus and bridge No. 3. A condenser of 0·002 mfds. must be permanently connected across terminals marked 1 and 2 (telephones or "input"). Try altering the value of your grid leak. (2) and (3) No additional apparatus should be required for the reception of either of these stations. The circuit comprises one detector valve with reaction and two note magnifier valves and a revised system of connections is not necessary.

"M.J.L." (Belfast) *asks (1) For particulars of honeycomb coils to tune from 350 to 30,000 metres (2) The connection of these inductances to a 3-valve amplifier. (3) For seven-way switch connections. (This question is not quite understood). (4) Whether* *slab inductances instead of honeycomb coils would give the same results and take less space.*

(1) Make 4½″ in diameter, 1½″ hole and wind with No. 26 D.S.C. wire. This will give you approximately 55 turns per coil. Space the coils about ¼″ apart, and you will require about 30 such coils in your aerial circuit to tune to 30,000 metres. Arrange several switches to avoid dead-end effect and to bring in various numbers of coils. You might make one slightly smaller for use alone on 300 metres. Use a similar bunch of coils for closed or reaction circuit, bringing one coil of each circuit near together for the purpose of providing coupling. (2) Connect aerial coils to grid and L.T. minus of the first valve, and connect reaction coils in the plate circuit. If your amplifier is L.F. use grid condenser and leak in the lead from the inductance to the grid and bridge primary of first transformer with a condenser value 0·002. (4) Honeycomb coils are preferable to slab inductances.

"G.T." (East Keswick) *asks for criticism of circuits.*

All of the circuits given would appear to be quite in order, but we would recommend you, if you can, to carefully test your resistances as to correctness of value by means of a delicate galvanometer and H.T. battery. Complications and stray capacity effects may be due to the fact that your H.T. is derived from your house mains. We presume that your apparatus possesses good insulation. As you only use one amplifier valve you would be well advised to make it a note magnifier.

"B.D." (Mill Hill) *asks* (1) *If crystal set diagram is correct and for capacity of blocking condenser.* (2) *If telephony will be heard.* (3) *What is the lowest resistance of telephones which may be used.* (4) *If an ordinary telephone receiver with a transformer is any good.*

(1) To make this set effective a small variable condenser should be connected across inductance, as shown in Fig. 3, page 60, April 8th issue. The telephone condenser should be 0·001 mfd. (2) You might hear Croydon telephony, but no other. If the wavelength range is suitable, ship stations and FL should be received. (3) and (4) For crystal sets high resistance 2,000 to 8,000 ohms telephones should always be used if possible. An ordinary telephone receiver with transformer would not be very efficient.

"D.G.B." (Putney) *asks* (1) *If telephone transformer must be used with 120 ohm telephones in a single valve set.* (2) *If variable condenser is correctly connected.*

(1) Yes. (2) This is a very inefficient circuit, as the idle sections of both inductances are short circuited; no reaction coil is used, and no telephone blocking condenser. Add a reaction coil and grid to condenser and leak, as shown in Fig. 3, page 90, April 15th issue.

"FORM 5 B" (Lancashire) *asks* (1) *For single valve capacity reaction high-frequency amplifier diagram to attach to rectifier panel.* (2) *Names of stations.* (3) *Why receiver circuit is noisy on 2,600 metres only.*

(1) This is rather vague. An effective capacity reaction cannot be used with the one valve only. Use a magnetic reaction connected to the terminals marked in your diagram. To add an additional valve, see Fig. 3 for connections. (2) Many of the calls are to be found in the "Year-Book of Wireless Telegraphy." (3) It is probable that the condenser is short circuited at the point which 2,600 metres is tuned. There is no other reason for it being noisy on only one wavelength.

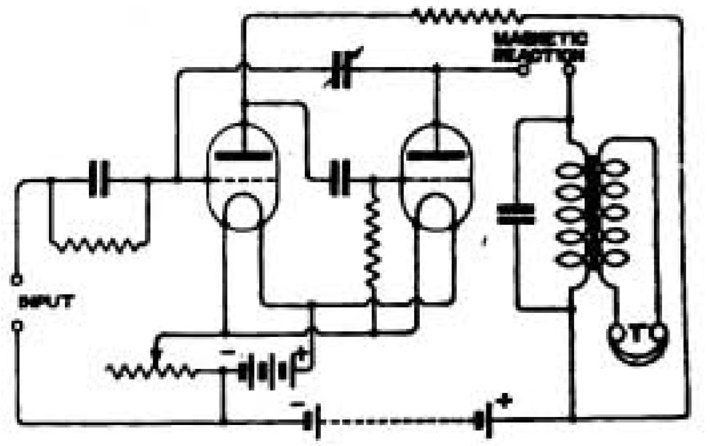

Fig. 3.

"H.R.N." (Ealing) *asks* (1) *For diagrams of two-valve L.F. amplifier to use with existing two-valve set.* (2) *If his* 8,000 *ohm telephones may be used in L.F. set.* (3) *If loud speakers magnify signals through acoustic properties of the horn.*

(1) and (2) The diagram given in reply to **"I.D.A." (Wellington)** may be adapted for your purpose. The 8,000 ohm telephones may be used in place of the telephone transformer shown. If two terminals are joined in series with the primary of the first transformer the telephones may be inserted there when it is not desired to use the note magnifier and terminals shorted by a link when it is used. (3) The signals are intensified by the horn, but they must be strong in the first instance.

"W.H.W." (Cardiff) *asks* (1) *To which side of L.T. battery the H.T. should be connected.* (2) *Why valve "howls" while set is reacting.* (3) *Why reaction coil must be reversed when the H.F. magnetic valve is cut out.*

(1) It is immaterial to which side it is connected. It is wrong to reverse the L.T. battery to test this, because you make the grid positive and come almost to the saturation point on the curve and stop the set working. (2) It is difficult to say the cause, as you appear to have made all the changes possible. It is probably due to a faulty reaction coil. (3) This is unavoidable, because changing the number of valves alters the sign of this current in the reaction coil. To overcome this it is necessary to have a spherical reaction coil which can be turned through 180 degrees.

"PADLOW" (Bradford) *asks* (1) *If Fig.* 5, *page* 813, *March* 18*th issue, is suitable for use with* 600 *metre H.F. transformers.* (2) *No results received on above set, using a* 6′ *frame aerial with single slab inductances.* (3) *How to employ coils to obtain satisfactory results.* (4) *If a diagram given is correct.*

(1) Yes, if the tuning circuit is correct. (2) For 600 metre reception a 6′ frame should be wound with about ten turns if a 0·001 mfd. tuning condenser is used. No loading coils are necessary. (3) and (4) The slab coils may be usefully employed connected as shown in your diagram. You omit to show the 0·001 mfd. condenser, which should be connected across the telephones. The reaction slab should be placed on top of the A.T.I. slab and, if necessary, turned over to make the set oscillate.

"MEREDITH" (Merioneth) *asks* (1) *Why his single valve set does not receive telephony.* (2) *Windings for* 1,200 *metre tuner.* (3) *Why his set does not oscillate under* 1,000 *metres.* (4) *If a circuit consisting of primary, secondary and reaction is necessary for telephony.*

(1) Your set is not sufficiently sensitive for telephony. You will require to add at least two more valves. Even then it is doubtful if you will hear any, as you are situated in a distant part of the country. (2) This may be a 4″×4″ A.T.I. wound fully with No. 26, and a 3″×4″ reaction coil wound full of No. 30. The aerial condenser and inductance should be in series. (3) It will not oscillate because with the present winding and arrangement of circuit the minimum wavelength is above 1,000 metres. For short waves the A.T.I. and A.T.C. should be in series. No. 30 wire is too fine for aerial circuits. (4) It is not essential to have this arrangement, but the circuit is more selective, therefore the tuning-in of stations is more difficult. Your diagram shows a resistance in the grid circuit but no condenser. There should be a small capacity fixed condenser across this resistance, otherwise it is of no use.

"R.T.H." (Winkleigh) *asks* (1) *For criticism of three-valve circuit.* (2) *Why it will not work on wavelengths longer than* 8,000 *metres* (3) *How to add another H.F. valve.* (4) *If possible for an amateur to make a loud speaker.*

(1) The circuit is O.K., except that there should be a 0·001 mfd. condenser across the transformer winding in series with the reaction coil. (2) Probably because there is not sufficient inductance in your tuning coils to go beyond this wavelength. You give no details. (3) The diagram given to "**SIRIUS" (Brighton)**, will show how this may be done. (4) It is possible, but we have no detailed information to refer you to other than articles in the February 19th, July 9th and August 20th issues of this journal.

"D.A.B." (Birmingham) *asks* (1) *For a diagram to add one H.F. and one L.F. valve to a circuit consisting of one rectifying and one L.F. valve.* (2) *If South African wireless telegraph regulations are similar to those existing in England.*

(1) *See* circuit given to **"B.D." (Leeds).** (2) We have no definite information, except that many private experimental stations exist in that country.

"H.W.P." (Cumberland) *asks* (1) *If a small dry battery may be used for filament lighting.* (2) *Which is the best all-round valve.* (3) *If* **FL** *telephony should be heard in Cumberland on a single valve set* (4) *Are there many ships using C.W.*

(1) No. Most of the ordinary dry cells would not stand the discharge current of about 3/4 amperes. In any case, it would be a wasteful method. However, specially designed valves passing low filament current may be operated from dry cells. (2) Either of the valves you mention are good. (3) With a well-designed set an experienced man might be able to make it just audible, but for good telephony about three valves will be required. (4) There are a good many ships now using C.W., their wavelength being 2,200 metres.

"2 R.J." (Maidstone) *asks* (1) *Why Dutch Concert is not received on a five-valve set, on which* **2MT** *and* 1,000 *metre amateurs are strong.* (2) *If set may be used for recording with a relay.* (3) *How to connect a* 1,000 *ohm G.P.O. relay in the circuit.*

(1) The set is not sufficiently sensitive for weak stations, as arranged. The reaction coil should be connected in the anode circuit of the third (rectifier) valve, and not in anode of the second note magnifying valve. There should be a 0·001 mfd. condenser across the rectifier anode winding. We do not like A.T.I. and A.T.C. in parallel for short waves. The billi condenser is wrongly connected for capacity reaction. Connect it from third anode to the first grid. (2) It might work for very strong stations used in conjunction with a Morse inker. (3) It might be connected directly in the anode circuit of the last note magnifier for a trial, but probably will be better if a step-down transformer, having a secondary of 1,000 ohms, were used.

"R.K." (Bristol).—You will probably find it difficult to eliminate the noises due to induction from the tramway wires. If the aerial is run at right angles it may reduce it. The use of low frequency magnifiers under such conditions will make matters worse, as the interference will then be caused by direct induction.

"INTERESTED" (Enfield) *refers to three-valve set, March 18th issue, and asks* (1) *If "R" valves can be used.* (2) *Are interchangeable transformers now on the market suitable.* (3) *For capacities of condenser C and C*1.

(1) and (2) Yes. They may be used if desired, and will necessitate a slight rearrangement of the apparatus mounted on the panel. "C" might be 0·0002 mfd. fixed, and "C1" a 0·0005 mfd. variable condenser.

"J.S." (Seacombe) *has a* 350 *to* 1,000 *metre single-valve set which will not oscillate when A.T.C. is shorted.*

The diagram given shows a variable condenser always across the whole of the A.T.I. This limits the minimum wave of the set. There should be a second slider on the A.T.I. An additional condenser in the aerial circuit will not reduce the wavelength to 180 metres. It will probably be necessary to have a separate A.T.I., but as no details of existing one are given we cannot say definitely.

"RADIO MORSE" (Bow) *asks* (1) *Where to obtain gramophone records for Morse instruction.* (2) *Winding on* 5″ *diameter former for* 200 *to* 3,000 *metres.* (3) *Reaction coil for same.* (4) *Tuning coil and reaction for* 100 *to* 600 *metres.*

(1) The Gramophone Co., Ltd., Hayes, Middlesex. (2) If coil is wound with No. 22 wire as desired it must be 20″ long, assuming that there is no tuning condenser in parallel. It will not be very useful below 400 metres. (3) This might be 4″×10″ of No. 26. (4) Tuning coil 4″×4″ of No. 22, reaction coil 4″×3″ of No. 26.

"R.C.B." (Cooden Beach) *describes two-valve H.F. magnfier set with tuned reaction and crystal detector, and asks* (1) *What results could be obtained by substituting grid condenser and leak for rectification.* (2) *Whether apparatus can be arranged in a more efficient manner.* (3) *Best way to add another valve.* (4) *Criticism of results obtained.*

(1) We do not think there would be a great improvement in the results obtained, but think it worth trying. (2) To change from present plain aerial arrangement to a coupled circuit tuner would greatly increase the selectivity, otherwise this is quite a normal two-valve set. (3) Add another valve as L.F. magnifier. (4) Results are good, but Lympne should be as strong as Croydon.

"DOUBLE C" (Bury) *asks* (1) *For single-valve diagram to utilise certain apparatus.* (2) *Wave-length range with existing formers.* (3) *What additions are necessary to increase range to* 30,000 *metres.* (4) *Maximum range for telephony.*

(1) and (4) A good circuit is given in Fig. 4, page 706, February 4th issue. This shows an additional valve as note magnifier, which may be put in or out of circuit as desired. You will find the second valve very useful for telephony, as you are a considerable distance away from existing telephone station. With additional valve you should hear **2MT** easily. (2) With the aerial condenser and inductance in series the maximum wavelength is 1,400 metres, and 3,000 metres with A.T.I. and A.T.C. in parallel. (3) To increase the range additional inductance in the form of slab or honeycomb coils will be required. These may now be purchased from advertisers almost as cheaply as they can be made. About 10 coils will be required to cover the range.

"B.E.A." (Folkestone) *asks* (1) *For dimensions for a variometer to tune to* 700 *to* 6,400 *metres with a* 0·0001 *mfd. fixed condenser across it.* (2) *Particulars of a frame for lid of box to receive* 500 *to* 1,500 *metres with* 0·0016 *mfd. condenser.* (3) *For reaction coil for same.*

(1) This is not a practical proposition, because a variometer to give such a great inductance change cannot be made. A variable condenser with tappings on plain winding is more straightforward. (2) Make a former to fit inside the lid and wind it with 40 turns of No. 26 wire. (3) The reaction coil former should be made to just fit inside the frame and should be pivoted on one end so that its position with reference to fixed coil may be varied. A suitable winding for 1,500 metres should be 60 turns of No. 30.

"P.J.W." (Port Said) *asks* (1) *Which is the better circuit to use for a* 3,000 *C.W. metre receiver, Fig.* 3 *or Fig.* 5, *February 4th, Q. and A. columns.* (2) *Particulars of honeycomb coils for tuning to this wavelength with a* 0·0007 *mfd. condenser and P.M.G. aerial.* (3) *Particulars of intervalve transformer for* 3,000 *metres.*

(1) We think Fig. 5 is the more reliable circuit to use for C.W. reception on this wavelength. (2) To give this wave range about five coils, which may be used for A.T.I. and reaction, should be made. They might be honeycomb or slab coils, 2″ diameter, wound with No. 24 or No. 26 wire to 150, 200, 250, 300 or 350 turns. (3) Exact windings for H.F. transformers cannot be given. Probably the ordinary 8-groove former about 2″ diameter will be found suitable if all the slots are wound full with No. 44 S.S.C. wire.

"E.T.M." (Wimbledon) *asks* (1) *For constructional details of chokes in transmitting circuit, Fig.* 1, *page* 774, *March 4th issue.* (2) *Constructional details of power and filament transformer.*

(1) For the iron core choke the secondary of an old ignition coil may be used. Its inductance value is not particular, provided it is greater than about 5 henries. The air core choke is for the purpose of keeping the H.F. currents out of the control valve circuit. The best value will depend upon wavelength and type of valve used, and must be determined experimentally. A 3″ diameter coil, wound with 3″ of No. 36 D.W.S., will be suitable as a trial coil. The feed condenser may be 0·001 mfd. and should withstand a 2,500 volt pressure test. (2) The design of power transformers is beyond the scope of these columns. Consult a book on Transformer Design, such as "Small Single-phase Transformers," by Edgar T. Painton (*Isaac Pitman*).

"J. G." (Edinburgh) *asks* (1) *For wavelength range of a basket coil with a* 0·001 *mfd. condenser.* (2) *If method of calculation given is correct.*

(1) The inductances of this coil is approximately 340 microhenries, and the wavelength is therefore 1,100 metres. (2) Your calculation is incorrect and you omit the Nagaoka constant K. Consult Nottage's Handbook or "Radio Measurements." The correct calculation is :—

$$L = \pi^2 d^2 n^2 e K$$

where

$D = 8$ cms.

$n = 18$ turns per cm. (No. 24 enamelled)

$e = 35$ cms.

K for ratio $\frac{d}{e} = \frac{8}{3 \cdot 5} = \cdot 49$

$$L = \pi^2 \times 8^2 \times 18^2 \times 3 \cdot 5 \times \cdot 49$$
$$= 69500 \times 0 \cdot 49 \text{ cms.}$$

or 695 × 0·49 microhenries, from which $L = 340$ mhys.

$$\lambda = 1885 \sqrt{LC}$$
$$= 1885 \sqrt{340 \times 001}$$
$$= 1885 \times \cdot 583$$

which is 1,100 metres.

"A.C." (Yorkshire) *describes a single-valve set and asks* (1) *For capacities of condensers.* (2) *Why set does not work on wavelengths lower than* 1,000 *metres.*

(1) You omit the most important dimensions of the variable condenser, *i.e.*, the distance between fixed and moving vanes. Assuming them to be $\frac{1}{16}$″, the capacities are 31 plates, 0·0007 mfd.; 13 plates, 0·00015 mfd. If the spacing is $\frac{1}{8}$″ the capacities will be half the above values, or double values if only $\frac{1}{32}$″. Grid condenser, 0·002 mfd. (2) For short waves, using any type of slab coil, the best combination of tuning and reaction coils requires careful selection, also the A.T.I. and A.T.C. should be in series. The grid condenser is much too large; it should be about one-tenth of its present value. L.R. telephones are inefficient without a transformer. Details for making one have been given several times recently. Connect a 0·001 mfd. condenser across telephone transformer H.R. winding. When these changes have been made there should be a great improvement in your short wave reception.

"MUNCASTER" (Clapham Common).—A four-valve diagram is given in reply to **"B.D." (Leeds)** in May 27th issue.

"NOVICE" (Loughborough) *asks* (1) *If possible to obtain a set of drawings for construction of a 3-valve set.* (2) *If a number of telegraph wires passing over house will interfere with reception.* (3) *If advisable to run aerial at right angles to them.* (4) *A wireless book suitable for an amateur.*

(1) We do not know where any such drawings may be obtained. The article commencing on page 13 of the April 1st issue should be of great assistance to you. (2) and (3) If wires pass over the house we are afraid a certain amount of interference will be unavoidable. The aerial should be at right angles if possible. (4) "The Amateur Valve Station," by Alan Douglas, from the

publishers of this journal (price 1s. 6d.), or the 1920 Admiralty Handbook will be found most useful.

"F.B." (Westcliff).—We cannot give size of basket reaction coils for your set, as you have given no particulars of the A.T.I. winding.

"C.J.F. (Stafford) *asks* (1) and (2) *For two and three-valve circuits.* (3) *Suitable telephone transformer for 100 ohm loud speaker.* (4) *Information regarding R.A.F. spark set with 9,000 volts transformer.*

(1) and (2) The circuit given in Fig. 4, page 32, April 8th issue, will allow either of the desired combinations to be used. (3) Any good standard transformer will do. A suitable one will be 3 ozs. of No. 44 and 6 ozs. of No. 32, wound on $\frac{1}{2}$'' soft iron core, 3'' long. (4) This is probably a set which was supplied with power from a propeller driven A.C. generator. We are sorry we have no information regarding the A.C. power required for transformer primary, and suggest that you apply to the B.T.H. Co., giving, if possible, the number of set and transformer.

"TRANSMITTER" (Leicester) *asks for particulars of a 2-valve transmitter to work on a 10'' square frame aerial.*

It is almost an impossibility to make such a set as you require. The circuit given in Fig. 2, page 185, May 6th, would be a suitable one for you to begin with, using an open aerial.

"W.M.S." (Dundee) *asks for a tuner with reaction coil for 400 to 5,000 metres to use with a two-valve set.*

The simplest arrangement will be to use a single layer A.T.I. with sliding reaction coil. This may be A.T.I. 6''×12'' of No. 28, with 5''×10'' of No. 28 for reaction. A more compact tuner may be made with honeycomb or slab coils. A set of 6 coils will probably be required, wound on 2'' diameter former, 1'' to 2'' deep, with 30 turns to smallest and 600 turns to largest coil.

"J.W." (Warrington) *asks* (1) and (2) *For information regarding a transformer marked "F542."* (3) *For efficiency of a 1/1 transformer wound with No. 42 wire.* (4) *Wavelength of a crystal set.*

(1) and (2) We are unable to recognise the transformer from the details given. (3) It is difficult to say without test. If there is not much leakage it may be 75 per cent. efficiency. (4) Maximum wavelength 4,500 metres approximately. No. 28 wire is too fine for aerial circuits when valve reaction is not used.

"REACTION" (Edinburgh) *has a single valve reaction set which does not give satisfaction.*

This circuit is badly proportioned: 0·0035 mfd. is far too much capacity to have in parallel with such a small amount of A.T.I. This should be reduced to 0·001 mfd. at the most, with a corresponding increase in the A.T.I. winding. For short waves A.T.I. and A.T.C. should be in series. Present maximum wavelength is about 9,000 metres and minimum about 2,000. When the alterations suggested are made, the set will not oscillate so vigorously, so that the musical spark stations will not sound husky.

"G.P.T." (Coventry) *asks* (1) *For inductance and wave range of A.T.I. described when used on a P.M.G. aerial.* (2) *If it may be used in a two-valve set.* (3) *If slab or basket coils may be used in conjunction with A.T.I.* (4) *Dimensions of condensers.*

(1) and (3) Inductance of solenoid 5,400 mhys; maximum wavelength, 2,000 metres. One of the sphericals should be used as coupling and joined in series with some basket coils to form the secondary circuit. The reactance may consist of basket coils coupling into the basket coils of the secondary circuit. (2) Yes. (4) When asking for condenser dimensions it is advisable to give the size of plates available. For both aerial and secondary circuits 0·0005 mfd. condenser may be made. If the plates are approximately 3'' diameter and the spacing between fixed and moving vanes $\frac{1}{16}$'', 19 fixed and 18 moving vanes will be required.

"R.L.T." (Gravesend) *asks* (1) *Time and wavelength of* **FL** *telephony.* (2) *Best crystal to use for receiver.* (3) *What stations other than* **PCGG, 2MT** *and* **MPD** *send out telephony concerts.*

(1) Most afternoons. No definite programme arranged. 2,600 metres. (2) Carborundum, with steel plate, is one of the simplest to use. Zincite-bornite, or galena-steel point, or galena-tellurium combinations all give good signals, but are not so stable as carborundum. (3) At present there are no other stations giving regular transmissions.

"R.O.C." (Leigh-on-Sea) *asks* (1) *For a two-valve circuit for beginner.* (2) *For particulars of transformer in circuit recommended.* (3) *Names of two stations "nearly always working on 700 to 1,000 metres."*

(1) The circuit given in Fig. 1, page 119, April 22nd issue, should be quite suitable. (2) The inter-valve transformer should be wound on a $\frac{1}{2}$'' diameter soft iron core, 3'' long. The primary should have 1 oz., secondary 3 ozs. of No. 44. The telephone transformer should be 3 ozs. of No. 44 and 6 ozs. of No. 32 on the same sized core. (3) We cannot say.

"H.A." (Salford) *asks* (1) *Capacity of condenser.* (2) *For diagram to add two-valve H.F. panel to existing three-valve panel.*

(1) The capacity is 0·001 mfds., if the $\frac{3}{32}$'' spacing refers to distance between fixed vanes. (2) Diagram of additional panel is given in diagram (Fig. 4). It is not necessary to use separate batteries for this panel, unless it is specially desired to do so.

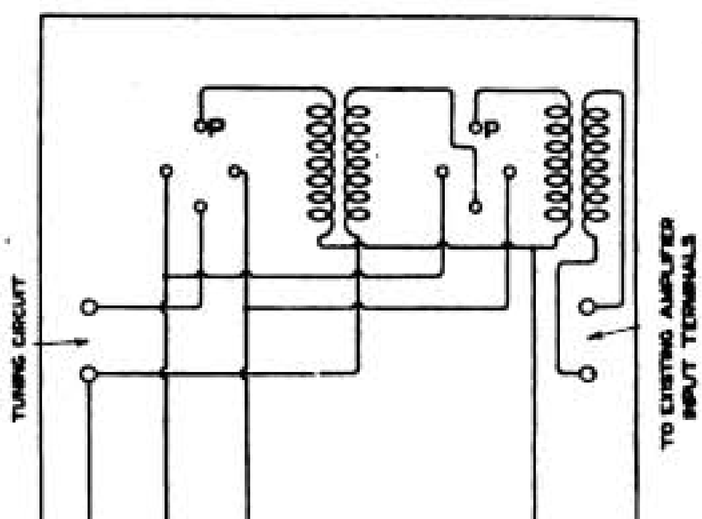

Fig. 4.

"W.H.P." (Bridgwater) *asks* (1) *If possible to hear* **PCGG** *on two-valve set.* (2) *What English telephony should he hear.* (3) *If safe to connect earth lead to a water-pipe.* (4) *Wavelength range of set.*

(1) Yes, though some experimenting may be necessary. An additional H.F. valve would make it more certain. (2) Croydon and **2MT** telephony should be heard. (3) Yes. (4) No particulars of the set are given which would enable us to calculate the wavelength range.

"E.A.W." (Derby) *shows two-valve diagram, and asks* (1) *If* 8,000 *ohm telephones may be used with circuit.* (2) *Should H.T. be* 60 *volts for "Ora" valves.* (3) *Any objection to common terminal for negative H.T. and positive L.T.* (4) *Suggestions for improvement of set.*

(1) It is fairly safe to use them if connected in the negative side of the H.T. (2) Yes. For all resistance amplifiers the H.T. should be about twice the normal anode voltage to allow for voltage drop across resistance. (3) No. (4) Provision of series-parallel switch for the aerial condenser would be an improvement.

"A.R.C." (Sheffield) *asks* (1) *If corrugated iron sheeting* 8′ × 2½′ *is a good earth.* (2) *Would connection to water-pipe* 20 *yards away be more efficient.* (3) *Criticism of single valve set.* (4) *Suggestions for strengthening signals, which are very weak.*

(1) This is hardly sufficient. Bury it deeply in damp earth and also make connection to water-pipe with a stout cable. (3) The circuit is correct, except that there should be a 0·001 mfd. condenser across the anode winding of telephone transformer. As no information is given regarding inductances, it is not possible to say if there is sufficient reaction. (4) 4 volts with a filament resistance is not sufficient for any valve. Increase to 6 volts. Make certain that telephones are connected to L.R. winding of transformer. The set is not sufficiently described for us to give further help.

"Q.R.A." (Boscombe) *asks questions regarding grid condenser and leak.*

It is not necessary to have either variable condensers or leaks. A 0·0003 mfd. condenser with 2 megohm leak across it is very useful for short wave spark and telephony signals. The Mark III potentiometer is not suitable for use as a leak. You will see how to connect a condenser and leak in circuit from Fig. 1, page 119, April 22nd issue.

"L.B.S." (Wallington) *asks* (1) *If separate heterodyne will make three-valve circuit more selective than using capacity reaction.* (2) *If Mark III tuner former with variable condenser may be used for heterodyne for all wavelengths.* (3) *Why set is better when H.F. transformer is tuned with a condenser and A.T.I. is untuned.* (4) *Why single valve set will not oscillate below* 1,000 *metres.*

(1) The selectivity may be improved if a separate heterodyne is used together with the capacity reaction, which should be adjusted almost to the oscillating point. (2) No. A set of slabs, similar to those used in the A.T.I. and reaction will be necessary, with variable condenser. (3) The condenser across the primary probably tunes the transformer to very near the wavelength being received, therefore increasing the efficiency of the transformer. If the A.T.I. were also tuned the results would be better still. (4) Oscillation below 1,000 metres is always more difficult than on longer waves, owing to the smaller inductances used, with consequent weaker coupling. Try as many combinations of slabs as possible and also connect A.T.I. and A.T.C. in series.

"DUD" (Atherton) *asks* (1) *Why speech and music are distorted on his single valve set.* (2) *For capacity in mfds. of* 10,000 *cm. Telefunken condensers, also capacity of two plates of same.* (3) *If "Ora" valves are good for a three-valve set.*

(1) You give no details of set, but the trouble appears due to tight reaction coupling. (2) 10,000 cms. is equal to 0·011 mfds. The capacity between two of these foils separated by 0·003″ micas is approximately 0·00042 mfds. (3) Yes.

"G.S.W." (Birmingham) *asks* (1) *For criticism and wavelength range of single valve set.* (2) *What stations should be heard.* (3) *For sizes of condensers.* (4) *Best arrangement of telephones.*

(1) The circuit is O.K. and should work satisfactorily. It would be an improvement to add a switch so that the aerial condenser may be connected either in series or parallel with A.T.I. The maximum wavelengths will be with condenser in series, 1,300 metres and in parallel 2,700 metres. (2) Croydon and **2MT** telephony, together with ship and coast stations on 600 metres, and Eiffel Tower should be heard. (3) The variable condenser might be 0·0005 mfd., made up of 3″ diameter vanes with $\frac{1}{16}$″ spacing between fixed and moving vanes, 19 fixed and 18 moving vanes. Condenser across telephones and battery 0·001 mfd., made up with 3 foils 2″ × ½″, separated by 3 mil. micas. (4) For this type of set L.R. telephones with a transformer are advised.

"A.M.H." (Romford) *asks* (1) *For diagram to add two valves to existing set.* (2) *If No.* 34 *D.S.C. wire may be used for H.F. transformers.* (3) *If* **PCGG** *will be received on set.*

(1) The diagram given in Fig. 4, page 32, April 1st issue, may be used for your purpose, if the grid condenser and leak are connected in grid circuit of No. 2 valve. (2) It is useful for short wavelength transformers, but makes them rather bulky. No. 40 is a better size. (3) Yes.

SHARE MARKET REPORT.

Prices as we go to press, May 26 h, are :—

Marconi Ordinary	£2	16	
,, Preference	2	10	
,, Inter. Marine	1	14	
,, Canadian		12	

Radio Corporation of America :—

Ordinary	1	4	6
Preference		15	3

10th JUNE, 1922. PRICE 6D. NET.

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THE
WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

Vol. X. No. 11. JUNE 10th, 1922 Weekly

The Valve Transmitter of the Eiffel Tower

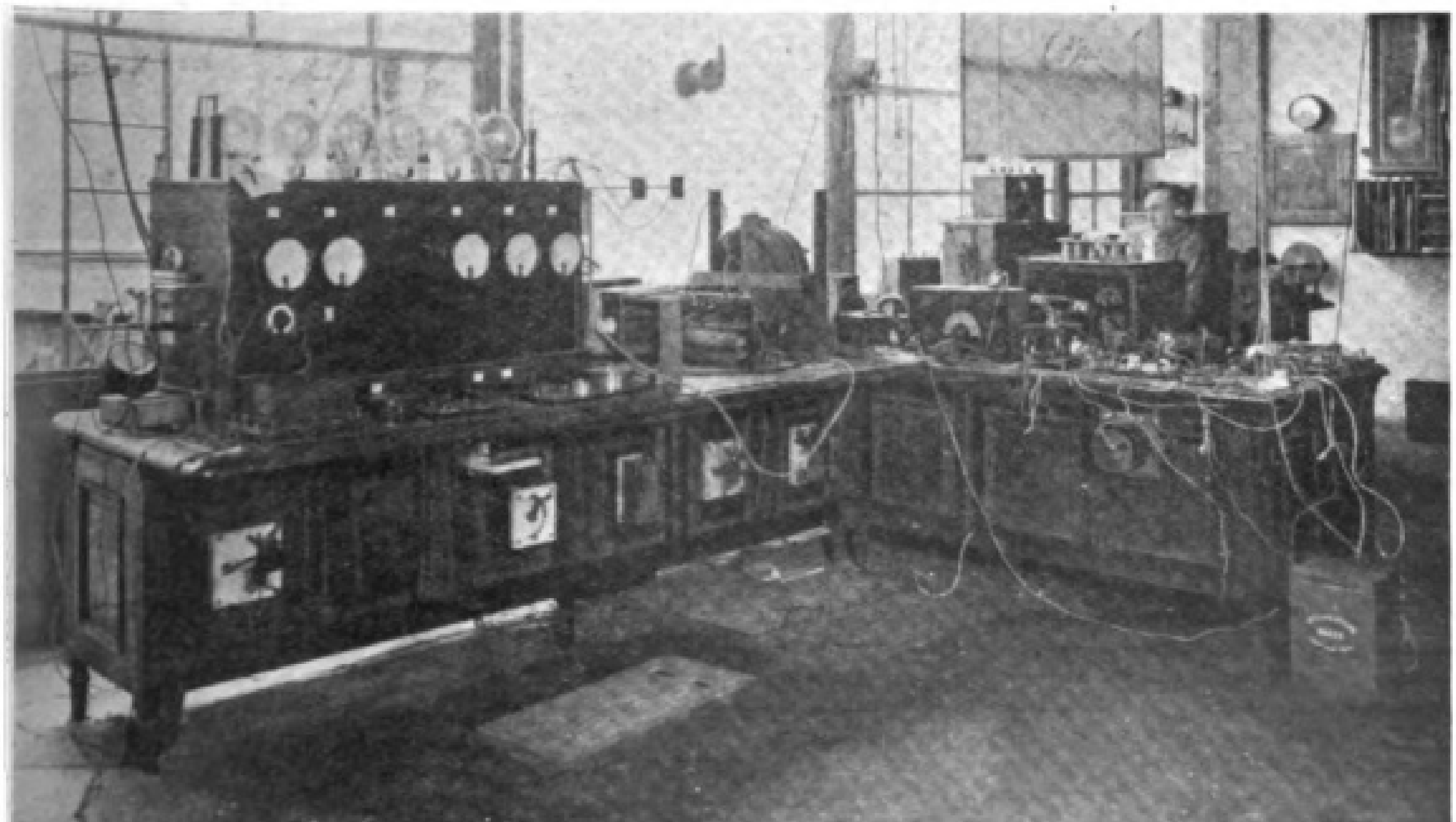
By E. Maurice Deloraine, Ing. E.P.C.I.

I.—Historical.

OUR intention is to give, as far as possible, a general description of the radio-telegraphy and telephony station of the Eiffel Tower. We shall begin by describing the valve transmitting station, because of the present great interest in radio telephonic broadcasting.

The first experiments in connection with this transmitting set were made in April, 1921. The question was then complicated by the fact that triodes capable of delivering large power were not available in France. The tubes on the market were first studied, and when this question had been roughly solved, the circuit itself was considered with a view to telegraphy. This was practically settled in September, 1921, and after this date efforts were directed towards adapting this installation to radio-telephony.

The set now used is experimental rather than commercial. It is the result of widely varied experiments, and the original ideas have been modified in many respects. A part of the apparatus might almost be called "junk." The erection of the set is entirely due to the military and civil



The Eiffel Tower Telephony Transmitter.

personnel of the Eiffel Tower under the distinguished direction of the Chief Engineer, Mr. Laüt.

II.—Triodes.

Three different types of triode can be used without involving any rewiring of the set. We shall cite the "Neuvron" type of triode (Fig. 1), made by Gaumont, the firm so well known in the cinema world. It stands about 14 inches high, takes a filament current of 5 amps. at 18 volts with a maximum plate filament voltage of 3,000 for model A, and 1,500 for model B. The input on the anode may amount to 500 watts without over heating. The anode in the form of a vertical nickel cylinder corrugated to increase its rigidity and radiating surface.

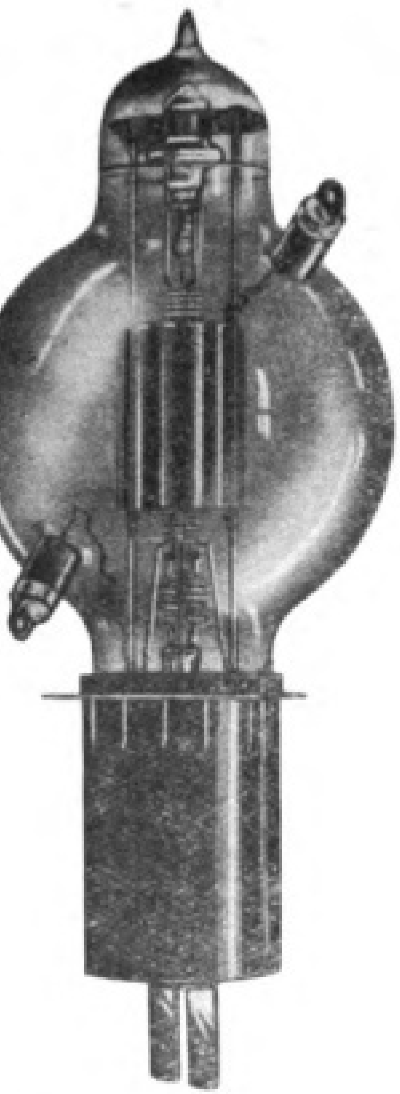


Fig. 1. A "Neuvron" Valve.

The grid is a spiral, coaxial with the plate. The filament is a closed V, supported at the top by a spring which keeps it in tension when hot. The ends of the V are joined to the socket by a zig-zag metal tape, which being capable of dissipating heat easily, prevents the glass from cracking owing to overheating. The bulb is exhausted as completely as possible, and the electrode submitted to an intense electronic bombardment to remove occluded gas. Partial sublimation of the metal takes place blackening the glass and thereby sometimes reducing the insulation of the electrodes.

The lamp should be placed in an upright position, and the bulb cooled by a downward current of air.

Another type of triode is made by S.I.F. (Société Indépendante de T.S.F.). This tube (Fig. 2) s

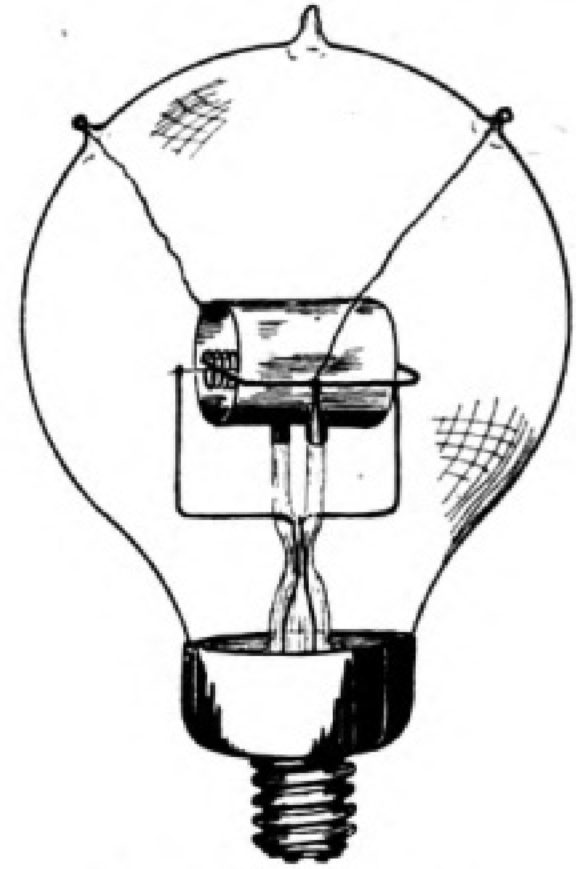


Fig. 2. A S.I.F. Valve.

somewhat smaller. It takes about 4 amps. at 12 volts and the input in the plate circuit at 2,300 volts is about 300 watts. The arrangement of the electrodes resembles closely the French type valve, but the plate is an eliptical cylinder instead of a circular one, and, being of tungsten, it may become red hot without danger of being perforated. The filament is a straight horizontal wire, and the grid a concentric spiral.

The socket is of the "Edison" type.

The third type of triode for which sockets were provided was that made by the Pilon Works, but it has not so far been used.

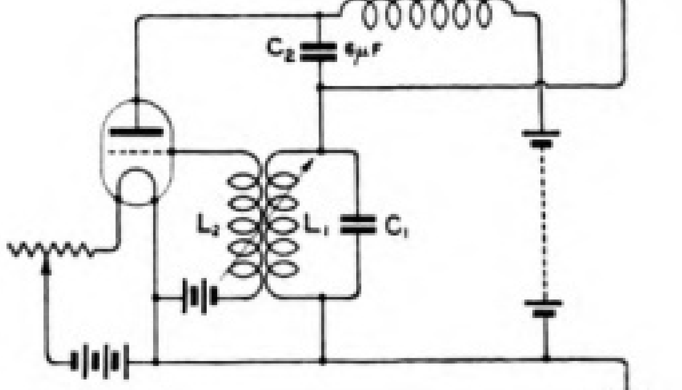


Fig. 3. The Circuit of the Telegraphic Transmitter.

The first two types give highly satisfactory results. In Fig. 5, tubes 1, 2, 3, 4, 5, 6 are S.I.F. make, and 7, 8, 9 Gaumont.

III.—TELEGRAPHY.

Fig. 3 gives the circuit diagram of the telegraphic circuit. The different triodes (4, 5 or 6 in number), are all in parallel and maintain the oscillations in the circuit C_1 L_1 in the plate circuit. This circuit reacts on the aperiodic grid circuit through a variable magnetic coupling L_1 L_2. The antenna-earth circuit is set to the wavelength of the resonant circuit by means of a variable condenser.

(a) *Filament Circuit.*

The filament current is supplied by a battery containing 10 units of 300 ampere hours. This battery normally works in parallel with a shunt-generator capable of giving 50 amperes at a tension up to 30 volts, the excitation of the machine being controlled by the rheostat 10 (Figs. 4 and 5). supplied by the battery and the machine respectively.

The potential drop across the filaments must be kept as nearly constant as possible during working, as a reduction of tension causes a corresponding diminution of the current in the antenna, and, on the other hand, excessive heating shortens the life of the triodes considerably. When the pressure across the filament exceeds the normal value by 1 volt, the circuit breaker (31) is actuated by the relay (29). A small commutator (18) is used to change the working point of the relays when the type of triode is changed.

Separate rheostats (10 to 17) allow the current and voltage to be set at the value specified by the maker of each type.

In the filament circuit there are included a commutator (30) which switches off the current, and fuses (35).

(b) *Grid Circuit.*

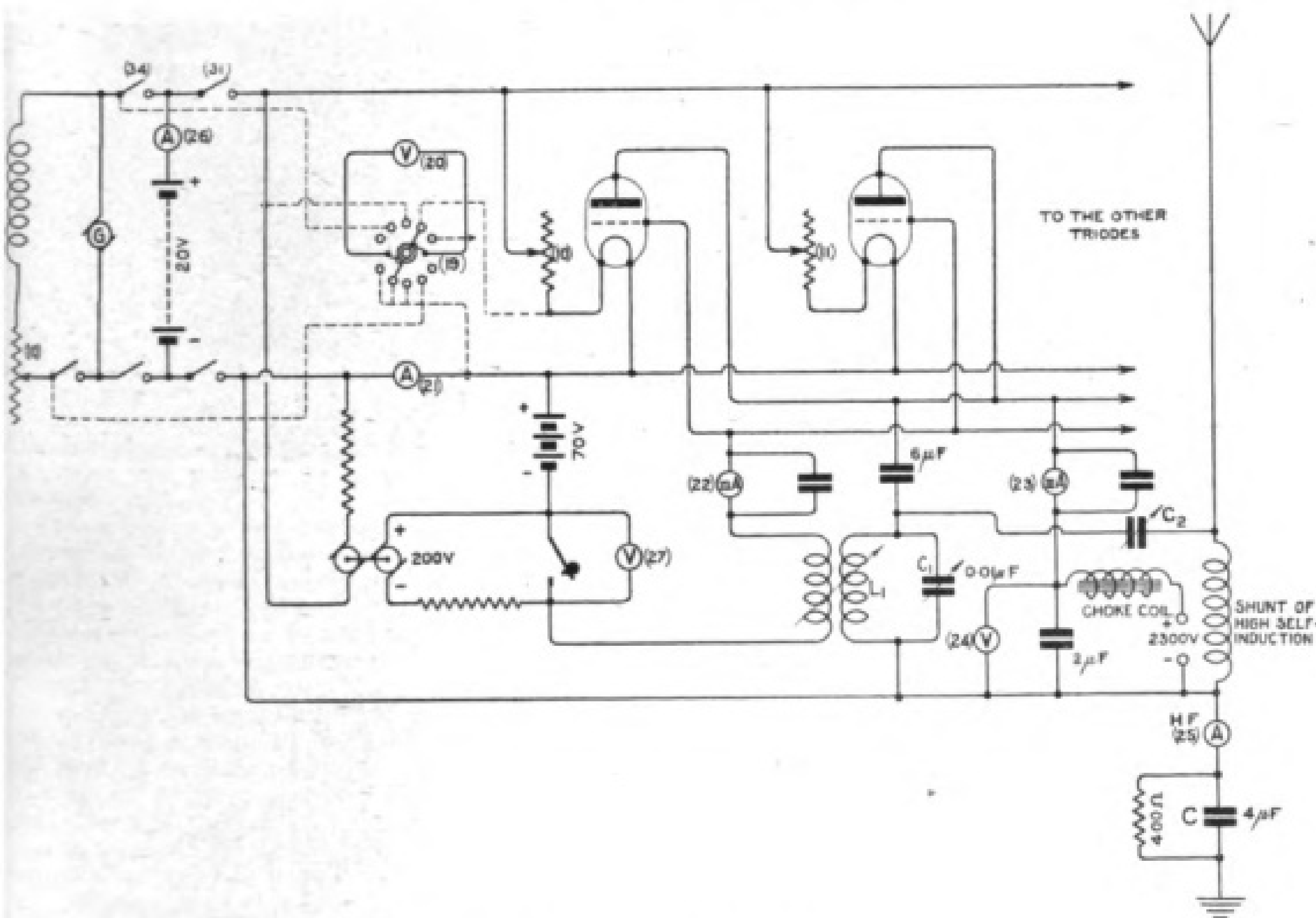


Fig. 4. Transmitter Circuit.

The potential across the terminals of the machine, r across the battery, is read on voltmeter 20, or a suitable position of commutator 19. The xcitation of the machine is regulated so that the enerated voltage slightly exceeds that of the battery, and the two may then be coupled without anger by means of the circuit breaker 34. The atter would prevent current from flowing back rom the battery to the machine. The total filament urrent is read on ammeter 21, while a differential mmeter (26) indicates the amount of current

The grids are wired in parallel and kept at a negative potential of about 70 volts by a battery of small capacity. The use of very negative grids, removing as it does the working point to the bottom of the grid plate characteristic, results in the production of an impulse only during the positive half cycle.

This gives an overall efficiency greater than would be obtained at the middle of the straight part of the characteristic.

The self-induction of the grid circuit can be

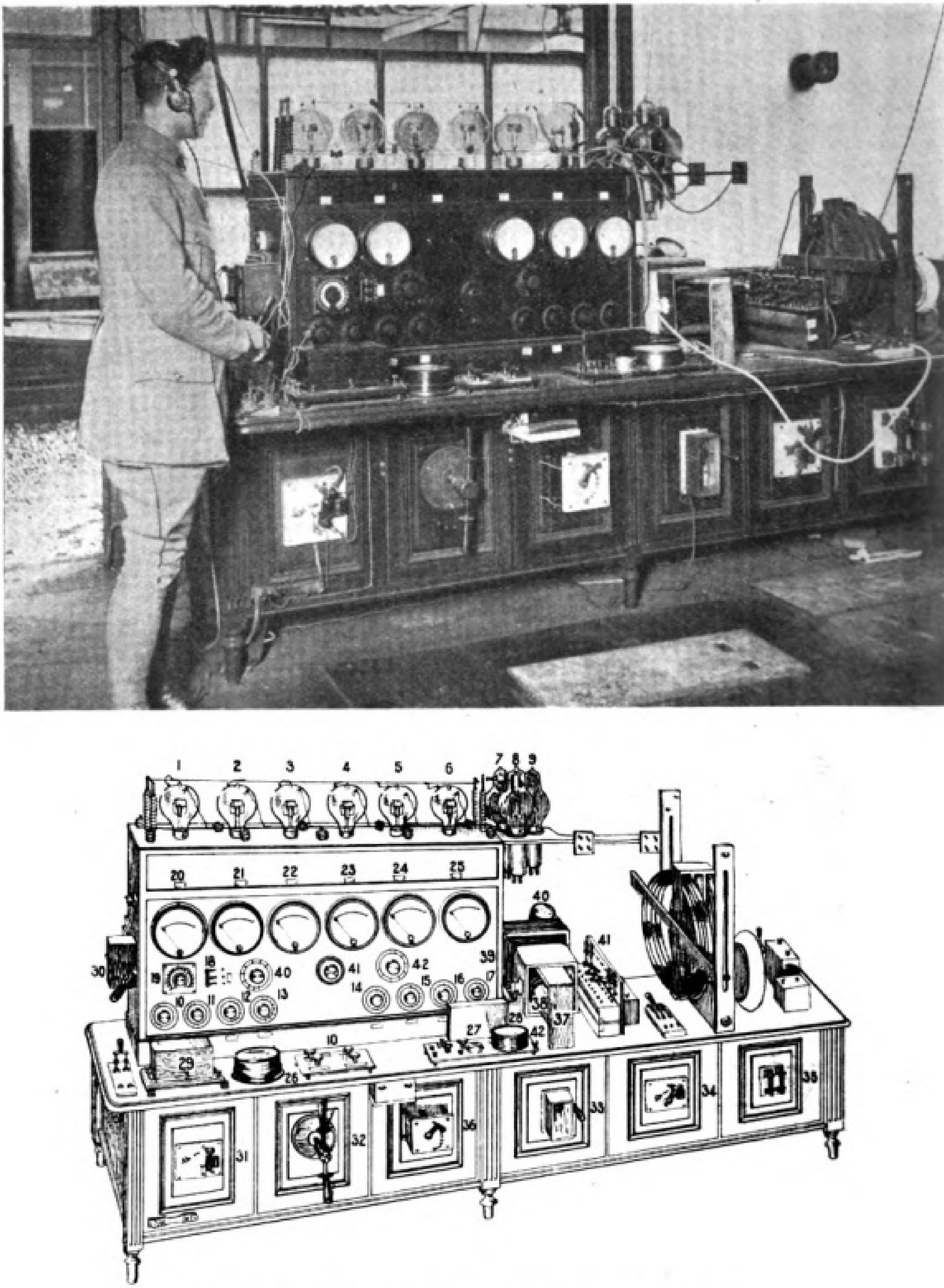


Fig. 5. The Transmitting Apparatus with explanatory diagram.

varied in steps by means of a commutator (40). A milliammeter (22) shunted by a condenser makes it possible to verify that the grid current remains very small.

(c) *Method of Signalling.*

To signal, the grid is made very negative by introducing a supplementary negative potential of about 200 volts (Fig. 4), which may be read on the small voltmeter (27). This negative tension is supplied by a small D.C. motor-generator, with two commutators, on one of which 20 volts is placed to work the machine, while from the other a tension of about 200 volts is taken. This dynamo starts automatically when the triodes are lighted.

The key short circuits the supplementary tension, the current supplied by the machine flowing in this case through a resistance. The signalling can be done by hand or Wheatstone, this system being able to work at very high speeds without any sparking at the contacts of the key. If desired, the triodes can be worked at their maximum power, when the key is on the marking stop, as when the key is up, the electronic bombardment is stopped by the grid, and the plate has time to cool. Under these conditions of working, the key should not be kept depressed as the plate becomes excessively hot.

(d) *Plate Circuit.*

The plate circuit is common to all the triodes. The resonant circuit L_1C_1 consists of a condenser of 0·01 microfarad and a self-induction L_1, whose value is varied by means of a contact (42). The degree of coupling between grid and plate is varied by means of a variometer (41). The antenna and earth are connected to either end side of the oscillating circuit. The capacity of the antenna itself is 0·007 microfarads, and it is connected in series with a variable condenser C_2. The wave-length of the complex circuit then obtained is set at 2,600 metres.

The plates are fed through a choke coil. A passage for high frequency oscillations is provided through a 6 microfarads condenser, connecting the plate to the oscillating circuit. This condenser has a large value as it acts as a reservoir. The grid is kept at a high negative potential, and the current impulses in the plate circuit are short and sharp. The condenser supplies instantaneously the current demanded in the plate circuit when the grid potential becomes sufficiently positive. The peaks of the plate current are very sharp, and give rise to an induced E.M.F. capable of maintaining a heavy oscillating current in the antenna, although the mean power taken from the high tension source is comparatively small.

It is not wise to have an antenna of the size of that in the Eiffel Tower, completely insulated from the earth, on account of the very large static charges which may accumulate on this antenna. A shunt of high inductance is provided, to allow these static charges to pass to earth, without, however, affording a passage to high frequency oscillations. As it was undesirable to earth directly one side of the high tension supply, a condenser of 4 microfarads is put in series between the antenna and ground, but is shunted by resistance lamps.

The mean plate current is measured by a millimeter (23), the plate voltage by a voltmeter (24), and the oscillating current in the antenna by a hot wire ammeter (25). With the apparatus it is naturally necessary to depress the key for several seconds to obtain the maximum deflection. If the triodes are delivering high power this is very inconvenient as the plates get excessively hot. Furthermore, during Morse-working the deflection of the needle is varying all the time without bearing a definite relation to the current in the antenna.

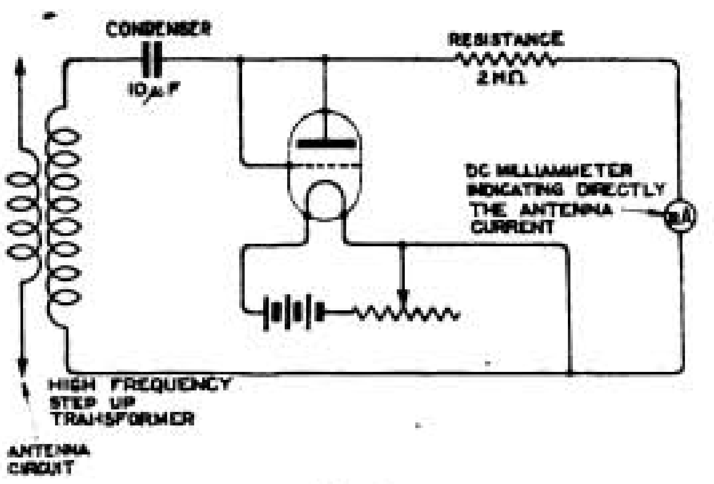


Fig. 6.

To overcome these difficulties a second ammeter has been provided which gives at any instant during working the maximum effective current in the antenna. The antenna is magnetically coupled with a secondary circuit of about two hundred turns (Fig. 6). The latter is connected on one side through a highly insulated condenser of 10 microfarads to the plate, and on the other to the filament of a small R triode. This condenser is charged to a potential equal to the peak value of the oscillations and discharges very slowly through 5 meghoms. When working commences, the condenser is charged in a couple of seconds and reaches its maximum potential. The needle then gives directly the value of the current in the antenna, and the reading is not influenced at all by the speed of working or the nature of the signals.

(e) *High Tension Supply.*

The plate supply was originally drawn from a ring wound generator driven by an asynchronous motor. An oil circuit-breaker (32) is inserted on the side of the high-tension supply. A commutator (33) controls the excitation, and a rheostat (36) allows the tension of this machine to be varied.

After an accident that happened to this machine, Mr. Laüt proposed the use of a system of rectified alternating currents. The source being the local supply or 220 volts at 42 cycles, which is stepped up through a transformer. A synchronous motor works a rotating brush which alternatively connects at the moment of maximum tension, positive or negative, the secondary of the transformer to one or other of the condensers C or C'. (Fig. 7).

This result is obtained in practice by the use of a small four-pole synchronous motor. A metallic arm is well insulated from the motor, and carries at each end a small wheel which in the course of one revolution connects successively a to c and b to d; a b c d being contacts placed at 90° around the periphery. These contacts consist of bow-shaped elastic steel wires of 1 millimeter diameter. These contacts are fixed on a movable ebonite mounting plate, which can be turned through such an angle that the contact is made at the time of maximum voltage. The condensers C and C′ have a large capacity: 15 microfarads. They are each charged 42 times per second and always in the same sense. Thus a continuous current can be obtained between the terminals of these condensers, with an undulating voltage. The fluctuations are partially choked out by the use of a choke coil in series and condensers in parallel, which at the same time prevents the return of high frequency current into the transformer.

The final fluctuations are of such small amplitude that they are not detected by a receiving set even when close to the sending station.

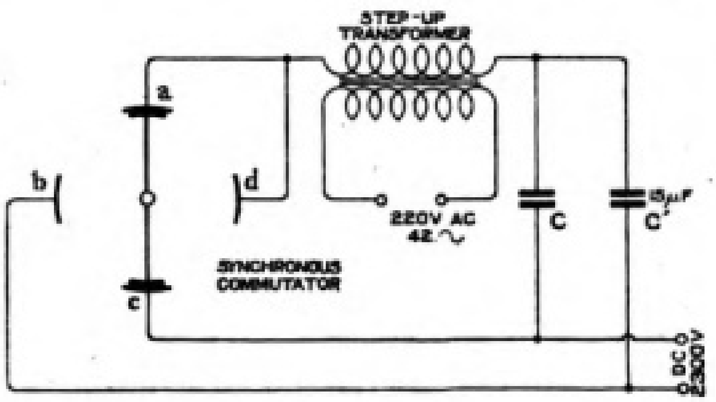


Fig. 7.

IV.—TELEPHONY.

The circuit used for telephony is exactly the same as for telegraphy, except that the signalling apparatus is replaced by a modulating device.

(*a*) *Oscillator.*

A new triode maintains in a resonant circuit a.b., oscillations whose frequency corresponds to the allotted wavelength.

The triodes in parallel have in their grid circuit a new self-induction L_3 which is inductively coupled with the oscillating circuit of the oscillator. These grids are further raised to a negative potential of 120 volts (Fig. 8).

The oscillations set up by the oscillator are thus transmitted inductively to the grids of the triodes and reproduced amplified in the plate circuit. The antenna circuit is then tuned to the same frequency, by adjusting condenser C_2. Thus the maximum current in the antenna is obtained. A retroactive coupling between the inductance L_1 in the plate circuit and L_2 in the grid circuit of the triodes compensates for damping in the circuits and further increases the amplitude of the oscillations. The advantage of the system is that the periodicity of the antenna oscillations is not determined by the characteristic of the antenna, but by the period of the oscillating circuit of the oscillator, with the result that the wavelength emitted is very nearly constant, and the inevitable variations in the capacity of the antenna, for example, do not cause variations in wavelength.

We may remark by the way that this kind of circuit would be very advantageous in high speed printing telegraphy where sharp tuning is used, and therefore the wavelength must be kept constant within extremely narrow limits.

(*b*) *Modulation.*

The first triode also plays an important part in modulation, as it is the oscillations in its circuit which are first modulated by the voice currents.

The speech waves may be generated in a microphone on the set, or transmitted over a special line-circuit from the local switchboard. The voice frequency currents are first of all amplified by means of a two-stage amplifier.

The triodes used in this case are small French tubes with cylindrical grid and plate. The coupling between the microphone circuit and the first grid and also between the plate circuit and the second grid is made through step-up transformers. The grid potential is − 6 volts to avoid the distortion which would result from the current which other-

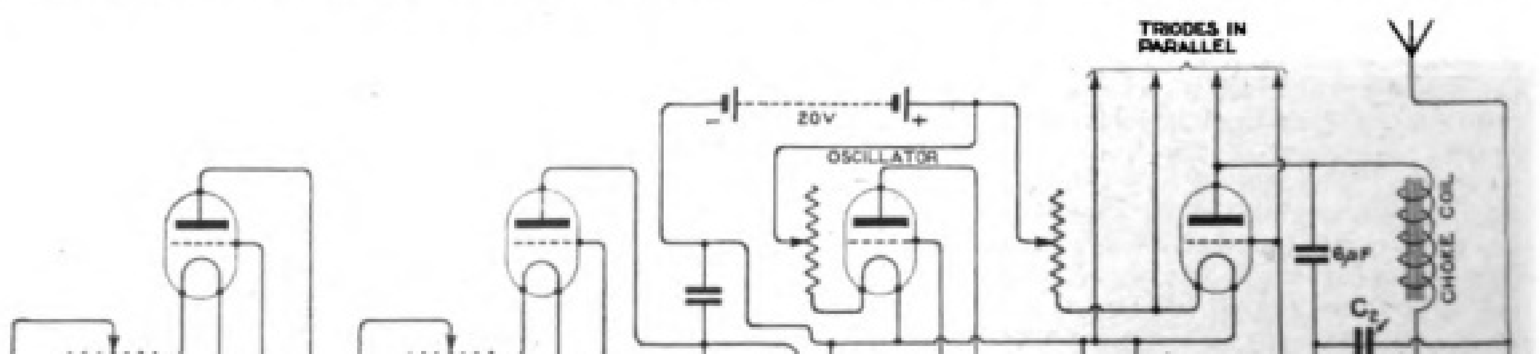


Fig. 8. Details of the Telephony Circuit.

wise would flow in the grid circuit at the points of maximum the positive potential. In the plate circuit of the second tube a self-induction and a condenser of about 0·001 microfarads are placed in series.

This impedance is necessary to obtain on the grid of the oscillator a potential varying according to the speech wave.

The local oscillations of circuit a b are thus modulated to telephone frequencies and through the coupling L_2 L_3 these modulated oscillations are transmitted to the antenna circuit. However, there exists a direct coupling between the self-inductance of the grid circuit of the oscillator and that of the triodes. The quality and amplitude of the modulation depends upon a correct degree of coupling between the inductances.

Referring back to Fig. 5, the self-inductances L_2 L_3 L_4, are indicated by the numbers 37, 38, 39. It is possible to change their respective positions to obtain a coupling which gives a modulation which is very nearly perfect.

No. 40 is an ammeter in the oscillator circuit and No. 41 is the capacity C_3 (Fig. 8).

The adjustment requires a high degree of skill and it is possible that a simpler circuit may be adopted later. It is, however, interesting to note that, contrary to what is often thought, excellent modulation may be obtained by merely varying the grid potential. Mr. Levy, in 1916, had already fixed up a set, with a range of 300 miles, giving excellent results, with grid modulation.

mitting the switch automatically disconnects the sending side from the antenna, serious consequences being thus avoided.

V.—Efficiency.

The overall efficiency of the set is relatively high. This is due in the first place to the use of a very negative grid, which causes only sharp current peaks in the plate circuit.

Furthermore the use of an oscillator with an initial frequency constant to within narrow limits, allows the different circuits to be sharply tuned to the conditions of maximum efficiency. When once this setting has been made it does not need readjustment.

When the set transmits under the following conditions :—

1. Non-modulated continuous waves of 2,600 metres. Corresponding to 7·5 ohms of effective antenna resistance.
2. With 5 triodes in parallel
3. With a plate voltage of 2,300 volts.

We have the following figures :—

Input plate current	0·550	amps.
Input energy on the plates	1,265	watts.
Effective antenna current	9·6	amps.
Energy in the antenna	690	watts.
Efficiency	55	%

When the oscillations are modulated the effective current may reach 11·5 amps. in the antenna. This corresponds to 1 kW. The efficiency is then less—about 50 per cent.

The exact degree of modulation is not known

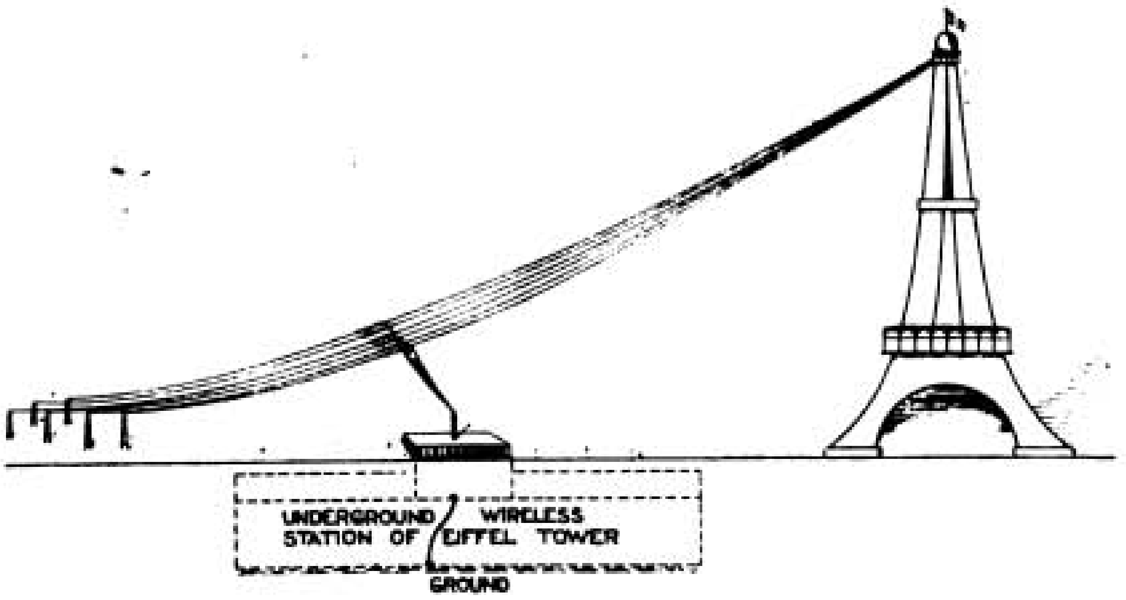


Fig. 9. Arrangement of the Antenna at Eiffel Tower.

(c) *Antenna.*

The antenna used is the large one of the Eiffel Tower, consisting of 6 galvanised steel cables fixed at the top but insulated from one another. They are led down like the guy ropes of a tent, and joined together where they enter the post (Fig. 9). The antenna capacity is 0·007 microfarads, and its natural wavelength about 2,000 metres. The earth consists of a large number of zinc plates buried under the station and having a total surface of 600 square metres. The antenna switch for the triode set is controlled electrically by a button (42). If by mistake the operator passes to the receiving position while the set is still trans-

precisely, as no oscillogram has been taken for the antenna current.

It is, however, possible to get an idea of the amplitude of the modulation by comparing the antenna current with and without modulation.

VI.—Results Obtained.

The results observed by the many posts that hear the Eiffel Tower's radio-telephony show that the quality of emission has been continually improving. This is due to more accurate setting and greater skill on the part of the personnel.

The receiving sets include the amateur's set using a simple crystal detector, as well as the specialist's set with a perfected selective set using multi-stage amplification.

In a general way it seems that amplified reception at high frequency with resistance coupling has given the best results, as far as clearness and distinctness of speech is concerned. A very high degree of selectivity may be used, reducing the effects of atmospherics and interference due to other stations, to a minimum.

We shall cite the following results:—

(1) 180 miles from Paris a simple direct coupled receiving set with a galena detector and 3-wire antenna, 260 feet long and 65 feet high, gives excellent reception.

(2) At the Hague, 250 miles from Paris, a correspondent of *Radio News* writes to say that he could hear very distinctly with a 4-wire antenna, 80 feet long and 13 feet above the roof by using a single triode.

(3) At Genoa, 260 miles from Paris, very strong clear reception, with a retroactive circuit on a twin wire antenna 180 feet long is reported.

(4) At Milan (400 miles) a 3-triode amplifier (the first tube being used at high frequency with retroactive coupling, and the other two at low frequency) gives reception with a loud speaker on an antenna 50 feet long when the first lamp works as an autodyne. Otherwise the speech is weak. In both cases there is a certain amount of distortion.

(5) At Edinburgh (620 miles) a 4-triode amplfiier (a high frequency tube, a detector with retroactive coupling two low frequency tubes) reproduces music clearly 12 feet from the telephones, using an antenna 100 feet long. Speech is slightly distorted.

(6) At Colomb-Bechar and at Ouargla (1,200 miles) the operators notify us that the reception is very good with the normal antenna using a 4-triode resistance-amplifier.

The Eiffel Tower transmits daily by radiotelephony a report of the national meteorological bureau indicating the weather expected on the next day in different districts.

This forecast, which was first of all sent out at 4.30 p.m. (Greenwich time), is now wirelessed at 6 p.m. summer time.

On account of the importance of a knowledge of the weather for certain industries and for agriculture, a second daily bulletin is being considered.

The transmission of Press and financial news is being studied at present by the Postal Administration, but such a service cannot really be satisfactory until 2 sets of at least 2 kW have been substituted for the present temporary one, whose power is less than 1 kW.

We wish to express our thanks to Mr. Le Commandant Jullien and Mr. Laüt for kindly allowing us to use information published in an article in the *L'onde Electrique*.

Charging Accumulators from A.C. Mains

By HAROLD E. DYSON.

A VERY large number of amateurs put themselves to the inconvenience of carrying their accumulators a mile or more to be recharged simply because their supply current is alternating and they believe that troublesome or costly apparatus is required to rectify the supply.

The principle of a simple apparatus that will serve the purpose will be seen from Fig. 1. A steel reed E of thickness 0·015 ins., is supported on edge and clear of the wooden base by the brass angle bracket C. It is free to vibrate but it must be tuned to vibrate at the supply frequency, as otherwise the movement is extremely small. This is accomplished by passing the fixing screw D through a slot in the end of the reed After completing the instrument and connecting on the supply (but not the accumulator) this adjustment is easily made, as when in tune the reed will swing from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. at the tip, and when out of tune the movement will be difficult to detect. Once the reed is tuned it will not need to be altered again. The dimensions given in Fig. 2 should be followed exactly for the usual frequency of 50 periods. For 40 periods it will need to be a little longer, and for 60 periods a trifle shorter, the right length being easily found by making it too long and cutting bits off until it will tune. The contact spring is made of steel 0·025 inches thick, and should be made exactly to dimensions for reasons connected with phase angle, which will be dealt with later. It should be firmly riveted on and fitted with silver contacts. Platinum would, of course, be better but is not essential.

The magnet A is clamped to the base by a brass strap B, with a screw through the centre. The pur-

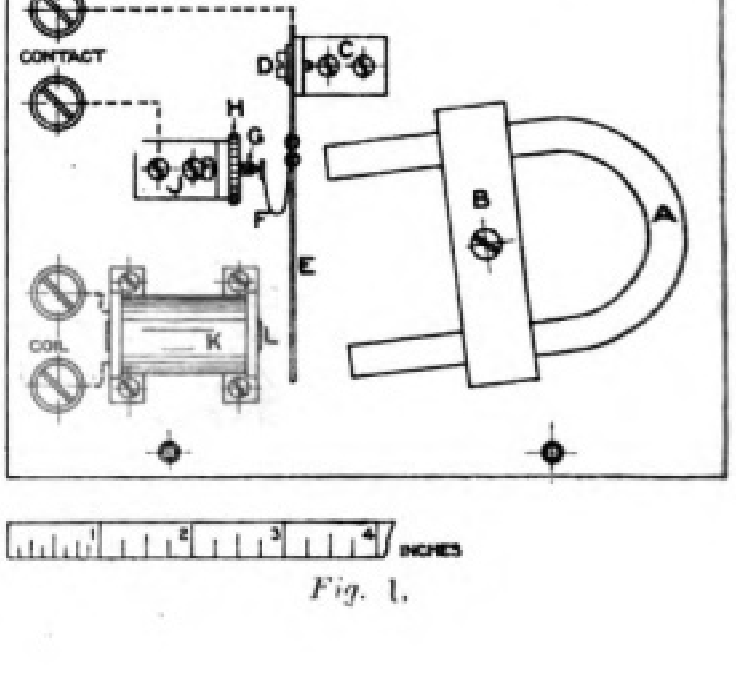


Fig. 1.

pose of this is to polarise the reed, as otherwise it would only vibrate at double frequency. The best position for this magnet can be found by trial.

One of the magnets used in telephone magnetos is suitable but a less powerful one can be used successfully if carefully adjusted to be as near as possible to the reed without touching it when it vibrates.

The reed is alternatively attracted and repelled by the coil K, which carries alternating current, thus causing the contact G to be open for one-half cycle and closed for the other.

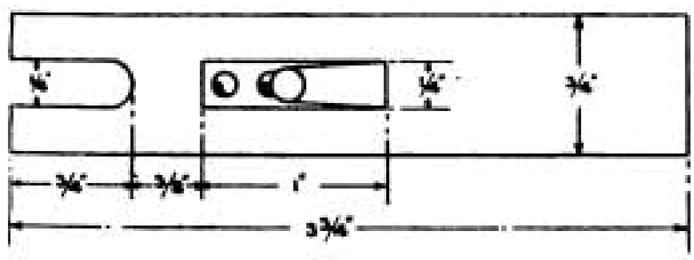


Fig. 2.

The coil may be fixed by a fibre strap or screwed to a small movable platform, so that it may be moved to the best distance from the reed. Movement of the iron core alone may give the requisite adjustment. The core should be about 5/16 in. diameter of ordinary iron core wire, for if solid it would not only overheat but the eddy currents would delay magnetisation. A bobbin with a winding of about 1 in. diameter by about 1½ ins. long, wound with No. 34 wire, is generally suitable.

The contact screw G in the angle bracket J is fitted with silver tip and knurled lock-nut H. It is the only thing that ever requires adjustment after the rectifier has once been set to work, and then only after the contacts have been cleaned.

It will be found that when running without sparking the contact will be open when the rectifier is stopped.

This makes any kind of cut-out unnecessary as the accumulator is on open circuit if the power should fail. If the contact be properly adjusted the reed opens the circuit when the A.C. volts have dropped to the accumulator voltage, so that no current is passing; this results in surprisingly little trouble with the contact.

All important dimensions have been given, but other dimensions may be varied to suit the maker.

The circuit to be used is given in Fig. 3, the rectifier terminals being shown at A. It will be noticed that a transformer is used. This results in a great saving of current as the 100 or 200 volt supply may be thus economically reduced to 15 volts for charging a 6-volt accumulator. This may seem too great, but it should not be reduced below this. Further reduction takes place in the resistance E. This may be a fixed resistance of 1 ohm if the rectifier is only used on a battery of 40 or more ampere hours, when the charging current will probably be about 3 amperes. If used sometimes on smaller accumulators a variable resistance should be used. It must never under any circumstances be omitted, as both the transformer secondary and the accumulator have such a low resistance that if the contact were even slightly out of adjustment, very large currents might flow which would immediately destroy the contacts and contact spring.

D is the accumulator to be charged and C is a direct current ampere meter. A moving coil ampere meter is suitable, preferably with centre zero, but if not available a simple coarse-wound galvanometer may be used if kept well away from all ironwork, especially the magnet of the rectifier.

It may be calibrated with sufficient accuracy by the use of measured pieces of resistance wire, and an accumulator. Its purpose is not only to measure the charging current but to indicate its direction. With everything connected except the main supply switch in the H.T. side of the transformer, close the rectifier contact by hand. Current will flow through the galvo. If the charging current is O.K. it will give a deflection in the reverse direction to this. If not, the accumulator must be reversed. Once correct polarity is obtained the rectifier will always start up in the correct direction.

The resistance B is unlikely to be wanted at all, the coil being straight across the transformer secondary.

It is marked on the diagram because it may possibly be found that no adjustment of the contact will produce either a sparkless break or a D.C. current. The reason for this will be that the phase relationship between the current in the coil and that through the accumulator is not correct. This may be altered by inserting in the circuit at B a 50 or 100 ohm resistance, and moving the coil nearer to the reed if necessary, to maintain vibration.

It is also possible to operate the coil from the H.T. supply side of the transformer through a lamp or condenser. This will use more energy, of course. The coil must never be put in series with either primary or secondary of the transformer.

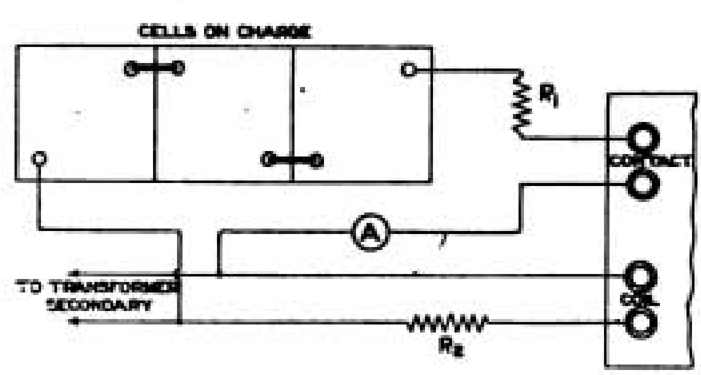


Fig. 3.

The rectifier from which these dimensions were taken has been in regular use for several years and runs most days for a few hours on currents from ½ to 2 amps. according to size of accumulators to be charged. It has occasionally been used on 4 amps 6 volts, with every satisfaction. It is left in circuit for 50-hour continuous runs on first charges without any attention other than cleaning the contacts with emery cloth after the run.

It is quite easy to use a split secondary transformer and a contact each side of the reed, but the arrangement illustrated has proved quite sufficient and uses an ordinary small power transformer. The energy to operate the coil is under 1 watt and no fear need be felt that the interrupted current is harmful to the accumulator.

The Construction of Flat Spiral Inductances

BY W. KENNETH ALFORD.

THE following notes on the design and construction of flat spiral or "pancake" inductances are the outcome of a considerable amount of research with a view to

(i) Producing a neat piece of apparatus.

(ii) Producing a "pancake" of more robust nature than that wound by the "spoke" method.

The "spoke" method, while undoubtedly appealing to the experimenter who does not possess a lathe or other mechanism adaptable to winding purposes, produces a "pancake" which when waxed is neither robust nor beautiful, especially in the larger sizes.

The method hereafter described is one which will only appeal to those possessing a lathe, and produces a truly flat spiral without the serrations appearing in coils wound by the "spoke" method, and have a very pleasing appearance.

Procure a piece of round mild steel about 4 ins. long and ¾ in. diameter. Mount this in chuck and turn down a part 3 ins. long from one end to a diameter of 2 cm. On this reduced part cut a thread ¾ in. whit, ¾ in. long. This constitutes the mandrel for winding the coils. Next procure two pieces of hard wood—mahogany or beech (the latter is preferable from the "turning" point of view) and turn two discs equal in diameter to the largest coil one wishes to make and ½ in. thick, and drill a 1 cm. hole through each. The faces of these discs must be dead flat. A nut and washer for the mandrel completes this part of the apparatus.

Now as to the winding of the coil. Having determined the size of wire and the dimensions of the coil it is desired to make—single silk-covered wire is much preferable to enamelled wire for this method of winding—procure two discs of celluloid—aero cellon does excellently—about 0·05 in. in thickness and about ½ in. larger in diameter than the desired coil. Drill a 1 cm. diameter hole through the centre of each and flatten if necessary by immersing in warm water and pressing.

Mount the steel mandrel in the lathe chuck by its thicker end and then place the discs on in the following order. Wooden disc, cellon disc, second cellon disc, and wooden disc, the nut and washer coming of course on the outside. The wire must now be passed between the "cellon" discs, the end being brought out through a small hole near the centre of the discs. The nut on the mandrel is now screwed up till the wire just passes comfortably yet fairly tightly between the cellon discs.

A clean tin must now be obtained, and a short length of ½ in. copper tubing soldered into the side near the bottom, to this is connected a piece of rubber tubing ending in a piece of drawn-out glass tubing. A screw-down pinchcock is used as a tap on the rubber tubing. A dilute solution of cellulose in acetone is made by dissolving a piece of cellon 5 ins. square in 50 cc. of acetone. This solution is placed in the tin which is arranged so that the liquid may be directed through the glass end piece between the cellon discs. The winding process may now begin—allow the cellulose solution to flow between the plates at a fairly fast drip and wind as fast as safety permits. When the wire is nearly filling the slot run in as much cellulose solution as possible and screw up the clamping bolt tightly, supplementing this if possible by two or three small carpenter's cramps. Remove from lathe and leave in a horizontal position in a fairly warm and dry place for 24 hours at least. It will then be found that when the clamping nut and cramps are removed the wooden discs may be lifted off, leaving the cellon discs welded together containing the flat spiral of wire. It is now desirable to trim off any excrescences from the edges of the cellon discs and fill up any open spaces with the cellulose solution.

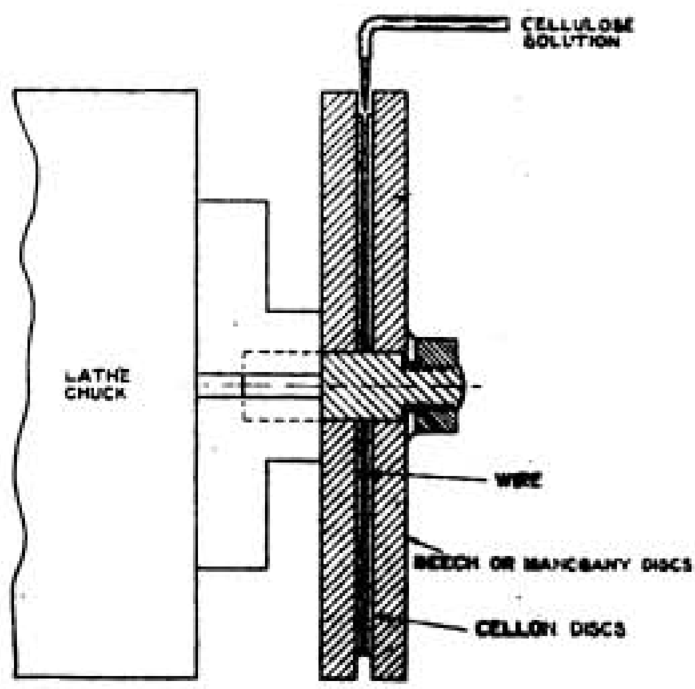


Fig. 1.

The resultant pancake is very robust and of pleasing appearance, and is well worth the trouble of the somewhat elaborate system adopted for its manufacture. Fig. 1 shows the arrangement for winding in a lathe. Fig. 2 is a series of curves useful in the design of "pancake" coils, allowing one to use the size of wire available, and to see at a glance the dimensions of the coil having the desired inductance.

The mean diameter is only taken up to 10 cm., as the overall diameter of such a coil is 22 cm., and the working of the winding method is liable to become cumbersome in larger coils.

Approximate wavelengths obtainable with certain inductance values and capacities of 0·0003, 0·0005, and 0·001 mfd. are given at the side of the the diagram.

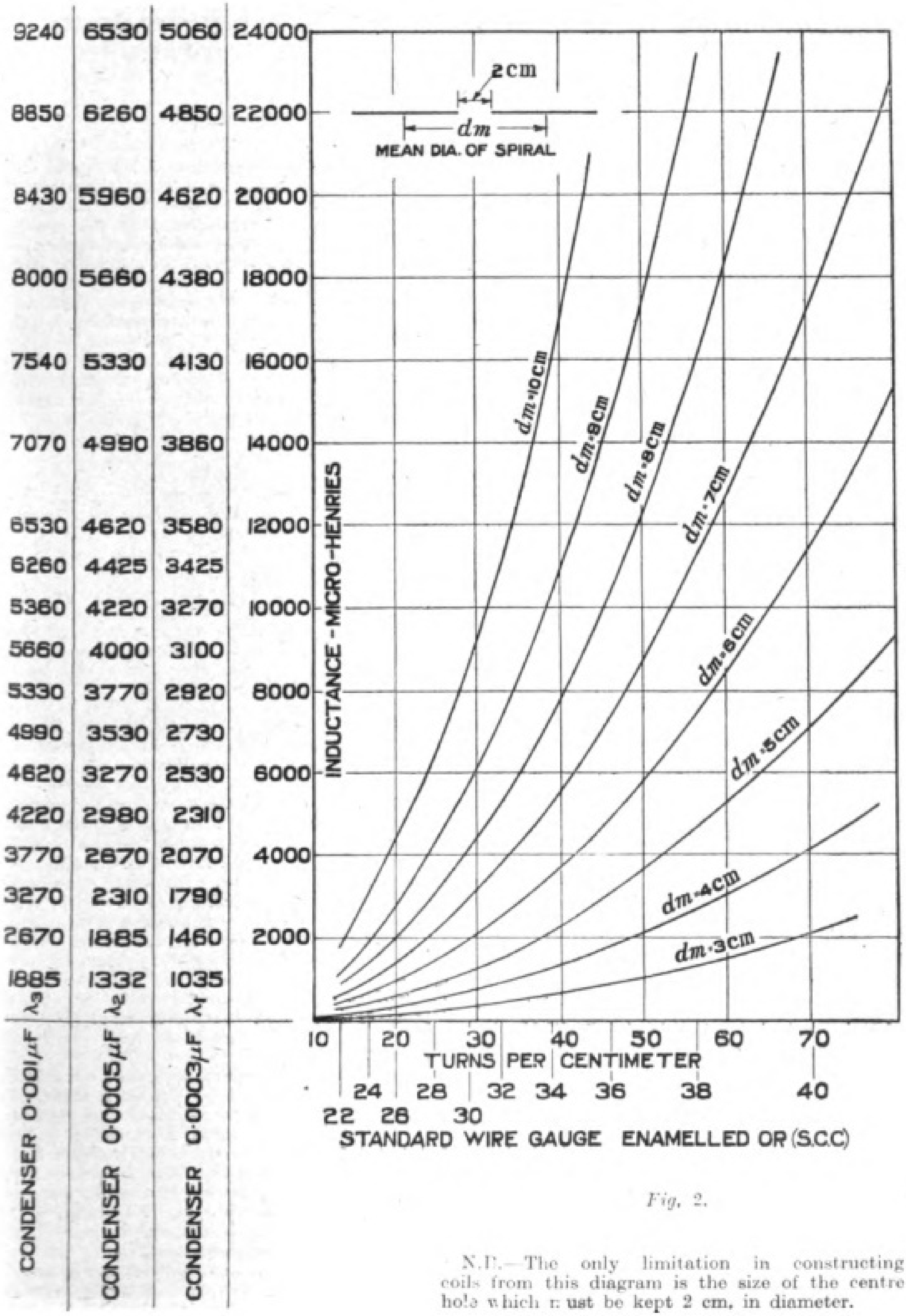


Fig. 2.

N.B.—The only limitation in constructing coils from this diagram is the size of the centre hole which must be kept 2 cm. in diameter.

How to Get the Best from Your Set

HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.
(Author of "The Maintenance of Wireless Telegraph Apparatus.")

I.—CRYSTAL RECEIVERS.

WIRELESS receivers for broadcast reception can be divided under the two headings of valve receivers and crystal receivers. Seeing that the wavelength for broadcasting has been so recently decided upon, the manufacture of sets specially designed for the purpose has not been long under way. At the present time, however, there are a number of sets in the second category already on the market, and it is thought that a few hints on how to get the best out of such sets (whatever their design or manufacture), may prove of use to the man who is just taking up wireless.

First of all, it should be clearly grasped that crystal receivers are not in themselves amplifiers of received signals, so that in such receivers, with their associated aerial and earth connections, it is imperative that all losses be cut down to a minimum. This point is of more importance in crystal receivers than in those of the valve type, as the latter, if suitably arranged, are capable of providing energy to make up *some* of the losses which may arise from inefficient arrangments, whereas in crystal receivers no such losses can be made up.

Other articles in this magazine have described the method of making and erecting wireless receiving aerials. Such aerials are invariably insulated at certain points to prevent the leakage of energy to earth; but because an aerial insulator is efficient when installed, it does not follow that without attention it will continue to act efficiently, and, indeed, in certain circumstances it may lose its insulating properties entirely.

Aerials are often erected among the chimney-pots. Frequently the mast is lashed to the chimney-stack itself, and in certain conditions, after the set has been in operation for a few weeks, the aerial wires, insulators, guy ropes, and mast, may become coated with a thick deposit of carbon from the smoke emitted by the chimney beneath.

In winter time, when heavy rain s are frequent this sooty deposit is largely washed away before it has time to accumulate. With long spells of dry weather, such as we had last summer, it may, however, become very harmful. All insulators should therefore be periodically inspected and wiped with a damp cloth.

Most of the crystal detectors now sold consist of a mineral substance such as galena or fused silicon, upon which the point of a fine wire lightly rests. The surface of a crystal is never uniformly sensitive, there are always certain spots where the best results can be obtained. Dust and grease are very injurious to the surface of a crystal, and on no account should the surface be touched with the finger, or a microscopic film of grease may be formed on the surface, and spoil its rectifying properties. Some detectors are enclosed in glass or other insulating tubes, to prevent the deposit of dust, and to lessen the chance of the surface being touched.

Again, the wire point should never be rubbed, even lightly, over the surface of the crystal, or the sensitivity, which is not uniform throughout the substance, may be removed by scratching. If the testing buzzer indicates that the maximum sensitiveness has not been attained, the point should be withdrawn, and very lightly applied to another spot, any change of position being carried out only after removing the point from contact. In those cases where the wire is attached to a kind of universal joint, the whole surface can be explored point by point. In other cases, the point can move across the crystal in one direction only, in which case, once a particular line has been explored, it is necessary to rotate the crystal in its holder to find a fresh area for test. A good crystal will have many sensitive points upon it, and when such a crystal is found, it should be treated as carefully and delicately as an expensive watch.

All crystals do not require the same pressure to give the best results. Some operate best when the point rests with the lightest possible pressure upon the surface; others give better results when the pressure is quite firm. The writer once possessed a piece of fused silicon which functioned admirably even under a pressure which would have fractured many crystals. A few careful experiments should therefore be made to find the best working pressure for the particular type of crystal in use. If possible, the dealer from whom the set is purchased should be questioned in regard to this.

A crystal detector which is very sensitive when properly handled, is a combination of zincite and one of the many varieties of copper pyrites. This combination generally goes under the name of "perikon." Zincite is a reddish and very easily friable crystal, which requires careful handling. The copper pyrites used in conjunction with it is a more robust substance. If several specimens of each crystal are available, a pair should be chosen which enable the maximum number of adjustments to be made. Zincite crystals should be picked to have one portion projecting more than any other, so that this point can be placed upon any part of the surface of the opposing crystal. Some of the crystals of the perikon detectors fitted to "disposal" apparatus I have found to be very badly mounted.

In selecting copper pyrites for such a combination, see that the specimen is as flat as possible. The two crystals should be so adjusted that they press together firmly, but not too heavily. Too heavy a pressure will tend to break the delicate zincite. If a zincite specimen is found to be insensitive, a tiny portion carefully broken or scraped away may reveal a more sensitive spot. Similarly, a poor specimen of copper pyrites may be improved by scraping. As before mentioned, it is extremely important that the surfaces should not be touched with the hand.

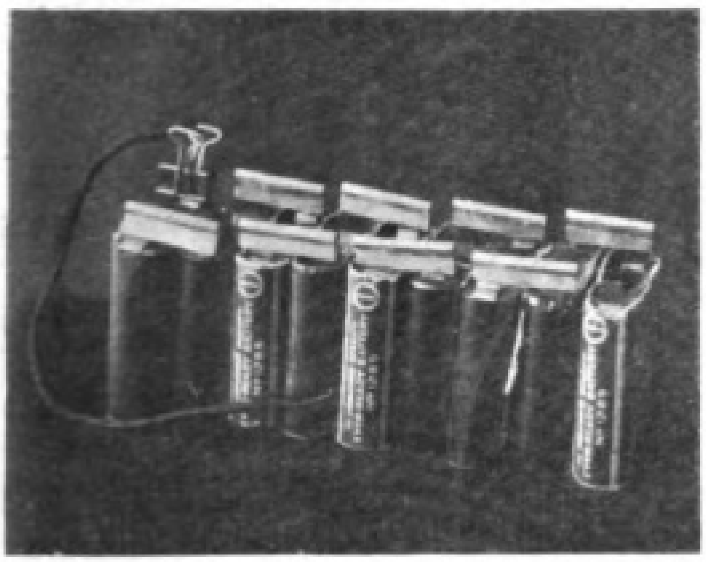
(A further article on the maintenance of wireless apparatus will appear in our next issue.)

Connecting Pocket Batteries for H.T. Supply.

By E. Vernon Barker.

A QUICK and effective method of connecting pocket batteries, which has the additional advantage of costing nothing, may be of interest to readers.

The usual 4-volt units are still used and preferred by a large number of wireless amateurs as being more economical than the larger units. Soldering the terminals together is the usual method employed, but the writer has come across experienced workers (one is a Transatlantic Test prize-winner) who have been content to exercise their patience by twisting bits of wire around the terminals—a most irritating and untidy-looking job. Both of these methods have obvious disadvantages.



In thinking out a better method of not only connecting but *disconnecting* these small batteries (an important point when a battery gives out and has to be replaced by a fresh one), it occurred to the writer that the back of a safety razor blade would be just the thing. So I looked out all my old "Clemak" blades (I have a habit of keeping rubbish, which frequently comes in useful years later), took off the backs with a pair of pliers, and there you have a perfect bridge ready to clip on to terminals. "Clemak," "Gem," or any single edge blade will do.

To make a neat job the negative terminals should be bent L-shape to bring them in line with the positive terminals, and then shortened with a pair of scissors to the same height as the positives.

The connecting of two small spring clips to H.T. leads will be found a good and cheap arrangement to complete the job. By clipping on to any of the bridges, tappings can be taken from either end for any voltages required. The method of arrangement is shown in the accompanying photograph.

Now it is quite possible that these old razor blades may not be easily obtained, although thousands must be thrown away yearly; so for the benefit of new radio recruits and others I will describe an easy method of making these bridges by hand. A sheet of tin will be found a most suitable material of sufficient springiness and easy to cut with a pair of scissors. Cut into small squares, size $1\frac{3}{8}$ins. by $1\frac{1}{8}$ins. Bend double lengthwise over a short length of metal rod $\frac{1}{16}$in. to $\frac{1}{8}$in. in diameter. Leaving the rod inside, press the two sides firmly together in a vice, or with pliers, leaving the folded end projecting, which will act as a spring when in use. After withdrawing the rod replace in the vice in the same manner and screw up tightly. This completes the work, as it will be found that when withdrawn from the vice, the amount of springiness in the tin has left an opening which is just right to slip on to the flat brass terminals and make a good electrical contact.

A written description of how to make or do anything mechanical usually looks at first more troublesome than the actual work; but, without exaggeration, the writer has made two dozen of these terminal bridges in less time than it has taken to solder or twist with wire the same number of terminals.

When once you have your bridges made they can be used indefinitely, and the making or reinforcing of a high-tension battery is a matter of minutes.

Notes.

The Nauen Station: Extension.

The wireless plant at Nauen is about to undergo an extensive development according to a statement in the *Telefunken Zeitung*. It is stated that seven more masts 210 metres high are to be erected while four of the existing masts are to be strutted. Work is already proceeding, and the Transradio Company has increased its capital by 25,000,000 marks to obtain the requisite funds.

Wireless Societies of the United Kingdom.

In the list of Wireless Societies of the United Kingdom, recently published, it is regretted that the name of the Edinburgh Society was incorrectly given. This Society is known as "The Edinburgh and District Radio Society." The following Society should be added to the list:—

The Wireless Society of Highgate, 49, Cholmeley Park, Highgate, N.6.

Personal.—Mr. A. A. Campbell Swinton, F.R.S., M.Inst.C.E., M.I.E.E., has joined the Board of Directors of Messrs. W. T. Henley's Telegraph Works Company, Ltd.

On Heterodynes: A correction.

Owing to errors in drawings in illustration of the instalment of the article "On Heterodynes," which appeared in the issue for May 27th, we give corrections as follows:—Fig. 14 should show one moving vane less on each side.

In Fig. 16 the double switch should serve to connect C_4 and C_4', C_5 and C_5', etc.

In Table III the first Coil No. should be 75 instead of 50.

Correspondence

To the Editor of The Wireless World and Radio Review.

Sir,—I would very much appreciate your publication of this letter informing all British amateurs that my station will discontinue all transmitting experiments after the 30th inst., and probably until October next. Knowing that "8AB is a very familiar station to many London amateurs," I would hate to think they are tuning for me while I am not sending.

May I take this opportunity of heartily thanking the numerous British amateurs who kindly reported signals and whose help was very valuable. I wish them all success in their work and more freedom for next winter.

With congratulations for the regularity of publication of your very interesting magazine.

Léon Deloy,
French, "8AB."

May 28th, 1922.

To the Editor of The Wireless World and Radio Review.

Sir,—My letter to the *Wireless World and Radio Review* of May 6th, regarding the many errors made in the daily press regarding radio science has brought me such a huge correspondence from persons who are interested in wireless that I venture once more to make a few remarks—this time to the amateur.

Now that we have entered upon the field of the most wonderful of nature's secrets it surely behoves everyone to study and thoroughly understand the functions and reasons for every unit of wireless apparatus. To-day there are thousands of people rushing to purchase complete receiving sets in beautifully polished boxes with ebonite tops; pretty little glowing valves and pretentious switches (but heaven only knows what is inside !) in order to satisfy their curiosity and "listen in." That curiosity is but natural. They are eager to hear what, after all, is a modern miracle. They can, with the expenditure of a few pounds, enjoy the results of twenty years of radio research, much of it patient and unproductive, as I know to my own cost, for in the early experiments in telephony upon low power for distance I worked daily for nine months without tangible result !

It is not the natural inquisitiveness that I criticise, but the amazing ignorance of so many amateurs all over the country—men who for several years have been "listening in" and have never taken the trouble to learn why their apparatus works, and who have never bothered themselves even to learn Morse. I fear that hardly fifty per cent. of our amateurs know anything of wave curve or time periods. Neither could they explain to a class the action of a hard valve, nor the real working of a crystal detector.

On the other hand I admit that some amateurs are really experts in radio. Certain amateurs whom I met before the war—one of whom I set up with his first crystal set—is now one of our greatest men in radio research—have really studied and become proficient in the technicalities of the science. But the majority, alas ! seem to content themselves with tuning in loud signals from GNI and others, and turning over the Hague concert into a loud speaker.

I agree that such proceeding means "radio for the public." But we want something more. Broadcasting is of course very interesting, but to the wireless amateur it should be far more interesting to be able to explain to his friends the function of every piece of his apparatus and so interest them in the real science of radio-telephony.

Dozens of amateurs have recently complained to me that all manufacturers assume that purchasers of their goods know all about them, hence there is a great difficulty in obtaining elementary instruction. This I admit, and only hope that some manufacturer will be enterprising enough to hold elementary classes at which radio could be taught like geography, and thus infuse into those who use receiving sets an enthusiasm for real and valuable research.

William Le Queux.

Devonshire Club, S.W.

To the Editor of The Wireless World and Radio Review.

Sir,—It is somewhat surprising that the Government advisers for the new "Broadcast" stations have omitted Leeds as a centre; they can hardly be aware of its remarkable geographical situation for the purpose of broadcasting.

If you open a pair of compasses to the 80-mile scale on a Bartholomew map and strike a circle with Leeds as a centre, it will be found to embrace the *whole* of Yorkshire, Durham, Westmorland, part of Cumberland, the *whole* of Lancashire, part of Flintshire, the *whole* of Cheshire, greater part of Staffordshire and Leicestershire, the *whole* of Derbyshire, Nottinghamshire and nine-tenths of Lincolnshire; that is, it includes the most important commercial manufacturing, industrial, shipping and agricultural areas of the whole kingdom, besides a considerable area of the sea, off our East and West Coasts.

It would be almost impossible to find another centre embracing such a varied and wide diversity of interests within such a radius.

Is it presumptuous to ask "the powers that be" to consider these points ?

E.K.S.

Book Reviews

The Year-Book of Wireless Telegraphy and Telephony, 1922. (London: *The Wireless Press, Ltd.* Pp. 1477 + lxxxix. Price 15s. net.)

The 1922 edition of this annual is an excellent indication of the progress made in wireless telegraphy. The principal features of the book remain as in previous issues, but all sections have been carefully revised and enlarged so as to contain up-to-date information. The list of wireless stations of the world, both land and ship, shows a considerable expansion over the previous Year-Book. The Record of Development, which forms a distinctive feature, has been completed up to the date of publication, and the Laws and Regulations relating to wireless in all countries of the world has been revised and enlarged.

Special articles by well-known wireless engineers again form a valuable feature, and in particular mention might be made of an article on the Recording of Wireless Signals, contributed by M. Henri Abraham, setting forth the different methods which have been made use of commercially for recording wireless signals, with special reference to high speed working.

In the section devoted to amateur and experimental wireless, an article appears which reviews the activities in the field of wireless from the point of view of the amateur and experimenter, whilst a big list of the experimental transmitting licences granted in the United Kingdom is included with particulars as to location, times of working, etc.

The list of patents records progress in invention and forms a comprehensive guide to what has been done during the past year.

At the end of the volume is included an entirely new feature which should prove of very considerable value and interest. This consists of a map of the world, specially drawn on great circle projection, with London as a centre, so that the correct direction and distance of any point in the world from London can be seen at a glance. This map will be found very valuable in estimating the relative distances of wireless stations heard in the London area, and the map is of course accurate for most practical purposes for a considerable range beyond the United Kingdom. This map is also of great value in connection with directional wireless.

The publishers have fortunately been able to reduce the price with this year's volume without in any way detracting from the general completeness and high standard of the annual.

RADIO QUESTIONS AND ANSWERS on Government Examination for Radio Operator's License. By Arthur R. Nilson. (New York: *McGraw-Hill Book Company, Inc.*).

This set of questions and answers is designed to cover the syllabus of the United States Government examination for wireless operators, and the subject appears to be well dealt with. The apparatus illustrated is exclusively American standard ship equipments, and the questions relating to Government regulations, traffic control, etc., are those operating in the United States.

Towards the end of the book a useful bibliography is included, classified according to the subjects dealt with in the volumes referred to.

Books Received

WIRELESS VALVE RECEIVER SET. How to Make It. By E. K. Spiegelhalter. (London: *E. & F. Spon, Ltd.* Pp. 79. 7" × 5". Illustrated. Price 3s. 6d. net.)

WIRELESS TELEGRAPHY AND TELEPHONY. By E. Redpath. (London: *Cassell & Company, Ltd.* Pp. 152. 7" × 5". Illustrated. Price 1s. 6d. net.)

THE A B C OF WIRELESS. A Popular Explanation. By Percy W. Harris. (London: *The Wireless Press, Ltd.* Pp. 64. 7" × 5". Illustrated. Price 6d. net.)

Calendar of Current Events

Saturday, June 10th.

HOUNSLOW AND DISTRICT WIRELESS SOCIETY.
Visit to Croydon Aerodrome.

Sunday, June 11th.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG, The Hague, Holland.**

Monday, June 12th.

WIRELESS SOCIETY OF HULL AND DISTRICT.
7 *p.m.*—Committee meeting.
7.30 *p.m.*—Lecture by Mr. W. J. Featherstone.

Tuesday, June 13th.

WOLVERHAMPTON AND DISTRICT WIRELESS SOCIETY.
8 *p.m.*—"Electrical Terms and Their Meanings," by Mr. Blackmore, A.M.I.E.E.
Transmission of Telephony at 8 *p.m.* on 400 metres by **2MT** Writtle, near Chelmsford.

Wednesday, June 14th.

WIRELESS SOCIETY OF LONDON.
6 *p.m.*—At the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Address by Sir Oliver Lodge, F.R.S.

NORTH MIDDLESEX WIRELESS CLUB.
8 *p.m.*—At Shaftesbury Hall, Bowes Park, "The Townsend Wavemeter and How to Use It," by Mr. L. C. Holton, followed by a Demonstration of the Reception of Telephony for Beginners.

Thursday, June 15th.

THE WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
"Interpretation of Wireless Circuits," by Mr. F. E. Strudt.

DERBY WIRELESS CLUB.
7.30 *p.m.*—At "The Court," Alvaston, "Continuation of A.C. Experiments in Relation to W/T.," by Mr. E. F. Clarke.

Friday, June 16th.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part II, by Mr. J. Stanley.

BRADFORD WIRELESS SOCIETY.
Lecture by Mr. H. G. Evans.

Sunday, June 18th.

Transmission of Telephony from the Hague, **PCGG**, as above.

Tuesday, June 20th.

Transmission of Telephony from **2MT**.

Thursday, June 22nd.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.
Demonstration of the "Ultra IV" Receiver, by Mr. F. O. Read, Member I.R.E.

Friday, June 23rd.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—At the Highgate Literary and Scientific Institution. Lecture and Demonstration.
"The Construction of a Valve Receiving Set," (Part I), by Mr. F. L. Hogg.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—Discussion on Direction Finding.

Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.—[ED.]

Experimental Station Design*

These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.

Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.

The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.

II.—THE EARTH.

THE aerial circuit is completed by a connection to earth or alternatively to what is known as a "lower capacity." The more general and by far the easier method is the former and is accomplished by running a piece of stout copper wire, say No. 18 S.W.G., to a water main. The length of this lead should be kept as short as possible, and it must take the shortest route to the point of earthing. A small turn or loop in the earth wire is particularly detrimental when receiving on short wavelengths. Should the water main be located at some distance from the instruments an endeavour should be made to run an insulated wire kept some distance away from the wall or metallic conductors. If this is done the length of the earth lead adds to the receiving efficiency by acting as additional aerial for the picking up of energy from the strains in the aether. This applies particularly if the operating room is situated at the top of a house, when the earth lead should be taken out of the window and kept away from the wall, either by a strut with

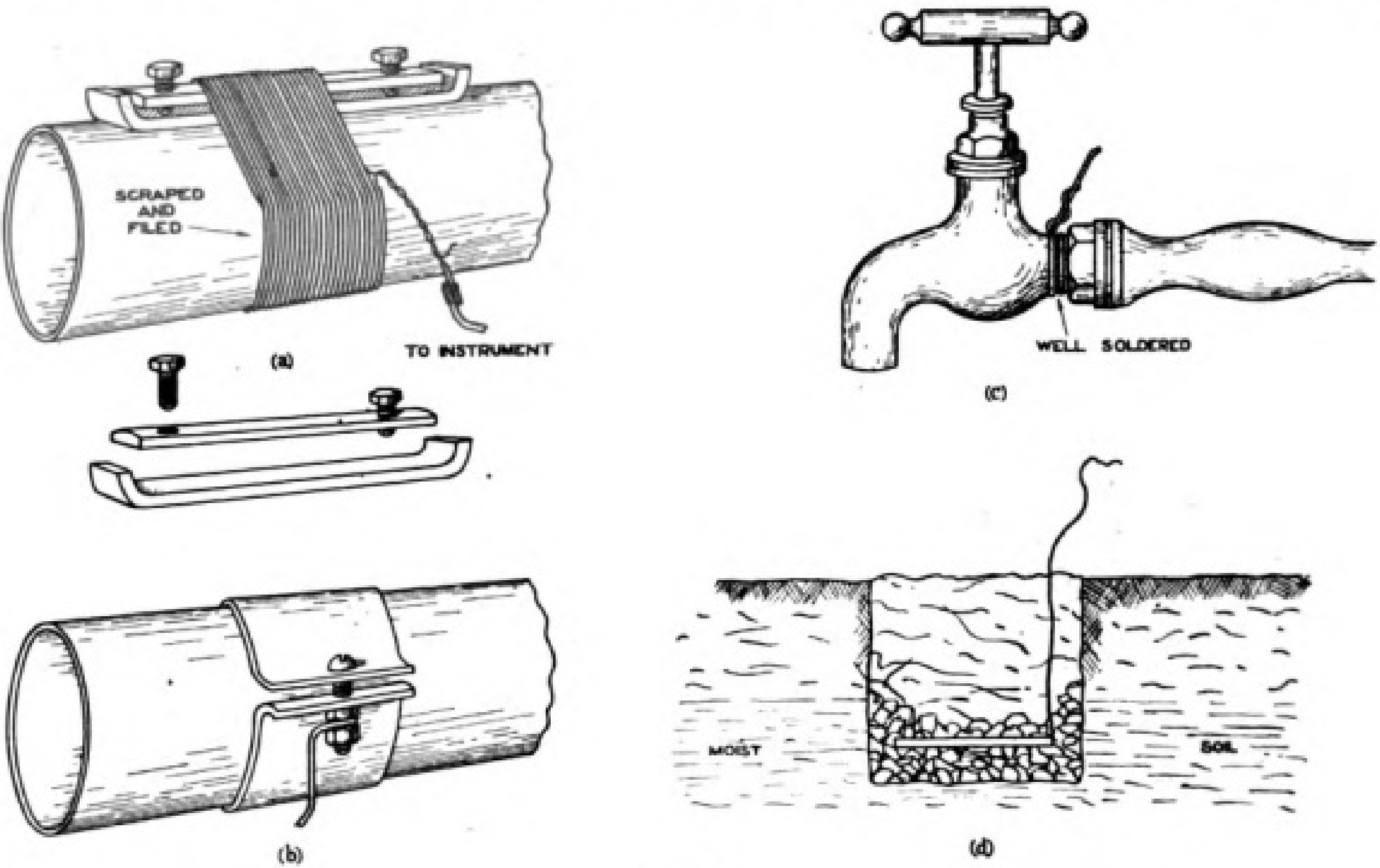


Fig. 1.

* The first article of this series, describing the construction of the aerial, will be found on page 259 of the issue of May 27th.

insulators or by making the earthing point some distance from the house and running a taut slanting wire. The reason for this, is because the wavelengths to which the receiver will tune depends upon the amount of wire in circuit in the aerial, instruments and earth lead, and should the earthing lead make contact with the earth on its way to the main point of earthing, the effective length of wire in circuit may be taken as a varying amount depending upon the point where the energy actually goes to earth. With short wave reception between 200 and 500 metres, small variations of the length of wire in circuit cause large changes in the wavelength to which the set is tuned and particularly is this the case when using an aerial of high capacity, such as one consisting of two wires and consequently the amount of wire in circuit must be definitely defined.

Various methods of making good electrical connection to water mains are shown in Fig. 1 (*a*) (*b*) and (*c*), and that embodying the use of two plates (*a*) with screw tightening is particularly recommended. Such an earthing clip can be seen on a telephone installation and is used for protecting the instruments from lightning and other high power electrical discharges. Before fixing any kind of clip, the pipe must be thoroughly cleaned either by scraping bright, if of lead, or by filing if it is of iron. Very reliable connection can be made by binding with clean copper wire and soldering, but this method is rather difficult unless a small blow lamp is available for raising the pipe to a sufficient temperature. A soldering iron is of very little use for the purpose, for the heat it slowly gives to the pipe is rapidly conducted away by the large amount of metal and the cold water. In using a pipe for earthing one must take the precaution of seeing that it is directly joined to the main and not through an intermediate cistern. If this is found to be the case the pipe may be used but a wire must also be run at the cistern, connecting the pipe to which connection has been made, across to the main supply pipe.

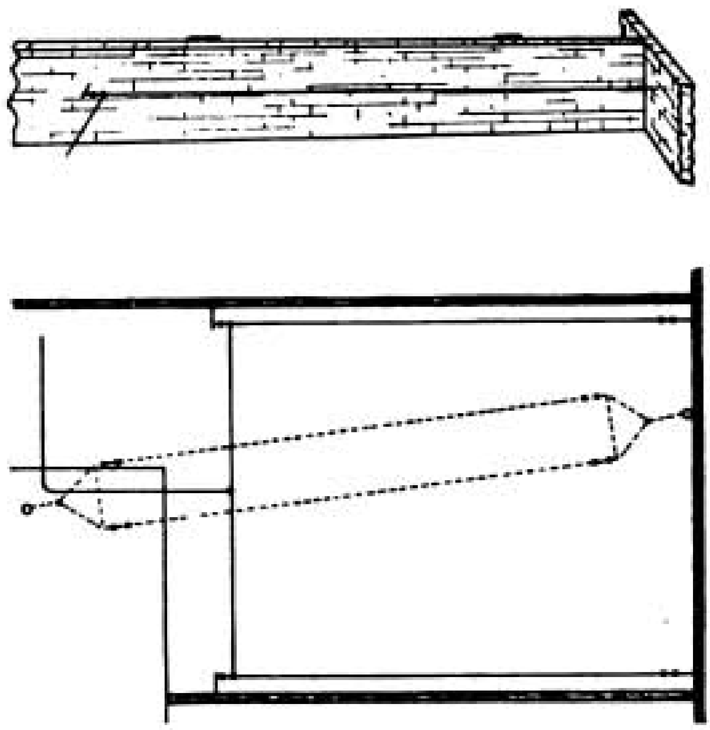


Fig. 2.

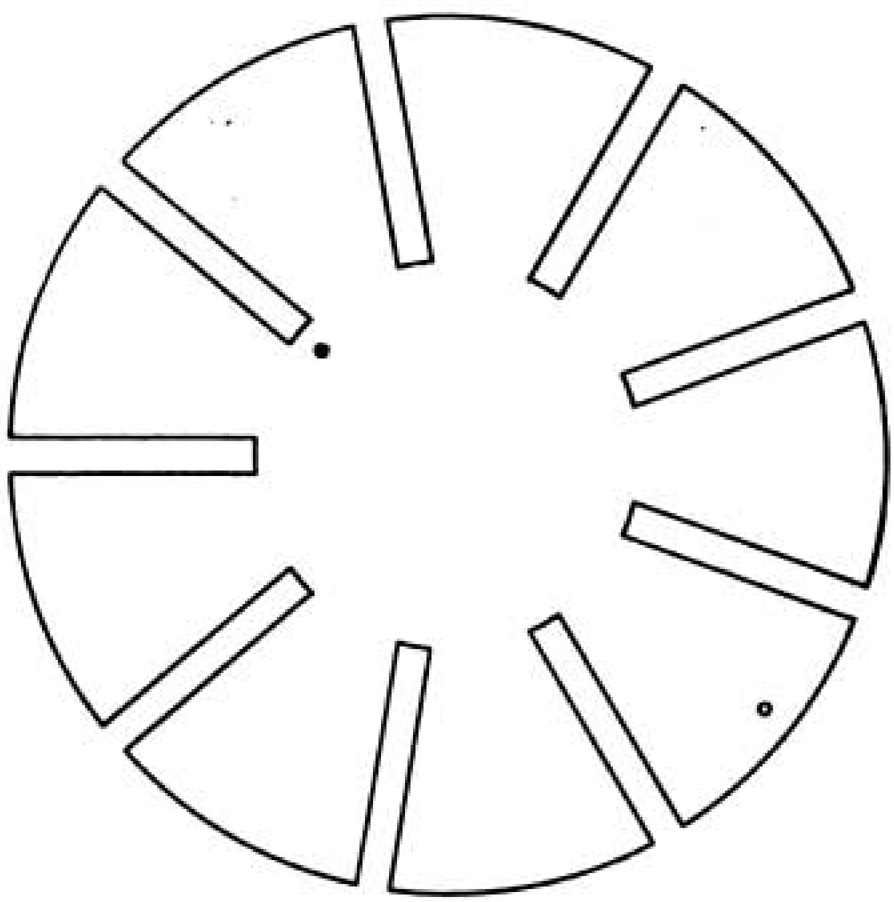


Fig 3.

C 2

Where no water main exists a good earth can be made by running a wire to a number of buried metal plates. A diagram of one of these plates is given in Fig. 1(*d*). A hole must be driven, if possible, down to wet soil, and thoroughly packed round with good clean coke. The plates may be of zinc, copper or even galvanised iron and the lead must make perfect electrical contact. The wire may be bolted to the plate to hold it mechanically and then soldered. For economy the earthing plates may consist of discarded galvanised iron household utensils, such as baths, dustbins, etc., but if so, the utmost care must be exercised to ensure that a good soldered joint is made to them. The plate is completely surrounded with coke before putting back the soil. Leads to the buried plate should not be of less gauge than No. 18 owing to their liability to damage and corrosion. If the soil is moist one plate 2 feet square will be sufficient, but in cases where it is dry several plates must be buried, spaced apart and connected together by wires of as near as possible equal length, the actual lead to the instruments being taken from the point where the plate wires join together. Where the soil is very dry, such as in gravel or sandy districts, what is known as a "lower capacity" may be found to give better results. This arrangement is shown in Fig. 2, and consists of two or more wires according to convenience, insulated and run beneath the aerial. The same class of wire of which the aerial is made should be used, and the same precautions taken with regard to ensuring good insulation. The lead in to the instruments may be of the same type as that used for bringing in the aerial wire. The diagram shows the wires attached to walls and this will be found particularly convenient as it offers support and protection. When a lower capacity consists of several wires they must all be equal in length and may either radiate out from a point in several directions or be arranged parallel to each other and the aerial. These instructions may seem elaborate but a reliable earthing system very materially adds to the efficiency and range of the station.

III.—SHORT WAVE TUNERS (150 to 450 metres).

The two designs given are of tuners specially suitable for the receptions of broadcasted telephony. In view of their simplicity it must not be thought that they are in any way inefficient or inferior to more elaborate designs and especially are they applicable when crystal detectors are employed. Even the experimenter, already in possession of an elaborate station, is well advised to make up a special set for the reception of broadcast in order that he may still pursue his experiments and yet always have a set in readiness to receive the short wave telephony. A simple tuner connected to a crystal detector can always be relied upon for telephony reception because it requires no batteries and portability may prove to be of advantage.

Many difficulties present themselves in the construction of tuners for short wavelengths, the greatest being due to the fact that the small amount of wire necessary to add in the aerial circuit for tuning, does not readily lend itself to the operation of

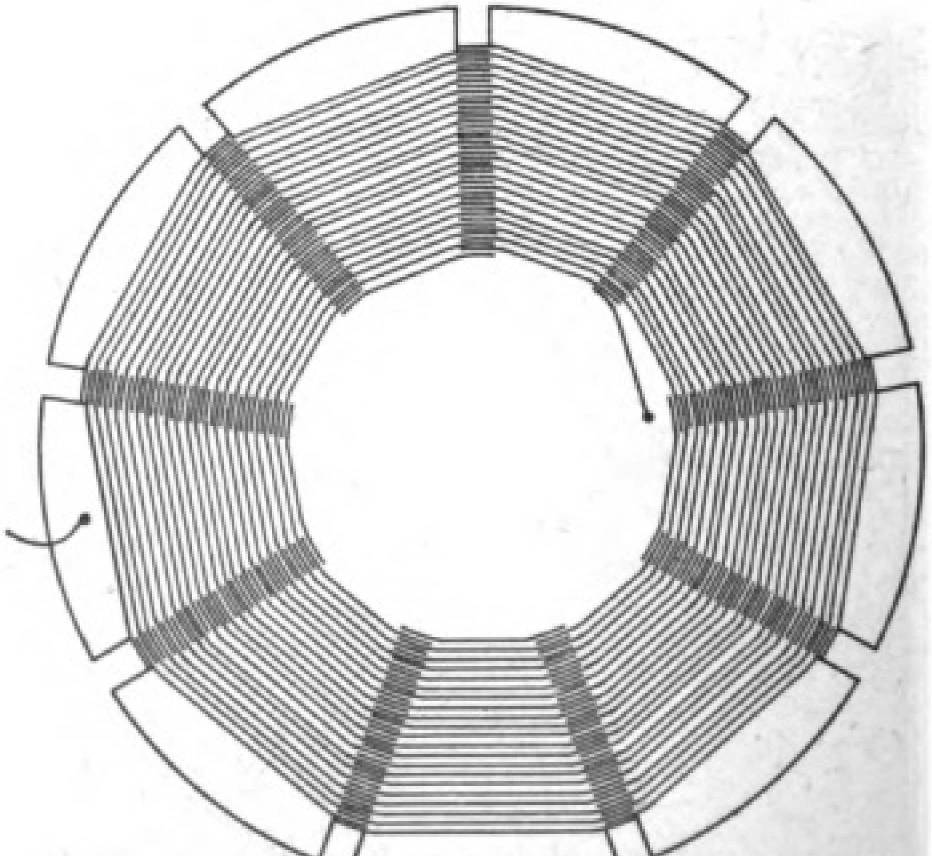


Fig. 4.

detecting devices. A very important detail in the reception of telephony is fine tuning adjustment. This is often achieved by the use of a variable condenser, but is by no means necessary, and apart from adding to the complications of the outfit, may even prove to be inefficient, and although sharp tuning is gained by its use, the loss of energy caused by the condenser may reduce the signal strength as compared with alternative methods.

The inductances in the first design consist of stiff cards wound with No. 28 single cotton covered wire or double silk-covered wire. In purchasing the wire, a quarter of a pound will be found ample and will leave enough over for connecting up and experimenting. The cards, not so tight that it distorts the card and bends it up basket-like. Correctly wound, the wire mentioned above will give about 44 turns, or as viewed from one side, 22. The finishing end is taken through a hole on the edge of one of the segments. The wire should be taken through cautiously to avoid tearing the card and bent back to keep the tension. Two such inductances are required. The wound cards are then placed in a moderately warm oven to drive out any minute traces of moisture the wire or cards may hav acquired during winding. After this they should be transferred to a bath of melted paraffin wax. They should be left in the wax during coolin until there is a sign that the wax is going to set

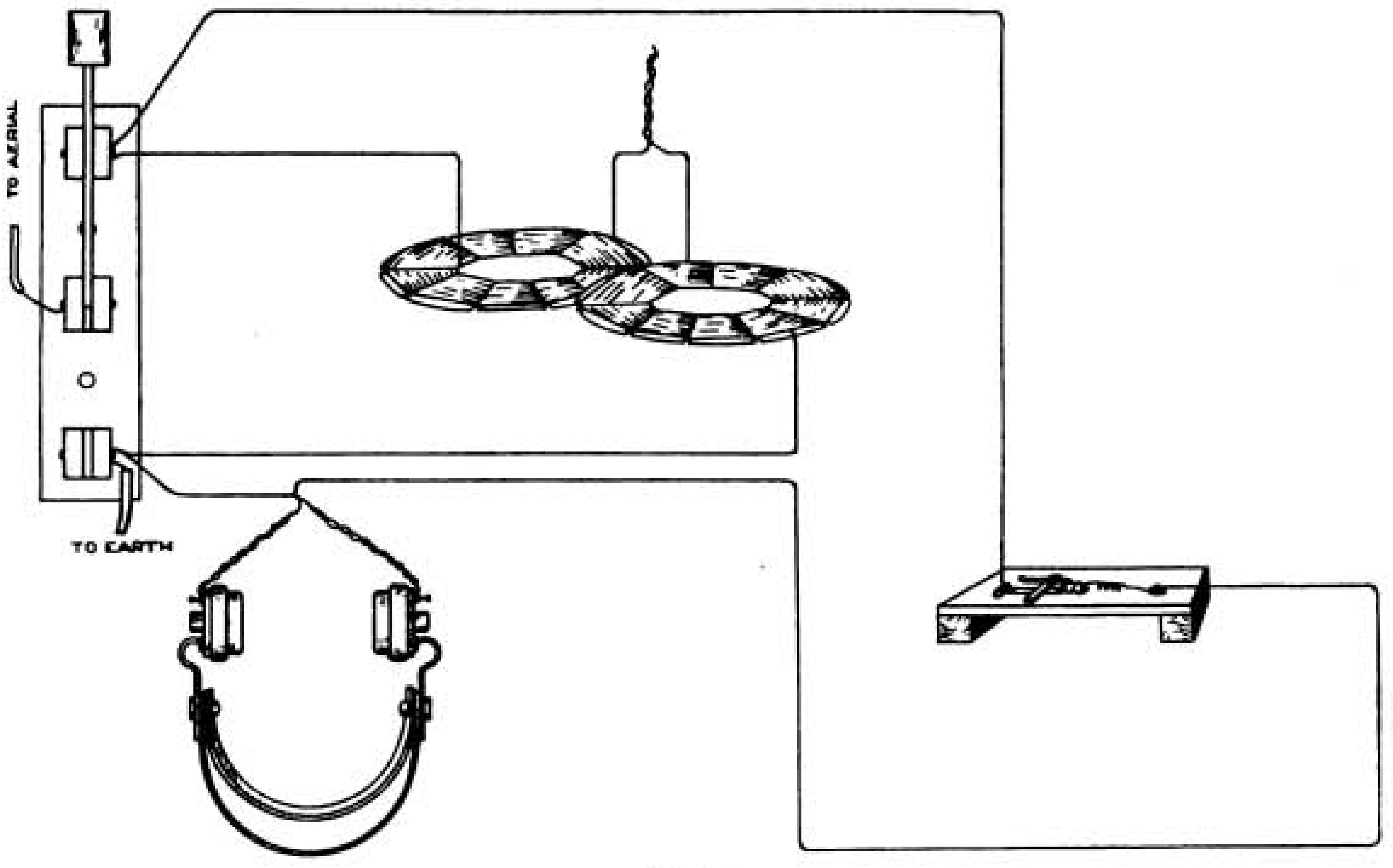


Fig. 5.

which may be made from ordinary postcards, must be very carefully cut to the exact dimensions shown in Fig. 3. This can be done by placing a postcard beneath the diagram and carefully pricking through at all corners. In cutting the slots great care must be taken that cuts are not made beyond the depth shown, or otherwise the segments produced by the cuts will become so weak that they are apt to break off when winding is commenced. Should one slot have been made, by accident, a little too deep the card should not be used, for the wire falling deeply into that slot will not build up evenly during winding. Winding is a simple process and requires little explanation. A glance at Fig. 4 showing a completed inductance will be sufficient. In passing the wire through the centre hole it should be sharply bent back to prevent it pulling through when beginning to wind. Pull the wire tightly during winding, but and then removed, pressed between two smooth flat boards and allowed to set hard.

The two coils connected in series as shown in Fig. 5 constitute the tuner. When placed over one another in one direction their magnetic fields oppose and their inductive values are very low, but when one is reversed the magnetic fields assist each other and the inductive effect is at a maximum, and by sliding them relative to one another intermediate values are obtained.

Another type of tuner which has gained a good deal of popularity in America for short wave crystal reception is that in which the inductance is wound on a cardboard or ebonite tube and connections taken from the wire to studded switches. Such a tuner may be more expensive to make, but possesses the advantage of giving a tuning adjustment that can easily be noted, and the switches can readily be set for the particular reception desired. As this is the only advantage gained by a more complicated arrangement, a brief description will suffice. For anyone making up this class of tuner with purchased switches, a good former on which to wind the wire is the small cardboard cylindrical box such as is used for packing upright gas mantles. This has an approximate external diameter of 1¾ in., and should be carefully wound with 90 turns of No. 26 double cotton-covered wire. It is necessary to dry out the cylinder by placing it in a warm oven before winding, as any subsequent drying will reduce the diameter and slacken the turns of wire. It should be treated in the same way as the inductances described above with regard to insulating by immersion in paraffin wax. Two ten-stud switches are suitable for varying the tuning and tappings must be made from every turn for the first ten turns, and on every ninth turn for the remainder. These tappings are made by tightly twisting up a short length of the wire as it is put on, leaving about 1½″ of twisted wire projecting for connecting up to the switches. Tappings stepping off nine turns are taken to one switch in order, and the single turn tappings are taken to the other switch. The two switch arms are the two terminals of the tuner. One switch will of course, provide for rough tuning, and the other having single turns of wire between its studs effect fine adjustment.

IV.—CRYSTAL DETECTOR.

One very simple form of crystal detector is that using contact between a piece of silicon and an iron wire. All that is required is a device to hold the crystal in position on a base to which is fixed the wire in the form of an easily bendable spiral and the actual construction of so simple a piece of apparatus can be left to the reader in order that he may make use of any fitments he may have to hand. Fig. 6 shows one way of making up this detector. It consists of a small base-board measuring 1½ins. by 2½ ins, which, in order to improve its insulating properties has been dried and immersed in melted paraffin wax. Struts connected across the bottom will serve to prevent warping,

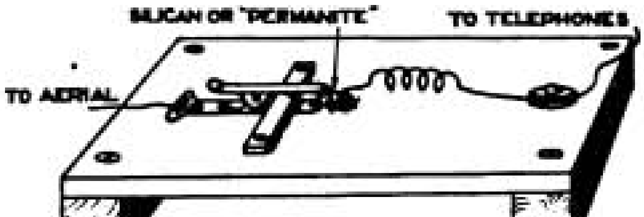


Fig. 6.

and also to keep the points of the screws driven into the top coming into contact with the table. A tie-clip is used for gripping the piece of silicon, and is held down securely by screws one of which may also be used as a terminal by twisting a piece of wire beneath it. The iron wire, bent into the shape shown in the diagram and held in position by a screw, is the other terminal, and carries a lead for connecting up.

There are many types of crystal detectors on the market, and for those who wish to purchase one, the perikon type can be well recommended. It may consist of a contact between zincite, a reddish looking substance, and copper pyrties, which has a greenish-yellow metallic appearance. Perikon is one of the most sensitive of detectors, and is easy to adjust as it requires a fairly heavy pressure when correctly set. Another type which is in general use is that consisting of a contact between a piece of carborundum and a steel spring. This kind of detector requires additional apparatus to render it sensitive, but is found incorporated in many well-known sets because of its remarkable stability.

V.—CIRCUIT AND OPERATION.

The method of connecting up the two slab inductances first described and the detector and telephones to the aerial and earth connections is seen on further reference to Fig. 5. Care must be taken to keep all leads away from one another and from contact with anything liable to reduce the insulation of the set. Terminals where fitted for convenience should be amply spaced. The telephone receivers must be of high-grade manufacture and only those of well-known makes should be adopted. Too much stress cannot be put upon the necessity for the use of efficient receivers, and this particularly applies when using a crystal detector. Each ear-piece should be wound to a resistance of from 2,000 to 4,000 ohms.

For operating the set the use of a buzzer for testing the sensitiveness of the crystal and ensure its correct setting, is practically essential, and a buzzer incorporated in a wavemeter, that is an instrument which will transmit feeble oscillations on a definite wavelength, is particularly useful, and the construction of such an instrument will be given in the next of this series of articles.

The tuning of the set is effected by moving the coils over one another, and their relative position controls the wavelength.

F.H.H.

Weather Forecasts for Farmers.

HOW AND WHERE TO OBTAIN THEM.

Weather forecasts for farmers are issued by the Meteorological Office, Air Ministry, Kingsway, London, W.C.2, during the hay and corn harvesting as follows:—

Regular Forecasts.—These are for the farmer who desires to have weather information daily. They can be telegraphed in the early morning, in the middle of the day, or about tea-time. They cover the next 24 hours. No charge is made except a registration fee of 1s., and the Post Office charge for telegraphy (the average cost of which is 1s. 3d. per message). Whenever a few days' settled weather is seen approaching, a message is sent out informing subscribers of the fact. A small charge of 6d. per message is made in this case in addition to the cost of the telegram. Full particulars will be supplied on application to the Director of the Meteorological Office, but forecasts will be sent on receipt of a request and a sum either in the form of a deposit of 7s. 6d. or sufficient to cover the total cost of the message asked for.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.
The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.

Ilford and District Radio Society.

At an informal meeting held on Thursday, May 18th, a somewhat novel procedure was adopted. The Chair was taken by the Secretary who, working in alphabetical order, called upon each member of the Society in turn to draw on the blackboard and explain the circuit he had adopted for reception at home.

Several of the newer members were at first a little embarrassed, but after a time confidence came, and many useful and novel circuits were shown, some of them for the first time. Naturally, there were a few of the standard self-heterodyne single valve circuits, but the majority were something more powerful.

The tuned anode—crystal rectification—circuit is apparently still the most popular, but it seems to be steadily losing ground to the reactance capacity circuit advocated by Commander Phillips in a recent discussion of the Wireless Society of London. This circuit with an additional high frequency valve coupled in a somewhat peculiar manner was given by Mr. A. E. Gregory, and the same member also submitted as a basis for experiment, a useful circuit for very short wave reception. An excellent idea was that of Mr. J. F. Payne, who uses two degrees of high frequency amplification before rectifying, the couplings being on the "plug-in" system. Different methods of coupling such as transformer, resistance capacity, reactance capacity or choke, are mounted on four-pin plugs, and thus without any complicated switching arrangements any method can be employed. Mr. F. C. Grover intimated that he was also using this circuit.

Probably the most useful circuit for Ilford—where nearly every house has D.C. mains laid on—was a device for using the mains as high tension supply, given by Mr. L. Vizard, where, by means of two carbons rotating, in a jar filled with water, between two others, any voltage from practically nothing up to the full two hundred, can be obtained according to the distance between the two sets of electrodes.

On Thursday, May 25th, the last meeting of our first year, Mr. L. Vizard lectured on "Continuous Wave and Telephony Transmission."

The excessively hot weather made lecturing extremely difficult but Mr. Vizard managed very well with the material at his disposal. He described briefly the struggles of the early pioneers with their attempts at modulating damped wave transmission by speech frequencies, and explained the great improvements that arose when the Poulsen arc system of continuous wave generation was discovered. The lecturer illustrated how a valve generates continuous oscillations, giving one or two simple circuits, and explained the principle of keying.

The next step in the evolution of the present-day radio-telephony transmitter was the use of a microphone for modulating the continuous stream of oscillations. Many different methods have been tried, such as inserting the microphone directly in the earth lead or coupling it to the A.T.I., but all these methods failed when used with high powers. A step-up transformer improved matters, and it was found that by using a microphone for varying the grid potential, large variations in plate current could be obtained. This method, known as grid control, is still largely used for short wave work. After reference to the choke control system, Mr. Vizard gave several useful circuits for experimenting with for obtaining quiescence, so that there is no radiation and consequent waste of power except when one is actually speaking. This would obviate the continuous carrier wave, the cause of so much interference. In conclusion he gave us a very interesting description of his own station, **2JX**, which is no doubt familiar to the majority of London amateurs.

Hon. Secretary, Mr. L. Vizard, 12, Seymour Gardens, Ilford.

Wireless and Experimental Association.*

A meeting of the above Association was held on Wednesday, May 17th, at the Central Hall, Peckham.

Various types of aerials were discussed, it being pointed out that a vertical wire should be ideal for transmission and reception, but that the nearest practical type of aerial would be the single wire kept as high as possible.

Suggestion was put forward by a member that a distinctive badge be worn, and the matter was held over for a committee meeting.

Preliminary arrangements were made for organising a public demonstration on wireless, and a committee was appointed to enquire into ways and means, and compile a working scheme to fulfil the requirements. Two candidates were admitted to membership, and we are looking forward to a big increase so as to more than maintain the reputation of being a decidedly live organisation. Special arrangements are being made for new members, especially beginners, who are invited to attend any of our meetings.

The meeting held on Wednesday, May 24th, at the Central Hall, Peckham, was, in the opening half, taken up by a discussion on the broadness of tuning when receiving telephony transmissions. The original query was, whether that effect were due to the amplitude of the modulation or to some other effect. The broadness of tuning of the transmissions of well-known stations affords an example, and the suggestion was put forward that it might be an effect due to the percentage modulation of the carrier wave. A very interesting half-hour was spent going well into this question, but there is still some more to be brought forward next week. The second half of the evening was an agreeable surprise as a four-valve unit panel receiver had been installed on the gallery of the main hall. Members were invited in turn to try their methods of tuning in, and many points were noticed regarding the peculiarities of the set in question. Music sent out by **2FQ** was received remarkably well on about 900 metres, provided the aerial inductance switch were making contact with two studs.

This was a good example of freak tuning. When the music stopped, the member listening in, reported that it had given place to Morse. On investigation, this proved to be friend **GBL**, and various comments were passed regarding the question of mistaken identity. Finding the meeting had overstepped its tune by half-an-hour, the meeting closed at 10.30 p.m. Prospective members are requested to communicate with the Assistant Secretary (Walter J. Joughin), 21, Troughton Road, Charlton, S.E.7.

Bradford Wireless Society.*

A meeting was held in the clubroom at 7.45 p.m. on Friday, May 19th, with Mr. W. C. Ramshaw in the chair. The minutes of the last meeting were read by the Secretary, following which a few new members were elected. The Chairman then called upon Mr. Whiteley to give his paper on "Radio Traffic and its Handling." In a very clear manner the methods of handling traffic were described and the lecture concluded with a demonstration of ship and shore working, in which the buzzer representing the ship station was operated by Mr. Burgess and the shore station by the lecturer himself. At the conclusion a hearty vote of thanks was passed.

Following the lecture a general discussion on the reception of short waves was opened, which was very much enjoyed by those present.

Please note that our Secretary, Mr. J. Bever, has now returned and that all communications regarding membership, etc., should be addressed to him.

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

Southampton and District Wireless Society.*

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A General Meeting of the above Society was held at its headquarters on Wednesday last, May 17th, a good attendance of members made an enjoyable evening. The discussion for the evening (variable and fixed condensers) following various makes of valves, which was loaned by Mr. Stockdale for the occasion, proved very interesting. It was announced at the conclusion of the discussion that a public demonstration would be given on the following Wednesday. A Burndept Ultra IV, kindly loaned by the Crays Installations, and demonstrated by Capt. Young, A.M.I.E.E., was to be used for the occasion, and an interesting evening is being looked forward to.

The Wireless Society of East Dorsetshire.

Hon. Secretary, Mr. E. T. Chapman, Associate I.R.E., Abbotsford, Poole.

A meeting with an elementary lecture on receiving circuits and apparatus was held in the Wimborne School, on May 18th.

The new concession of the Postmaster-General, *vide* speech by Sir Henry Norman in the House of Commons on May 4th, of unrestricted lengths of receiving aerials was exploited, but found to be of little advantage in view of the short wavelengths to be used by broadcasting stations, although there were several appreciable advantages.

An aerial is to be erected at the Wimborne School and members wishing to try their apparatus will be able to do so on meeting nights.

Members and enthusiasts in the Poole, Parkstone and Branksome districts are informed that a special meeting and demonstration will be held in Branksome Liberal Club (headquarters *pro tem.*), on Thursday, June 1st.

Further particulars from the Secretary who will be pleased to receive prospective members at Serpentine Road.

Romford Wireless Society.

Hon. Secretary, Dr. E. H. Chapman, 32, Meadway, Gidea Park, Romford.

The Romford Wireless and Scientific Society has recently been established in connection with the Red Triangle Community Centre, North Street, Romford. The Society has its headquarters at the Community Centre and masts for a twin aerial have already been erected. It is hoped to install an elaborate set of instruments for reception of wireless concerts in the near future. Morse code classes are in being, and are meeting weekly. During the summer months the Society will prepare for a big winter programme of technical classes and popular concerts. The enthusiasm of the initial members is well shown by the well-planned wireless exhibition and demonstration to be given at the Romford Sports and Fete on Whit-Monday.

Officers elected:—President, Major Castellan; Chairman, Mr. T. England; Hon. Secretary, Mr. E. H. Chapman, M.A., D.Sc.; Hon. Treasurer, Mr. H. Bristowe; Assistant Hon. Secretary and Treasurer, Mr. W. Evans.

A limited number of new members will shortly be elected. New members possessing working sets will be especially welcome.

Liverpool Wireless Society.

A meeting of the Liverpool Wireless Society was held at the Royal Institution, Colquit Street, on May 11th last, when Messrs. Robinson and Forshaw gave us the benefit of a very pleasant evening and demonstration in recording. Signals were received by Mr. Robinson on his apparatus, and were recorded by Mr. Forshaw by means of his relay and recorder. Carnarvon and similar high speed stations being successfully copied.

Mr. Coulton presided and proposed a hearty vote of thanks, which was carried with applause.

An attempt was made to get the *Daily Mail* broadcast of the fight result, but although a few words were heard, nothing satisfactory was received.

A special meeting of the Committee was held on May 23rd last, and it was decided that junior members under the age of 18 be admitted half-price, *i.e.*, 5s. This was also to apply to apprentices serving their time up to 21 and under certain circumstances, students.

It was also decided, in view of the great advance in amateur wireless, to recommend the members to pass a resolution to the effect that the Society remain open through the three months we generally close down. This was done, and we hope all the members will support us in the matter.

It was also decided that half-an-hour before every meeting there should be a lecture for beginners who know little or nothing about wireless. This meeting will take place therefore every evening before the main lecture, namely, at 7.30.

On May 24th the Society met and decided to postpone the meeting of June 1st until June 8th, in view of the sudden change in the programme for the summer months.

The Chairman, Mr. Grindrod, then introduced Dr. S. S. Richardson, who read a paper entitled "Some Things Worth Trying," and illustrated his remarks with numerous drawings.

This was much appreciated, and a vote of thanks was carried with applause. The evening concluded with a musical demonstration received by Mr. Lowey on his splendid home-made set, which was greatly appreciated by everyone.

Hon. Secretary, James K. Wilkie, "Avondale," Knowsley Road, Cressington Park, Liverpool.

Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

During the past two months several interesting lectures have been given by Mr. L. Grinstead and Mr. F. L. Hogg, and also an excellent demonstration of transmitting and receiving apparatus by Lieut. H. Walker. The Society's three-valve receiving set is now completed and is giving excellent results.

A series of elementary theoretical and constructional lectures and demonstrations have been arranged, the theoretical side being undertaken by Mr. J. Stanley, and the constructional side by Mr. F. L. Hogg, and one or two other lectures on special aspects of wireless theory and construction by other speakers will also be included in the series. These lectures will commence on Friday, June 9th, and we invite all amateurs in the district who are interested to be present at the first lecture of the series.

A field day has been arranged for June 24th, and it is hoped that permission will be obtained to hold this in Ken Wood. A licence for a portable transmitting and receiving set is being applied for for this occasion.

An advisory committee has been instituted, consisting of experienced members of the Society, to advise and help members who are in any difficulties with their sets.

The Secretary will be very pleased to receive enquiries regarding the Society from amateurs or others interested in wireless matters in Highgate or the surrounding districts, and to give further particulars of the lectures now being arranged.

The Willesdon Wireless Society.*

Enquiries for membership, etc., to Mr. F. A. Tuck, 87, Mayo Road, Willesden, N.W.10.

The Society met on the 23rd at their Headquarters, 25, Station Road, Willesden Junction, N.W.10, when an open meeting was held, Mr. W. Corsham giving an impromptu lecture upon short wave reception until the lecturer for the evening Mr. C. Dunham, arrived with his gear, consisting of a four-valve receiver, one H.F., one rectifier and two low frequency, a crystal set being also included in the same box. Several new members were present, and despite the heat, the attendance was fairly good. The meeting closed at 10.30 p.m.

The West London Wireless and Experimental Association.*

Club-rooms, Belmont Road Schools, Chiswick, W.4.

Hon. Secretary, Mr. Horace W. Cotton, 19, Busbey Road, Harlington, Middlesex.

Meeting held Thursday evening, May 18th. A very well attended meeting listened to our Vice-President, Mr. F. E. Studt, who gave a very interesting paper on the Reinartz Tuner. He also exhibited one that he had constructed for the purpose of his lecture, and great interest was taken in the small details which were so fully and ably explained.

A very hearty vote of thanks was accorded the lecturer when he had concluded.

It is undoubtedly encouraging to the various amateur societies and associations to see the great strides about to be taken in the science of wireless telephony, and applications for membership to these will no doubt pour in thick and fast now the P.M.G. has withdrawn many of the restriction which somewhat tied the hands of the would-be experimenter, and it is sincerely hoped that now with more liberty the amateur experimenters will make it a special business to see that they do not take any liberties with the concessions now or shortly to be placed in their way.

Radio Experimental Association (Nottingham and District).

Hon. Secretary, Mr. F. E. Bailey, 157, Trent Boulevard, West Bridgford, Notts.

A General Meeting of the above Association was held on Thursday evening, May 11th, Room 74, Mechanics Institute, Nottingham.

Mr. D. F. Robinson provided the bill of fare on this occasion when he demonstrated his five-valve amplifier set. Mr. Robinson gave a detailed explanation of all the component parts, and the way in which the set was constructed was very creditable indeed. An indoor aerial was erected, but unfortunately no signals were obtained,- with the exception of one ship, which was very weak. We put this failure down to the fact that our room is greatly surrounded by buildings and the maze of telephone wires which exist round the Mechanics Hall. In view, therefore, of the failure, we made the best of a bad job, and listened intently to Mr. Robinson's explanations of his set.

Particulars of the Association may be had on application to the Secretary.

Hounslow and District Wireless Society.*

The above Society continues to make good progress and in view of the boom in the press on broadcasting, we hope to do better. At the last meeting, on May 18th, a very interesting lecture was given by Mr. Gordon Fryer, L.D.S., R.C.S.Engl., our Vice-Chairman, entitled "The Elementary Theory of the Valve." Mr. Fryer delivered his lecture in a very able manner, showing he knew his subject well. We hope to have more papers of this kind in the future.

Hon. Secretary, Mr. A. J. Rolfe, 20, Standard Road, Hounslow.

The Sussex Wireless Research Society* and The Brighton Radio Society.*

Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton.

At a recent joint meeting of the above Societies, a most interesting paper was read by Mr. W. E. Dingle, President of the Brighton Radio Society, entitled "The Construction of a Submarine Cable," during the course of which the lecturer described the various processes and shops through which such a cable must pass before it is ultimately consigned to the bed of the ocean where it is required to fulfil its duty as a link of communication between this and distant countries for many years. Specimens of submarine cables kindly loaned by Messrs. Siemens, Bros. & Co., Ltd., of Woolwich, were passed to the members for inspection. These included a portion of the first Atlantic Cable which was successfully laid in August, 1858.

At the close of the lecture a short discussion ensued and Captain E. A. Hoghton concluded a very pleasant evening by proposing a vote of thanks to the lecturer. This was seconded by Mr. James Cowie and carried unanimously.

The ever-increasing popularity of Wireless in the vicinity of Brighton is well marked by the good attendance at these Societies' meetings, and it is pleasing to note that fresh faces join the throng at every meeting.

The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

At the meeting of the Society held on May 25th, Mr. F. Corfield lectured the members on the "Construction and Maintenance of Primary and Secondary Batteries." The lecture was well received and a hearty vote of thanks was passed to the speaker.

The usual "Question and Answer" period was opened after the lecture; many questions regarding wireless and kindred subjects being asked and answered by the members present.

This item will be included in the agenda of every meeting, and all members are invited to submit their troubles and difficulties to the Society.

It is intended to hold field meetings shortly, and the Hon. Secretary will be pleased to receive suggestions.

Wolverhampton and District Wireless Society.

A General Meeting of the above-named Society was held at 26, King Street, Wolverhampton, on Tuesday evening, May 23rd. After buzzer practice, at 8 o'clock, a lecture was delivered by Mr. Blakemore, A.M.I.E.E., on "The Thermionic Valve." The lecturer, who is very thorough and painstaking, illustrated his remarks by means of vacuum tubes and special drawings, giving the members much food for thought. This lecture was the second of three by Mr. Blakemore, which the Society have been fortunate in booking. The third will be "Electrical Terms and their Meanings," and will be delivered after buzzer practice on Tuesday, June 13th, at 8 p.m. not June 6th, as previously announced. Will members please note Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

Sutton and District Wireless Society.

A meeting of the Society is held every Thursday (8.0 p.m.) at the Adult School, Benhill Avenue, Sutton, and all who are interested are invited to come along. The entrance fee is 2s. 6d. with a 10s. annual subscription.

At the meeting on Thursday, 25th inst., one of the members, Mr. W. H. Norvill, gave a paper on "The Theory and Operation of the Valve."

As soon as we get our licence down we hope to start work in earnest.

Hon. Secretary, Mr. E. A. Pywell, "Stanley Lodge," Rosebery Road Cheam, Surrey.

Walthamstow Amateur Radio Club.

Hon. Secretary, Mr. R. H. Cook, 49, Ulverston Road, E.17.

The above Club is held at the Y.M.C.A., Church Hill, every Wednesday, at 7.30 p.m.

A programme has been arranged as follows:—7.30-8, free discussion; 8-8.30, club business and buzzer practice; 8.30, lecture followed by listening in.

On Wednesday, May 24th, the Hon. Secretary gave a lecture on "Electrical Measuring Instruments," and he has been requested to continue on the subject at an early opportunity.

The Club has decided to help at local fêtes, etc., by giving wireless exhibitions, and as they are able to receive very good telephony it will no doubt prove a success.

Recently our members wanted to dance to the music, but owing to the room being very full they had to give it up.

The Club will be pleased to welcome new members.

Pontypridd and District Wireless Society.

An Inaugural Meeting was held on Thursday, May 25th, at the Y.M.C.A., Pontypridd, when it was unanimously decided to form a society under the above name. The following officers were elected to hold office for 12 months:—President, G. J. Evans, Esq.; Vice-President, Mr. Billing; Hon. Secretary and Treasurer, Mr. D. V. Briggs; Committee, Messrs. J. Reilly, E. C. Bayliss, Dan Davies, W. James, N. Nevies.

It was decided to hold meetings on Tuesday evenings, that day being the most suitable. Any persons interested and needing further particulars may obtain same from Hon. Secretary and Treasurer, 5, Llwynmadoc Street, Pontypridd, Glam.

The Newport I.W., Carisbrooke and District Radio Society.

A wireless society has been formed with a membership of well over 30, and the following officials have been appointed:—President, the Rev. W. H. Mackinnon; Vice-Presidents, Messrs. E. Munden (Mayor of Newport, I.W.), S. J. Jackson (Postmaster), T. Turley, and J. H. Linington; Hon. Secretary, Mr. S. O. Feben; Treasurer, Miss E. Read; Committee, Messrs. G. S. Harris (Chairman), L. Norman, A. Long, Fry and Tyler; Auditors, Mr. G. Yelf and Mr. L. F. Salter.

The Hon. Secretary's address is Meadowside, Priory Road, Carisbrooke, and he will be pleased to hear from any intending members. Steps are being taken to affiliate to the Wireless Society of London.

In connection with this Society an interesting lecture was given by Mr. L. Norman on "Crystal Sets and their Construction," May 3rd.

With the aid of diagrams he clearly explained the construction and advocated the use of either carborundum or zincite-bornite for best results. Of the sensitive forms of crystals he considered "Permanite" as the most constant. The lecture was thoroughly enjoyed by the members, and questions were asked and ably answered.

On a proposition by Mr. J. H. Linington, the Chairman, a hearty vote of thanks was accorded to the lecturer, which was duly seconded and carried with acclamation.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only; Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"D.R." (Doncaster) *refers to reply given to* **"INTERESTED" (Walford),** *page 59, April 8th issue, and asks (1) For diagram showing the connection of parts recommended. (2) The values of grid condenser and leak. (3) For the name of a practical book on wireless.*

(1) The apparatus may be arranged as shown in diagram (Fig. 1). (2) The best values depend upon the type of valve used, but the following will generally be satisfactory: grid condenser 0·0003 mfd. and leak 2 megohms. (3) "The Construction of Amateur Valve Stations," by Alan Douglas (1s. 6d.), The Wireless Press.

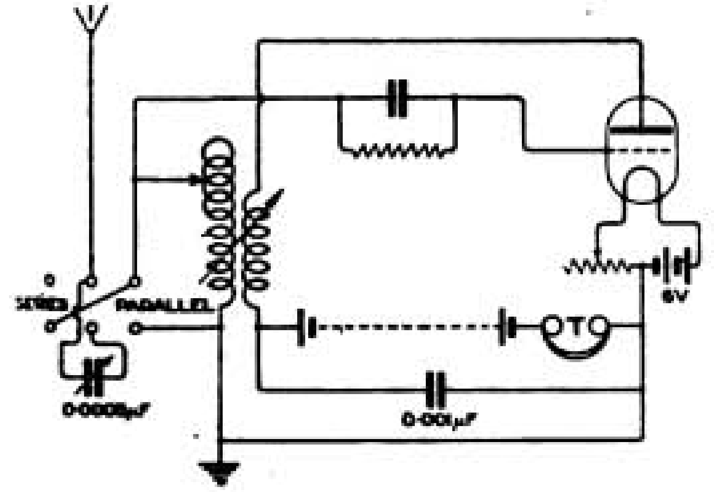


Fig. 1.

"E.R.B.R." (Birmingham) *asks questions regarding a crystal set.*

Both your diagrams are incorrect. Arrange circuit as shown in Fig. 3, page 60, April 8th issue. You will then probably hear **2MT** and Croydon weakly. A stage of H.F. magnification will greatly increase the usefulness, as shown in Fig. 4, page 61, of the same issue, in which use is made of the crystal, as shown in diagram given to **"D.R." (Doncaster)**, above.

"H.E." (Newark) *asks (1) Whether to add a H.F. or L.F. magnifying valve to an existing set, which consists of valve magnifier with crystal detector. (2) If reactance capacity coupling may be used. (3) Amount of wire to wind on telephone transformer to convert to an intervalve one.*

(1) It will be easiest and probably most effective to add a L.F. magnifier. Connect primary of inter-valve transformer to existing telephone terminals and secondary to grid and negative side of filament. (2) Yes, if a H.F. valve is added this method of coupling may be tried. (3) About 4 ozs. of No. 44 S.W.S. wire will be required.

"J.A." (Lydd) *asks questions regarding a single-valve set.*

The circuit shown in your diagram will not be very good for telephony unless you can manage to insert a reaction coil. If the A.T.I. is solid, make a reaction coil to slide over it. The grid condenser should be 0·0003 mfd. A variable condenser in the aerial circuit will be a great improvement and is necessary for fine tuning.

"D.R.E." (Sheffield) *refers to reply to* **"H.C.S." (Putney),** *page 709, February 4th issue, and asks (1) Capacity of variable condenser to use with windings given. (2) Which would give the better results on 30 volts H.T., "R" valves or "Ora." (3) Resistance of Brown telephones to use with telephone transformer. (4) Best direction of aerial.*

(1) 0·0005 mfds. (2) The "Ora" valves will probably be more suitable for use with 30 volts. (3) 120 ohm total resistance. (4) Your diagram gives no information to guide us. There appears to be no reason why it should not run in either direction.

"T.L.A." (Acton) *has a single-valve set which does not give satisfactory results.*

No particulars of set are given, so that we cannot say if properly proportioned. The grid leak is rather high at 2 megohms, and we suspect this is the cause of the trouble. The hum is caused by induction from lighting mains, and is usually heard when there is a break in the grid circuit. Try a new leak. Connect a 0·001 mfd. condenser across the 4,000 ohm transformer winding in the anode circuit. The aerial should be satisfactory.

"F.E.W." (Hampstead) *asks (1) If sample of wire is suitable for aerial. (2) Issues in which single-valve set is required.*

(1) This will not be very suitable, because it is a copper wire surrounded by a number of strands of iron wire. The presence of this would greatly increase the losses in the copper aerial. (2) February 5th, March 5th and 19th, 1921 issues.

"C.E.L." (Finchley) *asks questions regarding crystal set.*

No. 30 wire is much too fine for a crystal set aerial circuit. Re-wind the former with No. 24 wire. The maximum wavelength will then be about 3,000 metres. The circuit shown is correct, except that the crystal battery is not right. The correct connection of a potentiometer is shown in Fig. 2, page 59, April 8th issue. The variable condenser might be 0·0003 mfd. For telephone transformer use about 6 ozs. of No. 36 wire for the primary and 6 ozs. of No. 32 for the telephone winding. You should hear ship stations Eiffel Tower and **2MT** and Croydon telephony.

"C.F.H.C." (Surbiton).—Steel wire is useless for aerials. Use copper. Brown's 4,000 ohm telephones do not require a transformer. Condensers made of tinfoil or copper coil are equally efficient, and have equal capacity for same number of plates and thickness of dielectric, but tinfoil is very fragile.

"F.A.L.S." (Alton) *refers to "Work" 5-valve amplifier, and asks if 120 ohm telephones may be used without structural alterations.*

If this set has a telephone transformer these telephones may be used, otherwise an external one must be provided.

"BERTIE CLAQUE" (I.O.M.) *asks* (1) *If aerial shown will do for valve sets.* (2) *Can "R" valves be used for H.F. magnifier.* (3) *Will a single-valve set receive Marconi Concerts.* (4) *Is circuit shown suitable.*

(1) This seems a very poor aerial. For effective work it should be made considerably longer and the end farthest from the house raised. (2) Yes. (3) With a carefully designed set and a larger aerial you might possibly just hear it. You will probably hear the Harbour telephone set at Liverpool. (4) Yes, if a 0·001 mfd. condenser is connected across the telephones.

"A.H." (Gospel Oak) *asks for a crystal diagram, using two-slide tuning inductance and condenser.*

Arrange apparatus as shown in diagram given to **"L.H." (Mansfield)** opposite. This also shows how a L.F. valve magnifier may be added.

"CURIOUS" (Manchester) *asks* (1) *and* (2) *About using Sac Leclanche or Daniell cells for lighting one valve filament.* (3) *What days and times does* **PCGG** *transmit telephony.*

(1) and (2) A continuous discharger of 0·7 ampere is rather heavy for this type of cell. We do not advise their use except for H.T. batteries. (3) Regular transmissions are made each Sunday from 2 p.m. to 5 p.m. B.S.T. on approximately 1,050 metres. Occasionally there are transmissions on weekday evenings.

"O.K." (Lytham) *has a two-valve H.F. transformer coupled set to which he desires to add two more valves, and if possible to use a loud speaker.*

We suggest you use the circuit given to **"B.D." (Leeds)**, in which case you will have added one H.F. and one L.F. valve. **PCGG** should be very loud on this set. Signals should be sufficiently strong to operate the loud speaker satisfactorily.

"FRAME" (Dundee) *refers to page 37, April 8th issue, and asks what alterations to make to use with a frame aerial.*

A four-valve frame aerial diagram is given to **"W.D." (Huddersfield)**, (June 3rd issue), and this will probably be quite suitable for your purpose. It will give better results than the set to which you refer. The frame should be about 5′ square, wound with about 30 turns.

"L.H." (Mansfield).—As you are inexperienced in the use of valves, the simplest way to add one to your crystal set is as a L.F. magnifier. A diagram (Fig. 2) showing how to do this is given. The voltage required will be 30 to 50 volts of dry cells for the plate, with a 6-volt accumulator for the filament.

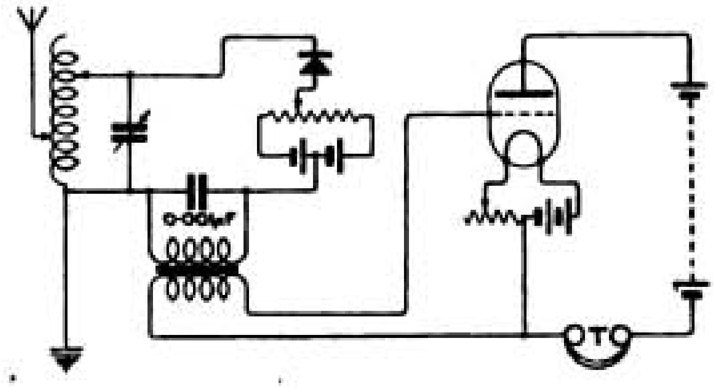


Fig. 2.

"A.S." (Stockport) *asks for particulars of telephone transformer for 120 ohm telephones.*

For this soft iron wire core, about ¼″ diameter and 2½″ long, together with 3 ozs. of No. 44 and 6 ozs. of No. 32 wire, will be required. Cover the core with a layer of tape, and wind on the fine wire in layers. Cover this winding with two or three layers of thin paper and wind on the thick wire in layers. The telephones should be connected to thick wire winding.

"SIGNALS" (Bradford-on-Avon) *asks* (1) *For condenser values of circuit, shown in Fig. 4, page 202, June 25th issue, 1921.* (2) *Refers to circuit, page 47, April 8th issue.* (3) *For criticism of two-valve set.* (4) *Which is the more efficient of two types of H.F. transformer.*

(1) The suitable values may be C.1 0·0005 mfd., C.2 0·0002 mfd., C.3 0·0002 mfd., C.4 0·0002 mfd. Telephone condenser 0·001 mfd., H.T. condenser 0·05 mfd. Grid leak, 2 megohms; potentiometer winding, 300 ohms. (2) This is given as a special circuit and, as the diagram agrees with the letterpress, we see no reason why it should not work satisfactorily. It is very probable that the insulation of the 0·004 mfd. condenser plays an important part. (3) This is quite an ordinary circuit and should be satisfactory if the proportions of A.T.I. and reaction are correct. (4) We do not care to say, as we have not tried these. In all probability separate transformers are slightly better.

"AMATEUR" (Stoke-on-Trent) *asks for criticism of aerial which does not give very good results.*

This appears to be a very good aerial, and unless the insulation is bad should be quite satisfactory. The receiver circuit, about which you give no information, is probably at fault. Write again, giving diagram of circuit and particulars of coils.

"W.H.W." (Lancashire) *has a two-valve set on which telephony is only weak. He asks for criticism of set and aerial.*

We think the aerial would be better if the lead-in was taken at the point B, giving a straight drop to the receiver. We do not think that a resistance capacity valve will work satisfactorily with two other valves, which are transformer coupled, and suggest that you add a third valve as note magnifier. We do not think you are doing badly to hear Croydon, as the existing H.F. transformer may not be most efficient at this wavelength.

"R.M.S.K." (Manchester).—If your inductance coil has only 8 tappings it will be advisable to connect the condenser in the lead from the aerial to the inductance for tuning between the studs. However, you might try connecting it across the inductance, as shown in Fig. 4, December 10th issue. To apply a battery to the silicon detector it will be necessary to have a potentiometer so that the potential on the crystal may be correctly adjusted. For leading-in wire use the same as for the aerial, and if possible have one long unbroken length for aerial and lead-in.

"AERIAL" (Southgate) *asks* (1) *How to eliminate buzzing from A.C. mains in a crystal set.* (2) *Which is the most sensitive crystal combination to use.* (3) *Criticism of circuit, and how many foils for blocking condenser.* (4) *Maximum wavelength, with a given size former.*

(1) The buzzing indicates a break in the crystal and telephone circuit. Trace connections and examine all joints. (2) Carborundum is the most stable crystal, but sometimes combinations such as zincite-bornite, or gelena steel point detectors are found to be more sensitive. (3) This is a normal elementary circuit. The condenser should have about 6 foils and its value would be about 0·001 mfd. (4) The maximum wavelength with No. 28 wire would be about 3,000 metres. This wire is too fine for an aerial circuit, which should not be wound with a wire finer than No. 24.

"A.T. (Windsor) *gives a circuit diagram, and wishes to know* (1) *The amount of wire required for the making of suitable basket coils for the set.* (2) *If the diagram is correct.* (3) *Asks for diagram of a three-valve circuit.*

(1) Without knowing the wavelengths, range and aerial dimensions, it is not possible to give definite details, but 20 basket coils of 2¼" hole by 4" full diameter wound with No. 26 D.C.C. will probably tune your aerial circuit through the full range of wavelengths. Make the reaction circuit of 18 coils of the same dimensions as above, except for using No. 34 S.S.C. Take one coil of each circuit and arrange near together to provide for reaction. (2) Do not put a variable condenser in series with your H.T. battery. Join the H.T. minus to the filament circuit. You have omitted the lead from the L.T. minus to the earth end of the aerial circuit. Connect a small blocking condenser 0·001 mfds. across the telephone receivers. (3) See amplifier circuit, April 8th issue, page 37, for diagram and details of a good three-valve circuit.

"D.P." (Sunderland) *asks* (1) *For a method of adding "Ora" valve to his present circuit for use as an amplifier.* (2) *Connections for converting crystal to a single-valve set.* (3) *If a reaction coupler can be arranged without placing coils inside aerial circuit.* (4) *Particulars of reaction coil.*

(1) and (2) Connect intervalve transformer in place of telephones and connect up a secondary as shown in the right-hand portion of Fig. 8, page 100, April 22nd issue. It would be much better to adopt one of the usual single-valve receiver circuits, using your crystal, if you like, for the purpose of rectification. See page 140, April 29th issue, also circuit Fig. 5, page 140, April 22nd issue. (3) Make a small slab coil and connect in series in your aerial circuit, using a similar coil placed over it for the purpose of reaction. (4) Windings depend upon wavelengths required, but by tight coupling your two slab coils you can keep on adding wire when once you have found the approximate wavelength the circuit gives. It is regretted that definite information as to windings of tuning coils cannot be given, as they depend so much on the remainder of the tuning equipment.

"ZENITH" (Liverpool) *asks* (1) *Which of two aerials to adopt, and whether he might make his leads in spiral form owing to their shortness.* (2) *Which is the better valve to use for telephony, "Ora" or "R," and which is the best all-round valve.* (3) *The maximum receiving range for a single-valve set with Burndept coils.*

(1) Owing to the shortness of your aerial adopt the two-wire type. Do not wind spirally. (2) Both quite suitable for general telephony reception. Many types of valves are designed for specific purposes. (3) Range of reception depends as much upon the power of the transmitter as upon the type of receiver. British experimenters report reception on the high-power American stations on single-valve receiving outfits. The reception of **2MT** on a single valve by you in Liverpool is quite good.

"EXPERIMENTER" (Liverpool) *wishes to construct a portable aerial, 3' × 2' × 2", and asks for windings.*

For wavelengths up to 2,500 metres wind with 100 turns of No. 30 D.C. and arrange for tappings at 10, 20, 35, 60 and 100 turns. For longer wavelengths you will have to use a two-pile winding.

"F.T." (Southwell).—Your circuit is quite correct. (2) Condenser "a," 0·0005 mfds.; "b," 0·0015 mfds.; "c," 0·001 mfds.; "d," 0·1 to 2 mfds. (3) Grid condenser and leak of correct values to suit your valve will improve results. (4) Quite suitable for the reception of **PCGG**.

"OPTIMIST" (Forest Hill) (1) *and* (2) *submits crystal circuit for criticism.* (3) *Asks if it is better to use insulated wire for lead-in.* (4) *Whether the earth lead should be insulated.*

(1) and (2) See circuit, Fig. 2, page 59, April 8th issue, and connect condenser, either in series, as is shown there, or in parallel, as you show, the former for short-wave reception and the latter for long wave. If your crystal is a perikon, omit the battery and potentiometer. The blocking condenser, presuming its value is suitable (0·002 mfds.) should be connected across your telephones. A closed circuit (inner coil) tuning condenser is recommended. (3) Aerial wire must not make contact with conducting or semi-conducting surfaces, and well insulate, either by using rubber-covered cable or by making use of an ebonite tube where the leads pass in to your instrument. (4) If your earth lead is long and can be kept well away from walls, etc., it should be insulated right to the point of earthing, otherwise take a heavy gauge bare conductor, such as No. 18 copper, to earth by the shortest route.

"J.M.C." (Forress) *gives a circuit of a two-valve receiver with X and Y terminals in first valve circuit for insertion of reaction coils and the other valve acting as a note magnifier, and asks* (1) *If the circuit can be improved by the addition of a high-*

frequency magnifier. (2) *How to connect it.* (3) *Should he get* **PCGG.**

(1) and (2) No grid leak is shown in your circuit, but possibly the condenser itself is leaky, and we presume that you connect a reaction coil to the X and Y terminals. A small fixed condenser, 0·001 mfd., should be connected across the primary of the iron core intervalve transformer. One stage H.F. can be added externally, and we do not think you would have much difficulty in completely modifying your set and connecting as shown in Fig. 5, page 15, April 1st issue. The fixed condenser 0·001 on the right-hand side may be omitted, and your terminals X and Y used for those marked "reaction coils." (3) Provided you have a good aerial your set should readily receive **PCGG.**

"VITTELLIUS" (Southampton).—(1) Three valve set with single wire aerial 60′ high and 40′ long should be suitable for **FL** and **PCGG** telephony. If you can possibly arrange two wires separated at least 6′ apart you would considerably improve results. (2) No, it is not essential that you join up the whole circuit with 7-strand wire. The instrument connecting wires are so short that any resistance that may be added in the circuit will be inappreciable. The answer referred to meant that the entire aerial, including lead-in and earth lead, might be of heavy wire. (3) Basket coils are, as a rule, better than slab coils for long wave reception, but in assembling them they should be spaced at least ¼″ apart. In the hands of the experimenter high resistance telephones connected directly in the H.T. leads are usually satisfactory.

"B.B." (Camberwell) *submits diagram, and asks* (1) *If tuning coil 9″ × 5″ diameter wound with No. 28 would tune to 2,000 metres.* (2) *Capacity of variable condenser.* (3) *Resistance of crystal potentiometer.* (4) *Resistance of telephones.*

(1) Yes. (2) 0·005 mfd. Do not connect as shown, but in series in the aerial circuit, or in parallel across the inductance. See circuit, Fig. 3, page 60, April 8th issue. (3) 750 ohms, but do not use battery and potentiometer with a perikon detector. (4) 4,000 ohms.

"A.L." (Stavenger) *asks* (1) *How he can eliminate the signals of a near-by high-power station.* (2) *For particulars of a receiving set having one H.F., one rectifier, one L.F., tunable over a wide range and suitable for reception of telephony.* (3) *If the wire sizes used in England are Birmingham wire gauge.*

(1) We think you should have no difficulty in eliminating these signals. Use a loose-coupled aerial circuit, and you may experiment with a paralleled circuit tuned to the wavelength of the interfering signals. (2) See circuit, page 37, April 8th issue. (3) No. The English Imperial Legal Standard or S.W.G., which between sizes 20 and 30 is very nearly the same as the Birmingham standard.

"E.B.G." (Aughton) *has a multi-valve receiver amplifier set, and wishes us* (1) *To suggest the cause of howling.* (2) *Asks the name of the high-power transmitting station working at* 10.30 *p.m. on April 20th.*

(1) Your circuit does not appear to be quite correct, and the action of the crystal is rather obscure. In whatever position your switches may be it does not rectify the oscillations set up across the ends of the reaction coil. When using crystal rectification it is not possible to arrange a common H.T. battery for oscillator valve and rectifier. The three stages of L.F. after H.F. may give rise to howling. With so many switches the arrangement of the leads must be carefully considered, as either leaky or inductive coupling will cause howling. You might try reversing the connections of the transformer. If you wish to use more than five valves in an amplifier set we recommend that they should be all H.F. Make your transformers to the exact value of the wavelength you require to receive, and test each one either with a buzzer or in a single valve H.F. amplifier, and see that they all function correctly. See left-hand column, page 112, April 22nd issue. After many stages of H.F. amplification it is usually not possible to use more than two L.F. valves, and these may have to be run with rather excessive filament current to prevent howling. (2) In all probability Paris, as you suggest.

"ABOUT TO START" (Hampstead) *asks* (1) *For an elementary textbook on Wireless Telegraphy and Telephony.* (2) *Where he can get private tuition on the subject.* (3) *Whether a single-valve set is suitable for the reception of* **PCGG** *and all-round purposes.* (4) *What would such a set cost.*

(1) "The Amateur Valve Station," by Allan Douglas (price 1s. 6d.), Wireless Press, Ltd. (2) Try a small advertisement in this journal. (3) **PCGG** can be received in London on a single-valve set, but a more elaborate installation is recommended. (4) Having seen what you require from the textbook, look through our advertisement columns and, if necessary write to manufacturers for quotations.

"F.H." (Kensington).—The crystal circuit you show is quite correct and the dimensions satisfactory. Avoid using enamel wire for aerial inductances unless you require to make use of a sliding contact. D.C.C. is somewhat better, because the turns become more spaced and the capacity between them lessens. A carborundum crystal without potentiometer and battery is not very satisfactory. Try a perikon, consisting of a contact between zinc and copper pyrites. Telephone condenser capacity 0·002 mfds. Wavelength range about 2,000 or 2,500 metres depending upon the dimensions of your aerial. You should hear Poldhu and **FL**, and ship and coast stations. It is doubtful if you can receive **PCGG**, or even **2MT**, on crystal in London. For a method of adding a valve, see Fig. 1, page 61, April 8th issue. A book such as that by Allan Douglas, "The Amateur Valve Station," would no doubt help you.

"J.H.A." (Bedford) *asks* (1) *For a circuit of a coupled crystal tuner, range 300 to 650 metres.* (2) *Range of such a set.* (3) *If it is suitable for reception of telephony from Chelmsford.*

(1) For circuit, see page 59, April 8th issue. The condenser may be connected either in series, as shown in the figure, or in parallel across the ends of the aerial inductance. Omit the potentiometer shown and use a perikon detector. For 300 to 1,000 metres aerial coils 4″ × 4½″ diameter, wound with No. 28 D.C.C. Closed circuit 3″ × 3″ diameter, wound with No. 30 D.C.C., and for 600 to 6,500 metres aerial inductance 12″ long by 7″ diameter, wound with No. 28 D.C.C., and closed circuit 7″ × 5½″ diameter, wound with No. 30. Range depends upon power of transmitting station. You should get all the high-power spark stations

of Europe, but it is doubtful if you will receive the ¼ kW transmission from **2MT**.

"D.V.D." (Edinburgh) *asks* (1) *For a simple aerial.* (2) *How many valves are required to receive* **PCGG** *with same.* (3) *For diagram of a suitable circuit.*

(1) A frame aerial about 4′ square, or an open aerial in the roof may be used. The open aerial should consist of several parallel wires joined in the middle or at one end, stretched out under the roof or in a long passage at the top of the house. The length should be as long as possible without the wires crossing. (2) Three or four will be required for good speech. (3) For the frame aerial a diagram was given to **"W.D." (Huddersfield),** June 3rd issue. For indoor open aerial any ordinary tuning circuit and amplifier may be used. See instructional pages in issue of May 27th on the construction of aerials.

"X.X.S." (King's Lynn) *asks* (1) *Who is* **BYE** *who is heard on about 1,000 metres.* (2) *Why 600 metre signals are improved when primary of loose coupler is shorted.* (3) *Number of valves for* **PCGG** *and* **2MT.**

(1) Ipswich Naval Station. (2) It is not clear from information given why this happens. It should not. (3) If a small variable condenser 0·0002 mfd. were connected across secondary, **2 MT** should just be heard without a valve. For **PCGG** two valves should be used.

"V.D.W." (Liverpool) *asks* (1) *Best kind of amateur aerial wire.* (2) *What wire to use for lead-in and connecting to apparatus.*

(1) There are several kinds of stranded wire now on the market, or a single wire of No. 18 gauge copper or phosphor bronze may be used. (2) The aerial and lead-in should always be one unbroken wire if possible. If a joint is unavoidable, join on a piece of the aerial wire. For indoor connection use No. 18 wire or lighting flex.

"V.J." (Liverpool) *asks* (1) *Resistance for a potentiometer.* (2) *If four-electrode valves may be obtained from the Marconi Co., and also price.*

(1) Any valve between 200 and 500 ohms will be suitable. (2) You should apply direct to that Company.

"C.L." (Huddersfield) *asks* (1) *If single valve diagram is correct.* (2) *Why spark stations are only heard when set is oscillating.* (3) *If telephony should be heard with A.T.I. and A.T.C. in series.* (4) *Suggested improvements.*

(1) In the diagram the anode circuit is incomplete, a connection between telephones and negative L.T. being missed out. Otherwise O.K. (2) There is not sufficient control with the set. Use a 6-volt cell and variable resistance so that filament brilliancy may be controlled. Weaken the coupling between A.T.I. and reaction until set just stops oscillating. Pure note sparks should then be heard. Try different reaction coils. (3) Until the set is made suitable for spark stations as above, you will hear little telephony. A.T.I. and A.T.C. should be in series for ships and short-wave telephony. (4) If set works well for spark stations and you cannot hear telephony, the only thing to do is to add another valve.

"E.W.C." (New Southgate) *refers to article on page 560, December 10th issue, and asks* (1) *If Fig. 1 may be changed to magnetic reaction set with slab coils for 400/24,000 metres.* (2) *If Fig. 1 above gives results equal to 1 H.F. and one reaction valve.* (3) *Best of three kinds of telephones to use for general work.* (4) *If Marconi four-electrode valve is on the market.*

(1) and (2) These circuits require testing experimentally before alterations can be recommended. Magnetic reaction may be adopted if the circuit is suitably modified. If you are pressed for time we recommend adopting a more standard circuit. A two-valve set will probably be efficient. (3) 120 ohm Brown telephones with telephone transformers. (4) Apply direct to that Marconi Co.

"R.E.C." (Guernsey) *has a school receiving set and a three-valve L.F. amplifier which howls badly.*

To get rid of this howl which is caused by interaction between the L.F. transformers it is necessary to reverse one of the grid windings. Which one must be found by experiment. To stop school set oscillating use smaller reaction coil, and also vary the coupling between the coils.

"W.T." (Strathaven) *asks* (1) *If single valve with crystal rectification circuit is correct.* (2) *Would 2,000 ohm telephones be suitable.* (3) *If telegraph wires a little distance away from the aerial will cause interference.*

(1) Connections are correct. The variable condenser might be 0·0003 to 0·0005 mfd. A 0·001 mfd. condenser across the telephones would be found an improvement. (2) They may be used with the circuit as given. (3) If the aerial is at right angles to the telegraph wires there should not be much interference.

"H.H.V.C." (Cardiff) *is making reactance capacity amplifier and asks* (1) *For criticism of circuit.* (2) *If the intervalve tuning coils should be placed at right angles to one another.* (3) *Number of plates for 0·0001 mfd. variable condenser. Moving vanes 3·25 cms. radius, fixed vanes 3 millimetres apart.* (4) *If potentiometer to detector grid is advisable.*

(1) The diagram shown has the A.T.I. shorted by the aerial and earth lead. Presumably you intended to insert a condenser across this inductance instead of short-circuiting it. There should be a small condenser across telephone terminals. This may be about 0·001 mfd. (2) We do not think there is any particular advantage in doing this. (3) Four fixed and four moving plates will be required. (4) Potentiometer rectifier control is not always necessary. With soft valves it may be used with advantage. It might be an improvement to connect a potentiometer in the grid circuit of the three H.F. valves, and a separate one to control the rectifier.

"G.D." (Luton) *asks if single valve circuit diagram is suitable for 250/20,000 metres with basket coils.* (2) *If possible to receive* **2MT** *telephony on set.*

(1) The circuit is quite suitable for the purpose desired. To cover this range you will require a number of basket coils and also coils of the honeycomb type. (2) Yes.

"E.S.W." (East Sheen) *asks* (1) *If two-valve set, detector with reaction and one L.F magnifier is efficient.* (2) *Connections for same.* (3) *If separate filament resistances are necessary.* (4) *Number of plates required for 0·001 mfd. condenser. Fixed plates 3·35″, moving 2½″ diameter.*

(1) Yes. (2) Suitable circuit is given on page 119, April 22nd issue. (3) No. (4) If the moving plates are 1/16" thick, and the spacing washers between fixed vanes ⅛" thick, 26 fixed and 25 moving plates will be required.

"**SOUTHERN**" (**Maresfield**) *asks* (1) *Capacity of condenser.* (2) *If possible to use capacity reaction with L.F. amplifiers.* (3) *Wavelengths of* **POZ.**

(1) Approximate 0·001 mfd. (2) Capacity reaction will probably make L.F. amplifier howl badly and is not to be recommended. (3) 3,900, 6,300, 9,400, 12,600 metres.

"**VALVITUS**" (**Bournemouth**) *asks for two-valve diagram with switching arrangement.* (2) *Particulars of winding for H.F. transformer.* (3) *Where to mkae tappings to H.F. transformer for different wavelengths.* (4) *Will signals be strong enough for 3' frame and loud speaker.*

(1) The circuit shown in Fig. 4, page 91, April 15th issue, with slight modifications will be suitable for your purpose. There should be a condenser and leak in the grid of the second valve and resistances in each filament in place of the common one. (2) and (3) Windings for an H.F. transformer to cover a range of 180/2,000 metres can only be determined experimentally. The transformers may either be in the form of a number of formers with two single layer windings to each, or of the slot type, the slots being alternately for primary and secondary windings. (4) On a 3' frame aerial about six valves will be required to satisfactorily operate a loud speaker.

"**F.K.**" (**Greenwich**) *asks for three-valve diagram with switching arrangements.*

A suitable arrangement is shown in Fig. 5 page 62, April 8th issue.

"**W.N.G.**" (**Dovercourt**) *gives single valve transmitter diagram and asks for suitable winding for A.T.I. and reaction.* (2) *Values of condensers A, B and C.* (3) and (4) *Value of resistance R, together with reason for using same.*

(1) Your diagram shows no connection from negative filament to earth. The A.T.I. may be 4" by 8" of No. 20 D.W.S. and the reaction coil 3" by 6" No. 24. (2) Condensers A—0·003 mfd., B—0·001 mfd. and C—0·01 mfd., all to be tested at twice the normal H.T. voltage. (3) and (4) The resistance R is necessary, and its value depends upon the type of valve used. The object of it is to maintain the grid at a most suitable value for oscillation by allowing the negative charge on the grid condenser to leak away. A suitable value would be about 10,000 ohms. Signalling is accomplished by opening and closing this circuit as shown in your diagram.

"**A.B.**" (**Durham**) *asks for three-valve diagram with values of component parts.*

See reply to "**D.F.T.**" (**Lincoln**) below.

"**J.G.C.**" (**Yarmouth**) *asks for a diagram of circuit to utilise certain apparatus, also for sizes of inductances.*

As a commencement you will find the circuit given to "**C.B.**" (**Hyson Green**), April 22nd, useful. The A.T.I. might be 6" by 10" of No. 24 D.W.S., and the reaction coil 5" by 8" of No. 28 D.W.S.

"**D.F.T.**" (**Lincoln**) *asks* (1) *The wavelength of 4" by 8" A.T.I. (No. 24 wire) with 3½" by 7" (No. 28) reaction.* (2) *If above will tune to Hague wavelength with three-valve amplifier.* (3) *Finest wire which may be used for short wave A.T.I.* (4) *For three-valve diagram. One H.F., one rect. and one L.F. magnifier.*

(1) Inductance of A.T.I. 4,750 mhys. and reaction 7,000 mhys. This will tune a P.M.G. aerial to 2,000 metres, or 3,400 metres with a 0·0005 mfd. parallel condenser. (2) Yes. Wavelength is 1,050 metres approx. (3) For short wavelengths 300/1,000 metres. No. 22 or No. 24 wire should be used. (4) A suitable three-valve diagram is given in Fig. 3.

"**J.R.**" (**Bradford**) *asks* (1) *If an "R" valve and "H" valve will work together in a two-valve set.* (2) *Why signals are weak when a two-valve set with 1,000 metre transformer is used.* (3) *How to obtain louder signals.*

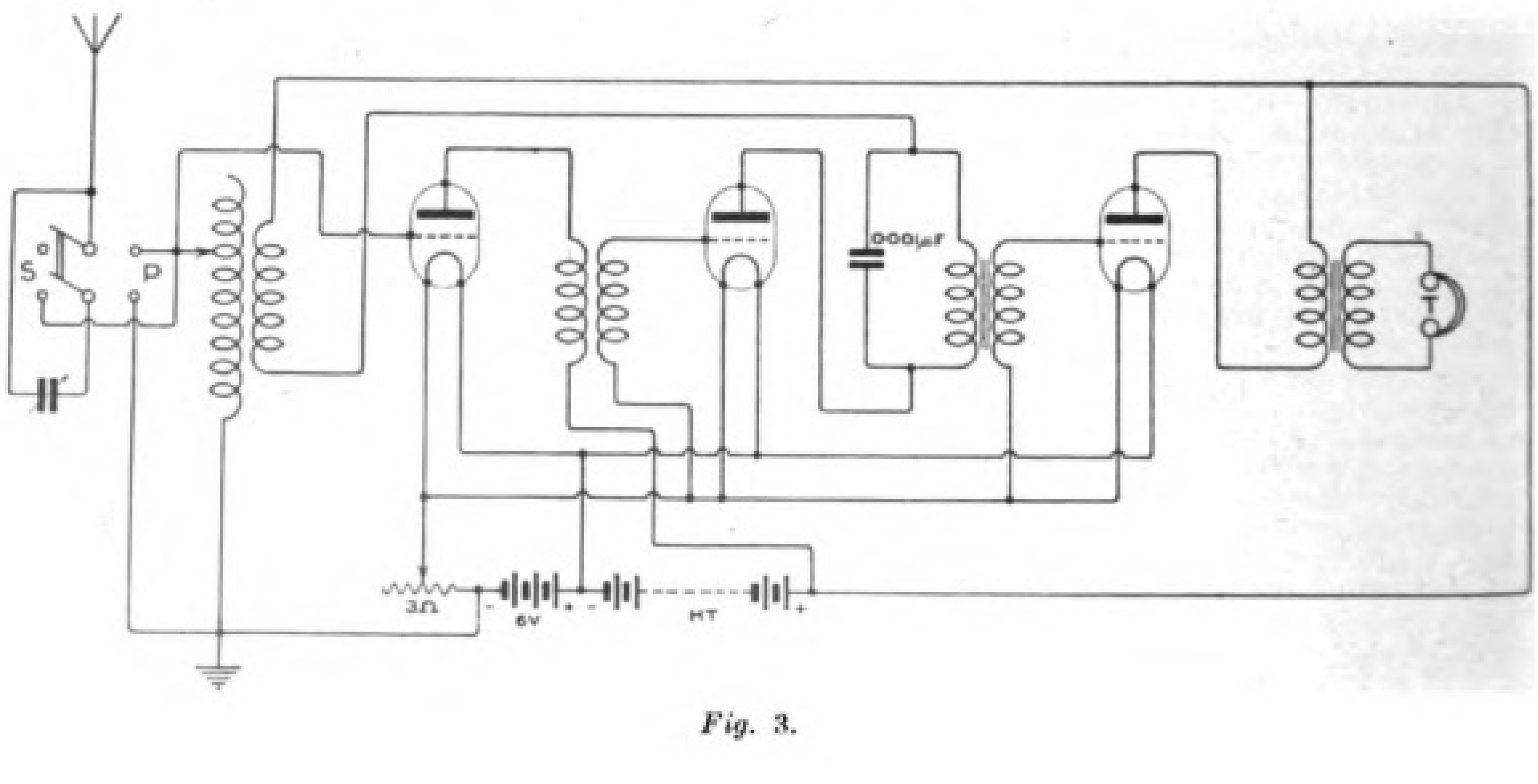


Fig. 3.

(1) It is difficult to say without tests whether results will be satisfactory. The best way is to try it out. (2) A 1,000 metre transformer is usually only suitable for wavelengths from about 750 to 1,300 metres, and unless the signals to which you were listening were within that range they would be weak. You do not give any particulars of tuning circuit and reactance, which may not be correctly proportioned for the wavelength range. A 0·001 mfd. condenser across the telephones would be an advantage. (3) To obtain loud signals a two-valve L.F. amplifier should be used after the rectifying valve, but there may be a certian amount of distortion of speech.

"D.G.C.T." (Merthyr Tydfil) *refers to two valve diagram given on page 778, March 4th issue, and asks (1) Why he cannot obtain any results. (2) Are slab coils as good as basket, loose couplers and duolateral coils for telephony. (3) Why speech from FL and Croydon though strong appeared indistinct.*

(1) It is not at all easy for us to say why no results are received on circuits which behave well in more experienced hands. The circuit referred to would be improved if there was a 2 megohm grid leak between grid and filament of second valve; also if a variable condenser were used either in series or parallel with the A.T.I. With careful adjustment it should be possible to make set oscillate. (2) The term "slab coils" should include basket and duolateral. Slab coils, if of the correct proportions, may be adjusted to give as good result as loose couplers, but the adjustment is more difficult. (3) It was probable that your reaction coupling was too tight so that set was oscillating. Weaken it slightly by sliding coils apart.

"C.E.T." (Tottenham) *has made an "Amateur Mechanic" crystal set upon which he receives no signals.*

If you have connected up circuit as described, and have followed the instructions carefully, there should be no difficulty in making set work. Examine all joints and parts; also see that aerial is properly insulated and a good earth connection made. There is not much advantage in adding a valve until some results are obtained on crystal set.

"C.L." (New Shildon) *asks for information regarding a 2 H.F. valve with crystal detector set, using reactance capacity coupling.*

(1) The use of several coils for the inter-valve reactance will be unavoidable to cover a range of 100/25,000 metres. Full information was given in the issue of April 8th. (2) There should be little, if any, coupling between the inter-valve reactance and the secondary inductance of the reaction coil. (3) With resistance capacity coupling the H.T. voltage should be twice the normal anode voltage.

"L.R.C.W." (Bordon) *asks for criticism of two-valve diagram for use with frame aerial.*

Your diagram is incorrectly drawn. For correct arrangement see diagram given to **"C.B." (Hyson Green)**, April 22nd. There is hardly sufficient amplification to use set with a frame. At least two more valves giving H.F. mag. would be required.

"H.M." (Manchester) *asks (1) For criticism of single valve diagram which is of coupled circuit type. (2) If two slide inductance could be utilised. (3) If a four-wire 15′ indoor aerial would be sufficient. (4) If tuner, consisting of secondary sliding in and out of A.T.I. with reaction coil revolving at other end of A.T.I., will be best arrangement.*

(1) Circuit is O.K. (2) This may be used as loading coil in arrangement recommended in answer 4. (3) This would be suitable for the Manchester district broad-casting, but for stations farther afield more valves would be required. (4) To obtain best results with a coupled circuit set, the coupling between aerial and secondary circuits should be weak. Otherwise there is a considerable mistuning as coupling is varied. We suggest you make the 6″ former the secondary, with the reaction revolving inside it. A small former about 4″ diameter, 3″ long, sliding in and out of the 6″ former will give the required aerial coupling to secondary circuit with the above-mentioned two-slide inductance as aerial loading coil.

"PONTY" (New Barnet) *asks (1) If single valve diagram may be improved. (2) How to extend wave range to 100/30,000 metres. (3) Why a "heterodyned howl silenced by unison tuning" is received on certain wavelengths. (4) What would be quantitative effect of putting the variable condenser in series with the A.T.I.*

(1) An improvement to set could probably be made if values of grid condenser and leak were known. There should be approximately 0·0003 mfd. and 2 megohms respectively; otherwise O.K. This is as much as we can say without fuller particulars. (2) The whole of this range may be covered by the use of a suitable set of slab or duolateral coils, the smallest having about 30 turns and the largest 1,500 turns on a former about 2″ diameter, and 1″ wide. Twelve to 15 coils will be required to cover the range. (3) This phrase does not convey much information. It is probably a howl due to too tight a reaction coupling. (4) The resultant wavelength would depend upon the capacity of the aerial and the value of the inductances, and cannot be guessed at. The maximum reduction is to halve the wavelength without the series condenser.

"Tyro" (Whitby Bay) *has added a H.F. transformer coupled valve to single valve set without much improvement to signals, and asks (1) For criticism of circuit. (2) Information regarding H.F. transformers. (3) If 60 volts is sufficient H.T. for R and "Ora" valves. (4) If there is any advantage in using 6 volts for filament lighting.*

(1) The circuit is correct. You will probably find it an advantage to use a potentiometer in the first grid circuit instead of two dry cells direct (2) You do not give diameter of transformer former, but it is almost certain that this is not suitable for the job. For 1,000 metres the transformer should be wound on a 1¼″ diameter former with 4″ of No. 40 wire to each winding. A small capacity condenser should be connected across the anode winding. Soaking in paraffin wax will not do any harm provided the wax does not remain soft. (3) Yes, O.K. for "R" valves, but is on the high side for "Ora." (4) A 6-volt accumulator with variable resistance should always be used as it gives control of filament brilliancy.

"J.N." (Mile End) *has a single valve set which does not come up to expectations. The circuit and aerial appear correct in all respects.*

The trouble is probably due to the slab coils. If wound with enamelled wire it is quite possible that the enamel has rubbed off in places, causing some of the turns to be short-circuited, and made the coil useless. Wind some similar coils yourself with different numbers of turns, and select a combination which gives best results. The howling is due to having too large a reaction coil, and may be overcome by using new coils or stripping turns off the one which gives the howl. When receiving spark stations, tightening the coupling should cause signal to gradually get stronger until the musical note is changed into a hiss. The set is then oscillating.

"COUNTRYSIDE" (Barnsley) *asks* (1) *For book on wireless apparatus for beginners.* (2) *What battery is required for valve on Mk. III* tuner.* (3) *What is the use of the buzzer on this set.*

(1) "The Amateur Valve Station," by Alan Douglas (Wireless Press, Ltd.). (2) The addition of a single valve to this tuner will greatly add to the efficiency for telephony stations. If this is a Mk. III short wave set, it is only suitable for the broadcasting waves of 350 to 425 metres, in addition to 600 metre ships. For the valve a 6-volt battery with variable filament resistance and a 30 to 50 volt H.T. battery are required. (3) The buzzer is provided for tuning up the receiver. A calibration chart of the secondary circuit is, or should be, provided, from which it is possible to set the secondary condenser to the wavelength it is desired to receive, then with the change-over switch in the "stand-bi" position, the buzzer sets the secondary oscillating at this wavelength, so that the aerial circuit may be also tuned to the same wavelength.

"W.J.F." (Hornsey) *asks regarding single-valve set* (1) *Wavelength range.* (2) *What long distance stations should be heard.* (3) *Suggested improvements.* (4) *Suggestions to receive telephony.*

(1) With A.T.I. and A.T.C. in parallel as shown in diagram, maximum wavelength 5,000 metres. With A.T.I. and A.T.C. in series this will be reduced to 3,000 metres, with a corresponding reduction in the minimum wavelength. (2) All European C.W. stations, working on wavelengths up to 5,000 metres. (3) Add series-parallel switch for aerial condenser; also reduce condenser across telephone transformer primary from 2 mfds. to 0·001 mfd. (4) On existing set it should be possible to hear Croydon and other aircraft stations on 900 metres, but for the new broad-casting it would be advantageous to make a smaller tuning circuit. For this an A.T.I. 3″ × 4″ of No. 22; for reaction 2¾″ × 4″ of No. 26 should be suitable. The best value of reaction should be obtained by experiment, stripping off some of the turns, until set gradually works up to oscillating point.

"D.G.B." (Putney) *asks* (1) *If single valve circuit is correct.* (2) *If possible to use D.C. mains for H.T. for valve.* (3) *How many plates for 0·001 mfd. condenser.*

(1) This is a very elementary circuit, which will not be very effective. Disconnect the secondary circuit from the aerial circuit, and also do not short the idle sections of inductance. Connect reaction coil to slide in and out of secondary in the anode circuit as shown in many recent diagrams; also a 0·001 mfd. condenser across telephone transformer H.R. winding. If a grid condenser and leak is used a crystal detector will be unnecessary. (2) This may be done provided proper precautions are taken to prevent short-circuiting of mains or of earthing one or both of them. (3) If a variable condenser is desired sufficient information will be obtained from reply to **"E.S.W." (East Sheen)**. For a 0·001 mfd. blocking condenser 2 foils 2″ × 1″ separated by 0·002″ mica will be required.

"G.H.R." (Ilkley) *asks* (1) *How to add note magnifier to existing single valve set.* (2) *Type of inter-valve transformer to use.* (3) *Why set does not oscillate below* 1,000 *metres.* (4) *Size of basket coils for* 700 *metres.*

(1) A diagram showing how this can be done is given on page 213, Fig. 1, May 13th issue. (2) This should be a L.F. transformer, each winding consisting of 10,000 turns wound on a ½″ soft iron core, 2½″ long. For this about 4 ozs. of No. 44 will be required. (3) No details of slabs are given so that we can hardly say if they are suitable. It is very probable that the A.T.I. and reaction slabs are not properly proportioned. For wavelengths below 1,000 metres the A.T.I. and A.T.C. should be in series. These sets require very careful adjustment to receive telephony. The position of the reaction coil being very critical and the tuning of the whole circuit very sharp. (4) With small tuning condenser in parallel with A.T.I., as shown in your diagram, the A.T.I. basket should be 1″ inside diameter, wound with 50 turns of 26 S.S.C. A similar coil will do for reactance.

"J.S." (Darwen) *asks* (1) *Capacity of certain condenser.* (2) *Particulars of smoothing choke and condenser for use in adapting D.C. mains as anode battery.* (3) *Where to connect smoothing choke in circuit.*

(1) Approximately 0·001 mfd. (2) For a smoothing choke obtain if possible an old ignition coil secondary winding provided with a soft iron core. The smoothing condenser should be about 0·5 mfd. This may be made up with 100 sheets of tin foil 10 cms. × 5 cms. separated by mica sheets 0·003″ thick. (3) The smoothing choke should be connected in the positive H.T. lead. In adapting D.C. mains for use as H.T. great care should be taken as regards earthing the filament of the valve. If there is already an earth on the positive main, earthing the filament will cause a short circuit of the main. This must be avoided.

"F.T.M." (Battersea) *asks* (1) *If possible to receive* PCGG *on two-valve set shown on page* 202, *June* 25*th*, 1920. (2) *What value of grid leak to use.* (3) *Capacity of certain size of condenser.*

(1) Yes, if the inter-valve transformer is correct for 1,000 metres. (2) As a potentiometer is used the grid leak value will not be very important: probably 1 to 2 meghoms will be suitable. (3) 0·0005 mfd.

SHARE MARKET REPORT.

Prices as we go to press on June 2nd, are :—

		£	s.	d.
Marconi Ordinary	.. ..	£2	14	0
,, Preference	.. ..	2	9	0
,, Inter. Marine	.. ..	1	14	6
,, Canadian	.. ..		12	0
Radio Corporation of America :—				
Ordinary	.. .. ..	1	3	9
Preference	.. .. ..		15	0

17th June, 1922. PRICE 6D. NET.

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VOL. X. No. 12. JUNE 17TH, 1922. WEEKLY

Methods of Deriving Valve Current from Public Supply Mains

By F. H. HAYNES.

THIS subject may be divided into four main headings :—

(1) The production of H.T. from D.C. mains.
(2) L.T. from D.C. mains.
(3) H.T. from A.C. mains and
(4) L.T. from A.C. mains.

(1) H.T. FROM DIRECT CURRENT MAINS.—This is without doubt the easiest and offers several alternative methods, and the two given below are generally favoured. All D.C. supply will have one main earthed and in practically every case it will be the negative. Leads must be run from the mains to a convenient point for connecting to the apparatus and should terminate on a double pole switch, followed by 1 amp. fuses (Fig. 1).

Two batten-type lamp holders are arranged as shown for joining two lamps in series and connecting them across the supply voltage, to which also is paralleled a condenser of good insulation, having a capacity of two microfarads. This condenser has the property of shunting a good deal of ripple

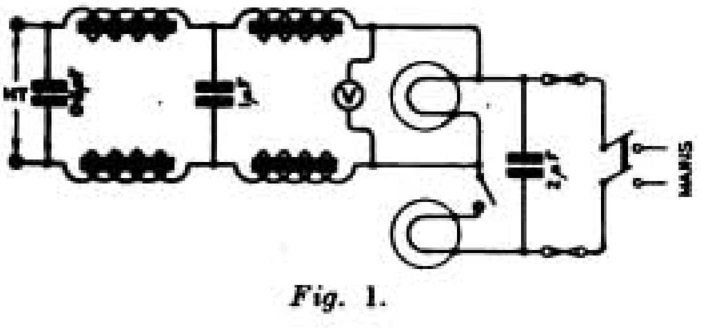


Fig. 1.

off the mains before the H.T. potential is bridged off, and consequently if the H.T. voltage required is half that of the mains this condenser is twice as effective across the whole voltage, as it would be if it were only joined across the leads providing the H.T. potential.

The choke coils are shown in the circuit as being separate coils in opposite leads. This is preferable to the method of winding opposite coils on a common core, as it reduces the liability to breakdown. Intervalve transformers may be used as chokes but it would probably be more economical to make special coils to the following details. The core which has a diameter of $\frac{3}{8}$'' is shown in Fig. 2, arranged with end cheeks which fit tightly and are $1\frac{1}{4}$'' × $1\frac{1}{4}$'' × 5/16'' ebonite. The outer sharp edges of the holes carrying the core are countersunk

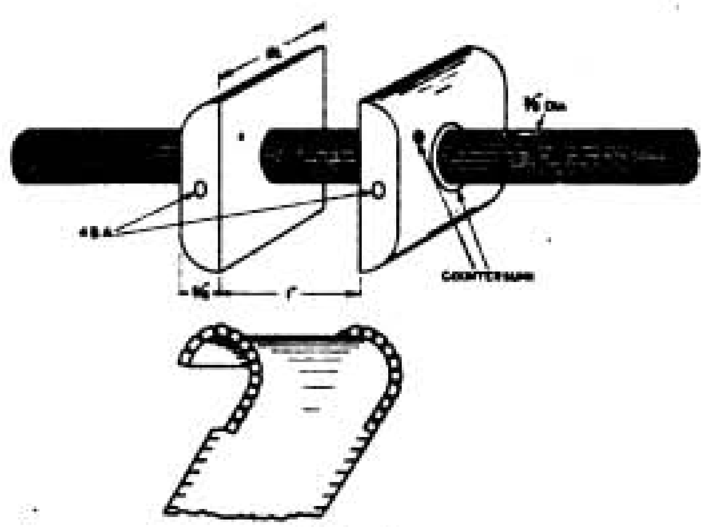


Fig. 2.

in order that when the core has been wound the core wires which are of No. 22 or finer, soft iron, may be divided and a half bent round on either side to completely close the magnetic circuit. Opposite edges are also rounded for the same purpose. Holes are made in one edge of each end piece and tapped 4 BA to provide for fixing the coil when finished to a base. Other holes are also made for passing out the leads and these, too, should be slightly countersunk to remove sharp edges that would be likely to damage the wires. Before winding, a piece of empire cloth, moistened on its inner face with oil to prevent rusting, must be wrapped round the core, leaving no parts exposed. The cheeks are spaced 1'' apart and the piece of empire cloth should have a total width of about $1\frac{1}{16}$'' and small cuts made in its edges so that there may be a turning up against the cheeks to obviate any possibility of the wire slipping down into contact with the core. In securing this piece of insulating material in position, the reader is cautioned against the use of certain well-known adhesives as the preservatives and other materials they contain frequently have low insulating properties. A little tacky shellac varnish and cotton wrapping is the best way of holding down the edges of the empire cloth. The most convenient way of winding the bobbin is, of course, to wrap one end of the core tightly with bare copper wire and hold it in the chuck of a light lathe, which can be run at high speed, but if this is not available an arrangement can probably be improvised by the experimenter for revolving it by means of a small hand brace held in the jaws of a vice. Alternatively clearance holes may be made in wooden uprights to act as bearings and a stiff piece of wire bound round one end of the core will serve as a handle.

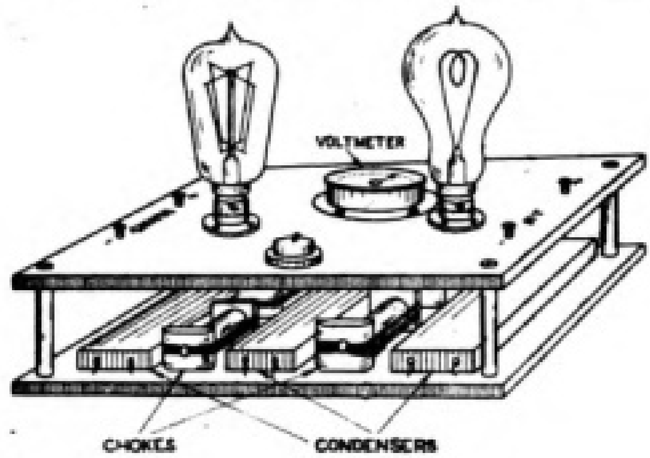


Fig. 3.

This will be rather a slow process for winding but provides a means which, with a little patience, is entirely practicable. The wire used should be between 38 and 42 gauge with a single silk covering and is wound on to a diameter of about $\frac{7}{8}''$ or a little more than half an ounce of wire. The ends are brought out through the cheeks by flexible leads composed of several strands of fine insulated wire. On the completion of the winding a piece of stiff fibre is wound over the wire, tightly fitting between the cheeks, and serves as a covering for the windings and also to prevent the cheeks from closing in when the core wires are bent round. This piece of fibre will need to be tied round with thread to keep it from springing open. The core wires will also need to be tied round after being bent, to keep them in position. This completes the construction of a choke coil and it may be noted that this design is equally suitable for the construction of intervalve and telephone transformers excepting that primary and secondary are required and an additional piece of empire cloth insulation between the windings. Four such coils will be required and connected together as shown in the diagram. Two more bridging condensers of value 1 mfd. and $\frac{1}{2}$ mfd. are connected across the chokes at the points shown.

This arrangement provides a very effective way of eliminating the ripple usually present on supply mains, and on most circuits can be used as a source of H.T. for operating multi-valve amplifiers without undue humming. Adjustment of H.T. voltage to any value from a few volts up to the maximum across the mains may be obtained by using lamps of various voltages, patterns, and candle powers. A convenient arrangement is to have a number of miscellaneous lamps, suitably marked for identification, and to prepare a chart, showing the voltages that various combinations of lamps will give. If it is desired to use a voltmeter for showing the potential it must be connected across as shown in the diagram, for if it is connected beyond the chokes it is apt to give a low reading depending upon its efficiency, and moreover, the current which actuates it will have to be passed by the chokes. Connected on the H.T. output side it is also liable to re establish the ripple if many valves are operated. Fig. 3 is a sketch of a complete outfit made up on the lines described.

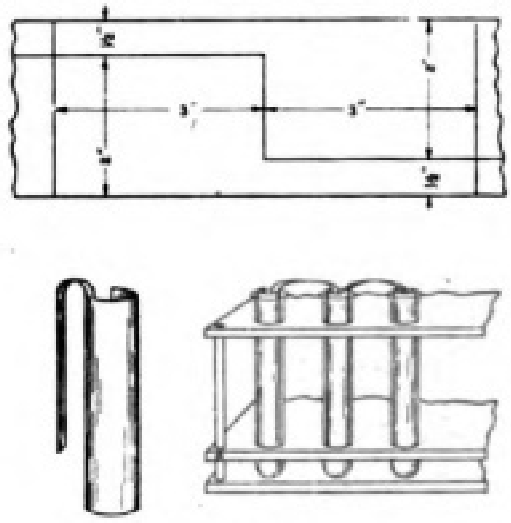


Fig. 4.

Another method is to build an accumulator battery of many cells and charge it from the mains. This system gives very little trouble and entirely eliminates ripple particularly if the cells are not on charge at the time of being used. There is the objection, of course, that batteries, owing to the use of sulphuric acid, cannot be incorporated in a set as a part of it, ready for operation from the electric lighting circuit. A method of constructing the battery is shown in Fig. 4. The plates are cut from sheet lead about $\frac{1}{16}''$ thick, or of just sufficient thickness to retain their shape. Fig. 4 also shows how to cut the plates from the sheet without waste. In order to increase the effective surface, a number of parallel cuts are made as close as possible together on both sides of the narrow end, and one side of the wider end. The wider end is then bent round a piece of cylindrical wood with the grooved face inwards, to give it a circular shape and sufficiently small to give it a good fit in the glass boiling tubes. To prevent the positive, which will be the inner strip, from making contact with the cylindrical negative, it must be wrapped with an insulating material that will permit of the free flow of the acid. The best way of doing this is to fit inside the negative a piece of corrugated celluloid of the kind specially made for this purpose. The plates require no special treatment with oxides of lead, as is usual with larger cells, before bringing into use. The rack shown in the figure for holding the tubes must be liberally treated with paraffin wax to prevent it being acted upon by the acid and to maintain insulation between adjoining cells.

The charging rate for such an accumulator battery is very low. The current passed by a metal filament lamp connected in series with the battery and across the mains is suitable for charging (Fig. 5). If the charging rate is 0·25

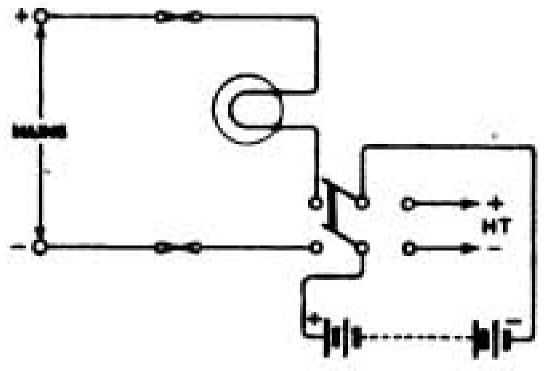


Fig. 5.

amperes and the battery is kept on charge for fifteen minutes, it will acquire a charge of almost $\frac{1}{16}$th of an ampere hour, which will suffice to furnish the H.T. for a multivalve amplifier for several hours.

current without excessive temperature rise and for the more general gauges of "Eureka" wire may be taken as shown in the accompanying table,

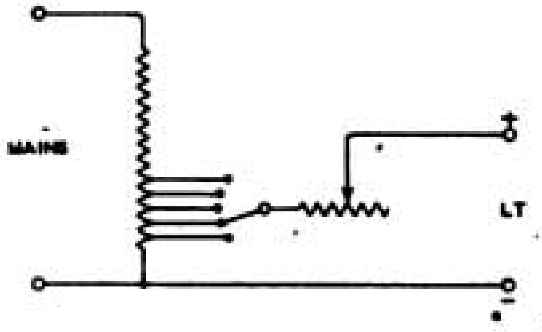


Fig. 6.

which also gives the resistance per yard and the approximate number of yards required on the more usual supply voltages.

Number of Valves.	Gauge S.W.G.	Current Carrying Capacity.	Resistance per yard.	Length required for various voltage.			
				100 v.	200 v.	220 v.	240 v.
		amperes.	ohms.	yds.	yds.	yds.	yds.
1	22	1·09	1·00	100	200	220	240
2	20	1·6	·661	100	200	220	240
3	18	2·5	·372	110	220	240	260
4	16	3·75	·210	120	240	265	290

(2) L.T. FROM DIRECT CURRENT MAINS.—Where a D.C. supply is available it is usually preferable to charge accumulators and to use them for the purpose of providing the L.T., but where the use of accumulators is not desired, valve filament current may be provided by a potentiometer arrangement.

It is always possible, of course, to connect the valve filament to the mains through a suitable resistance, but such an arrangement is usually rather dangerous as it is difficult to critically adjust the current from a high voltage supply and also the control of the grid potential presents difficulties.

Fig. 6 shows a circuit arranged on the potentiometer principle and in order that a series filament resistance may also be made use of, it is necessary to provide a current flow across the potentiometer resistance of slightly more than that required by the valves. To provide this resistance one must employ wire capable of carrying the requisite

It will be seen that the amount of wire needed to pass the required current is of unwieldly length and arrangements must be made for winding it into a convenient form, at the same time bearing in mind that insulation must be maintained and that the wire is likely to become fairly hot. One method is to take a board about three feet long and screw to its opposite ends a row of small bobbin porcelain insulators and zigzagging a resistance wire tightly between them. In lieu of the board the under side of the operating table may be used, but in stowing the wire out of sight there is a danger of overlooking excessive temperature rises. It must be pointed out that this arrangement of deriving L.T. directly from D.C. mains must not be regarded as economical, for supposing a three-valve set is used on a 220 volt supply, over ½ a kilowatt will be used.

If L.T. and H.T. is to be obtained simultaneously very little consideration is required to devise a suitable circuit.

(*To be concluded.*)

Some Effects of Capacity on Mutual Induction

WITH SPECIAL REFERENCE TO THEIR APPLICATION TO THE ELIMINATION OF JAMMING.*

By J. H. REEVES, M.B.E.

BEFORE I start reading this paper I wish to express my regret that certain demonstrations I had arranged have, for some reason, fallen through. I have to ask your indulgence to take it that what I intended to do, actually takes place.

It will be well if I explain exactly what is meant by the words, "Mutual Induction," in the title. In my student days high-frequency oscillations were not a feature of every-day life, and for the low frequencies of 50 to 100 periods of ordinary electrical power distribution, the coefficient of mutual induction was, in effect, a measure of the power of alternating currents in one coil to produce an alternating E.M.F. in one adjacent to it. Till a little while ago I regarded the words "mutual induction" to have the same meaning with respect to coils carrying radio-frequency oscillations, but I now understand that mutual induction is used only in connection with true magnetic induction, and that the power mentioned is described by the words "total coupling." This total coupling is then the resultant of true magnetic mutual induction and the effect due to electrostatic coupling arising from the fact that all coils must have a certain amount of self and mutual capacity.

Now magnetic induction is a function only of the dimensions and relative position of the coils employed. By making certain assumptions, the coefficient of mutual magnetic induction can be calculated mathematically. Elaborate expressions are given in Eccles's "Handbook of Wireless," pp. 70–74, and the mathematical development by means of Bessel's Functions formed the subject-matter of Professor Howe's presidential address to the Radio Section of the Institute of Electrical Engineers. I have searched in vain for corresponding expressions for self and mutual electrostatic induction, and I hope someone will be able to throw some light on this matter, because I find that in quite ordinary circumstances of reception with loosely-coupled circuits the effect of electrostatic coupling exceeds that of magnetic.

As a recent beginner in wireless I started in the days of multi-valve amplifiers. In company with most beginners my initial circuit was a one-valve single coil circuit with reaction; naturally before long I found from practical acquaintance the meaning of the word "jamming," and later as amateur telephony at 1,000 metres grew in volume I learnt the meaning of distortion, and for some while now all my efforts have been directed towards obtaining as near as possible perfect enunciation of music and the human voice with elimination of jamming. The first great step towards these objects consisted of substituting coupled circuits for the single coil one. Countless others have advocated this as being well worth the extra expense and the extra trouble in tuning. If only every amateur would do the same we should be freer of the condenser swinging fiends, who too often make Sunday afternoon hideous by their efforts to get the Dutchman's carrier wave on half a valve.

One day, working with Burndept coils, on the usual type triple mount, I noticed that as the coupling was gradually loosened from its tightest position a certain signal died away to zero, or nearly so, and then came on again. This position of zero signal strength I have called the "Silent Point," and in conversation with others I gather that quite a number have noted this phenomenon. I further noted that in receiving signals of different wavelengths the longer the wavelength the looser had to be the mechanical or apparent coupling before the silent point was reached. One day, listening-in to Croydon very loosely coupled, I was badly jammed by **GFA**, and it occurred to me to try the effect of tuning-in Croydon at that coupling which formed **GFA**'s silent point. The experiment succeeded. I got Croydon without a sound of **GFA**, but an alteration of the coupling either way made the latter audible. This observation was the starting-point of my investigations and ultimately of this paper. I tried in like manner to get rid of **BYK**, **BYM** and other Admiralty stations, but this failed, partly because there was no true silent point for any of them, but only a minimum point, and this was so close to Croydon's own silent point that even his signals were very feeble and, in consequence, they were still masked by those of **BYK**, etc.

In this common form of mount there is only one degree of freedom of movement, that is to say, for a given distance between the coils the angle between their planes is fixed, so I made another mount by which I could vary independently the distance and the angle. The result, however, was the same. I could always eliminate **GFA**, but could not get rid of **BYK**, etc., without making the other signals so feeble as to be useless. So I put the matter on one side and proceeded to make a large reception unit, the two bottom panels of which I have rough mounted to show you. These are made almost exclusively from parts of the Mark III short wave tuner.

The reception coils are wound with No. 26 D.C.C. wire on the formers, turned smooth. The middle one, stationary, is the secondary, one movable, is the A.T.I., and the other movable is a reaction coil. Above these is the detector, which is a seven-valve Marconi type 55 D, and beyond these coupling coils are loading coils for the higher wavelengths. For 1,000 metres about three-quarters of both the A.T.I. and secondary are needed.

One evening I was using this set to receive

* Paper read before the Wireless Society of London on the 24th May, 1922.

Mr. Maurice Child (1,000 metres, 10 watts), when he was badly jammed by **BYM**. Slowly loosening the coupling till the movable coil was nearly square with the stationary one, I found I could entirely eliminate **BYM** and yet get Mr. Child quite clearly and of more than readable intensity. The adjustment was extremely critical. By a movement of the handle either way, hardly perceptible to the eye, **BYM** came in and entirely obliterated the telephony. This experiment was several times repeated in the hearing of a few members of the Kensington Wireless Society, and in exactly a similar way I could get rid of **GFA**, but never both **GFA** and **BYM** simultaneously.

I had intended to demonstrate to you how critical is the adjustment required. This experience encouraged me to undertake a systematic investigation of the principles underlying this phenomenon. To describe in detail all the experiments would take far too long. In brief, I found that whatever was the original distance apart of the coils, I could almost invariably obtain a silent point with all wavelengths I used, mainly 600, 900, 1,000 and 1,450. Sometimes the adjustment had to be extremely critical, and at others not so. Finally I put together this little reception circuit, which I show you.

You will notice I have added a slow movement for coupling, together with a vernier to measure the approximate amount of movement from one silent point to another. For 600 metres I got a well-defined point with ¾″ overlap, for 900 metres the overlap was ½″, and for 1,450 metres it was about 0·2″. Hitherto no particular note had been taken as to the connections of aerial and earth grid and potentiometer to the respective coils, so while at the silent point for 600 metres I reversed the aerial and earth leads to the A.T.I. Strong signals at once came through, which could only be silenced by further loosening the coupling till the coils were clear of one another, as on pushing this loosening further I could get no readable signals. I reverted to the original connection, and noted that the various leads were joined up as in Fig. 1. At this

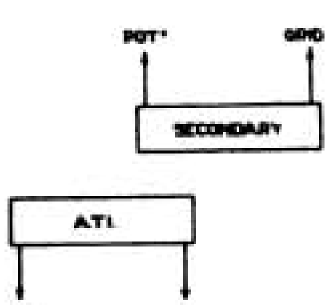


Fig. 1.

stage I thought I could enunciate the laws of total coupling as follows, viz. :—

1. The total coupling is compounded of two,
   (*a*) true magnetic, independent of the frequency,
   (*b*) electrostatic, which increases with the frequency.
2. The electrostatic is opposed to the magnetic and is of the nature of a back E.M.F. similar to that of self-induction. At coupling "tight" the magnetic exceeds in strength the static. As the coupling is loosened the magnetic falls off more rapidly than the static, till the silent point is reached, when they are equal. Beyond this point the electrostatic is in excess.
3. If the coupling is inside the silent point, the signals come through by reason of excess of magnetic, if outside the silent point, then by excess of electrostatic.

Subsequent experiment added a fourth law, which modifies 2; but, in the main, I think these laws are true.

The immediate result was the question, "What will happen if the capacity coupling is greatly increased?" I set about finding a means to make such an increase.

In Stanley, Vol. I, p. 359, a coupling is shown where the serial end of the A.T.I. is connected to the grid end of the secondary through a small variable condenser. Stanley calls this "electrostatic" coupling. A similar coupling is shown in Eccles, p. 89, Fig. 18. He calls it "electric" coupling. I think, for reasons to be given, the latter expression is the more correct, and I looked for a true static connection which did not involve metallic connection with the active ends of the two coils. Eventually I evolved what I now call "static couplers," and will return to the electric coupling later.

The first pair of static couplers consisted each of a strip of aluminium, ¼″ wide, embracing about half the circumference of each coil. One strip was placed over the active end of each coil and the two were joined by a wire. Small but definite results were obtained, and I made a larger pair, ½″ wide and embracing nearly the whole circumference. Later still, fearing damping effects from eddy current, I constructed laminated couplers. On a former of the right size diameter I placed one turn of ¾″ insulating tape; on this I wound about 20 turns of No. 26 enamel-covered wire. Baring the insulation along a line parallel to the axis, I soldered a bridge-piece across the turns, and then cut through the whole helix at the point opposite to the bridge-piece. I thus got a plate with 20 laminations, insulated in the direction in which eddy currents might arise.

I will now demonstrate the effect of these couplers. You notice that while over the inactive ends no result is noticeable, but as I move them towards the active ends the coupling has to be continuously tightened to get the silent point. With this pair of couplers, with these identical coils, the A.T.I. being detached from its mount, I and many others have heard 600 metre signals from the Mediterranean, with the coils 10′ apart. Indeed, after a foot or so between the coils, the signals remain of constant strength, however much this distance is increased.

The immediate deduction is fairly obvious. In the original form the elimination of jamming was due to the difference of two coupling effects, both of which fall off as the coupling is loosened, while the effect of the static couplers is independent of distance. Hence, to get maximum sensitiveness a good plan seemed to be to reduce the capacity of each coil to a minimum and to rely on the static couplers for the elimination. As it was desirable to have close uniformity in winding coils of the same inductance with varying self-capacity, I looked round, and found at Tingey's a number of the cases covering the condensers taken out of the

Mark III tuner. On these, in a screw-cutting lathe I have wound on these as formers, coils of the same pitch, and hence of approximately the same number of turns of Nos. 32, 36, 40 and 47 gauge wire. Some of my observations on these fine wire coils have been interesting and instructive, and I hope to have time to refer to them later, but I now come to an accidental discovery, due to my want of experience in using a screw-cutting lathe.

I have here two coils, mounted side by side, to all external casual investigation the same. They are both of 36 gauge, 84½ turns, spaced 22 to 1″; but one is a right-handed, the other a left-handed helix. It was my intention to demonstrate their different action in connection with this third coil, which is right-handed. It would have been seen that with the left-handed coil a decided silent point was reached in the end-on position, but not in the side-by-side position, but with the right-handed coil these results are reversed.

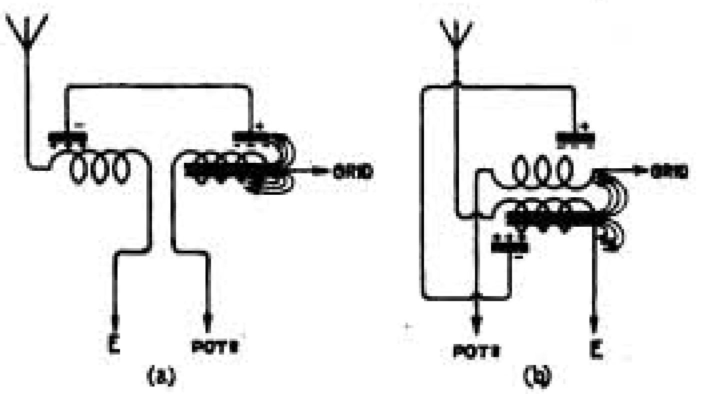


Fig. 2.

An explanation of this may be found by a consideration of these two figures, Figs. 2 (*a*) and (*b*). The first indicates two right-handed coils in the end-on position with the static couplers in place and the second, the coils in the side-by-side position. If then, the incoming wave is at the maximum positive potential, the magnetic field runs as indicated by the arrows.

The effect of the field is in the first case to make the grid end of the secondary negative, but as in the second the direction of the field in the secondary is reversed, the grid end is positive. The effect of the static couplers is always to make the grid end negative. Hence, in case 1, both effects are of the same sign, but in case 2 of opposite sign and a silent point is to be expected.

Further, replacing the right-handed A.T.I. by a left-handed, or reversing the aerial and earth connections to it, or changing the end-on to the side-by-side position, each in turn produces a change in sign of the grid potential due to the magnetic portion of the coupling. Hence we get the following possibilities to obtain a silent point, with consequent elimination of jamming by waves of one length: (*a*) Both coils right (or left) handed as in Fig. 3 and (*b*) One coil right, the other left-handed as in Fig. 4.

These figures give a variety of selection, but for reasons of convenience I prefer the end-on position, and the preferable arrangements seem to me to be:—

1. For thick wire coils, use two right-handed coils. Place the couplers in position as in A(i), but put a switch or plug in the connecting wire; also place a reversing switch in the aerial and earth connections to the A.T.I.

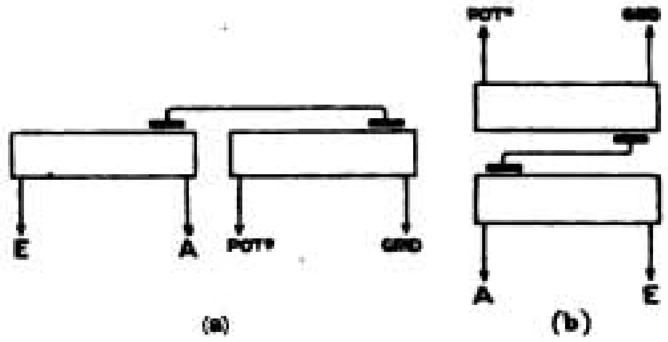


Fig. 3.

Normally make these connections as in A(ii) and leave open the plug. To avoid jamming, which even the loosest coupling cannot eliminate, reverse the aerial and earth switch and close the coupler plug.

N.B.—If the coils are tapped, the permanent fixture must be at those ends immediately under the couplers.

2. For thin wire coils use B (i) and work normally with the coils well apart. To stop jamming tighten the coupling. This is my usual method in connection with these coils of 40 gauge.

This pair, right and left-handed, with the third, serves also another useful purpose in that we can get some measure of the coupling power both of the static capacity of the coils themselves and of the couplers. Given a source of constant strength, the silent point for the right and left-handed pair can be found. The third coil is now placed opposite the right-handed one and the signals are received on this pair. As by the former trial the magnetic and static couplings are equal, the effect of each is half the signal strength obtained in the latter trial. Time will not allow me to make these measurements this evening, but the difference between the results of this pair of No. 36 and this pair of No. 26 is decidedly noticeable.

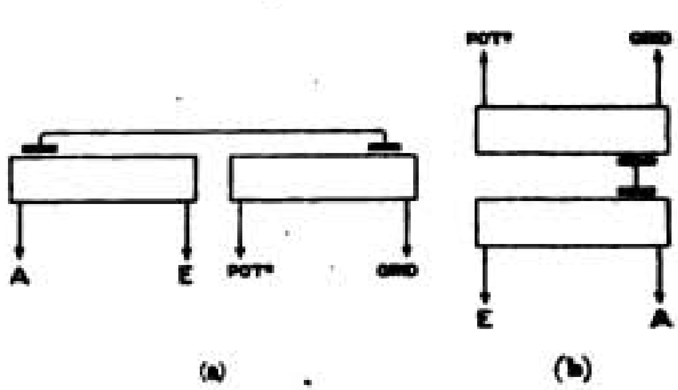


Fig. 4.

I will say a little about these fine wire coils which I have found (for short wavelengths, *i.e.* from 1,000 downwards, on my particular reception set) very effective. There is no need to emphasise the need to eliminate self-capacity as far as possible while keeping the coils of reasonable size. I can say nothing of the relative values of the different coils on the market for long wavelengths.

Suppose then we start with a single-layer cylindrical coil, wound on a former of this size, which is a little over 3" diameter. It is to be tapped, and the number of turns to make it reach 1,000 metres is about 75 to 80, and occupies with No. 26 D.C.C. about 2¼" of the former. What happens if the 26 wire is replaced by say 36, wound to the same pitch, or as I have standardised it 24 to 1", 72 turns, occupying 3" length. The inductance is much the same, the self-capacity is diminished and the resistance increased. The mathematicians have given us a damping coefficient, due to the ohmic resistance, but I do not know of a similar one for self-capacity. I believe there is one for distributed capacity along a straight line, such as a submarine cable. In the absence of a coefficient of capacity damping effect nothing but experiment can see how far the increase of efficiency due to decreased capacity compensates for the loss due to ohmic resistance.

The question is also complicated by consideration of clearness of articulation. One man is contented provided he can understand what the person transmitting is saying, and aims at getting his results with a minimum of valves; another man does not mind an extra valve or two, provided that by so doing he gets nearer his ideal of complete absence of distortion. I will mainly speak of, firstly efficiency, and secondly clearness of articulation.

As regards efficiency, this set of tapped No. 40 gauge coils have been tried on a number of circuits, the H.F. sides of which have included resistance-coupled, reactance-capacity-coupled and various types of transformer-coupled units. On one they were classed as highly inefficient, but on most, provided the reactance coil was used, the signals were as good, or very nearly so, in point of loudness as with various types of lattice, cylindrical and basket coils.

As regards clearness of speech. At audio frequency the damping effect of the small capacity of any of these types ought to be small, but it may be serious on radio frequencies. Speech, as transmitted by wireless, consists in general of the variations in amplitude of the carrier C.W. of constant frequency. Hence, if the damping coefficient is not a function, *inter alia*, of the amplitude, both high and low musical notes should be damped out in the same ratio, that is to say, in wireless transmission of telephony, capacity damping ought not to affect the clearness. A recent article in *The Wireless World and Radio Review* shows that this is not so if the carrier wave is long, but as we are dealing with waves of 400 metres the statement is closely accurate. This deduction does not apply to iron-cored transformers. My experience does not however bear out this deduction. Everyone who has listened-in with these coils on my own set agrees that the absence of distortion is distinctly marked, and this has been found so by trying them on certain others.

On some the improvement is not much, but it is impossible to dogmatise, as so many other conditions enter into consideration. It is, however, clear that here is a matter on which every amateur can experiment for himself, and, with a view of helping those who would care to experiment, I have brought here the rough instrument on which all my latter coils have been wound, and I will be pleased to show it to anyone after the meeting as also the different types of tapping details I have tried.

Besides these main points there are others, which I will briefly enumerate.

The tuning is extremely sharp. Without using the silent point method of elimination, I have tuned out GNI as against OST, and *vice versa*.

The high damping resistance factor alone blots out such long-wave jamming stations as FL. The difference in this respect between the 26 and the 40 gauge coils is very marked.

I do not know if during this year atmospherics have existed. With the exception of a very few evenings, when heavy thunderstorms were close, I have not heard an atmospheric for months.

They are more difficult to get to oscillate, but not inordinately so. You see how small a reaction is needed down to 300 metres. Lower I have not yet tried. This property is a valuable asset in circuits prone to oscillation, as is mine.

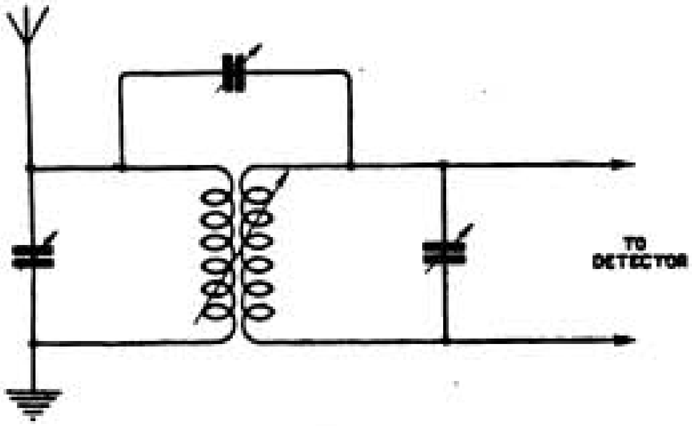


Fig. 5.

I will now return to the electrostatic coupling of Stanley, Vol. I, p. 359, and Vol. II, p. 92. Fig. 5 needs no explanation. The variable condenser must be very small indeed, *i.e.*, a billi, in dealing with wavelengths of 1,000 and under. I have not tried it on higher. Its effect is precisely the same as that of my static couplers, and gives a third alternative method of working. In this method the mechanical coupling may remain fixed, and the jamming station eliminated by varying the small coupling condenser. However, in Stanley, Vol. II, p. 93, it is pointed out that the variation of this condenser alters the wavelengths of both coils. To a certain extent this is also the case, if the metal connection between my couplers is made or broken, as the case may be, but so far as my experiments have gone the alteration in the former method is considerably larger than the latter, and therefore in practice it requires more care and trouble in adjustment of the tuning condensers. Again, in using this form of coupling I have found FL much more liable to break through, nor is this surprising, because the oscillations forced on the aerial are but little affected by the tuning of the A.T.I., and we have, more or less, through this coupling, a single circuit working, through the secondary coil, and therefore just as liable to jamming as is the case of the plain single coil reaction circuit. In this matter my experiments have been few, because as soon as I got FL breaking through, which never happens with the other form of static coupling, I gave it up, and it is possible that under different circumstances these defects may vanish. It is a very easy matter for anyone to try for himself by joining the aerial terminal to the grid through a variable billi condenser, taking care that the magnetic coupling between the reception coils is in the right sense, as indicated above.

As a last example of the use of either of these methods of electrostatic coupling, I will refer to a point raised in this room some months ago when the lecturer spoke of intervalve transformers which do not transform, and of the reactance capacity coupling. Contrast Figures 6 *a*, *b* and *c*. Are not (*a*) and (*b*) both modifications of (*c*) ?

In (*a*) the two coils of (*c*) are coupled as tightly as possible with or without tuning.

In (*b*) the second coil and condenser (*c*) are cut out and replaced by the simple plate of a second condenser, the two condensers in series thus formed being replaced by their equivalent single condenser, or *vice versa*. Diagram (*c*) is an extension of (*b*), in that the condenser of (*b*) is made tunable. Here both coils being of identical inductance, and placed well apart, the two condensers can be equal and manipulated similarly by one handle, so that with no more trouble in tuning in than is the case with (*b*) we get a doubly tuned anode circuit, with its consequently increased selectivity. We might even go further by making the coils of (*c*) right and left-handed, though otherwise identical, and by placing them in mutual magnetic inductive relationship. Our main reception could then be made by the usual type of loose-coupled coils, and if a very strong local station persists in breaking through all the four tunings, it might be possible to get rid of it by pushing the coils of (*c*) closer together. I have not yet had the time to try this and put it forward as a suggestion. Perhaps those in the shadow of **GFA**, may find the time and the desire to experiment in this direction.

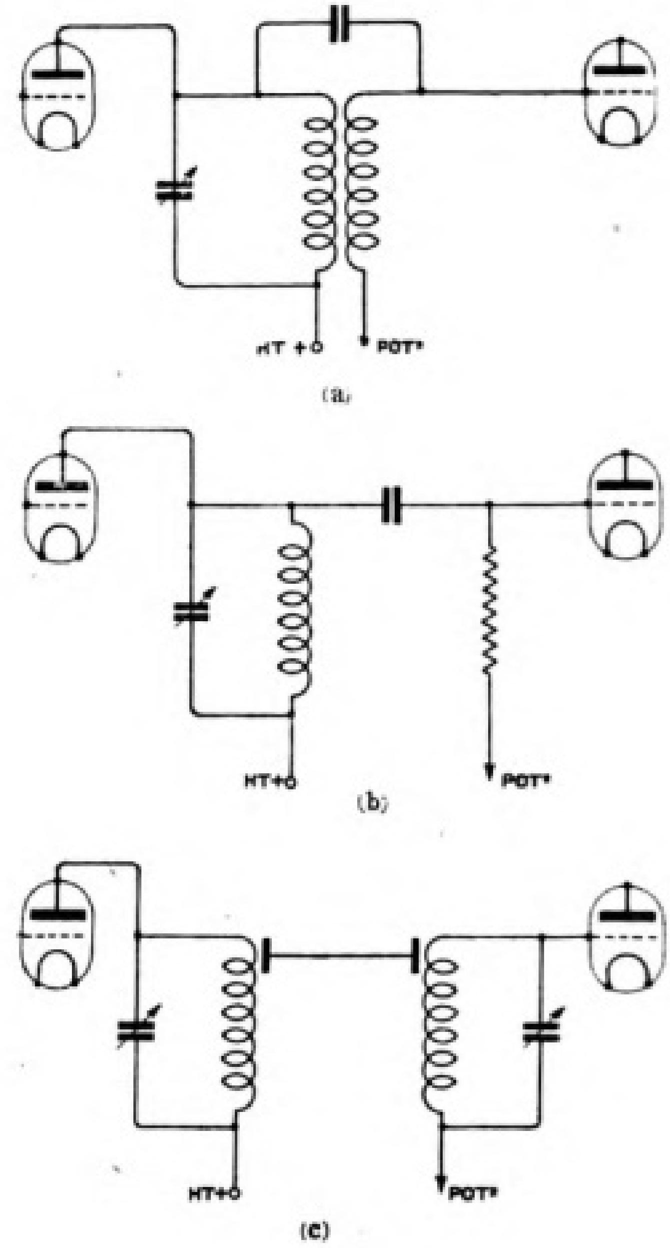
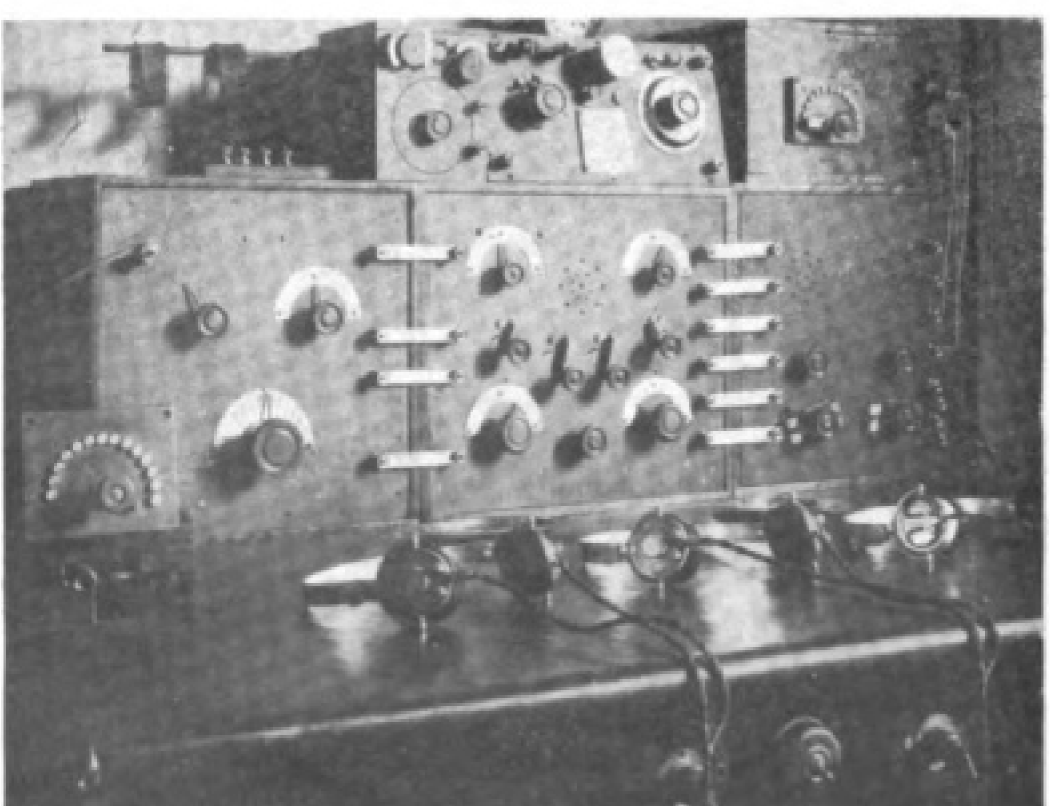


Fig. 6.



A Liverpool Amateur Station

By C. G. WILLIAMS

The general arrangement is shown in the accompanying photograph. The panel on the left is the tuner and by means of fifteen honeycomb coils covers a range of wavelengths from 200 to 35,000 metres. A Townshend wavemeter seen above the tuner is useful for finding adjustments up to 3,000 metres. The detector panel is in the centre and is provided with a number of adjustments giving critical control. On the right is a two stage low frequency amplifier. Other than the telephone receivers all of the apparatus is homemade. The outfit gives very good results, the longest range being **NPO** 9,000 miles away.

Notes on the Design of Closed Coil Receiving Sets*

By J. HOLLINGWORTH, M.A. (*of the National Physical Laboratory*).

THE use of a closed coil and amplifier for reception, often a very convenient method where space is a consideration, involves, if efficient working is to be obtained, many problems, some of which are not always fully appreciated. Limitations are, of course, often imposed by the space or apparatus available for the purpose; but if this is not the case there is a very wide range of possibilities, and it is important to make a correct choice.

Generally speaking, the rule has been to use as large a coil as space would permit, with as many turns as possible, in order to pick up the maximum amount of energy, and to use stranded wire in order to reduce the resistance loss.

It is often noticed that such coils do not come up to expectations, particularly in the matter of stranding. The type of wire employed sometimes does not appear to make any difference at all to the strength of the received signals. Also it is not easy to tell whether the coil is working efficiently on all wavelengths. It is possible to make adjustments so that maximum signal strength is received from any particular station, or even from all required stations, but this is in itself no test of whether the coil is giving the best possible result at all wavelengths for a given e.m.f. induced in it.

Measurements of amplification on the amplifier alone are liable to give meaningless results when applied to a coil set; the coil and amplifier are one unit and cannot be dealt with separately. Figures obtained for the amplifier alone cannot be applied to the complete set without making sure that the constants of the coil are unaffected by the inclusion of the amplifier. This may be stated in another way by saying that it is impossible to neglect the power absorbed by the amplifier. It may be, and generally is, extremely small, but it must be remembered that the volts applied to the amplifier are produced by the resonance of the receiving inductance, and so may be several hundred times greater than the actual induced e.m.f. Losses produced by these resonance volts will, in consequence, have a correspondingly great effect on the circuit.

It is often assumed that, provided the grid of the first valve is made sufficiently negative, amplifier losses can be disregarded. In as far as they are caused by steady grid current this is true, but the latter may not be the only, or even the chief source of loss.

The problem of these losses was not originally undertaken as a separate investigation. It arose out of experiments made to determine by means of a coil and amplifier the potential gradient produced by a distant transmitting station. In the course of this work it was found that the discrepancies between the measured and the calculated results were so great that it was essential to enquire into their cause and possible elimination.

The method of measurement was in brief as follows:—A coil and condenser of known values were connected in the ordinary way to a four-valve resistance amplifier, and the effect of the incoming signals on the latter measured. The receiving set was then disconnected, and the amplifier joined to a local calibrated circuit, oscillating at the same wavelength, by means of a variable aperiodic coupling, which was then adjusted until the effect on the amplifier was the same as before. It was the fact that this coupling was aperiodic which brought out the effect.

In the usual method by which the known oscillation is induced directly into the receiving circuit, the term involving the resistance of this circuit does not appear in the subsequent calculations. The aperiodic coupling had been deliberately adopted so that there should never be more than one tuned circuit in existence at the same time. The e.m.f. induced in the receiving coil is in this case calculated as follows:—Since the two circuits produce the same effect on the amplifier the e.m.f's they impress on its terminals must be the same. From the calibrated circuit the value of this e.m.f. E say, could be found. Then if L is the inductance of the receiving coil, S the tuning capacity and R the resistance of the circuit (assumed to be entirely in the coil), the actual e.m.f. induced in this coil by the incoming waves is

$$\frac{ER}{\sqrt{R^2 + p^2 L^2}}$$

(In general pL is large compared with R so that this reduces to $\frac{ER}{pL}$

As a test of this, e.m.f.'s of known value were induced in the receiving coil from another oscillating circuit about 30 feet away, arranged in such a way as to permit of easy calculation of the mutual inductance. They were also measured by the method described above, with the following results (see Table 1), showing that actually a very small percentage of the received energy was being usefully employed.

A further series of tests using currents of sufficient size to give direct readings on a reflecting thermogalvanometer, showed that these losses occurred as soon as the filament current of the amplifier was switched on, showing that the trouble was in the amplifier itself.

Making the grid of the first valve more negative

* Received April 24th 1922, and published by permission of the Radio Research Board.

TABLE I.

Wavelengths metres.	Ratio $\frac{\text{measured e.m.f.}}{\text{calculated e.m.f.}}$
2,500	0·038
4,000	0·091
5,000	0·18
8,000	0·39

only reduced the effect slightly, and it could also be seen from the slope of the grid characteristic curve that grid current effect could not account for losses of this magnitude.

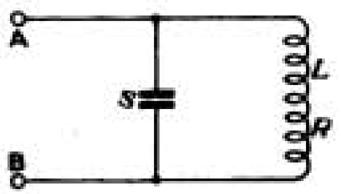


Fig. 1.

Now in the circuit of Fig. 1 if an oscillating e.m.f. E be induced in the coil and the circuit tuned, the current is E/R. If a high resistance R_1 be then connected between A and B two effects occur.

(1) The set requires slight re-tuning.

(2) The current in the coil decreases considerably. With quantities of the order involved in this problem (1) is negligible, but assuming the re-tuning to be carried out the current becomes :—

$$I = \frac{E}{R + \frac{L}{SR_1}}$$

Now most coil sets are tuned by varying S, keeping L constant, so it is convenient to eliminate S from the above. If R_1 is large we have very nearly

$$LSp^2 = 1$$

Hence

$$I = \frac{E}{R^2 + \frac{L^2p^2}{R_1}}$$

i.e., the set behaves as a simple circuit with an effective series resistance.

$$R + \frac{L^2p^2}{R_1}$$

Under wireless conditions Lp is usually large (in this case it is 3,400 at 2,500 metres) so that, even if R_1 be of the order of a megohm the second term may swamp the first term R, which is the normal high-frequency resistance of the wire forming the coil. (Incidentally this shows that insulation resistance may be an important factor in all circuits involving high frequency oscillations.)

There appears very little doubt that this is often the cause of no visible improvement being effected by stranding the wire, since the wire resistance may only be quite a small part of the total effective resistance. Curve C (Fig. 2) gives the apparent resistance of the circuit as calculated from Table I, and this works out to be roughly equivalent to a resistance of 50,000 ohms between the grid and filament of the first valve. Now the loss due to grid current was found from the grid characteristic to be certainly the equivalent of not less than 500,000 ohms; so that this can only have contributed to the loss in a small degree as confirmed by actual experiment. But it has been shown by Miller (*Scientific Papers of the Bureau of Standards*, No. 351, November, 1919) that it is not possible to neglect the inter-electrode capacities of a valve, and that the general effect of them is to transfer some of the energy supplied to the grid circuit into the anode circuit, where it may be dissipated. In general he shows that a valve with a resistance in the anode circuit can be represented as regards the grid circuit by a resistance in series with a condenser, while a valve with an inductance in the anode circuit is equivalent to a condenser in series with a negative resistance which may lead to regeneration, though in the latter case the equation for an inductance to give regeneration is not always soluble in real terms.

Formulæ are deduced for calculating these quantities. Now these inter-electrode capacities are very small, of the order of 5 to 10 micromicrofarads. They are in consequence liable to considerable variations, depending not only on the design of the valve, but also of the valve-holder, and to a certain extent on the general layout of the amplifier. Thus their effect cannot be predetermined to any high degree of accuracy. Typical curves are given by Miller which show that for an

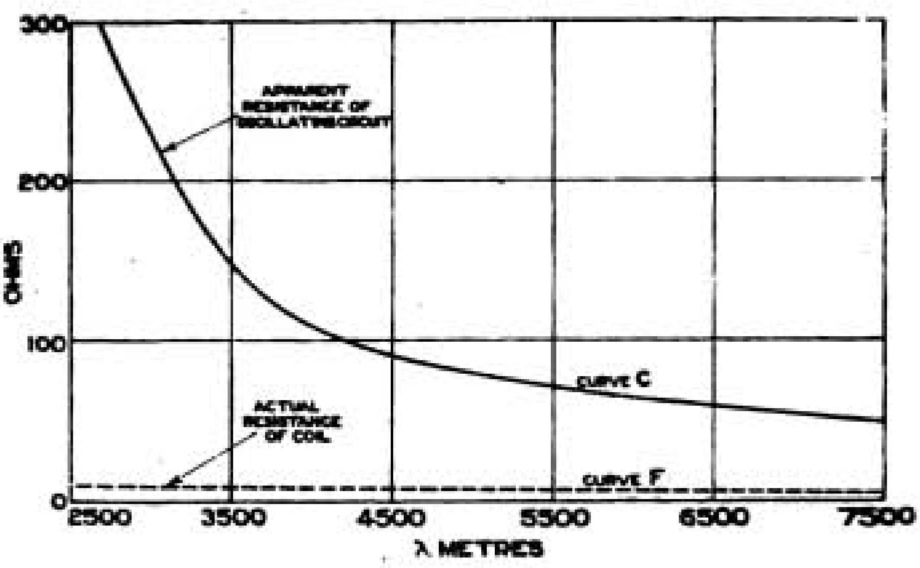


Fig. 2.

anode resistance of 90,000 ohms as used in these tests the equivalent capacity and series resistance are about 85 micromicrofarads and 10,000 ohms respectively. This agrees fairly well with the figure of 50,000 ohms with no series capacity given above. If this be the correct explanation it should be possible to eliminate this effective grrid leak by inserting inductance in place ofthe resistance in the anode circuit of the first valve.

The general implication from Miller's results is that a transformer amplifier should be used; but there are objections to this in some cases. As is well known with such amplifiers, there is the problem of stability, which is of maximum importance wherever measurements are involved. Also a transformer amplifier can be made extremely efficient for one particular wavelength range, but the falling off in amplifying power with increase of wavelength is very serious. A resistance amplifier on the other hand increases in amplifying power as the wavelength increases, but has this trouble of large losses at the lower end of its range. As the trouble is, according to Miller, principally due to the anode circuit of the first valve, the compromise suggests itself of using a transformer between the first two valves and leaving the remainder resistance coupled. The amplifier was accordingly reconstructed on these lines.

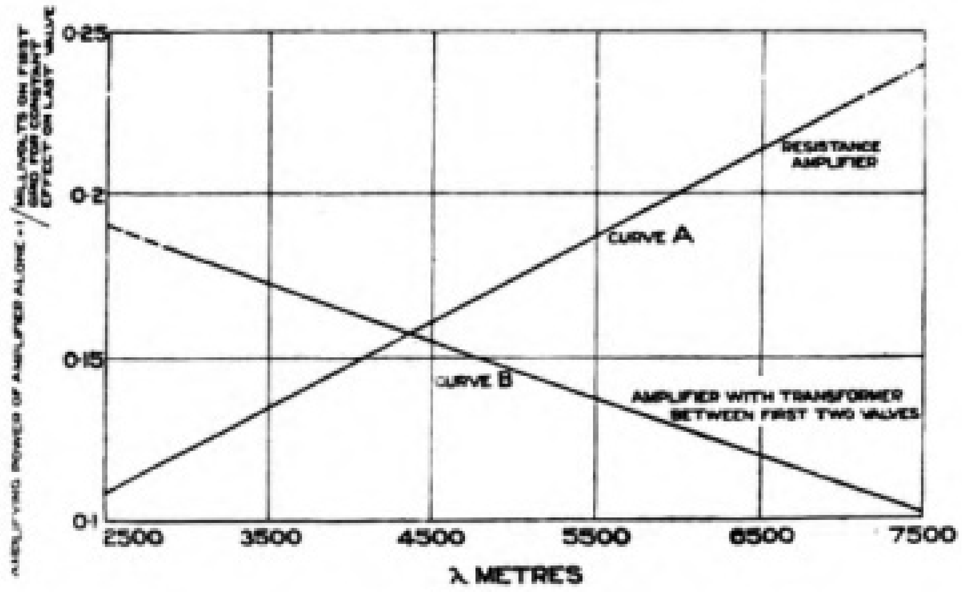


Fig. 3.

The effect of the alteration on the pure amplifying power is shown in the curves A and B (Fig.3), the ordinates being the reciprocals of the voltage required to maintain a constant effect at all wavelengths on the last valve of the amplifier.

It will be seen that in the reconstructed amplifier the amplifying power is greater than that of the original for wavelengths below 4,400 metres, but less above this value. But when connected to the coil set the difference between the new and the original arrangements is very great.

At 2,500 metres the set oscillated but could be stabilised by the insertion of resistance. At higher wavelengths this was unnecessary, and the apparent resistance fell to practically the high frequency resistance of the coil (curve E, Fig. 4). Comparing this with curve C (Fig. 2), it will be seen that, even if considerable resistance be deliberately inserted for the sake of stability, the gain is still very large, except perhaps at the top of the wavelength range. On 2,500 metres the set was perfectly stable, with an added resistance of 54 ohms, and with 24 ohms was moderately so, though not enough for the particular purpose required.

The total result on the whole set is given by curves D and E (Fig. 4), which show the e.m.f. which must be induced in the coil at various wavelengths to produce a constant effect on the amplifier. It will be seen that with the reconstructed amplifier the overall efficiency only varies in the ratio of 1 : 2 between the working limits; whereas the variation with the original amplifier is about 1 to 5, and the new one is more efficient throughout. About 8,000 metres the original certainly comes out more efficient, but if much work had to be done at wavelengths above this value it would be preferable to use another coil with a larger number of turns, and possibly a different transformer in the amplifier.

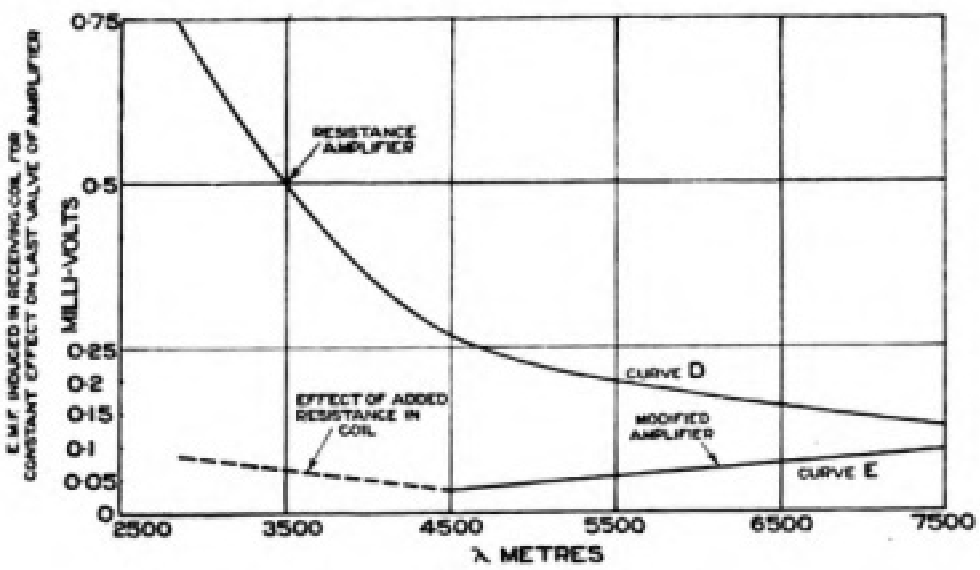


Fig. 4.

Effect of these results on the Design of Coil Sets.

The first deduction from these results appears to confirm the idea that within reasonable limits the size of wire on the coil is a matter of minor importance. It is evident that it only becomes a deciding factor when the losses in the amplifier are negligible. This implies a transformer at any rate between the first two valves, and if this be designed so as to make the apparent resistance of the set practically zero, the set will be extremely unstable and liable to oscillate at the least provocation.

Moreover, the apparent resistance of such an amplifier is slightly dependent on wavelength, so that even if it were possible to design the set so as to have the apparent resistance a definite small positive quantity (which would be very difficult since the quantities involved are not known to a high degree of accuracy) the amplifier would probably require readjustment for each wavelength.

For reliable stability it appears that a certain amount of resistance is necessary, which may just as well be incorporated in the wire as added separately.

Where a transformer is used, even if the apparent resistance of it is intentionally kept slightly positive, it is evident that there will not be the same objection to working near the lower limit of the wavelength range as in the case of the resistance amplifier. A complication is, of course, introduced by the self capacity of the transformer winding, which may tend to produce instability at some particular wavelengths.

The main object in design is to keep $R + \frac{L^2 p^2}{R_s}$ as low as possible consistent with satisfactory working. This involves so many options that it is impossible to give a general rule. It is, however, evident that it is always an advantage to use coils of as large an area as circumstances will permit, as by doing this the ratio area-turns/inductance can be kept up, and consequently larger induced e.m.f.'s obtained for a given value of L.

With a pure resistance amplifier as large a value of tuning capacity as possible should be used as until $\frac{L^2 p^2}{R_s}$ comes down to the order of R the inevitable loss of area-turns is more than compensated for by the reduced apparent resistance.

November 18th, 1921.

Wireless and Crime

THE VALUE OF THE WIRELESS TELEPHONE AS AN AID TO POLICE INVESTIGATION

ON Friday, June 2nd, a demonstration of the possibilities of the wireless telephone as an aid to the police was given at the Annual Meeting of the Chief Constables and Police Representatives of England and Wales held at the County Hall, Spring Gardens. The demonstration was organised by the *Daily Mail* and the technical side was conducted by the Marconi Company, transmissions taking place from their station at Marconi House. The demonstration consisted in despatching from Marconi House (which for the purposes of the experiment played the part of transmitting and receiving station) messages to a detective officer somewhere in Essex, who used a portable receiving station, the instruments being packed away in a small suitcase and the aerial supported by a fishing-rod.

The programme consisted in the transmission from Marconi House of messages to the detective officer in Essex, who, of course, represented only one of the whole mobile detective staff of a county or area. The message broadcasted from Marconi House was a description of a man wanted for fraud and the Chief Constables at the County Hall, Spring Gardens, heard this message with the aid of a loud speaker. Shortly afterwards an announcement from Marconi House was also given that the Detective in Essex had received the message in his car and had acknowledged by ordinary telephone. Two messages were put through to the detective in this way and the replies came through by wireless telephone from Marconi House within an extraordinarily short space of time.

Mr. E. Blake, A.M.I.E.E., of the Marconi Company, lectured on "Wireless and Police Work" to the audience at the County Hall and it was whilst this lecture was in progress that the results of the demonstration as it progressed were received by wireless telephone from Marconi House. Mr. Blake in his lecture dealt first in general with wireless telegraphy and telephony in its application to communications and referred to directional wireless and in particular to the work recently disclosed by Mr. C. S. Franklin, at the Institution of Electrical Engineers, in a paper describing short wave directional wireless. Referring to the application of wireless telephony as an aid to the police, Mr. Blake said :—

In the ideal scheme, I suggest, there would be a chief station at Scotland Yard, so equipped that when it is necessary, (as I, a layman in these matters, suppose must be fairly often), it can communicate simultaneously with the office of every Chief Constable in the kingdom. This presupposes a receiver, at least, in every such office, and a detailed scheme for listening-in, or some kind of alarm-bell which would call each constable on duty to the receiver.

Another need, I presume, would be to link up each central police station with the outlying stations in its area. Let us assume that the Chief Office of a police area is equipped with wireless telephone, and further, that it is desired to convey a message to every other police station under the control of that office. Now, if there is available the necessary staff, standing orders can be issued that each outlying office is to "listen-in" on the wireless receiver at a certain time, in order to receive information or instructions, say, the first ten minutes of each hour, night and day. If there is not sufficient staff available at the outlying stations, then there is obviously a need for the installation of an apparatus which, on a signal from the Central Station, will ring an alarm-bell, causing someone to attend to the apparatus at once—just like a doctor who can be called up by wire telephone at any hour of the day or night.

Suppose it is required to ask all the police in a given area to look out for a motor-car with a certain number or of a certain make, or to detain a man with certain characteristics. The Chief Constable's Office will make a signal which will ring a bell in every police station in its area, and then give its instructions by wireless telephony.

Having foreseen the necessity of a calling-up device in connection with any extensive system of wireless telephony the Marconi Company has introduced the Wireless Bell, which is an automatic device operated by a distant transmitter and performs in a simple and efficient manner the same function as that of a call-bell on the ordinary land line system. It is insensitive to all signals except those actually intended to operate it.

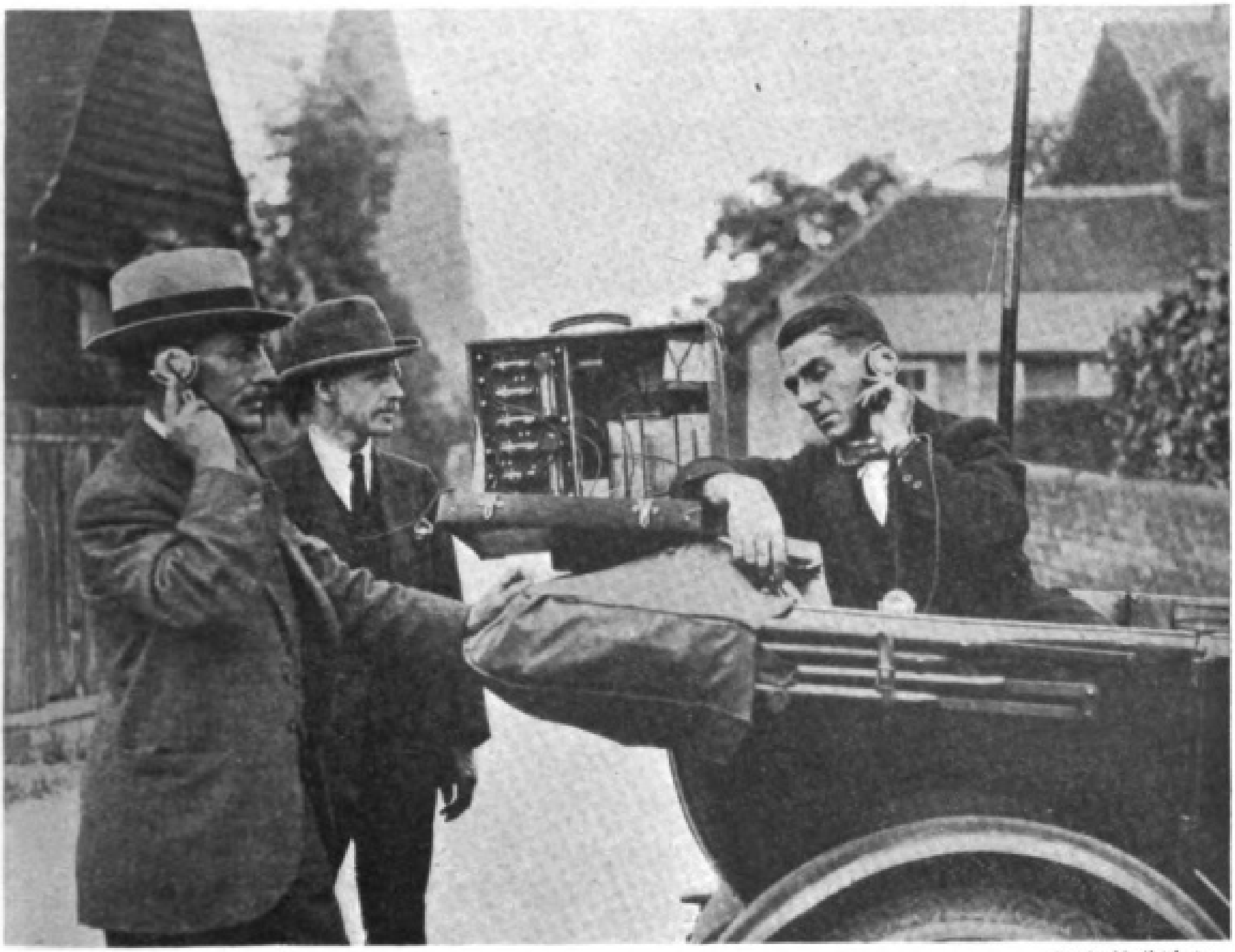
The "general call" is sent out by one simple movement of a handle. When the signal is completed the handle reverts to its original position without human assistance.

At the receiving end, the receiving telephones are hung on a special rest, this automatically putting the call-receiver in a stand-by position, ready for registering a call.

In brief, the arrangement I have outlined would permit Headquarters to get as many constables as it wanted on the road in five minutes from pulling the handle of the call-bell transmitter.

For more than a year this system has been in use between the offices of the Mersey Docks and Harbour Board in Liverpool and the Bar Lightship outside the mouth of the Mersey.

Another possible system would be the installation of the Marconi Duplex Wireless Telephone. This system permits of uninterrupted conversation between two stations, just as in line telephony. In simplex wireless telephony, neither party can break in on the other. One party speaks and ends by saying "changing over." He then switches over to receive, whilst the other party switches over to "send," and when he desires a reply he also says "changing over" and the reversal takes place again. But a Duplex system allows for a rapid and unhampered conversation without the necessity of constantly switching over between "send" and "receive."



Daily Mail Photo.

Receiving the Broadcast message in an Essex village.

When the call signal is sent from the central station the call-bell is set in motion and continues to ring until the telephones are removed from the hook, whereupon the "call" receiver will automatically be put out of action until the telephones are again hung up.

Assuming that all the call-bells have been actuated and attended to, the central station would then proceed to broadcast its message in the usual way. Acknowledgment of the message would, or could, be sent back to Central by each station in order, according to service instructions, which would have to be worked out in detail when the system is installed.

The operation of the apparatus is extremely simple and "fool-proof" once the set has been installed by a competent engineer. Means can be provided whereby complete control of the set is effected from any distance up to about 50 yards, thus eliminating the noise of running machinery. In this case the only apparatus required at the operating table consists of the headgear telephones, the transmitter and one switch.

The range obtainable is dependent upon local conditions and the power input. In most cases, however, a range of 20-30 miles may be expected, these figures being well exceeded under favourable conditions. As an example, if the range is about 20 miles, a simple sum in mensuration shows that the station can operate over a roughly circular area of about 1,200 square miles. Sets operating with higher power, can, of course, be designed.

So far we have explored only the possibilities of fixed stations. Let us now consider a system consisting of one fixed station and any number of mobile stations. As I have explained, the power of the fixed station determines the extent of its effective working area. In any case we may assume that the mobile stations would be equipped with receivers of sufficient delicacy to meet all the demands of the particular service they would be called upon to perform.

The requirements of the fighting services, especially during the war, have been such that efficient, simple, robust, self-contained, wireless sets have been fitted to well-nigh every kind of vehicle, to pack-animals, aeroplanes, submarines, and to the man himself. I do not think, however, that a wireless telephone transmitter has been adapted for human portage; to fit a receiver to a man, is, however, simple.

For police work telephone sets, both for sending and receiving, can be fitted in motor-cars or to motor-cycles with side-carriers. For reception, only light portable frame or fishing-rod aerials can be carried with ease; for sending, it would be necessary to have the aerial wire on a reel, as in aeroplane sets, so that it can readily be unwound and the end elevated to a tree or lamp-post. You will probably recall that a few years ago the Marconi Company demonstrated for the London Fire Brigade how a set carried on a motor vehicle can get into touch with its headquarters within a few minutes. The car was driven to Putney Heath, the aerial was tied to a convenient tree, and excellent wireless telephone communication was established with a fire station at Southwark. During its return journey, the car was run up a side street, the aerial tied to a lamp-post and communication again established with Southwark.

Daily Mail Photo.

The Portable Set with "fishing rod" aerial in use in rural surroundings.

On one occasion it was demonstrated how a motor-bus could tour the Essex roads with a frame-aerial fastened outside it, flat against the body; music and speech were well received from Chelmsford whilst the bus was in motion.

The adaptation of wireless telephone sets to vehicles presents no special difficulties now; indeed the problem has already been solved for most cases.

The so-called "pocket sets," I regard as interesting toys. Certainly it so happens that I have never used one, and I am not in possession of any information as to the success with which they have met in the hands of the Chicago police, who are reported to have tried them. The possibilities of a suitcase set have already been demonstrated, but then the carrying of a suitcase reduces the mobility of the carrier.

The specification that the set has to be highly portable—worn like a knapsack as a part of the normal equipment—at once determines several other things. For instance, it means that the aerial must be small, and the smaller the aerial the less electrical energy it can pick up. If we wish to counteract that drawback by making the receiver more powerful, we are again confronted by difficulty, for if the receiver is not to be an intolerable burden to the man, it must be light and small. Unfortunately, the more powerful the receiver the larger and heavier it is likely to be. Boiled down, these considerations show that the designer of the set would have to strike a mean between its performance and its portability. Probably the reception range of a "pocket set" would be little more than a mile or two, and there would be no possibility of the user acknowledging the message. Speech could be heard, however, over a distance of 30 miles, on a portable receiver weighing not more than 10 lbs., using a fishing-rod as an aerial. The rod could be 15 feet long when open and three feet long when closed. For this the power of the transmitting station would have to be about 1½ kilowatts. A receiver of this weight would, I presume, be too heavy to form part of the regular kit, but would be quite suitable for special excursions, when an officer had to report to headquarters after investigating a case.

With a fairly cheap, simple, light receiver, however, such as might be carried in a leather case by slings, after the manner of binoculars, it would be possible to receive messages from ten miles or so, if a large aerial were available. To meet this difficulty I suggest that it would not be at all impracticable to erect special "police aerials" in various parts of a large town and at suitable places along country beats, all of which would be known to each officer. Standing orders might provide, for instance, that every officer on duty shall "listen-in" at the nearest aerial once every hour, or two hours in districts where the aerials are more scattered. The aerial and earth terminals would be placed in a small locked box attached to the aerial pole and each officer would have a key. All he would have to do would be to open the box, connect the aerial and earth terminals to his receiver by means of two brass plugs, and listen in his telephone receiver for the stated period—say, five minutes—afterwards re-locking the box.

It is only by some such arrangements, I think, that a very small light receiver could be made of real use. The idea I have just explained might be extended to permit officers on duty to converse with headquarters, by setting up the aerials and small huts like the Post Office public telephone boxes, containing a wireless transmitter. That is quite a practical suggestion, though costly to carry out.

I now come to what, in my opinion, is the root of the whole subject. Wireless telephony conversation can be intercepted not only by those legitimately concerned, but by anyone else within range, including criminals and their accomplices and tools. Innocent amateurs within range would overhear police instructions and would be tempted to gossip or flock down to the scene of the crime. The veil of secrecy behind which the police work would be rendered rather transparent by wireless telephony. Only routine matters and others of no particular secrecy could be confided to the æther. You yourselves are the best judges of what should be broadcasted, but there would probably be scope for grave errors of judgment on the part of your subordinates.

What then is the way out of the difficulty? I can only offer a partial solution of the problem. You can have recourse to code, but that would prohibit conversation, or, at best, would render conversation slow in the extreme. Instructions needing no reply, however, might be in spoken code, which could be changed from time to time. You might transmit on a wavelength such that the number of casual listeners who might hear you would be very small. But the use of code and wireless telegraphy instead of telephony, so that Morse code signals instead of speech is transmitted, would ensure much more secrecy, because it is certain that in future the majority of people holding licences for wireless reception will be unable to read Morse, having acquired their instruments solely for the purpose of listening to wireless telephony concerts.

Where, however, the police authorities desired the fullest publicity and wished to enlist the help of the public, descriptions of "wanted" persons could be broadcasted by telephony far and wide and would inform thousands of people who might miss the same printed in the newspapers. In this case, in fact, wireless might leave the fugitive from justice very little chance indeed.

The Size of Wire to Use

THE inexperienced constructor should remember when deciding the size of wire for his tuning coils that what he must seek to achieve is a satisfactory compromise between the two opposing considerations of efficiency and compactness. The finer the wire used, the smaller the coils, but also the higher their resistance, and therefore the greater the damping of any tuned circuit in which they are connected. Now damping is a great enemy to efficiency, for it reduces not only signal strength but also the sharpness of tuning, thus increasing trouble from jamming. Hence the importance of the satisfactory compromise.

The actual gauge of wire to use depends to some extent upon wavelength, since short wave coils are not very large and can therefore be wound with wire almost as thick as one chooses, while a thinner size must be used for the long wave coils, lest they become excessively bulky. Suitable sizes for aerial circuit coils are as follows :—

300 to 1,000 metres, No. 20 or 22.
1,000 ,, 4,000 ,, ,, 24 ,, 26.
4,000 ,, 20,000 ,, ,, 28 ,, 30.

Secondary circuit coils :—

300 to 1,000 metres, No. 22 or 24.
1,000 ,, 20,000 ,, ,, 28 ,, 30.

Reaction coils, No. 30 for all waves.

Where compactness is particularly desired, use the finer of the alternative gauges, and where efficiency is the first consideration, use the thicker.

G. P. Kendall.

Time Table of Transmissions of the Eiffel Tower Wireless Station.

The Eiffel Tower gives continuous wave transmissions with a certain number of European Correspondents. The service is conducted in duplex, reception by the Correspondents being checked by the Central Military Listening Station of Nogent le-Rotrou or the Central Listening Station of the Administration of Posts and Telegraphs, at Villejuif.

The times of these transmissions are given in the following table, together with those conducted on spark.

Times of Transmission G.M.T.	Type of Transmission from Eiffel Tower.	Call Sign of Correspondents.	Type of Transmission of Correspondents.
0220	2,600 metres Spark	**C Q** (Meteorological message for France)	
0300	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
0415	3,200 metres Arc	Naval Stations	
		FUD (Dunkerque)	
		FUC (Cherbourg)	1,350 metres Spark
		FUN (Lorient)	
		FUR (Rochefort)	
0420	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
0700	3,200 metres Arc	Naval Stations	
		FUE (Brest)	4,500 metres Arc
		UA (Nantes)	6,750 metres Arc
0820	2,600 metres Spark	**C Q** (Meteorological message for France)	
0835	3,200 metres Arc	**PRG** (Prague)	1,700 metres Valve
0923	2,600 metres Spark	**C Q** ordinary international time signals (automatic)	
0958	2,600 metres Spark	**C Q** Scientific time signals (beats)	
1033	2,600 metres Spark	**C Q** **URSI** signals and semi-automatic time signals (French)	
1100	8,000 metres Arc	**NTT** (American ship in the Black Sea)	
1130	2,600 metres Spark	**C Q** (European meterological message)	
1205	3,200 metres Spark	**C Q** (Press)	
1300	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
1420	2,600 metres Spark	**C Q** (Meterological message for France)	
1500	6,500 metres Arc	**BUC 2** Bucharest	7,300 metres Arc
1705	3,200 metres Arc	Naval Stations	
		FUA (Bizerte)	5,150 metres Arc
		FUT (Toulon)	
1710	2,600 metres Valve	Wireless telephony meteorological forecast	
1745	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
1920	2,600 metres Spark	**C Q** (Meteorological message for France)	
2130	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
2158	2,600 metres Spark	**C Q** (Scientific time signals)	
2205	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
2236	2,600 metres Spark	**C Q** (Semi-automatic time signals)	
2250	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc
2315	8,000 metres Arc	**UAB** (Beyrout)	6,100 metres Arc
2325	6,500 metres Arc	**BUC 2** (Bucharest)	7,300 metres Arc

How to get the Best from Your Set

HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.

(Author of "The Maintenance of Wireless Telegraph Apparatus".)

(2) CRYSTAL RECEIVERS—*Continued.*

THE carborundum detector will probably be popular in broadcasting receivers. In this a crystal of carborundum is pressed against a piece of polished steel. The pressure in such cases should be quite firm, and the steel surface must be entirely free from rust, dirt and grease. If the steel surface is found to be rusty, it can be repolished with fine emery paper.

The carborundum detector is a very robust device, and if good crystals are used, a high degree of sensitiveness can be obtained. To get the best results a couple of dry cells and a potentiometer are needed, so that the electrical pressure applied to the crystal can be carefully adjusted. A new pattern carborundum detector has recently been devised in which an adjustable potentiometer is unnecessary.

A potentiometer needs occasional attention, and may be the cause of unsatisfactory working. The sliding portion must make good contact with the wire, but must be free from roughness, or the fine wire on which it rubs will soon be cut through. If these points have been attended to and signals are still not satisfactory, a disconnection in the wiring of the potentiometer may be the cause. Dirt and corrosion on the bare wire are also fruitful sources of trouble.

If a crystal receiver is not provided with a cover, never leave it open to the dust. It is well to keep a soft camel-hair brush (reserved for this purpose alone) to remove any dust that may settle upon the crystal surface. For obvious reasons the type of detector which is enclosed has much to recommend it.

Most crystal receivers are provided with a simple tuner consisting of a coil of wire, the number of turns in circuit being controlled either by stud switches or by a slider running over a section of the coil which has been freed of insulation. For fine tuning a condenser may be added. Better sets have inductively coupled circuits, which, again, may have sliders or stud switches on both primary and secondary windings. Usually such sets are fitted with variable condensers. Tuner troubles (apart from disconnections of the wires) usually resolve themselves into imperfect contact between the sliders and the wire, or between the switch blades and the studs. If the slider is not making good contact, it is practically impossible to rectify the fault whilst the slider is *in situ*. Unfortunately, some of the cheapest sets are so made that the removal of such a part is difficult.

Actual disconnections frequently occur at the point where the moving portion of a switch is connected to a wire. In the best sets the connection is made by a rubbing contact. In cheaper sets a flexible wire is simply soldered to the spindle of the switch and is a common source of trouble.

The resoldering of connections in a wireless receiver calls for considerable care. Flux must be used very sparingly, if at all, and must be of the non-corrosive type. In any case it must not be allowed to run over the ebonite or it may form a film which is in effect a high resistance leak and may cause serious loss of signal strength.

There is one particular difficulty connected with the soldering of connections in wireless apparatus which gives much trouble to the beginner in instrument making, and may disagreeably surprise any man who attempts to repair apparatus. If, for example, a switch stud requires a lead soldered to it, use a very hot soldering bolt and apply it to the stud for a minimum of time. If the stud gets thoroughly heated it will probably loosen, no matter how carefully the locknut may have been tightened beforehand. This is due to the softening of the ebonite under heat. The trouble can only be avoided by the method indicated above.

Some cheap receivers have their coils wound upon unsuitable formers which shrink and cause the windings to become loose. This particularly applies to formers of cardboard, which are never satisfactory, save when very carefully baked and impreganted before winding. All good receivers have their coils wound on tubes of ebonite, bakelite, or one of the newer insulating materials which do not shrink. Well seasoned mahogany is also a good material. In cases where the windings become loose, the only satisfactory remedy is to take out the old coil and wind a new one.

From the list of faults indicated above the reader will have gathered that a cheap crystal receiver may prove expensive in the long run. The list will also give some indication of what to look for in choosing a crystal set.

(3) WANTED: WIRELESS SERVICE STATIONS

Even at this stage of the wireless boom, there is a great need for "wireless service stations" in all the leading towns. Such stations can be easily organised by keen electricians who are also wireless men. I would like to see one such station in every locality where there is a wireless society.

A wireless service station should first of all have full and adequate facilities not only for charging accumulators promptly, but also for maintaining them in good order. At the present time there are a number of garages who will charge accumulators at a reasonable fee, but usually the amateur has to wait his turn, and nothing is more annoying than to be without an accumulator on an evening when a concert is to be broadcasted. The wireless service station must therefore be able to guarantee delivery of the charged accumulator at a definite time.

Two other forms of service are also of great importance. The first relates to the erection and maintenance of aerials (this can probably be arranged in connection with the local builder who will be able to supply ladders, etc.). The second relates to the measurement and calibration of sets with the aid of an accurate wavemeter. Every purchaser of a set needs to know the adjustments for the chief wireless telephone transmitters (English broadcasting stations, Writtle, the Hague, Eiffel Tower, etc.) and these can be indicated for him by the service man with his wavemeter. Other important services will soon suggest themselves to the enterprising man.

(*To be continued.*)

Notes

Transmission of Telephony from Marconi House.

On Friday, June 16th, a transmission of Wireless Telephony from Marconi House, 2LO will take place at 8 p.m., in connection with a Fête which will then be in progress at Caxton Hall, Westminster.

Advance in Radio Work in Czecho-Slovakia.

The Ministry of Post and Telegraph of Czecho-Slovakia has followed all the latest developments in radio, sending engineers to foreign countries to study operating systems. When weather conditions are favourable, a large station will be built at Podebrady, Bohemia, where the natural features are said to be ideal. It is reported that a central and subsidiary wireless system will soon be established.

The main station will be equipped with high frequency generators (Letour-Bethenod type), producing 50 kW in the antennae. The entire station will be able to produce additional energy up to 100 kW in the antennae. If the work demands it, an additional 50 kW set will be installed. Two towers, 150 metres in height, will be erected. It is estimated that the range of the station will be about 4,000 kilometres.

Podebrady station will be the main sending station for Prague, but a small station will also be erected there by the State Post and Telegraph Office, equipped with a valve transmitter.

At Kral Vinohrady, a district of Prague, a radio station with a radius of 400 kilometres is now being operated. At Brunn, Moravia, another station has just been completed and tested.

For communication between Slovakia and Prague, as well as the Orient, a new station is being erected at Kosice, Slovakia, and another, at Bratislave, will be operated for the benefit of the Danube shipping and the International Danube Committee now sitting there.

A station has been projected for Liberec (Reichenberg) and it is hoped that it will be completed by August 20th.

Because of the importance of radio communication to aerial navigation, the Czecho-Slovakia Ministry of Post and Telegraph and the Ministry of National Defence are now building a station with a range of 1,000 kilometres at Kbely, near Prague, the starting point of aeroplanes for Paris and Warsaw. In Western Bohemia, at Plzen or Cheb, a station for operation in connection with the air service for Paris will also be established, and another in North-eastern Bohemia for use in connection with the aerial route to Warsaw. The Ministry of National Defence is now proposing to build a system for military purposes only.

New Wavelengths for Eastern Stations. Clearing the Pacific Air.

After considerable difficulty in reaching a wavelength which does not interfere with the transmitting of the British and Japanese radio stations on the Pacific, the U.S. Naval Communication Service has determined upon a wavelength of 13,700 for east-bound messages from the Naval Station at Cavite (NPO). A two-weeks' test between Cavite and San Francisco (NPG) showed that with this wavelength the signals from the Japanese station sending from Iwaki did not interfere as was previously the case. Originally the Cavite station sent eastern messages on 14,200 but that interfered with the English stations, and 13,900 was tried out with interference from Iwaki. To-day, however, NPO comes through to San Francisco on 13,700. West-bound messages from San Francisco and San Diego are not sent direct to Cavite, but relayed through Pearl Harbor.

Direction Finding Stations in the United States.

It has been unofficially reported that during the past winter fourteen large merchant vessels were saved from destruction by the U.S. Navy's wireless direction finding stations. Due to the severe storms in the Atlantic, ships were often unable to determine accurately their positions on approaching the coast. By simply calling by radio the nearest station and asking for bearings, they were given their positions accurately and it is estimated that fourteen ships thus aided would otherwise have been wrecked.

The U.S. Navy maintains along the coast of the United States 62 D.F. stations and the value of ships saved from destruction during three months of bad weather will more than offset the total cost of installation and maintenance of all the D.F. stations.

The Townsend Wavemeter.

On May 15th the Royal Commission on Awards and Inventions heard a claim by Professor J. S. E. Townsend, F.R.S., Professor of Physics at Oxford, in respect of the wavemeter which bears his name.

Evidence was given in support of the claim by Professor Townsend and Professor Whiddington, of Leeds.

The Commission reserved its decision.

Correspondence

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—On reading the 20th May, 1922, issue of *The Wireless World and Radio Review*, I have noticed an interesting article, "Listening In," by Mr. J. E. Wilkes. In it the writer goes on to say that while confining his attentions mainly to the use of a 3-valve C Mark III amplifier, he has found it to give excellent results on all normal telephony, barring the Dutch concert. Why does it fall short in this particular case? At the conclusion there is an invitation to compare results.

I too, have a similar amplifier and am able to hear the Dutch concert four feet from the telephones—conditions being normally good.

Being in the Army Signal Service, I have had considerable experience of this type of amplifier.

Should Mr. Wilkes require any information to help him receive the Dutch concert on this amplifier I shall be only too pleased to assist, as it seems to me quite unnecessary to have recourse to a six-valve amplifier for this station when three will answer almost equally well.

N. G. BAGULEY,
Lieut. Royal Corps of Signals (T.)

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—While listening on my set this morning (May 30th) about 11.30 a.m., I picked up some telephony in French, which varied from 900 to 905 metres.

I feel sure it was not Le Bourget, nor any other station on the Civil Air Route in France, as the voice was not familiar to me.

The position from here of the transmitter was S.E. by E.

His carrier wave was quite loud, also he was very persistent in calling "Hello" many times, and then started off in French, giving mostly figures, but no call letter, unless I missed it at first.

I should be greatly obliged for any particulars regarding this station (position, name, etc.).

Thanking you in anticipation.

Yours truly.

G. F. ROBINSON.

9, Southgate,
Sleaford, Lincs.

May 30th, 1922.

JAMMING BY VALVE RECEIVERS.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am aware that you have received numerous letters on this subject in the past and must therefore apologise for asking you to publish this further protest against the amazing and unnecessary interference caused by badly handled self-heterodyning valve receivers.

I hope that this letter will reach the eyes of a few at least of the rapidly growing body of devotees to "Reception by howling," which habit, for habit it is, seems to grow on them like drug taking.

Nearly every time I go out in this neighbourhood I see some new amateur aerial in course of erection. I should wish to experience a feeling of pleasure at the advent of a new fellow-worker to the engrossing hobby of wireless, but instead, I find myself anxiously calculating the distance to my own station in fear and trembling that here will be yet one more instrument to be added to the "Jazz Band."

How these offending stations manage to receive telephony passes comprehension. Telephony, obviously, it is to which they are attempting to tune. They can be heard following the conversation of two transmitting stations from one wavelength to the other, the while they keep their sets in a state of continuous and violent oscillation.

"And even spoiled the women's chats
By drowning their speaking
With shrieking and squeaking
In fifty different sharps and flats."

Oh for a "Pied Piper" to quel them !

Even the transmissions of stations such as **2 FQ** and **2 ON**, which approach perfection, and whose volume in this neighbourhood is immense, are considerably marred by this eternal choir of shrill voices.

Finally, I would make an earnest appeal to all amateurs, especially to those who are new to the game, to remember that, badly handled, their sets can radiate very powerfully, which radiation seriously interferes with other stations' enjoyment of some interesting speech or music.

O would some power the giftie gie them
To hear themselves as others hear them.

Please excuse this misquotation.

M.J.G.

Bromley, Kent.

May 31st, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I should like to appeal to those sending out telephony to state as clearly as possible the name of their town as well as their number or call sign.

Many listening-in with cheap or home-made sets are anxious to know the range of their apparatus and often a concert will be heard, but to catch the two letters of the sender correctly is often impossible.

I heard a gramophone concert being given to Walthamstow. The sender called up Walthamstow but only gave his call letters, which I could not get. I have looked through the Wireless Year Book for some of the letters I thought it might have been but it was evident that I had not got them anything like right.

Now if he had stated the name of his town I could have no doubt got it as I could hear his speech fairly plainly.

GUY WILLIAMSON.

Bromley, Kent.

June 7th, 1922.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I should be grateful if you could find space in the *Wireless World and Radio Review* for the following :—

The reception of Chelmsford Concerts on 400 metres : On Tuesday, May 23rd, I was delighted to hear the operator at Chelmsford inform all who were listening-in, that on May 30th the transmission of music and telephony would be on 400 metres, this, he said, was not only to get rid of jamming from a spark station, but to give more people the pleasure of listening-in.

Alas ! The 400 metres transmission began this evening, and although the Marconi music and speech was just as good as ever, there would be few of the Potteries Amateurs who would have the pleasure of hearing it through. This state of affairs being entirely due to many, either ignorant or indiscriminating amateurs allowing their sets to keep up a continuous howl, apparently by reactance methods. Immediately one got the set off the oscillation point and was receiving the concert nicely, in would come a terrific howl, as strong as Marconi's carrier, and set the whole apparatus oscillating strongly again.

In the end I switched off in disgust, totally fed up with the jazzing of condenser or reactance howls.

If this is going to be the state of affairs the broadcasting boom is going to reduce us to, I am afraid the enthusiastic experimenter will sell up, and instead of the wonderful science progressing it will be a dismal failure. As I have said before, perhaps the offenders are ignorant of the fact that while they are attempting to time-in they are stopping many others from getting good results.

It was far preferable to get jammed out with a spark station than to have a jazzy band of disturbance.

My advice to a beginner in the Potteries is to join the Potteries Wireless Society and learn something of the apparatus before making a dismal failure of the whole district; we are sorely troubled with power strays, and have enough to contend with in that respect.

Thanking you in anticipation.

Yours faithfully,
P. E. BANKS,
Hon. Secretary,
N. S. Rly. Wireless Society.

Headquarters:
Elec. Dept., Stoke Station.
Club night, 7 p.m. Wednesday; open to railway employees only.
Stoke-on-Trent Society headquarters: 6, Liverpool Road, Burslem. Open to all.

Book Review

THE A.B.C. OF WIRELESS: A Popular Explanation. By Percy W. Harris. (London: *The Wireless Press, Ltd.* Pp. 64, illustrated. Price 6d. net.)

This little book has been specially written to meet the requirements of those who, without having had any experience in wireless matters, wish to acquaint themselves both with an introductory knowledge of the subject and with what has been accomplished by the science from its earliest discovery up to the present time.

The opening chapter deals with a consideration of the ether and waves in various mediums and describes how the experiments of Hertz led on to the beginnings of wireless telegraphy.

Subsequent chapters deal with the gradual development of wireless telegraphy, describing the early work of Branly, Lodge, and Marconi. Methods of tuning and detecting wireless waves are explained, after which are considered in turn the three-electrode valve, continuous wave telegraphy and wireless telephony.

The concluding chapters are devoted to an explanation of how to proceed to take advantage of the facilities now offered to the public to participate in the service which wireless can give.

Within its sixty-four pages it may be said that this little booklet gives a complete introduction to wireless, forming the basis for further study, whilst those who do not wish to go deeply into the subject will find that by carefully reading through this attractively written little volume they can acquire a very sound general knowledge of what wireless really is, its history and its future possibilities.

Calendar of Current Events

Sunday, June 18th.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

Tuesday, June 20th.

Transmission of Telephony at 8 p.m. on 400 metres by **2MT**, Writtle, near Chelmsford.

Thursday, June 22nd.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

Demonstration of the Ultra IV Receiver by Mr. F. O. Read, Member I.R.E.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Extraordinary General Meeting to consider Club's wireless telegraph set and transmitter, Club's Quarters and subscriptions, arrangements for Summer Season, and any other business.

Friday, June 23rd.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. Lecture and Demonstration:—"The Construction of a Valve Receiving Set" (Part I), by Mr. F. L. Hogg.

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Discussion on Direction Finding.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston. "Experiences as a Wireless Telegraph Operator," by Mr. F. Harrison.

Saturday, June 24th.

WIRELESS SOCIETY OF HIGHGATE.

Field Day. Outing to Ken Wood.

Sunday, June 25th.

Transmission of Telephony from the Hague, **PCGG**, as above.

Tuesday, June 27th.

Transmission of Telephony from Writtle, **2MT**, as above.

Friday, June 30th.

WIRELESS SOCIETY OF HIGHGATE.

7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part III, by Mr. J. Stanley.

Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.—[ED.]

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

North Middlesex Wireless Club.*

The 92nd meeting of the Club was held at Shaftesbury Hall, Bowes Park, N., at 8 p.m., when the Chair was taken by the President, Mr. A. G. Arthur. After the minutes had been read by the Secretary, the Chairman, after a few remarks, called on Mr. D. Macadie to give his lecture on "Direct Current Measuring Instruments, their Design, Construction and Use."

Mr. Macadie had brought to the Hall a large number of measuring instruments, both ancient and modern. These were displayed on the lecture table, and made a fine and imposing show. He started with the ordinary linesman's galvanometer, and explained the various types that were in use. The lecturer said that it was now considered preferable to use instruments that read direct in volts or amperes to an instrument that gave a purely arbitrary reading, and showed examples of these instruments of the moving coil, hot wire, and the electrostatic types, and by means of large clear diagrams attached to the blackboard he explained the characteristics of each.

He then passed on to the measuring of resistance, and explained in detail the principles of the well-known Wheatstone Bridge and the method of using it. His description of the way in which plugs were removed in certain ways, which had the effect of inserting various resistance coils of known value, and enabling readings to be taken over a large range, was followed by members with great interest. Mr. Macadie then explained the action of the Megger testing generator, and on the suggestion of Mr. Holton, the Club's aerial was tested as a demonstration, and it was satisfactory to learn that the resistance was all that could be desired.

A very interesting instrument was the "Avometer," which was one of Mr. Macadie's own design. By an ingenious arrangement it was made to read amperes, volts and ohms, as required. The instrument was of neat and compact design, and was much admired.

The Chairman moved a vote of thanks to the lecturer, which members responded to in a hearty fashion.

New members continue to come along, and full particulars may be had on application to the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

Sussex Wireless Research Society.*

Hon. Secretary, Mr. Edward Hughes, B.Sc., A.M.I.E.E., The Technical College, Brighton.

The above Society held its last meeting of the present session at Cottesmore School, Hove, on Wednesday evening, May 31st. A statement of accounts was submitted by the Hon. Treasurer which showed that the Society was in a very satisfactory position financially. After the discussion of various business items, the President, Capt. Hoghton, F.Inst.P., gave a short lecture on the electronic theory of matter, explaining in particular the application of this theory to the production of electromagnetic waves.

The Wallasey Wireless and Experimental Society.*

At the meeting of the Society held on Thursday June 1st, the Secretary gave a short lecture on "Landline Telegraphy."

He dealt with the progress of an ordinary commercial telegram from the time of handing in to its final transmission along the submarine cable and gave a short description of the instruments used at each stage.

The Society still has room for a few members, and the Secretary will be pleased to forward full particulars to anyone who wishes to become a member.

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

Leeds and District Amateur Wireless Society.*

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

A General Meeting was held on May 26th at the Leeds University, Mr. G. P. Kendall, B.Sc. (Vice-President), taking the Chair at 8 p.m. The Chairman called upon Mr. T. Brown Thomson to deliver a lecture entitled "Types of Valves."

Mr. Thomson commenced his paper with an exposition of the electron theory of matter, showing its particular applications to the study of vacuum tubes as used in wireless work. He emphasised how important it is that the amateur should fully understand what his valves require to work most efficiently, *i.e.*, different valves require different voltage and current values, etc. He then explained the two main properties valves possess, these being their uni-directional conductivity and non-uniform conductivity. Two electrode valves or diodes were then considered, the characteristic curve of these tubes being examined carefully. The lecturer then explained the three-electrode or triode valve, showing very clearly the function of the third or control electrode. Characteristic curves of various triodes, including the French "S" valve, the British "R" and "Q," the German A.E.G. type, and the De Forest Audion valves, were shown, explained, and compared in detail.

At the close of Mr. Thomson's remarks the Chairman declared the discussion open. Some very interesting points bearing on the electron theory were examined still further, the effect of potential drop along the valve filament and the filament current's electro-magnetic effect on characteristic curves were touched upon. After the discussion had closed, a hearty vote of thanks was accorded to Mr. Thomson, for the very interesting and instructive lecture.

After certain business had been discharged, the meeting terminated at 10 p.m.

Blackpool and Fylde Wireless Society.*

Hon. Secretary, Mr. C. Sheffield Doeg, "The Poplars," 6, Seventh Avenue, South Shore, Blackpool, to whom all communications should be forwarded.

Owing to the large amount of publicity being given to the new scheme of wireless broadcasting by the press, and the great interest taken in the subject by the general public, this Society's membership has within the last few weeks been increased by quite 50 per cent.

Classes are to be commenced in which new members will be taught a number of subjects, of which the following are only a few:—Construction of instruments, fault detection, erection and dismantling of stations, manipulation of sets, etc.

A morse class has been in operation for some time, and those having passed out, are quite capable of passing the P.M.G. transmitting speed test as well as reception.

The Society is divided into two sections, junior and senior, the age limit of 18 being the dividing line, quite a number of ladies are on the register and come in very useful where matters of a social order are concerned, both sections are represented on the Executive Committee amongst whom are two ladies.

The Society, although only 18 months old, is in a fair way to becoming a real asset to the local amateurs, numerous difficulties, necessitating several changes and rearrangements in the personnel of the governing body have been satisfactorily dealt with in the past, and, optimistically speaking, there is nothing but plain sailing ahead.

As the membership increases, so of course does the work, and the Executive Committee expect to have to appoint an Assistant Hon. Secretary very shortly.

The Society draws its support from an area quite as extensive as Manchester, although Blackpool itself is comparatively small in point of acreage, and branches are to be thrown out at suitable places for the benefit of members who otherwise would have upwards of ten miles to cover to attend the weekly meetings at Headquarters.

One of the customs of the Society is to extend a special welcome to members of the other Societies who visit the King of English Watering Places. Mr. W. G. Dixon, a member of the Committee of the Newcastle and District Wireless Association, favoured the Blackpool and Fylde Wireless Society's Hon. Secretary with a visit on May 28th last.

As the summer season is once more almost upon us, the Blackpool and Fylde Wireless Society renew their open and standing invitation to all and every member of other Wireless Societies to visit them when in Blackpool, the address of their Headquarters is the top floor, Café Waldorf, corner Church Street and Coronation Street, and the regular weekly meeting is on Thursdays, time 1930, B.S.T., and they wish every Wireless Society "very good broadcasting."

Woolwich Radio Society*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The May monthly meeting of the above Society was held at the Woolwich Polytechnic on Friday, May 26th, at 8 p.m. There was a large gathering of both members and visitors. The meeting took the form of an exhibition of amateur home-made apparatus and there was a large and varied assortment of exhibits, numbering about forty, and including:—A three-valve set, embodying several interesting new features, also an independent heterodyne, which he used as a wavemeter as well, by Mr. Beeson; a three-valve set with tuned anode and slab coils, very neatly mounted on "R" valve pins, by Mr. Smith; a Mark III set converted to a two-valve set with crystal rectification, in which six different circuits could be used by means of change-over switches, also a short wave tuner, using a Mark III coil as secondary, by Mr. South: a Mark III set converted to valve, using the round 16 circuit, with internal and external coils at will by Mr. Potter; a fine variometer, a loud speaker and a short wave tuner, by Mr. Vincent; an old-fashioned crystal set and still going, also honeycomb coils of various sizes, by Mr. Frazer; a converted Mark IV set, by Mr. Dowlang; a captured German three-valve set, a three-valve set for V 24 valves and a short wave tuner on variometer principle, by Mr. Morley.

There were also many other miscellaneous items, such as coils, condensers, telephones, valves, too numerous to mention.

Mr. McPherson briefly explained the salient points of some of the exhibits, and then the meeting was thrown open for inspection.

Mr. Beeson connected his set to the aerial and amplifier and loud speaker and soon music and telephony from our usual friends came wafting in from the ether.

The exhibitors were soon deluged with enquiries as to how the various pieces of apparatus were made and worked.

At the end of the meeting, which came all too soon, all expressed themselves highly gratified at the success of our first exhibition.

Southampton and District Wireless Society*.

Hon. Secretary, Mr. T. N. Cutler, 24, Floating Bridge Road, Southampton.

The above Society held its first public demonstration on Wednesday, May 24th, at the Kingsland Assembly Rooms, Southampton, and a very enjoyable and instructive time was spent by the large gathering. The Hall was packed to its utmost, large numbers of people failing to gain admission, and because of the disappointment a further demonstration will be announced shortly.

A variety of instruments were exhibited by the courtesy of Capt. Young, A.I.M.E.E., of Crays Installations. Mr. Smethurst, of Smethurst & Co., electrical engineers, of Southampton, also kindly loaned other apparatus. The Club had their powerful three-valve receiver installed with a three-valve amplifier and loud speaker. Mr. Towsend, of the Marconi Company (a member of the Society) was placed in charge of the Club apparatus and messages were logged by him, communication being established with Paris, Leafield, and various American stations, Barcelona and Gibraltar. Telephony was picked up from Croydon Aerodrome and the concert from FL in the early part of the evening. At the conclusion of the demonstration a hearty vote of thanks was accorded the Chairman, Mr. Freeman, and the Secretary, Mr. Cutler, for the able arrangements made. Twelve new members were enrolled.

A meeting was held on May 31st and a fair attendance was recorded. The following business was transacted for the evening:—Discussion on various rules for improvement of the Society and the admission to the Society of various firms dealing in wireless apparatus and not at present holding receiving licences. After a lengthy discussion it was decided to call all the members together and hear their views. There were 14 new members' names submitted for membership, but they were not at present holding receiving licences, and as the rule stands they could not be admitted to the Society. This will be brought up at the next meeting. Listening in on the Club set brought the evening to a close at 9.30 p.m.

Southport Wireless Society.*

The members of the above Society spent a very enjoyable afternoon on Saturday last, when wireless transmission and reception tests were carried out between Parbold Hill and Ashurst Beacon, at both of which places temporary stations were erected. Eleven members, with the Society's portable transmitting sets, took part in experiments which were highly successful. At the conclusion of the tests a very enjoyable tea was partaken of.

It is intended to hold a series of similar outings during the next few weeks.

Hon. Secretary, Mr. R. W. Brown, 71, Norwood Crescent, Southport, to whom all communications should be sent.

Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Heaton, Bradford. Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the Club-room at 7.45 p.m. on Friday, June 2nd, with Mr. W. C. Ramshaw in the Chair. At this meeting we were to have had the pleasure of hearing Mr. H. F. Yardley, of Leeds, lecture on "Short Wave Reception," but unfortunately he had to go away on business. However, we hope to have the opportunity of hearing this lecture later on. In the absence of the lecturer, a discussion on members' experiences in connection with wavelengths below 600 metres was opened and taken part in by Messrs. J. Bever, A. Liardet, A. Bever, W. C. Ramshaw and N. Whiteley, each of whom related what experience he had had to date.

The proceedings closed at 9.30 p.m.

The West London Wireless and Experimental Association.*

Club Rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

A Special General Meeting was held on Thursday, evening, June 1st, a large percentage of the members being present. The purpose of the meeting was to amend the existing rules in regard to subscriptions, and the formation of one or two new rules for the better management of the Association generally. After the business agenda was terminated, Mr. J. F. Bruce and the Vice-President, Mr. F. E. Studt, detailed their experiences with the Reinartz short wave tuner and much useful advice was then given to the members present. Both gentlemen were heartily thanked for their very interesting remarks.

A large party of the members and their friends, by permission of the Air Ministry, paid a visit to the London Terminal Aerodrome and Wireless Station at Croydon on Saturday afternoon, June 3rd, and although the Aero Club races were in progress, the Civil Aviation Traffic Officer on duty gave us a hearty welcome and placed us in the hands of his wireless staff, who were most courteous and entertaining. The whole of the radio station and apparatus was very fully explained to us by Messrs. Lane and Luger, who, in turn, dealt with different items during our visit.

We had a fine view of the races and various flying stunts which were in progress, and had the gratifying experience of watching the arrival of one of the large passenger machines from Paris and unload its complement of passengers and goods, also the giant monoplane from Brussels. We then adjourned to the tea rooms, where the whole of the party sat down to a very enjoyable tea.

The party heartily thanked the gentlemen who had so kindly made our visit so interesting.

The Hon. Secretary will have much pleasure in sending full particulars of the Association to any gentleman who may desire to join us and in view of the great possibilities which undoubtedly are to be met with in the near future.

Bishop's Stortford and District Amateur Wireless Association.

An *alfresco* meeting was held at Halfacres, Bishop's Stortford, on Tuesday evening, May 30th, to form a local wireless society. A considerable number of interested persons attended. Mr. E. F. Cooper welcomed those present and outlined the objects of the meeting. It was resolved to form a Society under the name of "The Bishop's Stortford and District Wireless Association," and the following were elected:—President, Mr. W. Field; Vice-President, Mr. E. F. Cooper; Secretary, Mr. J. Cooper; Treasurer, Mr. J. Thorpe; Committee, Messrs. Ashford, G. Featherby, W. S. Filby, Lucas, Moore and Rose. At 8 p.m. the company "listened in" to the Marconi Wireless Concert upon the Secretary's installation. Arrangements for meetings, lectures, morse practice, etc., were left in the hands of the Committee. Communications should be addressed to the Hon. Secretary, 2, Half-acres, Bishop's Stortford.

Stockton-on-Tees and District Amateur Wireless Society.

A meeting was held in the Jubilee Hall, Stockton-on-Tees, on Thursday, June 1st, which was attended by a very large number of interested persons.

It was unanimously agreed that a Society should be at once formed under the above name. The meeting was under the Presidency of S. G. Marston, Esq., Borough Electrical Engineer, who was supported by a large number of interested gentlemen.

It was decided that the Society should be open to any person of any age who was an amateur and wished to take up the study of wireless.

Forty-two members were enrolled and a further large number sent in their names but were prevented from attending, which will make the membership one of the largest in the district.

Mr. J. Mulcaster, of Eaglescliffe, was appointed President, Mr. S. G. Marston as Vice-President, and Mr. W. Wood as Secretary (*pro tem*).

Communications should be addressed to Mr. E. Barnes, Bishop Street, or to Mr. G. Dean, Dovecot Street, both of Stockton-on-Tees.

Hounslow and District Wireless Society.*

On Friday and Saturday, May 26th and 27th, we gave a demonstration in receiving at the local Hospital Fête, a good sum being collected for the Hospital. Messrs. S. G. Brown of Acton were kind enough to loan us a microphonic relay and H.1. loud speaker, and a special permit was obtained from the G.P.O. allowing Lieut. H. S. Walker, of Brentford, **2 OM**, to transmit to us music and speech on both days on a wavelength of 440 metres. The demonstration was a huge success, and all members worked very hard. We have been invited to give another show on Messrs. Pears' recreation ground at Isleworth on July 22nd, and another one at Hounslow on July 29th. We will do our best as both are in aid of Hospitals.

On Thursday, June 1st, the Society held its first annual meeting. Various letters were read *re* new publications. The annual report was then read by the Secretary explaining fully the year's working, including several demonstrations, also showing that we have been going forward all the time. Lieut. H. S. Walker then moved the adoption of the report, and in his speech said he hoped to see us expand more than ever, and assuring us he would do his best to help us expand. He further made an offer of a Brown microphonic relay, to the Society on condition that someone else gave a Brown H.1. loud speaker.

Councillor J. J. Bonnet rose and stated it gave him great pleasure to second Lieut. Walker, and commented on the success of the Society in its first year's work, and hoping it would do even better in the forthcoming year. He also thanked Lieut. H. S. Walker for his generous offer, adding that he thought we could call the relay ours.

Later Mr. Gordon Fryer, L.D.S., R.C.S., Eng., headed a list with £2 1s. towards the loud speaker, Councillor J. J. Bonnet added a pound, and other members also contributing made up the required sum. As we are noted for doing things quickly, we shall now have a relay and loud speaker.

The Chairman, Mr. A. R. Pike, in his reply, thanked Lieut. H. S. Walker, Councillor J. J. Bonnet and Mr. Gordon Fryer for their generosity, he also asked for a vote of thanks to be passed to Mr. F. O. Read, as, although Mr. Read was not present, he had given the greatest of assistance in enabling the Society to become firmly established. The vote of thanks was duly passed, and perhaps Mr. Read heard it, for it was certainly loud enough.

The balance-sheet was read and showed receipts for the year, £33 17s., expenditure, £29 0s. 11d., leaving a balance in hand of £4 16s. 1d., showing that the Society always paid its way and had not got into debt. All the existing officers were elected to stand for another twelve months.

If any gentlemen would care to join a real live wireless society, they are asked to move to Hounslow and join us.

Mr. A. J. Rolfe, Hon. Secretary, 20, Standard Road, Hounslow.

The Ilford and District Radio Society.

The Society held its first Annual General Meeting on June 1st, the Chair being taken by the President.

The Secretary and the Treasurer in their reports showed that the Society is now in a flourishing condition. In spite of early difficulties with regard to proper headquarters we had eventually secured the use of St. Mary's Church Hall at a reasonable rental and this has proved itself in every way suitable. The Society possesses a considerable amount of apparatus, has both fixed and portable transmitting licences and a very satisfactory financial position, our only trouble being the way attendance falls off as the summer approaches. No doubt other Societies as well suffer this transition from the valve to the racquet.

Mr. J. Scott-Taggart, M.I.R.E., was unanimously re-elected as President for the coming year, but Mr. Vizard intimated that owing to increasing home responsibilities the intense volume of secretarial work was beyond him. Mr. A. E. Gregory was accordingly elected Secretary. Other changes were few, the constitution now being as follows :—

President, Mr. J. Scott-Taggart, Member I.R.E. ; Chairman, Mr. H. Lassman ; Vice-Presidents, Messrs. A. P. Welch, J. E. Nickless, A.M.I.E.E., and L. Vizard ; Secretary, Mr. A. E. Gregory ; Assist. Secretary, Mr. A. G. S. Gwinn ; Treasurer, Mr. F. Grover ; Committee, the foregoing and Messrs. Dewar, A. B. Gregory, Hummerston, Payne and Spence ; Auditors, Messrs. Andrews and Elliott.

The retiring Committee had made several recommendations all of which were adopted. Among them was the reduction of the entrance fee to 5s. and the annual subscription to 7s. 6d., and the formation of a junior section (under 18), with an entrance fee of 2s. 6d. and subscription 5s.

We still have room for new members, and full particulars can be obtained from the Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, E.7.

Barnsley Amateur Wireless Association.

An attempt is being made to revive the activities of the above Association, a meeting being held with this object in view, on May 30th, at 7 p.m., in the drapery department of the local Co-operative Society.

The chair was taken by Mr. Cooke, the head manager of the department, and in his opening remarks he spoke of the recent " boom " in wireless, and the demand for a local Association, and he expressed the opinion that the Co-operative Society —which has started a wireless department—would give us their help in ensuring the progress of the Wireless Association.

The Secretary of the Association then gave a brief outline of Wireless, past, present and future, also a short epitome of the history of the Association. He pointed out the need of a suitable room to use as headquarters and as a meeting room, the lack of which had been responsible for the tardiness of resumption of work of the Association.

Marconi's concert was then switched on, signals being rather weaker than was anticipated, probably due to change of wavelength, and afterwards local amateurs working, came through with convincing loudness and clearness.

A sheet for the entry of names of prospective members was tendered and was duly filled in by upwards of two dozen enthusiasts.

An announcement will be made later when a room has been procured. Will persons wishing to become members please communicate with the Hon. Secretary, Mr. G. W. Wigglesworth, 13, King Edwards Gardens, Barnsley, Yorks.

Wireless Club for Putney and Fulham Districts.

Mr. Bruce L. Houstoun, of 125, Hurlingham Road, Fulham, S.W., will be pleased to hear from local amateurs with a view to forming a club.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only; Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"KEPPEL ANAMBA" (Over) *has a number one unit of single valve long wave set and wishes to increase range from 3,800 to 10,000 metres.*

You do not say whether the No. 2 reaction winding is wound on the moving former or only the No. 1 winding. If the latter is the case we would advise you to make an entirely separate A.T.I. and reaction for the long wavelengths.

"C.A.J.B." (Putney) *has a single valve set working on an indoor aerial and asks (1) Why set will not work. (2) For suggestions for improvements. (3) Diagram to add another valve. (4) Wavelength with given tuning coil.*

(1) It is wrongly connected up. There is no connection from negative L.T. to earth. The condenser A is presumably intended to be in parallel with B, in which case the present lead from condenser to negative L.T. and earial should be removed and a connection made from this side of condenser to earth. (2) Connect a 0·001 mfd. fixed condenser across telephones. (3) The additional apparatus required and method of connection will be seen by referring to Fig. 1, page 213, May 13th issue. (4) This inductance is only suitable for wavelengths up to about 600 metres.

"ECONOFIL" (Herne Hill) *refers to Fig. 4, page 561, December 10th issue, and asks (1) For criticism of circuit. (2) If the three circuits containing variable condensers must all be tuned to the same wavelength. (3) Best way to arrange circuit for searching. (4) The most efficient transformer for crystal circuit.*

(1) The circuit will no doubt give good results if circuits are properly proportioned, and after one has become used to it. The values of capacity which you give should be quite suitable. (2) Yes. (3) A circuit of this type cannot easily be modified for quick searching. It would always be necessary to be tuned beforehand to the wavelength it is desired to receive. (4) The best transformer ratio can only be found by experiment, and as the crystal circuit is untuned it should be at least 2/1. The primary of the transformer should have sufficient winding to tune with variable condenser to wavelengths of other parts of the circuit. The crystal winding should have at least twice the turns of this winding.

"RADIO" (E.C.3) *has a three-valve transformer amplifier which is troublesome because of vigorous oscillation which cannot be controlled.*

It is a natural tendency for amplifiers of this type to oscillate freely round about the natural wavelength of the transformers. To limit this it is necessary to make all the internal connections as short and direct as possible, keeping all the leads separate. The principal trouble is through having too large a reaction coil. To obtain a gradual increase of reaction it is necessary to strip turns off and test until the desired result is obtained. A potentiometer control of the first two grids is necessary.

"LANE" (Edinburgh) *asks (1) Dimensions of former for A.T.I. to take 1 lb. of No. 28 DCC. (2) Maximum and minimum wavelengths on small aerial. (3) Will certain condenser do for crystal set. (4) What stations will be heard.*

(1) For a crystal set No. 28 wire is too fine. Use No. 24 and wind a 5″ diameter × 10″ former full of it. (2) The diagram shows condenser across A.T.I., but for crystal set it should be in series. The wavelength range will then be from 2,800 metres at maximum down to about 400 metres minimum. (3) This may be used. Its capacity is 0·0005 mfds. (4) The number of stations that will be heard is very limited. You will hear ship and coast stations, and possibly the Eiffel Tower.

"BEGINNER" (Bournemouth) *asks questions regarding a single valve set.*

You will not find the circuit shown in your diagram very effective. We suggest you rearrange it as shown in reply to **"BELLRINGER" (Walsall).** With suitably proportioned inductances you should be able to hear both Eiffel Tower and Chelmsford telephony.

"STICKER" (Earley) *asks for windings for 300/3,000 metres for reactance formers as advertised. (2) Suitable circuit to use. (3) How to add amplifier to long and short wave set.*

(1) Formers of this type are not very efficient for such a wide wavelength range. As experimental windings we suggest you wind the A.T.I. former full of No. 28 and the reaction full of No. 36. (2) This might be incorporated similar to that given to **"BELLRINGER" (Walsall).** (3) Several diagrams have recently been given showing how to add a L.F. valve to existing single valve set.

"C.W.B." (Kent) *asks (1) Capacity of two condensers. (2) Wavelength of certain inductances with above condensers. (3) If reaction coils given are suitable for use with inductances in No. 2. (4) What effect would lengthening the aerial have on above calculations.*

(1) Capacities are (A) 0·0003 mfds; (B) 0·0005 mfds. The minimum capacity cannot be calculated.

(2) Wavelength of 15½″ × 5½″ former with condenser A is 7,000 metres; with 9″ × 3½″ former with condenser B 4,200 metres. (3) There is quite enough reaction winding for both formers and it may be necessary to take a few turns off when using the set. The wavelength will be approximately proportional to the length of the former given in your example. (4) This would slightly increase the wavelength values.

"SHOLOMPOTS," (Cardiff) *asks* (1) *For diagram of simplest single valve circuit to use crystal set A.T.I.* (2) *Suitable size for reaction coil.* (3) *Maximum wavelength range.* (4) *If possible to hear* **2MT** *concert.*

(1) The best arrangement for a single valve set is given to **"D.R." (Doncaster).** (2) This may be 8″ × 4″ of No. 28. (3) The diagram referred to shows a 0·0005 mfd. aerial condenser. If this is used the maximum wavelength with inductance given will be 2,700 metres, with switch in series position, and 5,000 metres in parallel. (4) If the set is carefully adjusted you might just hear it, but an additional L.F. valve is advisable.

"RADIOBUG" (Kilburn) *refers to Fig.* 3, *page* 90, *April 15th issue, and asks* (1) *For windings for* 120/10,000 *metres, to use two complete sets of tuning coils.* (2) *If capacities given in reply to* **"H.R.H." (Bristol),** *the same issue, are suitable.* (3) *Connection of switching arrangement to introduce crystal detector.* (4) *How many tappings to closed circuit reaction coils.*

(1) For efficient short wave reception make first set wavelength up to 1,000 metres and second up to 10,000. For short wave set make coils as follows:—A.T.I., 4″ × 4″, No. 22; coupling coil, 2″ × 2″, No. 22; secondary, 3″ × 3″, No. 22; reaction, 2″ × 3″, No. 28. For long wave set:—A.T.I. 6″ × 10″, No. 28; coupling coil, 3″ × 4″, No. 28; secondary, 6″ × 10″, No. 34; reaction, 5″ × 10″, No. 28. (2) These values may be used except that of the A.T.C. which should be 0·001 mfd. (3) As this would necessitate tuning the anode circuit by means of a variable condenser we do not recommend its use. The grid condenser and leak will give very efficient rectification. (4) There might be three tappings on each of the closed circuit and reaction coils.

"F.H." (Dorset) *wishes to install a telephone receiving set with loud speaker in a large room.*

If set is mainly intended for reception of Dutch concert there is no object in going to the trouble of making it a complicated set for 300/20,000 metres. It is advisable to use an outdoor aerial, but if desired a 5′ or 6′ square frame may be used. To get satisfactory results from Holland on a frame aerial, six valves will be required, or with an outside aerial four valves. A diagram showing how to arrange set and giving as much information as space allows is given in diagram (Fig. 1).

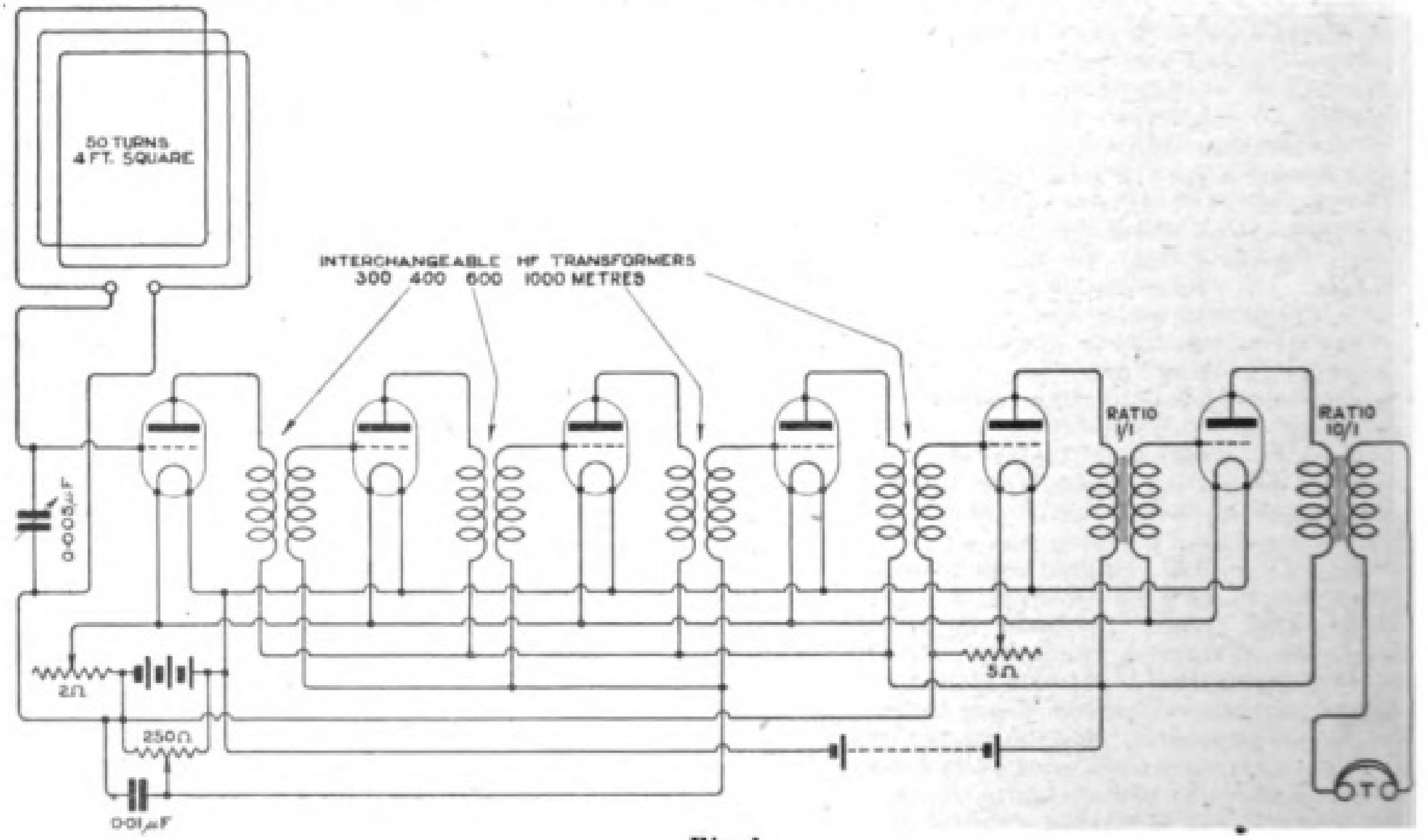


Fig. 1.

"ROOKIE" (Woodside) *asks* (1) *For windings for tuning coils and L.F. transformers for a set consisting of crystal detector and one L.F. magnifying valve.* (2) *Capacity of condenser for secondary circuit.* (3) *Resistance of telephones to use with transformer recommended.* (4) *If capable of receiving Dutch concerts.*

(1) For a maximum wave range of 3,000 metres the following coils will be required:—A.T.I., 5″ × 10″, No. 26; coupling coil, 3″ × 3″, No. 26; secondary, 4″ × 8″, No. 26. The transformer No. 3 should be wound on a soft iron core ½″ diameter 2½″ long, and should have its primary winding 1 oz. of No. 44 connected to the crystal circuit, and the secondary 3 ozs. No. 44 in the grid circuit of the valve. The transformer 4 should be 3 ozs. of No. 44 and 6 ozs. of No. 32, wound on a similar core to No.

3. The grid winding of No. 3 should be connected directly to the negative side of filament. No advantage is gained with this circuit, using a grid potentiometer. (2) This should be 0·0005 mfds. variable. (3) Telephones should be 120 ohm connected to the thick wire winding of the transformer. (4) It is very doubtful if it will be received on this set. A valve circuit with reaction coil is really necessary. It will be quite suitable for the English broadcasting stations.

"S.O.S." (Swansea) *asks* (1) *The best length for spreaders of twin wire aerial.* (2) *Are there any advantages or disadvantages due to the aerial being placed on rising ground.* (3) *How to make grid condenser with lead pencil lined leak.*

(1) A very convenient length is 5′. (2) The diagram given does not convey much information regarding the contour of the land. If there is a considerable rise, which takes the ground level above the highest point of the aerial, there may be a certain amount of screening. (3) The grid condenser might be made of two pieces of copper foil, 2″ × ½″, separated by a thin sheet of mica. It is not possible to give accurate dimensions for such a leak. One can be made by rubbing lead pencil on about a 2″ length of slate pencil, until best results are obtained. This is a very crude arrangement, and far more satisfaction would be gained if one is bought.

"J.F.F." (East Grinstead) *cannot obtain results on a three-valve resistance capacity amplifier. It appears that the short wave telephony is not received with the two or three valve set because insufficient H.T. voltage is used.*

"R" valves, anode volts 40 to 60, should be used with 80 to 100 volts when in a resistance capacity amplifier. This allows for voltage drop across the external resistance. If this additional voltage does not improve matters it will be necessary to substitute H.F. transformers for the resistances and condensers. The transformers should be connected in the circuit as shown in Fig. 5, page 62, April 8th issue. It will be necessary to have separate transformers for 400, 1,000 and 3,000 metres, to receive Writtle and the broadcasting stations, the Dutch concerts and Eiffel Tower. When connecting the two-valve amplifier in circuit in place of the single valve, it is necessary to change over the reaction coil connections as the current flow in the circuit is reversed.

"NOVICE" (Swinton).—The additional telegraph wires should not increase the interference with your set.

"J.L." (Brighouse) (1) *Refers to additional apparatus in a cabinet set.* (2) *If a spark coil may be used for the H.T. supply in a transmitting circuit.*

(1) If the set gives good results at present we see no object in adding either a crystal or H.F. valve. A crystal will be no better than the rectifying valve already in use, and an additional H.F. valve would take up about 5″ square, which space is probably not available on the existing panel. (2) If the H.T. voltage were passed through a rectifying valve into a smoothing condenser the arrangement might be made suitable for a lower power set.

"EARLY BIRD" (Reading) *asks for winding for reaction former for* 300/1,200 *metres.* (2) *Size of grid condenser.* (3) *Is there a Wireless Club in Reading.* (4) *Best circuit for telephony for above former.*

(1) No mention is made of winding space available, but trial windings might be outer former wound full of No. 26 inner former full of No. 28. (2) Two copper foils, 2″ × ½″, separated by a thin sheet of mica. (3) The Reading Radio Research Society, Hon. Secretary, Dr. L. L. Phillips, 73, London Street, Reading. (4) Single-valve circuit given to **"D.R." (Doncaster)**, will be found most suitable.

"VALVE" (Hull) *has a two-circuit crystal receiver which he desires to convert to a valve set.*

If valve were added as shown in diagram (Fig. 2), the existing rectifier could be used as desired. This, however, would not be suitable for C.W., for the reception of which the set would have to be made into a single-valve reaction set similar to the one given to **"D.R." (Doncaster).** This circuit would be more useful to you than the diagram given above.

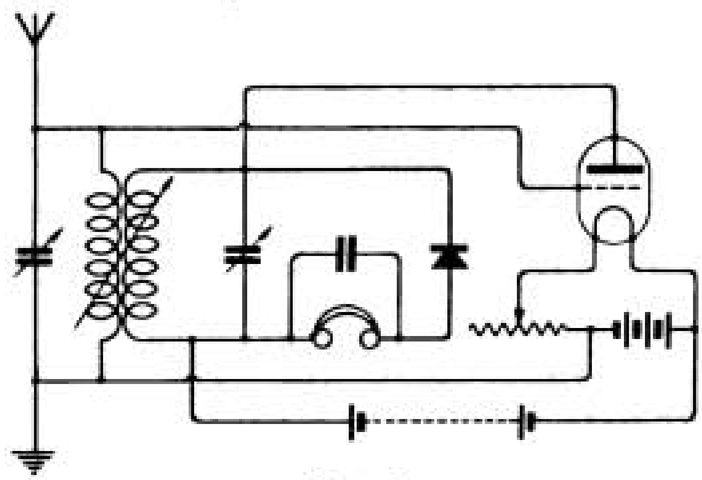


Fig. 2.

"C.F.L." (Bingley) *gives a transmitter diagram which is incorrect and asks for constructional details.*

The single-valve transmitter, given on page 185, May 6th issue, will probably be more suitable than the one you have shown. In this circuit no choke coil is required. The condenser across the H.T. might be about 0·002 mfds. The microphone transformer should have about 10,000 turns for the grid winding, and about 200 each for the microphone and buzzer windings. Condenser across grid winding of transformer 0·001 mfd., and across the 1,000 ohm resistance 0·002 mfd. A.T.I., and reaction coil windings cannot be given without some knowledge of the wavelengths to be transmitted and size of aerial.

"NOVICE" (Cornwall).—We think it will be satisfactory to install the receiver on the third floor provided a good stout earth lead is used. See also the Instructional Articles on Experimental Station Design.

L.W. (Fulham) *asks* (1) *For advice as to position of an aerial.* (2) *What aerial wire to use.* (3) *Type of coil.* (4) *What earth connection is best for protection from lightning.*

(1) The position you indicate for the aerial should be satisfactory, but it would be better, if possible, to avoid running any part of the aerial so near the house roof. (2) 7/22 stranded phosphor bronze is probably the best, but any copper or phosphor bronze single strand would do if not less than No. 18. It is not at all essential that the aerial wire should be enamelled. (3) There is little to choose between the different types of coils you mention. (4) The earth should be satisfactory, remembering that when earthed as a protection against lightning,

all leads to earth from the aerial should be external to the house.

"TRIODE" (Bishop's Stortford).—(1) *Does the length of P.M.G. aerial include the leads inside the house.* (2) *If aerial and earth leads inside the house of 20 yards each will effect reception.* (3) *In this case should the earth lead be insulated.* (4) *If aerial sketched is satisfactory.*

(1) Presumably yes, as it includes the down lead to the instruments. (2) Probably the effect would be serious; if this arrangement is unavoidable the aerial lead should be kept right away from walls, etc. (3) Yes, preferably. (4) Yes.

"W.B.B." (Ashbourne) *asks for advice regarding a single-valve French set.*

Without a diagram of connections of your set or some further details it is impossible to advise you.

"H.D." (Hornsey) *asks* (1) *The gauge of samples of wire enclosed.* (2) *If single layer coils could be used in place of pile wound coils for the single valve long range receiver described in earlier issues.*

(1) All three samples are No. 30 gauge. White is S.C.C., green D.S.C., and brown S.S.C. (2) We would not recommend you to attempt this as the set was designed for this particular method of winding, giving very tight coupling.

"P.L." (Teignmouth) *asks* (1) *How to identify various stated systems of transmission.* (2) *The order of the stations when calls are made.*

(1) Tonic train and chopped C.W. are the same system of transmission, a clear high note is produced in the telephones audible *with* and *without* reaction. For arc reception the receiver must be oscillating as for all C.W. reception. The sound in the telephones is not so crisp as in the case of ordinary C.W., and it is usually possible to hear the steadily emitted signalling wave corresponding to the carrier wave in telephony. It is easy to identify an arc station if it is heard starting up before signalling is commenced. High speed service may be spark or C.W. In the telephones a continuously emitted signal is heard composed of signals made at rapidly succeeding intervals. The sound resembles the rattle of the discharge from an induction coil, but is, of course, a very small sound in comparison. Quenched spark is sometimes difficult to distinguish from some other methods of spark transmission. The Telefunken quenched spark has a high-pitched note, which is easily identified from familiarity with it.

"N.B." (Broughty Ferry) *has a coil 4½" × 5" wound with about 2½ ozs. of No. 18 and wishes to use this as a primary inductance. Asks* (1) *For dimensions for a secondary winding range,* 300-1,500 *m.* (2) *Wire for secondary.* (3) *Capacity of condenser across it.* (4) *For a two-valve diagram using a particular circuit.*

(1), (2) and (3) On a former 3½" diameter, wind 2" of No. 32, using a variable condenser of 0·0015. (4) See Fig. 3, but it should be remembered that resistance-capacity coupling is not suitable for amplification below about 1,000 metres.

"ANXIOUS" (Hexham) *asks for detailed instructions for the construction of an efficient set.*

See the three-valve set described in the issues of April 1st and 6th, 1922.

"G.P.T." (Coventry) *asks* (1) *If upstairs or downstairs is the best location for apparatus.* (2) *What use can be made of No. 38 enamelled copper wire.* (3) *Can* 2MT *be received in Coventry with a crystal detector only.* (4) *Certain questions re the formula* $\lambda = 1885\sqrt{CL}$.

(1) The instruments should be located downstairs as the earth lead should be as short as possible. (2) Might be used for secondary of telephone transformers—enamelled wire is not recommended for H.F. intervalve transformers. (3) Very unlikely. (4) In the formula quoted the self-capacity of the inductance L is included in the value assigned to the capacity C. If the self capacity of the inductance is ignored it will always be found that the calculated wavelength will be less than the actual wavelength to which the circuit will tune in practice.

"S.H." (Leytonstone) *gives a single valve circuit and asks why the Marconi concerts are scarcely audible.*

Your circuit shows no grid leak. Try the circuit with a leak of 2 megohms connected from the grid side of the grid condenser to the negative end of the filament. You will probably require more than 50 volts H.T. with an "R" valve. We cannot say who is the station transmitting on the wavelength you mention.

"L.W." (Bournemouth).—With such an aerial you will not get much with a crystal. As you do not give the length or number of wires of your aerial it is not possible to estimate to what wavelength you can tune, but probably you will not get above 6,000 or 7,000 metres with the tuning coil you describe. No battery is necessary with a zincite bornite combination crystal. Possibly the plates of your variable condenser are making contact somewhere. A variable condenser is not necessary where you show it in your circuit; instead, put it in place of the battery in your diagram.

"R.C." (Godalming) *asks why set sketched will not oscillate on or below* 1,000 *metres. How to add two additional valves to his existing three-valve set.*

Your circuit is not good as it stands. The reason for non-oscillation is probably due to the absence of a shunt condenser across your H.T. battery, which at present acts as an impedance in the oscillating circuit. For a five-valve circuit try that on page 680 of the February 4th issue, inserting

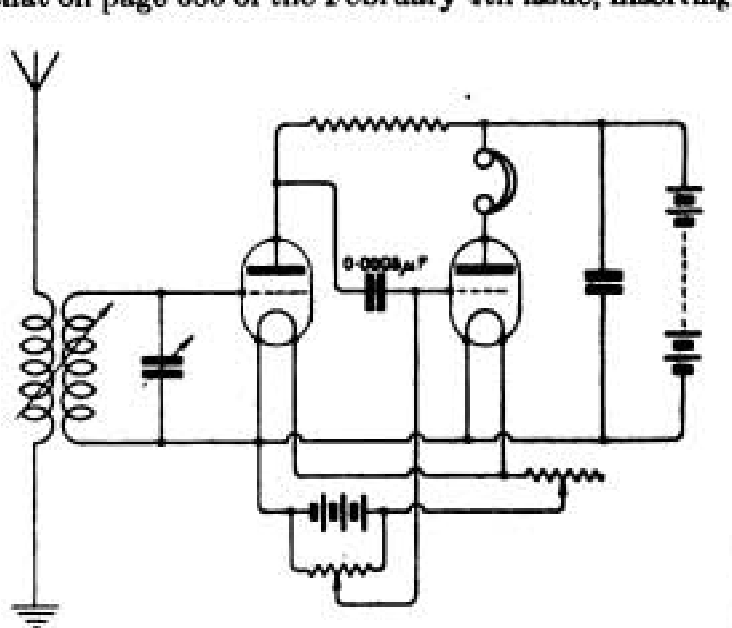


Fig. 3.

the reaction coil in the plate circuit of the third valve.

"**S.W.J.**" **(Hendon)** *asks for a circuit for a three-valve set, one H.F., one detector and one L.F. valve, and for advice in winding a tapped H.F. transformer in a slotted former.*

For a circuit see page 15 of the issue for April 1st 1922. As you do not state wavelengths required, it is quite impossible to suggest windings for the transformer. See an article on page 588 of the November 13th, 1920, issue for useful help.

"**A.J.R.**" **(Cardiff)** *asks* (1) *If several basket coils can be used in series for a tuning inductance.* (2) *If mean diameter of basket coils is 2¼" how many turns of No. 26 are required for 5,000 metres with a 0·0005 variable in parallel.*

(1) Yes, but for the lower wavelengths it is better to wind single layer on a former. If several basket coils are used in series they should be spaced about ⅛". (2) Up to 1,500 m. wind on a former 3½" in diameter 3¾" of No. 26 D.C.C.

"**ROVER**" **(Hammersmith).**—Your circuit is quite wrong. See p. 119 of issue for April 22nd for a two-valve circuit. Your secondary would tune to about 1,400 metres, with a 0·0001 mfd. variable condenser, or to about 4,000 metres with a 0·001 mfd.; the wavelength to which the primary will tune depends upon the valve of your aerial.

"**RADIO**" **(Alum Rock).**—You do not give the diameter of your coils, and therefore we cannot calculate the wavelength. Eight tappings should suffice for the cloud circuit inductance, but they should be graded and a variable condenser connected across the inductance for tuning.

"**H.T.**" **(Scunthorpe).**—The closed circuit should be arranged as in Fig. 3, page 90, of April 15th, 1922, issue, the value of the grid leak being 2 megohms and the grid condenser about 0·0002 mfd.

"**GILJO**" **(Brickhill)** *asks* (1) *How to proceed to get wavelength below 600 m. when his smallest coil will not oscillate below that.* (2) *Who transmitted a "CQ" concert on Friday, April 28th.* (3) *If grid leak and condenser are necessary with added stages of amplification.* (4) *For criticism of circuit sketched.*

(1) You probably will have to reduce the size of your aerial. (2) See account under "Notes" column of the issue for May 13th. (3) The function of the grid leak and condenser is to rectify the incoming oscillations and this or some other method of rectification must be used, and should be employed after H.F. and before L.F. amplification. (4) Your circuit is quite wrong. See instead the circuit given on page 15 of the April 1st issue.

"**R.H.**" **(Barnsley).**—(1) *Sends a picture of a variometer former he has purchased and suggests that the slots are insufficiently deep for reaction and aerial tuning inductances.* (2) *Asks if 40 D.C.C. is suitable for the windings.* (3) *Asks if a condenser in parallel with A.T.I. increases wavelength and in series reduces it.*

(1) The former is more suitable for use as a variometer, particularly for short wave tuning—for circuits see article in *The Wireless World and Radio Review*, page 281, of June 3rd issue, by F. Rumford. The inside former is sufficient for reaction coil, and the outside is sufficient for coupling with additional inductance in series for longer wavelengths. (2) No. 40 is too fine a gauge for A.T.I. or reaction coil; use No. 22-26. (3) Yes

"**MIRAMARE**" **(Bristol)** *sends a sketch of his circuit asking what is necessary in order to be able to tune down to 180 metres and lower.*

Your circuit being resistance capacity coupled is unsuitable for amplification below about 800 or 900 metres. Use H.F. and transformer coupling for the H.P. valve, connect your grid leak from the grid of the second valve, and use a variable condenser in series with your A.T.I. and earth to reduce wavelength, or reduce the size or number of wires of your aerial.

"**E.G.K.T.**" **(Bradfield)** *has used circuits Figs. 10 and 12, p. 726 of issue for Feb. 18, and asks for advice.* (2) *For a good two-valve circuit for Writtle and Croydon telephony.* (3) *What is wrong with a valve which emits blue light.* (4) *If he would be better advised to use H.F. transformer instead of resistance capacity coupling.*

(1) Fig. 10 should show a condenser shunting the telephones and H.T. battery. It is difficult to say what is the cause of the peculiar results you have been getting. (2) The circuit Fig. 1, page 119, of the issue for April 22nd, should be suitable, and a further valve for H.F. amplification might be added if you wish to increase strength. (3) Obviously your valve is "soft"; too much H.T. or too bright a filament will sometimes aggravate this trouble, but it is generally the valve which is responsible owing to it being insufficiently exhausted in the process of manufacture. (4) Yes, transformer coupling is better for short waves and resistance capacity for 1,000 metres and above.

"**J.G.**" **(Westminster)** *asks for the wavelength range of a number of slab coils and gives only the number of turns of wire in each.*

In order to calculate these values it is necessary for you to tell us the gauge of wire, whether D.C.C., D.S.C., etc., and all external dimensions of the coils.

P.C.G.G. (Sunderland) *sends a sketch of the connections of his set and asks various questions.*

Your set might tune up to about 3,000 metres, but as you do not give any particulars of your aerial it is not possible to give you an accurate estimate. The purpose of the 0·0002 condenser is not apparent from your sketch, it would be better connected between your terminals 6 and 8. You might get FL but not PCGG with this single valve set. A variable condenser, say 0·0002 across your terminals 3 and 4, would probably improve your results.

"**H.E.J.**" **(Rugby)** *asks* (1) *If a Mullard "Ora" valve can be used in the set described in issues of February 5th and 19th, and March 19th, 1921.* (2) *If the use of this valve would mean any difference in the construction of the set.* (3) *Amount of wire required in the construction of this set.* (4) *For values of coils and condenser.*

(1) and (2) Yes, without alteration of set (3), 2½ ozs. of No. 26 and 1½ of No. 32.

"**R.B.F.**" **(Spondon)** *asks* (1) *Where four-electrode valves as described in the 1921 Year Book can be obtained and what price.* (2) *Gives a circuit employing a four-electrode valve for telephony transmission and asks if it will work.* (3) *If it is better than that given on page 671 of the January 21st issue.*

(1) Marconi Scientific Instrument Company. Price about 45s. (2) Your circuit should work, but see issue of 29th May for a better arrangement.

Also see issue of May 13th for information on these valves. (3) Probably yes, but it is a matter for experiment. (4) Without knowing your desired wavelengths or your aerial dimensions it is not possible to help you. 0·001 mfds. would be suitable for the condenser.

"J.H.P." (Mansfield) *asks for a valve and crystal circuit for the Marconi concerts.*

Use the circuit given in Fig. 1, page 90, of issue for April 15th. To use valve alone include a switch to short circuit the crystal and crystal battery and potentiometer.

"NEW READER" (Liverpool) *sends a sketch of a crystal circuit and asks various questions.*

You should connect to the mid-point of your battery and not to the end of the potentiometer, otherwise the circuit is correct. You are unlikely to get any results worth while with an indoor attic aerial and crystal set, and with low resistance telephones you would probably get nothing. The annual licence fee for a receiving set is 10s. Apply to the Secretary, G.P.O.

"J.T.B." (Stockport).—For satisfactory reception of **PCGG** not less than two valves are recommended. You should get **2MT** well with one. A three-valve amplifier is described in the issues of April 1st and 8th. Very full constructional details for a tuner having the range you require appeared on page 344 of the issue for September 3rd, 1921. There is little to choose between the single wire or twin wire aerials of the dimensions you give —use whichever is most suited to your location. It is better to use low resistance telephones with a telephone transformer. The price of these together is about the same as for high resistance telephones.

"A.W.F." (Seedley) *asks* (1) *and* (2) *For circuit diagram and details for construction of the tuning coils of the B.T.H. portable set.* (3) *If this set would work with a single wire aerial instead of the frame, and* (4) *if it would receive the* **2MT** *transmissions with a small frame aerial.*

(1) and (2) We cannot give data for the construction of marketed sets. (3) Yes. (4) Possibly, but certainly would with an external aerial.

"NIMROD" (W.1) *sends sample of wire (No. 26 enamelled) and asks* (1) *What wavelength he can read with an A.T.I. 12″ × 5½″, wound with this wire, and a* 0·001 *across it.* (2) *Dimensions for a reaction coil.* (3) *Diagram for a suitable valve circuit using slider A.T.I.*

(1) You do not give details of your aerial, but with a two-wire P.M.G. aerial you would reach about 4,500 metres. (2) If you use the same gauge of wire you will require about 5″ on a 4″ diameter former, and the winding might preferably be tapped. (3) See Fig. 4, herewith; this circuit would be suitable for reception of telephony.

"E.C.S." (Manchester) *asks if we recommend for general use of amateur the single valve set described in Vol. VIII, and if the set will receive telephony.*

Experience has shown that amateurs find great difficulty in carrying out the pile winding required in the construction of this set and the efficiency of the set depends entirely on how this is done. The set will receive telephony, but we would recommend a set with a more limited range of wavelengths or interchangeable coils.

"FRAME AERIAL" (Leicester) *asks* (1) *If he could use the frame aerial described in the April 17th, 1920, issue, with a crystal receiver and valve note magnifier in place of the four-valve amplifier.* (2) *What difference would this make to the range of the set.* (3) *Would he receive* **2MT** *and* **PCGG.** (4) *Would* 750 *ohms telephones do.* (5) *How to change four-figure time into ordinary time.*

(1) A crystal set followed by valve magnification would be useless with a frame aerial. (2) and (3) You might possibly get very loud stations in your immediate neighbourhood — you would certainly not hear **2MT** and far less **PCGG.** (4) A telephone transformer would be necessary with these telephones. (5) To read four-figure time take the first two figures to denote the hour and the last two to denote the minutes. If the first two figures are less than 12 the time is before noon, and if the first two figures are more than 12 the time is after noon and 12 should be deducted from the number to arrive at ordinary time. Thus, 0230 is 2.30 a.m., 1430 is 2.30 p.m., 1730 is 5.30 p.m.

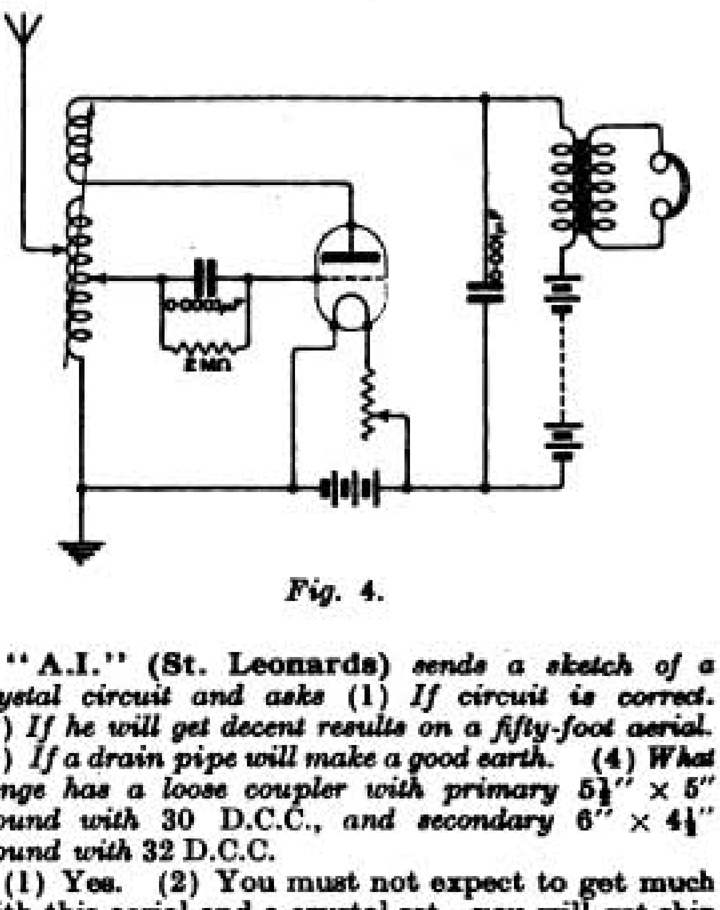


Fig. 4.

"A.I." (St. Leonards) *sends a sketch of a crystal circuit and asks* (1) *If circuit is correct.* (2) *If he will get decent results on a fifty-foot aerial.* (3) *If a drain pipe will make a good earth.* (4) *What range has a loose coupler with primary* 5½″ × 5″ *wound with* 30 D.C.C., *and secondary* 6″ × 4½″ *wound with* 32 D.C.C.

(1) Yes. (2) You must not expect to get much with this aerial and a crystal set—you will get ship stations and some of the high power European spark stations. (3) The drain pipe will make a fairly good earth if it is all metal and goes underground with a short path from your instruments to earth. Some metal drain pipes empty into non-metallic pipes without making good contact with earth at any point. (4) With a 0·0002 condenser your secondary will tune to about 2,000 metres. The range of your aerial tuning coil it is not possible to estimate accurately without more particulars of your aerial, but probably it will tune to about 2,000 metres too.

"ABSOLUTELY" (Edmonton) *asks* (1) *For a circuit to show how to add one stage of L.F. amplification to a detector valve circuit.* (2) *For a suitable L.F. transformer for this set.* (3) *Would it receive* **PCGG.**

(1) See Fig. 1, p. 119, of issue for April 22nd. (2) See pp. 152-155 of issue for May 28th, 1921. (3) Possibly with skilful handling.

"SMALL HEATHER" (Birmingham) *asks questions regarding a crystal set of which he sends a circuit diagram.*

Your circuit is correct except for the inclusion of a battery in series with your telephone blocking condenser. This is quite wrong, no battery is required here but might be used with a potentiometer in conjunction with your crystal. For Method of connecting up see Fig. 2, p. 120, of April 22nd issue. We cannot give you the value of the capacity of your variable condenser without knowing the spacing of the plates and the dielectric. As you say there are five fixed and four moving vanes you can arrive at the capacity as follows: Multiply the area of one plate measured in square centimetres by 0·00000707, and divide the result by the spacing between the plates measuerd in millimetres. This will give you the approximate capacity of your condenser in microfarads. With your coil and a 0·001 condenser in parallel you would tune to about 15,000 metres or more but it is not possible to estimate accurately without knowing the dimensions and number of wires of your aerial. You could not get 2 MT with a crystal set in Birmingham

"H.A.E." (Farnham) *asks* (1) (*a*) *For wavelength to which a coil 4" × 12" wound with No. 28 W.G. enamelled and shunted with a 0·0006 will tune.* (*b*) *A similar coil wound with 36.* (*c*) *Both coils in series and shunted with a 0·0006 condenser.* (2) *How many foils 1" square are necessary for a condenser of 0·001 mfds., using mica as sample submitted.* (3) *What is the filament consumption of an ordinary "R" valve.*

(1) (*a*) About 7,000 metres. (*b*) About 11,000 metres. (*c*) About 13,000 metres. (2) Six foils. (3) 0·5 to 0·6 amp.

"H.G.O.B." (Irthlingboro) *asks* (1) *For a book on winding inductances and reaction coils in single layer windings.* (2) *If a certain type of resistance is suitable for the H.T. battery for a single valve set.* (3) *The respective merits of different types of coil windings.* (4) *For windings and number of tappings for reaction coil to work with certain coils he possesses.*

(1) We do not know of any book which treats thoroughly of single layer coils alone. The Radio Experimenter's Handbook, by P. R. Coursey, just published, gives very full data for coils of all types including, of course, single layer. (2) The modern hard valve does not require a fine adjustment of the H.T. potential, it is quite sufficient to be able to vary the voltage in steps of one or two cells at a time. (3) Where space permits it is preferable to use single layer coils for inductances owing to their low self capacity and the fine tuning which can be obtained as a consequence. When other types of windings are used those having the least self capacity are to be preferred. Where basket coils are required to be used for long wavelengths it is best to use several reasonably sized coils spaced say one inch apart and connected in series. (4) Wind say 5" of No. 26 or 4½" of No. 28 on the 3½" former, and take off three tappings. The former for the reaction coil should be independent of the secondary former in order that their relative positions may be varied.

"T.W.H.J." (Acton).—We have no information regarding proposals for broadcasting from Northolt station. The most complete list of wireless stations in this country and amateur stations is contained in the 1922 edition of The Year Book of Wireless Telegraphy. Any of the types of coils you mention would be equally suitable for your single valve set, provided the values were suitable for the wavelengths you wish to receive. You should be able to bring the wavelength down to the value you mention with the small condenser in series.

"A.C." (Golders Green) *asks* (1) *If a twin aerial of 50 feet is better than a single wire of 75 feet.* (2) *Is there a maximum wavelength for a cheap crystal receiver.* (3) *If batteries are necessary with crystal receivers.* (4) *If 8,000 ohms telephones are better than 2,000 ohms with a crystal set.*

(1) Yes. (2) By adding inductance you would be able to reach any desired wavelength, but your set may be designed only up to a certain wavelength, as it stands. (3) Some crystals, such as carborundum, work better with a small potential controlled with a potentiometer. You would then require two dry cells arranged as in Fig. 5, page 124, of the April 22nd issue, where a potentiometer and battery is shown in use with a crystal. (4) Yes. A satisfactory crystal receiver should be obtainable at the price you mention but we cannot advise you without knowing the set.

"C. de G." (Smethwick) *wishes to convert a crystal set to a single valve set and asks* (1) *If the diagram Fig. 8, page 778, of the issue for March 4th, 1922, would do.* (2) *If a telephone transformer is necessary.* (3) *What batteries to use.* (4) *What valve.*

(1) Yes. (2) With your telephones a transformer would not be necessary, the two earpieces together give a resistance value of 4,000 ohms. (3) Your 4-volt accumulator will serve for the filament, and you will require not less than 45 volts for the plate voltage. If your flash lamp batteries are the ordinary type containing three cells the total voltage is 4½ volts. The number you mention is therefore sufficient. (4) The "R" type valve would be satisfactory.

"MOORHASETT" (Melton Constable).—The method of mounting coils appears to be satisfactory provided that the spring clip makes good contact. We do not know the composition of "Kenidgoid" and cannot therefore advise you as to its insulating properties. There would be no object in using a variable condenser as you suggest. To satisfy yourself you might enquire of the company concerned. We cannot undertake to give advice on patent questions.

"RELAY B." (Lewisham) *asks for advice re the erection of a station.*

A single valve set is described on pages 140 to 141 of the issue for April 29th, 1922, and the details given there should be enough to guide you. An external aerial such as you describe would give better results. The microphone transmitter would be satisfactory for the purpose.

"B.H.R." (Harpenden).—You could not get the Hague concerts with a crystal receiver. It is extremely difficult with one valve but has been accomplished successfully.

"T.W.J." (Huddersfield) *asks* (1) *Where to apply for an agate cylinder for the Johnsen and Rahbek apparatus described in a recent issue.* (2) *For the address of the author of this article.* (3) *If a Brown microphone amplifier could be used instead of the microphone described*

(1) We believe these can be ordered through Messrs. James Gregory, of 139, Fulham Road, London, S.W.6. (2) Correspondence addressed, c/o The Editor, will be delivered. (3) No doubt this could be used but an ordinary microphone gives all the results that can be desired.

"C.D.P." (Monmouth) *asks questions regarding the erection of an aerial and if the stay wire of a telegraph pole in parallel with the aerial will interfere with reception.*

The stay will not interfere much with your reception if at all, but its effect will be less if your aerial crosses it at an angle as you suggest.

"H.W.J." (Chester) *sends a circuit diagram of a four-valve set and asks why he does not get good results.*

First of all your grid condenser and grid leak should be in the grid circuit of the second valve, not the first, which is intended for H.F. amplification in your particular circuit. You might dispense with the tuned circuit in the plate circuit of your first valve. The values of your grid leak and condenser are not suitable, try 2 megohms and 0·0003. The wavelengths over which you can receive will depend upon the windings of your H.F. transformer. The condenser across your H.T. battery might be 0·002, not 4 microfarads as you show it.

"PROTON" (Acton) *asks (1) Which of two circuits sketched is better for* **2 MT** *telephony. (2) If it matters seriously having his instruments located a considerable height above the ground for receiving. (3) Where a description of electrostatic telephones may be found. (4) If the inductances of aerial circuit, closed circuit and reaction coil should be equal or in any particular ratio.*

(1) Your sketch, Fig. 2, would be more satisfactory, the grid condenser and leak being 0·0003 and 2 megohms respectively. (2) Not very much for reception. Your lead to earth should be as direct as possible. (3) Many text books describe the electrostatic telephone. See Eccles' "Handbook of Wireless Telegraphy and Telephony," page 284-5. (4) The inductance of the closed circuit should usually be a considerably higher value than the inductance of the aerial circuit coil, since the latter has added to it the inductance of the aerial and the capacity of the aerial to bring up the wavelength to the required value. The value of the inductance of the reaction coil is independent of wavelength.

"GALENA" (Stockholm). *(1) If it is possible to get amplification of signals on a crystal set without the use of valves. (2) Is perikon more stable in use than galena. (3) The filament and plate voltage required for "telefunken" valves and if they are suitable for detecting and amplifying.*

(1) Not without strong signals and the employment of a sensitive relay. (2) There is not much to choose from the point of view of stability. (3) We do not know to which particular type of valve you refer, but if they are war-pattern valves, 4 volts filament and 60-80 volts plate, should be satisfactory. They are usually good detecting valves and would serve well for amplification also.

"SILICON" (Goodmayes) *asks various questions regarding a crystal set and for a circuit diagram of the "Tf" three valve set.*

You would not receive **2 MT** with a crystal set at your distance. A combination of zincite and bornite forms a very sensitive detector. A brass wire point is suitable for use with silicon. We are unacquainted with the "Tf" set.

"D. McC." (Edinburgh) *asks for names and particulars of stations transmitting weather reports (1) For North Sea. (2) Irish coast and North Atlantic.*

Norddeich sends a meteorological forecast for the North Sea daily at 1015 G.M.T. on 600 metres spark, the call signal being **KAV**, and again at **2130**. As you are a regular reader we refer you to the supplement issued with January 7th, 1922, number, where particulars of most of the meteorological transmissions of Europe are included. We do not know of any radiotelephone transmissions from coast stations in Europe.

"H.I.P." (Cardiff) *is troubled with interference from electric trams passing near by and asks (1) How to avoid the interference. (2) What alterations to make to set an aerial.*

(1) It is hardly likely that you will be able to overcome this trouble but (2) if you are willing to make the sacrifice in signal strength you would probably avoid much of the interference by dispensing with L.F. amplification.

"1914 READER" (Halifax) *sends a circuit diagram of a three-valve set with tuned anode circuits and asks (1) If the wiring is correct. (2) If it is possible to arrange for the inductance of the tuned anode circuits and their tuning condensers to be common to both circuits to avoid separate tuning. (3) How to avoid noises. (4) If "R" valves are unsuitable.*

(1) The circuit appears to be correct but the inclusion of a variable condenser across the reaction coil is an unnecessary additional tuning complication. (2) No. (3) Some of your trouble may be due to howling of the set, especially if it occurs most on short wavelengths. Try using a potentiometer to control the potential of the grids in a manner similar to that shown in Fig. 2, page 682 of issue for February 4th, modifying to suit your circuit. (4) "R" type valves should be quite suitable.

SHARE MARKET REPORT.

Prices as we go to press on June 9th, are:—

Marconi Ordinary	£2	10	9
,, Preference	2	6	10
,, Inter. Marine	1	13	0
,, Canadian		11	2
Radio Corporation of America:—			
Ordinary	1	2	4
Preference		14	9

4th June, 1922. THE PRICE 6D. NET.

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VOL. X. No. 13. JUNE 24TH, 1922 WEEKLY

The Production of Beats at Audio-Frequency

SOME SUGGESTIONS FOR EXPERIMENTS

APART from the ordinary application of the principle of heterodyning to the reception of wireless signals many other applications of heterodyning are possible and some of these provide a wide and fascinating field for experiment.

In making use of this principle for the reception of undamped waves we generate locally in the receiving circuit a frequency differing slightly from the frequency to which the incoming signals are tuned. The effect then is that we get a resultant frequency audible in the telephones.

If we call the frequency to which the incoming signals are tuned n_1, and n_2 the frequency generated locally, then $n_1 - n_2$ (or $n_2 - n_1$) will give us the frequency of the note in the telephones.

In the reception of undamped waves by this means we may employ either *autodyne* or *heterodyne* circuits. In the case of autodyne reception the locally generated oscillations are obtained from the same triode as is used for detection in the same circuit, whereas by the separate heterodyne method the local oscillations are generated in an independent circuit, inductively coupled to the receiver circuit.

A circuit arranged for beat reception of undamped waves in the method described above, employing the same triode for the generation of local oscillations as for detecting is shown in Fig. 1. Here the circuits A and B are tuned, the one to the frequency of the incoming signals and the other to a slightly different frequency of such a value that the resultant beat note will be of an audible frequency in the telephones.

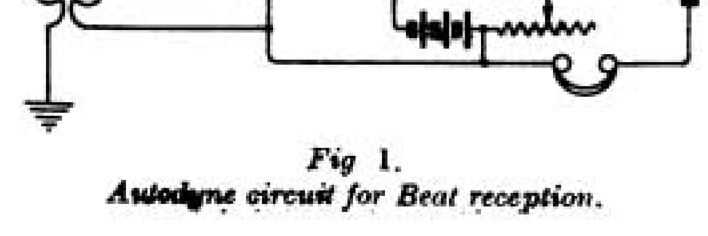


Fig 1.
Autodyne circuit for Beat reception.

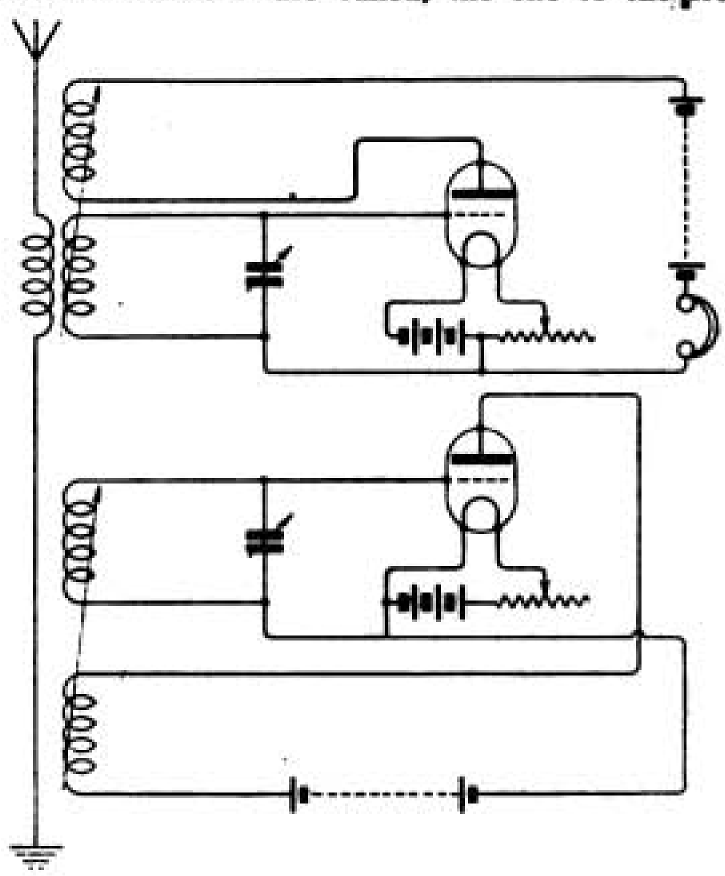


Fig. 2.
Circuit using seperate oscillation for Beat reception.

Where an external heterodyne is employed with an independent triode for the purpose of generating the local oscillations, the circuit may be arranged as in Fig. 2, where again two circuits are tuned to slightly differing frequencies to bring about the same production of beats of audible frequency in the telephones.

The frequencies generated in the circuits A and B Fig. 1 and in the circuits of Fig. 2, are obviously controlled by the values of the capacity and inductance of the circuits, and if one or other of the circuits is kept constant, and a change is made either in the value of the inductance or capacity of the other, the resultant beat note heard in the telephones will change its frequency.

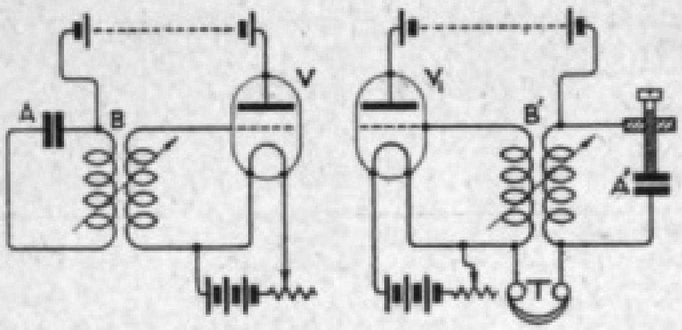


Fig. 3.

Circuit used for physical measurements.

In practical work it is very much more convenient to control the frequency of the circuits by a variation of the value of the capacity rather than of the inductance, and this is done by means of a variable condenser.

The effect produced by the change of capacity of this condenser has formed the basis of experiments conducted by Professor R. Whiddington in the measurement of extremely small physical quantities.* In his experiments Professor Whiddington employed a circuit arrangement as shown in Fig. 3, where A′ was a condenser, the spacing of whose plates could be conveniently controlled.

When in this case the right-hand circuit had, say, a frequency of one million, if the left-hand circuit were caused to oscillate at a frequency of 995,000, then a resultant beat note of a frequency of 5,000 was obtained in the telephones, so that a comparatively small change in either of the circuits produced a very much greater proportionate change

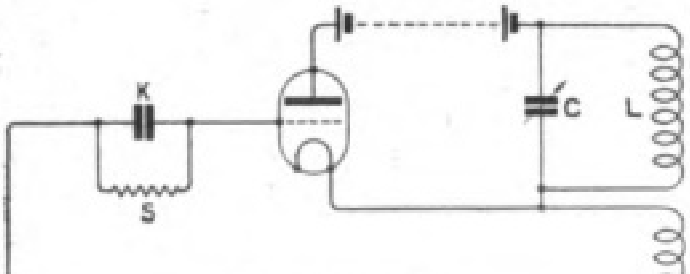


Fig. 4.

A circuit where K is the varying capacity.

in the resultant beat note. The nearer the two oscillatory circuits are brought to the same frequency the more pronounced becomes the change in beat frequency produced by a small change in frequency of either circuit.

In practical working a difficulty is experienced here since it is found that when the two circuits are so closely tuned there is a stong tendency for the one to drag the other into step and, of course, the moment this happens, the production of beats ceases. This trouble may be largely overcome by loosening as far as possible the coupling between the circuits, but here again, by so doing, the strength of the beat note may be so far weakened as to render it inaudible in the telephones.

In order to overcome these difficulties, a third circuit may be arranged having a very large capacity and inductance to produce oscillations of an audible frequency close to that produced by the resultant beats of the two main circuits. In this manner loud slow beats can be obtained between the two oscillations of audible frequency. With such an arrangement, Professor Whiddington found it possible to detect a movement of the plates of the condenser A′ of as small a value as 1/200,000,000th of an inch.

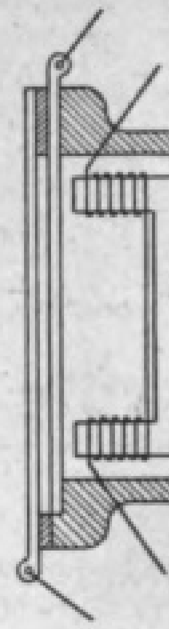


Fig. 5.

In a paper read before the Institution of Electrical Engineers†, Dr. W. H. Eccles and Miss W. A. Leyshon, B.Sc., have described other circuits

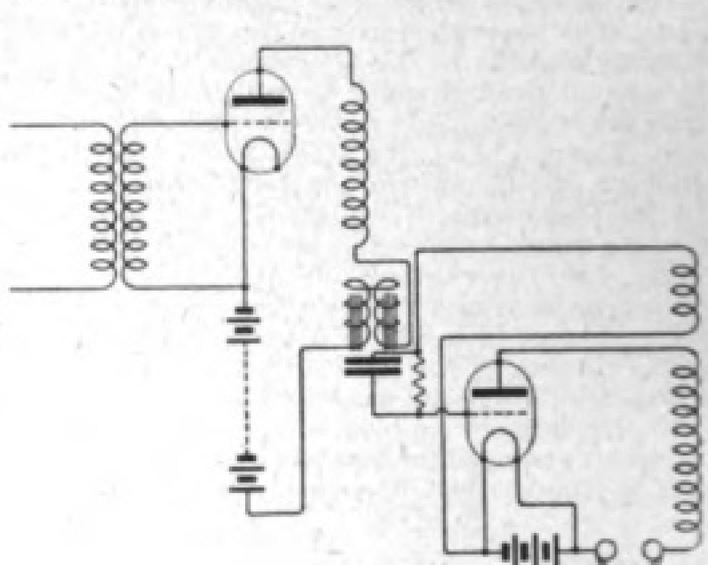


Fig. 6.

Circuit for electro-magnetic control of capacity.

making use of the principle of the change in resultant beat note of two oscillatory circuits which can be brought about by a minute change in the capacity of one of the circuits, and they have suggested the application of the principle as forming the basis for relays actuated by extremely feeble currents or by extremely small movements of conductors. A

* Wireless Valve Circuits as Applied to the Measurement of Physical Quantities. By R. Whiddington, M.A., D.Sc., a paper read before the Wireless Society of London, December 21st, 1920.

† Some Thermionic Tube Circuits for Relaying and Measuring. March 16th, 1921.

circuit suggested is that of Fig. 4, where K is the condenser of small capacity the variation of which is to be detected, N is a large inductance, C and L are the inductance and capacity of the oscillatory circuit and S is a grid leak.

The change in the capacity of the small condenser may be brought about either by varying the spacing of the plates or by the movement of an independent conductor in the electric field produced by these by the incoming signals of say, a wireless receiving circuit. The electro-magnet may be the electro-magnet of an ordinary telephone receiver, the diaphragm of which forms one plate of the condenser and the other is formed from a metal plate, parallel and in close proximity to the diaphragm. Such an arrangement is shown in Fig. 5. Further circuits, where the changes in the capacity of the condenser are controlled electro-

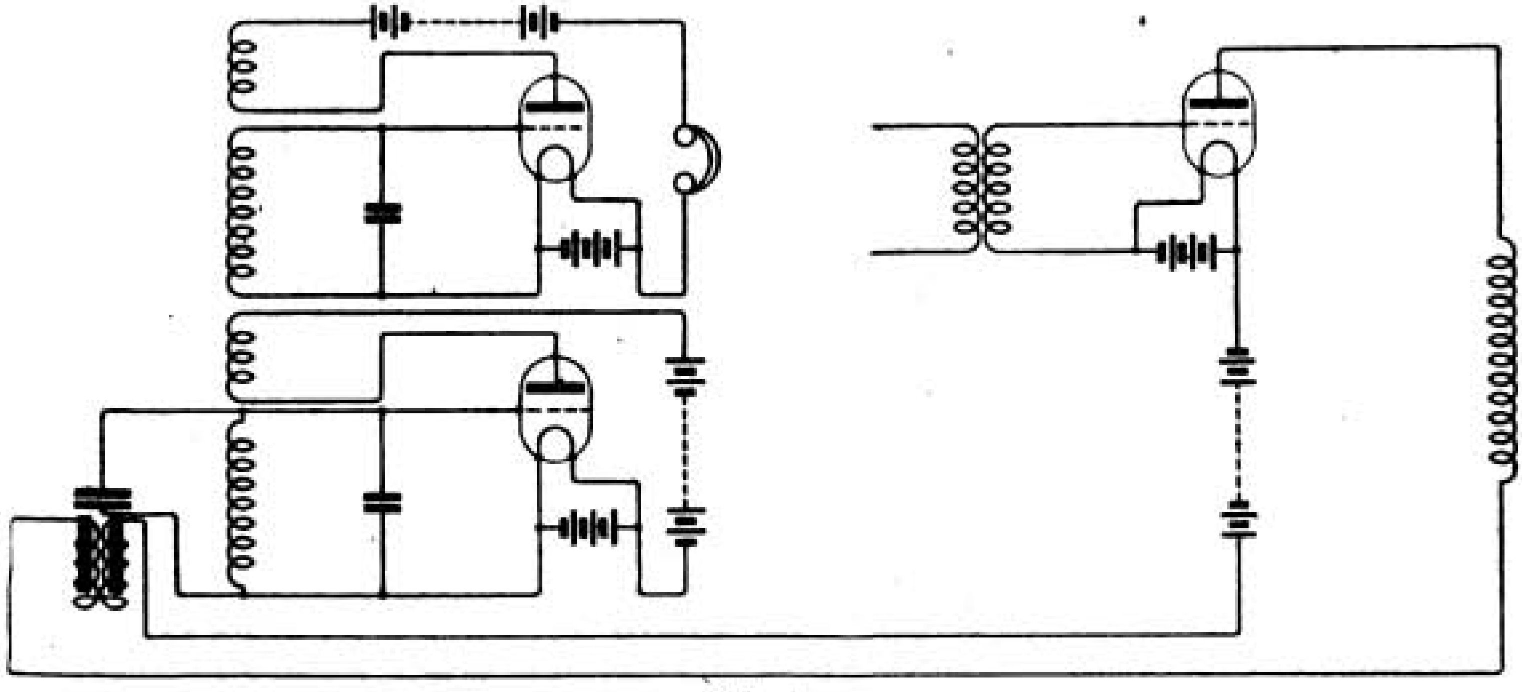


Fig. 7.

The application of the arrangement to a practical receiving circuit.

plates. The conductor between the plates might consist of the pointer of a galvanometer, the sting of an Einthoven galvanometer or the leaf of a gold-leaf electroscope.

In order that the condenser shall have a large capacity it is desirable that the plates should be as close together as possible and the surface area should not be too small.

In Patent No. 159,377, Dr. J. Robinson and H. L. Crowther describe an application of this effect where one plate of the condenser whose variation affects the beat frequency is caused to move by means of an electro-magnet which is itself controlled magnetically are given in Figs. 6 and 7. In Fig. 6, the value of the grid condenser is varied and hence the frequency of discharge determines the pitch of the note heard in the telephones.

In experimenting with any of these circuits it should be borne in mind that, in general, in order that the changes in frequency produced should be as great as possible, the distributed capacity of the circuit in which the condenser to be varied is included, should be kept as low as possible, and hence the inductances should be wound so as to have the least possible self-capacity.

H. S. P.

A Five-Electrode Valve*

By J. P. PRANGNELL.

IN this paper it is my endeavour to briefly describe the experiments carried out with the above-mentioned valve.

We are all acquainted with the 3-electrode valve and have heard in all probability something about the one containing four electrodes, but it is my privilege to introduce to your notice a valve of my own invention having five electrodes, consisting, as you will observe, of one filament, two grids and two plates (see Figs. 1 and 2). As I have only just received the valve from the manufacturers, it will be readily understood that I have by no means completed my experiments. I have done sufficient, however, to justify my stating that it will do wonders in the way of magnification.

I will first of all show you in Fig. 3 one of the circuits I have tried, with great success. It will be observed that an ordinary "R" valve is used as a rectifier. Grid 2 is coupled through the transformer Tr_1 to

* A Paper read before The Dartford and District Wireless Society.

Fig. 1.

the plate of the rectifying valve and remains at a steady negative potential all the time. The "R" valve is not then called upon to rectify, but as soon as the latter is affected by an incoming signal, Grid 2 becomes more or less positive. Transformer Tr_2 is adjusted by the potentiometer in such a manner as to be just on the point of oscillating at audio-frequency. When a signal, for example a dash, is detected by the "R" valve, it causes variations of potential in the primary winding of the transformer Tr_1 which are passed on to the secondary winding and cause Grid 2 to become more or less positive, allowing a greater flow of electrons to pass from the filament to the Plate 1.

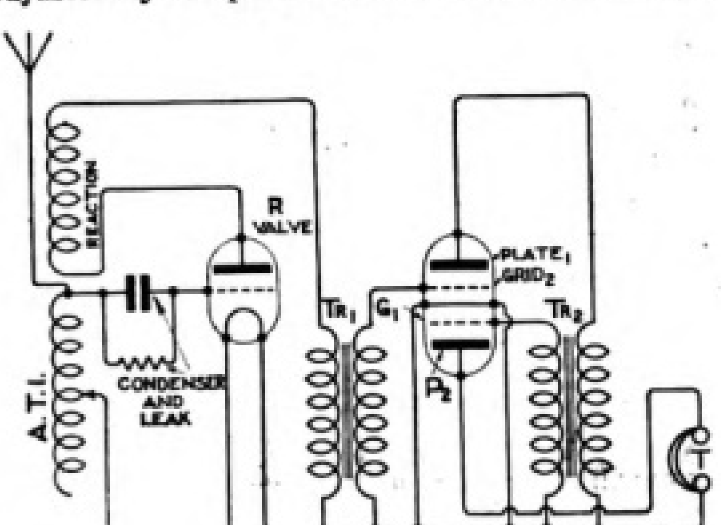


Fig. 2.

A circuit for use of the five-electrode valve.

The increase of electrons is sufficient to cause the transformer Tr_2 to oscillate for the period of the dash and then return to its normal potential.

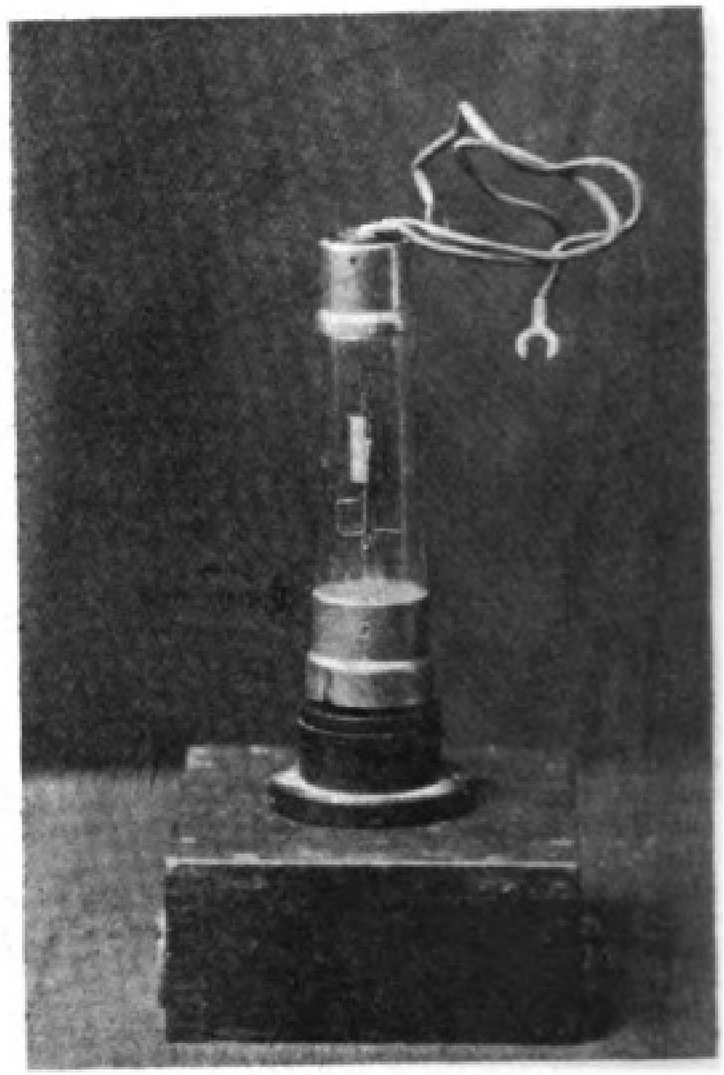


Fig. 3.

The oscillations which take place in the transformer circuit T_2 cause a varying potential between Plate 2 and the filament. These variations of potential are heard in the telephones in the form of a gruff note similar to that of a spark station. A signal which is just audible with one valve can be sufficiently amplified, when this circuit is employed, to be heard 20 feet from the telephones.

Questions and Answers.

In our next issue an important announcement regarding our Questions and Answers columns will appear.

A Dynamic Model Illustrating the Action of Tuned Electrical Circuits.*

AN interesting demonstration of a dynamic model of tuned electrical circuits was given before the Institution of Electrical Engineers on Wednesday, June 7th, by Professor C. F. Jenkin, C.B.E., M.A., M.I.E.E.

The author suggested that the use of dynamical models to represent electrical circuits often makes the behaviour of such circuits easier to understand or, at any rate, easier to visualise. When he began to play with wireless circuits he found it difficult to realise the effects of each part of the complex circuit made up of the aerial and the tuning inductance and capacity, and, in particular, the effect of changing the coupling of the inductance and the capacity from series to parallel; he had therefore attempted to make a dynamical model to represent the circuit. The model as finally arranged illustrated many of the fundamental properties of oscillating circuits in a striking manner.

Proceeding, Professor Jenkin explained that the essential thing in a dynamical model is that the mathematical equations for the motions of the various parts should be the same as those for the electrical circuit, and it is further desirable that the model should have some similarity of appearance to the electrical circuit so that its motion may be accepted by the mind as analogous to the behaviour of the electric circuit.

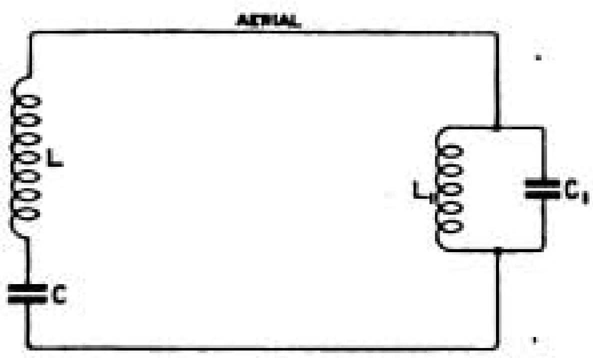


Fig. 1.

The electrical circuit represented by the model.

To make the mathematical equations the same it is well known that inductances may be represented by masses, capacities by springs, and resistances by friction (assumed to be proportional to velocity).

The electrical circuit is shown in Fig. 1, where the aerial is represented conventionally as an inductance in series with a capacity to earth.

The dynamic model is shown in Fig. 2. The inductances are represented by masses; the capacities by cantilever steel springs; the electric circuit by a *circuit* of string. The inductances may be varied by increasing or decreasing the masses, while the capacities may be varied by increasing or decreasing the length of the springs; these latter are fixed between wedges which may be put in at any point in their length. Quantities of electricity (coulombs) are represented by lengths of string; currents, by velocity of string; voltages, by forces. Thus the voltage across a condenser is represented by the difference of the tension of the string above and below the spring, and the charge by the deflection of the spring.

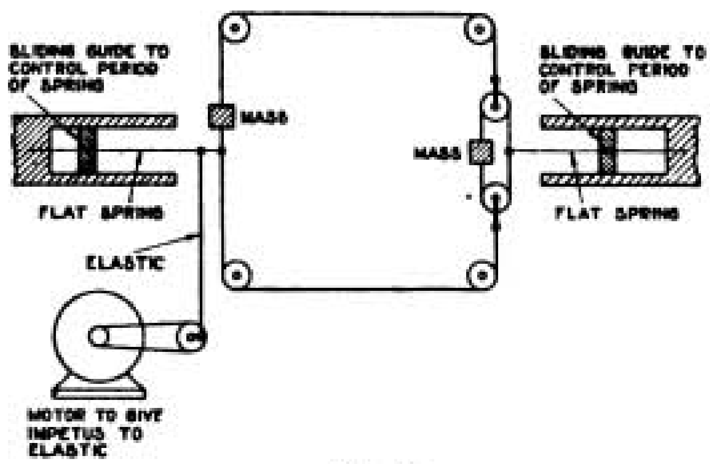


Fig. 2.

Diagram of the dynamic model.

When the tuning condenser and reactance are connected in parallel, the corresponding mass and spring are connected side by side. When, on the other hand, the tuning condenser and reactance are connected in series, the mass and spring are connected in series (but a simpler change, having the same effect, is produced by inserting a wedge jamming one of the floating pulleys).

The behaviour of the model may be most easily followed by beginning with some simple examples.

Telephone engineers are familiar with the use of inductances and capacities in parallel for separating direct or low-frequency currents from high-frequency currents. Let the tuning capacity and inductance be connected in parallel as in Fig. 1, and then :—

(i) Apply a very low-frequency E.M.F. by moving the left-hand spring slowly up and down. The whole current will in this case flow through the coil; the right-hand spring does not deflect.

(ii) Apply a high frequency. In this case the whole current flows through the condenser; the right-hand mass is almost still.

(iii) Slowly reduce the frequency until the resonating periodicity is reached. Violent motion of mass and spring then results with hardly perceptible motion of the string representing aerial, *i.e.*, no current can flow in the aerial since a tuned circuit blocks the way. This experiment illustrates

* Abstract of a paper given with a demonstration before the Institution of Electrical Engineers on Wednesday, June 7th, 1922.

the use of a tuned inductance for coupling two valves usually termed tuned anode coupling; there is a high potential difference (string tension) across the combination.

Next consider the whole model. A few trials show that it has a natural period which it will maintain, the amplitude being reduced gradually by friction.

The natural period may be found from the equation :—

$$p^2 \left\{ \frac{L'}{K'} + \frac{L}{K'} + \frac{L'}{K} \right\} - LL'p^4 - \frac{1}{KK'} = 0,$$

where

L, L' are inductances or masses.

K, K' are capacities or deflections of springs per unit force.

$p = 2\pi \sim = 2\pi/T$. T = periodic time.

This is a quadratic in p^2; there are therefore two natural periods. After making a few trials we hit the second natural period. With the one natural periodicity the springs move up and down together; with the second natural periodicity the springs move in opposite ways.

Let the pulley next be wedged so that the mass is now attached to the spring, that is, the inductance and capacity are in series. Again there is a natural period of vibration, which may be timed and compared with the former two. In this case both masses and both springs have the same motion and the period is the same as that calculated for a single spring with stiffness equal to the sum of the stiffnesses of the two and a mass equal to the sum of the two masses (or a single condenser of elastance equal to the sum of the elastances of the two and a single inductance equal to the sum of the two inductances).

To represent a Post Office aerial, the aerial spring must be made very short and its mass small. To tune the circuit to large wavelengths a large loading mass is required; the natural period then becomes practically independent of the aerial capacity and inductance.

Some Effects of Capacity on Mutual Induction

By J. H. REEVES, M.B.E.

(*Continued from page* 350).

DISCUSSION.

The President.

I feel sure that most of us present have experienced some of the effects that have been mentioned to-night, although very few of us may have taken the trouble to analyse the cause of them. I have had the same experience with something I have been doing during the last few days, not with tuning inductances, but with intervalve transformers. In last week's *Wireless World and Radio Review* there was a short article about negative reaction. By coupling a small coil in the grid circuit of the first valve with the intervalve transformer you got rid of howling effects. I have tried it and it certainly is good and does no harm to the long waves at all; but with short waves it alters the calibration of the wavelengths somewhat. It is a nuisance from that point of view. I used two valves, and coupling my small coil to my high frequency transformers I moved it about in exactly the same way as Mr. Reeves and the effects were identical. You could place it where it improved the signals, place it where it made no effect and you could rest it between the two transformers and find the best position. As regards the effect on short and long waves everybody who has tried it must have noticed it, as it is very marked indeed with this arrangement, that is to say, that for long waves it generally effects an improvement. Another point is the capacity effect obtained by shielding two transformers. I used a metallic shield and the effect very greatly improved the signals in every case. It corresponded with the capacity effect described by the lecturer.

I think that is all I have to remark on the experiments and I will now ask gentlemen to discuss the subject. Perhaps Mr. Coursey would open the discussion.

Mr. P. R. Coursey.

Mr. Reeves has described to us this evening experiments in wireless reception that he has carried out with a view to reducing interference. The question of reducing interference is always one that is very close to the heart of every experimenter, and this fact makes the paper have a special interest.

He raised a point about the definition of inductive coupling and of mutual inductance. I should very much like to have specific instances, if he can quote us one or more, in any well-known textbook, of the definitions to which he referred. I was fortunate enough in having the opportunity of perusing Mr. Reeves's paper some little time ago, and since then I have looked up this question. In the text-books to which I have referred it seems to be very clearly stated in most of them that mutual inductance refers to magnetic linkage only, being defined in terms of the common magnetic flux lines linking with both circuits.

Most of them—take Eccles' Handbook for instance—give this type of definition. I admit there *are* loose definitions, but I have not seen any quite on the lines of those he has referred to, and I would like some specific instance.

I take it, therefore, that in the title of his Paper, where he uses the term "mutual inductance," he understands a definition of the type he mentioned, and not the usually accepted meaning of the term. If the usual meaning is taken the title, of course, would require some modification.

In reading the Paper, the author referred to the formulæ for coupling and the absence of expressions for other forms than magnetic coupling. There is, I believe, a general formula for any type of coupling between circuits. I would just like to write it on the board because I think it might be helpful. One symbol k is used for the general coupling coefficient and it may be written as:

$$k = X / \sqrt{X_1 X_2} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where X is the common coupling reactance of whatever nature it may be, magnetic or electrostatic; and X_1 and X_2 are the corresponding reactances in the primary and secondary circuits. If we substitute in that general expression the appropriate quantities for magnetic coupling, viz., M for the mutual inductance between the two circuits, L_1 for the inductance of the primary, and L_2 for the inductance of the secondary, we get the usual formula for magnetic coupling, viz.,

$$k = M\omega / \sqrt{L_1\omega . L_2\omega}$$

$$= M / \sqrt{L_1 L_2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In the case of electrostatic coupling where C is the coupling capacity, the common static coupling reactance is $1/C\omega$ and if we divide that by the respective reactances, $1/C_1\omega$ and $1/C_2\omega$, the whole thing simplifies into $k = \sqrt{C_1 C_2}/C$ . . . . (3)

I have not seen this method extended at all but it would seem to me that it ought to be possible to extend that general equation (1) to include the mixed coupling which Mr. Reeves has been describing to-night. The type of circuit which he has been using can be represented electrically by his Fig. —. Whether he has one or two coupling capacities, their effective value can be represented by a capacity C; while the mutual inductance which he also has between his circuits can be represented by M. Hence, the coupling reactance in this formula (1) can be represented by $(M\omega \pm 1/C\omega)$, the plus or the minus sign being taken depending upon whether the two couplings assist or oppose one another. As regards the corresponding reactances of the two circuits, I would suggest that as the two circuits—the primary and the secondary—are each tuned to the signal frequency, they will behave practically as non-inductive resistances for frequencies close to the values to which they are tuned—in a similar manner to the well-known rejector circuits. Hence the form of the general expression (1) above will, in this case, become somewhat as follows:—

$$k = \frac{M\omega \pm 1/C\omega}{\sqrt{R_1 R_2}} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Hence we see that in this case the coupling coefficient is no longer independent of the frequency since the numerator has two terms involving the frequency $(\omega/2\pi)$ while over a small range of frequencies the denominator is independent of the frequency. Obviously if one coupling opposes the other there is a position where the numerator is zero, and it would seem to me that this is the case which Mr. Reeves has been describing. In other words we not only now have the tuning qualities of both circuits but our coupling itself is a function of the frequency and therefore we have increased selectivity, since k becomes zero for a particular adjustment and frequency and has a definite value for frequencies higher or lower than the one required to give this "silent point."

Of course, I am open to correction, and am merely putting this forward as a suggestion. I hope someone will tell us some more about it to-night. From this point of view of increased selectivity what we get by the form of mixed coupling that has been described is a means of discriminating between two frequencies which are very close to one another, and to which, to all intents and purposes, the two circuits are tuned. Obviously if the e.m.f's. due to the two couplings are exactly opposite in phase, so as to get a silent point (and we cannot get a silent point unless they are), that numerator in equation (4) will be zero for one frequency only, and shows that there will be some effective coupling from one circuit to the other for all other frequencies. Whether or not this is the explanation, the results that have been described are very interesting.

I am afraid I somewhat fail to see the reason for drawing so much distinction between the so-called "static couplers" and the similar circuit with a variable condenser electrostatic coupling. The two circuits are similar to a type often used with purely electrostatic coupling between the two, but it seems to me that Mr. Reeves's couplers are nothing more than two condensers in series. Apart from the fact that they are two condensers with a relatively bad dielectric, I cannot see that there is a difference, provided the effective capacities are made the same in each case. If there is a difference actually in operation it would be extremely interesting to have the reason for it elucidated.

In connection with his fine wire coils, I believe the idea of resistance in one or more of the tuning circuits for reducing interference has been tried before, and to that extent there is little new in it. What one is doing is to wipe out the effect of the resistance by retroaction with the valve for one particular frequency only.

The author of the paper referred to the good results he has obtained in wiping out atmospherics. I should like to ask him if he has heard any during the last few days, because I have heard quite a lot (laughter), as, if his apparatus has been completely successful during this period, it should be well worth further study. (Applause.)

Mr. G. G. Blake.

First of all I would like to congratulate Mr. Reeves on the work which he has put into his investigations. I would like to ask Mr. Reeves whether he finds that with these combined magnetic and capacity reactance connections, there is a decided diminution in signal strength? Or does he find them as loud as when using ordinary magnetic reactance coupling? I have made up a tuner of the Reinartz type, working on the lines suggested by Mr. Harris in his article in *The Wireless World and Radio Review* of May 13th. (This tuner makes use of combined magnetic and capacity coupling.) I find that its selectivity is splendid, it almost entirely eliminates jamming, also the atmospheric troubles are reduced to a very remarkable extent and I may instance my experience this morning when I heard both interference and atmospherics on a set using ordinary electromagnetic reactance, but avoided both these troubles with the Reinartz set.

I find the tuner excellent for all comparatively strong signals and telephony, but it is practically useless for the reception of weak strength amateur transmissions. I would like to have Mr. Reeves's views on this point.

(Mr. Blake then showed the set, Fig. 7, which

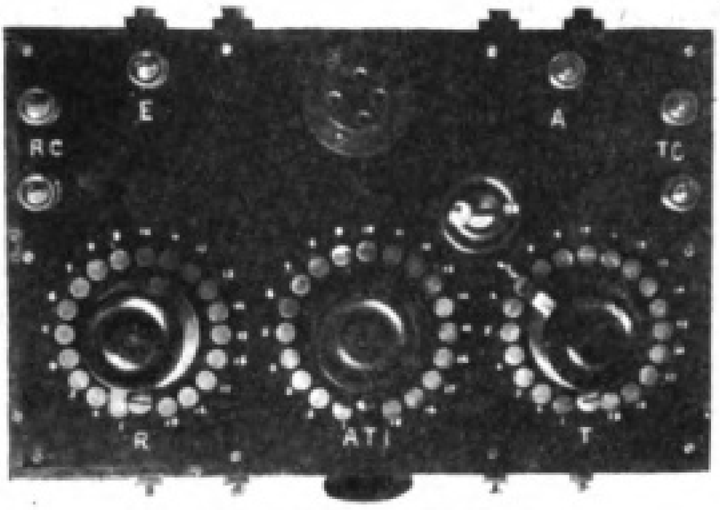


Fig. 7. The Reinartz Tuner.

he had made and an X-ray photograph, Fig. 8, showing its interior construction, together with a blackboard diagram reproduced in Fig. 9.)

I may also point out the necessity of the telephones being left in circuit to act as an impedance when the set is connected by terminals X and Y to the input transformer of a note magnifier.

Ordinarily, terminals X and Y are shorted by a strip of metal.

R = Reaction coil (magnetic component), 38 turns, with 19 tappings.

A = A.T.I. coil, 19 turns with 19 tappings one at each turn.

L_1L = The grid inductance, 110 turns, the first tapping at the 20th turn and then tapping at every 5 turns.

S = A switch which when set on its off position breaks the grid inductance after the 7th tapping to remove dead end effects when receiving short waves.

C and C_1 = Two variable condensers having a capacity of 0·0005 mfd. The set receives below 150 metres and up to 1,100. The maximum wavelength on tapping 7 of grid inductance is 500 metres.

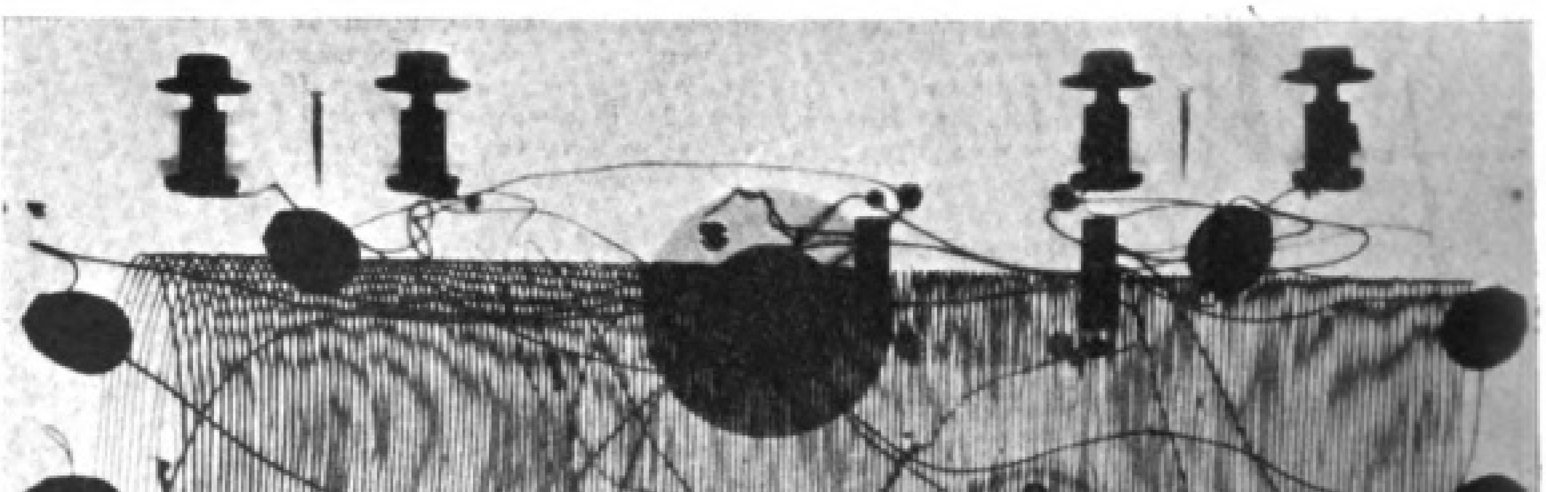


Fig. 8. X-Ray photograph of Mr. Blake's Reinartz Tuner.

Condenser C′ can be omitted and a small fixed condenser such as those employed for a grid condenser inserted in its place. All reactance adjustments are then made by varying the magnetic component R.

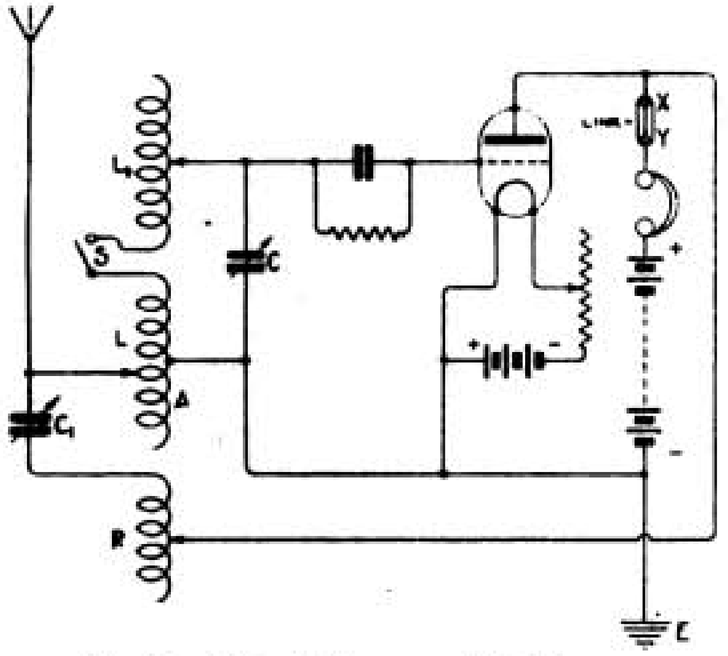


Fig. 9. Circuit diagram of the Tuner.

Fig. 9. The inductances and reactance are wound on one former, 3″ in diameter and of No. 22 gauge cotton-covered wire afterwards shellaced and baked.

Mr. R. E. H. Carpenter.

Mr. Reeves has asked where he can find expressions for capacitative and magnetic coupling. I think he will find them if he will look in circular No. 74 of the Bureau of Standards, which he can get from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A., for the small sum of 60 cents. plus postage. It is one of the most valuable books on radio telegraphy of which I know. He will find expressions such as those Mr. Coursey has so ably developed for electric and magnetic coupling. Further, he asked where he could find some methods of determining the increase of resistance due to self-capacity of the coil. I think he will find that lucidly treated also in the same book.

With regard to Mr. Coursey's remarks I think he has thrown a flood of light on the method of operation of this interesting device which Mr. Reeves has described to-night. It occurs to me as possible in connection with the formula $k = \frac{M\omega \pm 1/C\omega}{\sqrt{R_1 R_2}}$ which he developed, that there might conceivably be a differential effect between signals of different strength so that if the valve grid circuit is in parallel with the sort of circuit described it is conceivable that there will be a different result according to the amplitude of the oscillations. It seems possible that for C.W. signals, at any rate, there will be some differential effect due to the value of R_2 varying with the grid damping and therefore with the amplitude of the signal. What it will do is to cut out an unwanted station of different intensity. (Applause).

Mr. M. Child.

As many of our members here have dealt with some of the most important points of Mr. Reeves's paper, I think that I have only to say that I am extremely interested in Mr. Reeves's experiments. I have followed his work very closely from time to time, and I can confirm in every way the results which he has obtained. There is no doubt that, providing the bridging clips are properly set up the apparatus is extremely selective in the way in which he has described it to us. I am personally a little sceptical as to whether this method of obtaining highly selective tuning is of practical value, that is to say, I do not see quite how you can complete a practical instrument using the coils that he is using here to-night, which will give us the reaction which is necessary. It is very easy to get these results with coils separated and set out on the table, and I have noticed in all his experiments that he has always taken care to have them spaced, but when we come to make a practical instrument utilising the principles that he has outlined to-night, it is rather a difficult matter, I think, using these static couplers round the coil. I quite think that, providing a suitably fine condenser is arranged across the coils, we ought to get these results. I think, as a matter of fact, Mr. Reeves developed these static coils from an idea I had mentioned. I think he will remember a conversation we had when I mentioned putting a condenser across the coils in that way and these strips were the outcome of further work and mainly on account of the fact that the condensers which we had at the time were much too large in capacity. The actual capacity of these strips there must be of the order of something like 0·000005 microfarads. Using a small condenser, it is quite a practical thing to work. There is one little point that perhaps Mr. Reeves can give us further information about. Mr. Blake raised the question just now, "is there a loss of strength ?" I think that there undoubtedly must be loss of strength. Mr. Reeves has done some very excellent work and I think his paper will be very valuable to many here in bringing to the notice of many of us these effects that they have on each other, but I think, had he not been using a valve amplifier giving very high amplification, he would not have got those results. When we are using very small magnification I think there will be a serious loss of strength. There is another point and that is that the selectivity depends more on the transmitting station than with the receiving apparatus, and that is a point which we have to remember. There does not seem to be much gain in making our receiving apparatus very selective when we have a station like Paris with a big damping. I think that is all Mr. President.

Mr. C. F. Phillips.

I had the advantage of examining one or two of Mr. Reeves's coils with static couplers upon them and as I was extremely busy at the time I was unable to examine them as closely as perhaps they merited. I very soon discovered that coils of that nature were hardly suitable for combining within apparatus, owing to the space occupied. Again, in the design of receiving apparatus, it is generally found that one of the greatest difficulties is to get rid of stray electrostatic coupling. The use of electrostatic coupling to control magnetic coupling and the balancing of the two types of coupling one against the other, would undoubtedly provide an added means of obtaining selectivity at the receiving end. To do so in practice without a great deal of space at one's disposal would be a matter of serious difficulty; it would necessitate the receiving coils being separated by a distance of 1 ft. or even more, and it would necessitate all wiring within the set being run widely spaced, the greatest care being taken that all crossings should run at right angles to others. The result would be a set which would occupy dimensions quite impossible from a manufacturing point of view. When I say impossible it may be that such a set would be valuable in commercial working at stations designed to receive exclusively from another station having a fixed wavelength, but amateurs as a rule are not satisfied to receive on some one wavelength, but they nearly all desire to receive on all wavelengths from the shortest to the longest.

I have made some rough measurements on Mr. Reeves's coils, and I find that the capacity from static coupler to coil varies from 60 to 80 micro-microfarads. As in his circuit, two such couplers are in series, we get an effective capacitive coupling of 30 to 60 micro-microfarads. A coupling of that order is very reasonable because in some text books which describe such couplings I think it is very often said that the maximum value of the variable coupling condenser should be of the order of about 100 micro-microfarads.

As regards the previous use of circuits of this nature, I am afraid I am the culprit in stating that the principles are not entirely new. The actual static coupler is, as far as I know, very nearly new, although it was used by General Squier in his coil antennae. There is another circuit which Mr. Reeves can see in one of Scott-Taggart's books in which a plate is shown round the A.T.I.

I have had some personal experience of balancing static against magnetic coupling, and I have found the same effects as Mr. Reeves has described to-night. I was particularly interested in his first definition as to the necessity for having the two coils of a different rotation. In using three circuit coil holders I have noticed a marked increase in selectivity is sometimes obtained by reversing the leads to the primary coil; this effect is particularly valuable on short waves. If Mr. Reeves will produce a tuner by means of static couplers so selective as to get rid of some of the harmonics of GBL he has achieved a great object!

The Performance of a Radio-Telegraphic Transmitter with Special Reference to the New Installation at North Foreland*

By Norman Lea, B.Sc., A.M.I.E.E.

I. Introduction.

In making a survey of publications devoted to radio-telegraphic work, the dearth of information in connection with the detailed behaviour of transmitting apparatus becomes evident at once. This fact is to be deplored, not only because the matter is of some scientific interest, but also on account of the fact that the progress in this branch of applied science is such that a particular design may become embodied in a large number of installations.

Although the transmitter dealt with in this paper possesses many interesting features, it is only proposed to describe it in sufficient detail to render the results which will be quoted properly intelligible.

The actual 1½ kW spark transmitter on which the measurements were made was later installed at the Post Office station at North Foreland, and has now been in operation for nearly a year. Another set of the same type is now being installed at the Post Office station at Seaforth, near Liverpool, and since many others have been fitted in ocean-going mail steamers, it will be realised that the results have more than a mere laboratory application.

II. General Description of the Transmitter.

The transmitter is designed primarily to handle traffic to and from ships at sea. It is capable of giving signals on any wavelength between 300 and 900 metres. Four working waves (usually 300, 450, 600 and 800 metres) are provided, any one of which may be brought into use by the operation of one hand-wheel.

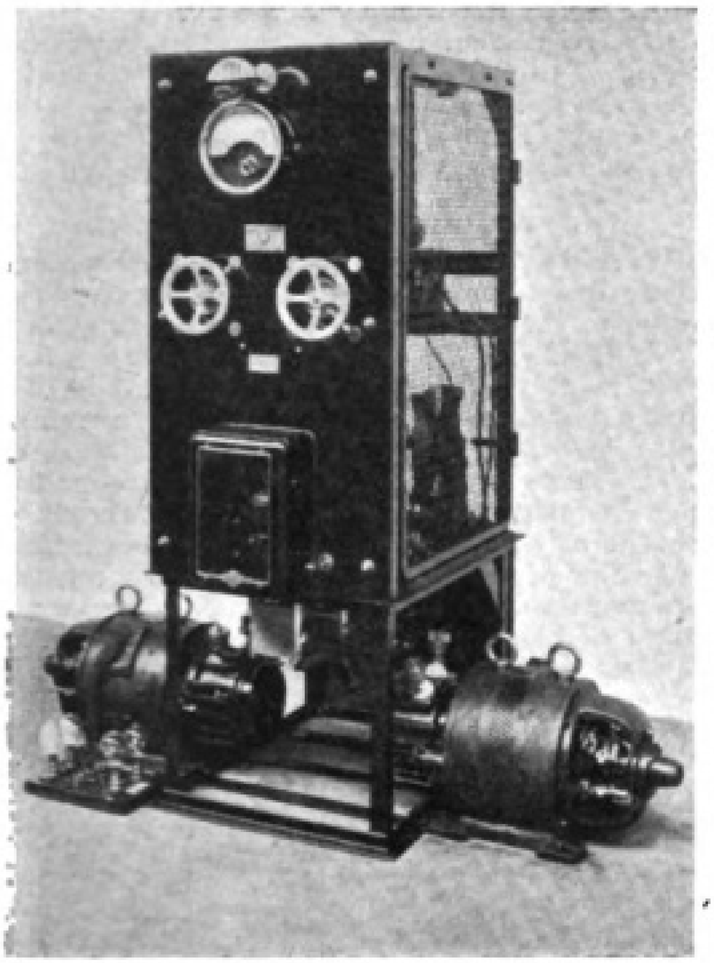
Power is obtained from a motor-alternator of the two-bearing type having a frequency of 500 periods per sec. The output from this machine to the step-up transformer and primary high-frequency circuit is regulated by the adjustment of alternator excitation. Fixed tappings are provided on the alternator field regulator which correspond to full, half, and one-quarter power. A special form of synchronous spark-gap is mounted on the end of the machine and is fitted with a phase adjustment. A spark frequency of 1,000 per second is obtained by discharging the condenser once every half cycle, and this arrangement, of course, gives a note vastly superior to that obtained when using an alternator of lower frequency but with the same spark rate. The type of spark-gap employed has several important practical advantages over the stationary quenched gap sometimes employed. Some of these are:—

(1) The power may be changed without any readjustment of the gap whatsoever.

(2) The behaviour of the gap is sensibly the same whether it is hot or cold; no time is wasted, and no outside stations are interfered with at the time of starting up.

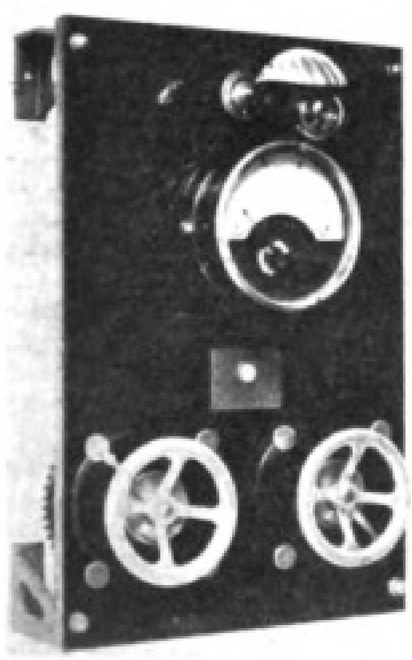
(3) The note is clear and very penetrating.

* Abstract of a paper read before the Institution of Electrical Engineers on Wednesday, June 7th, 1922.



The Transmitter showing duplicate Motor Alternators.

(4) The efficiency is high, especially when judged by the only criterion which is of importance, namely, the ratio of power used to strength of signal received.



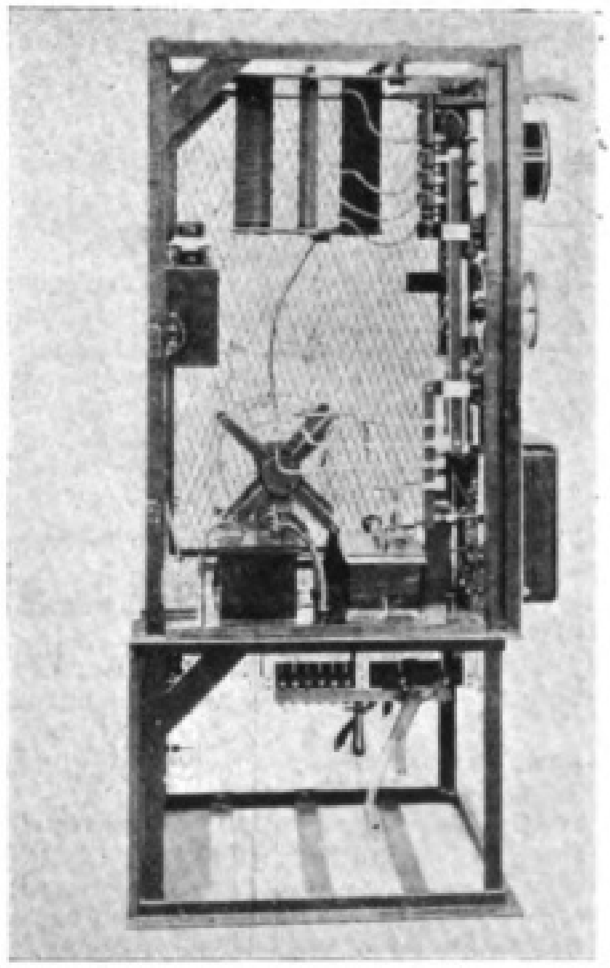
Remote Control Board for Wavelength and Power.

An emergency unit working on the Wilson principle is arranged to excite the same high-frequency circuits as are employed for power transmission. In the event of the main power supply failing, it is possible, therefore, to transmit on any one of the four waves without readjustment of tuning.

The general arrangement of the set and of the various details connected therewith will be best understood from the lantern slides.

III. Determination of the Losses.

When interpreting the results which follow, it is to be assumed, unless it is stated to the contrary, that the measurements refer to the conditions



Side view of the Transmitter with one gate removed

prevailing when transmitting on full power at 600 metres on an artificial aerial, and with the key depressed continuously.

(*a*) *Motor-alternator.*—The machine is of the two-bearing type with armature and rotor on the same spindle. Both stator and rotor are provided with windings, the former, which acts as the field, having 10 pairs of poles.

The losses were determined by the usual methods which need not be described. The figures are as follows :—

Total input (5·7 amperes at 480 volts) 2,730 watts.

Motor losses :		
Armature (copper)..	..	8·5 watts
Field (copper) ..	..	39·5 ,,
Iron, friction, windage of motor and alternator	..	415·0 ,,
Alternator losses :		
Rotor (copper) ..	..	6·5 ,,

Field (copper)	.. ..	149·0 ,,
Iron	.. .. ..	519·0 ,,
Total	.. ..	1,137·5 watts

Motor efficiency = 83·2 per cent.
Alternator efficiency = 70 per cent.

(*b*) *Transformer.*—This is of the oil-cooled type wound for 500 periods per sec., the nominal voltages being 200 and 10,000 (R.M.S.).

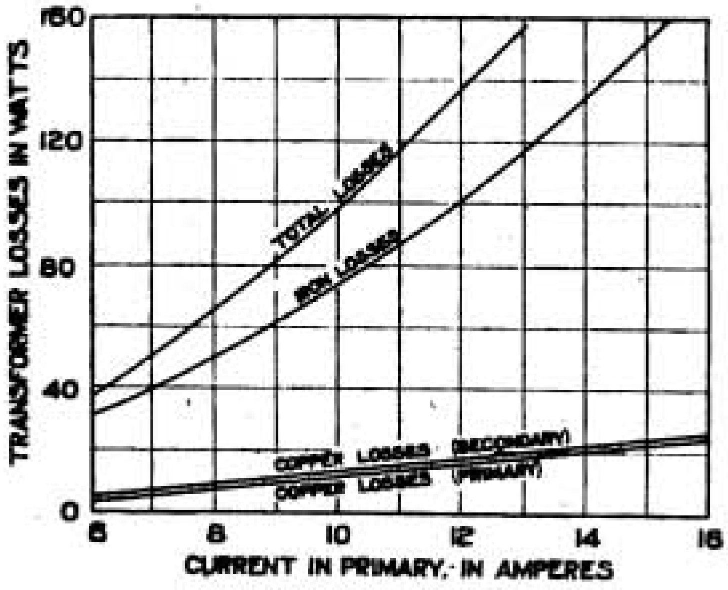


Fig. 1.

Copper losses at full power from the known resistances and currents are :—

Primary	12·2 watts
Secondary	18·8 ,,

The total losses were obtained by the Hopkinson method and are shown plotted for various currents in Fig. 1.

At full power we find :—

Iron (hysteresis plus eddy currents)	95·0 watts
Total losses	127·0 ,,
Efficiency	91·2 per cent.

(*c*) *Low-frequency choke.*—This consists of a coil having a fixed number of turns wound on an iron core of the two-window type, but with an air-gap in the centre limb. The copper losses and total losses were measured by a wattmeter for various sine-wave currents. These results are plotted in Fig. 2.

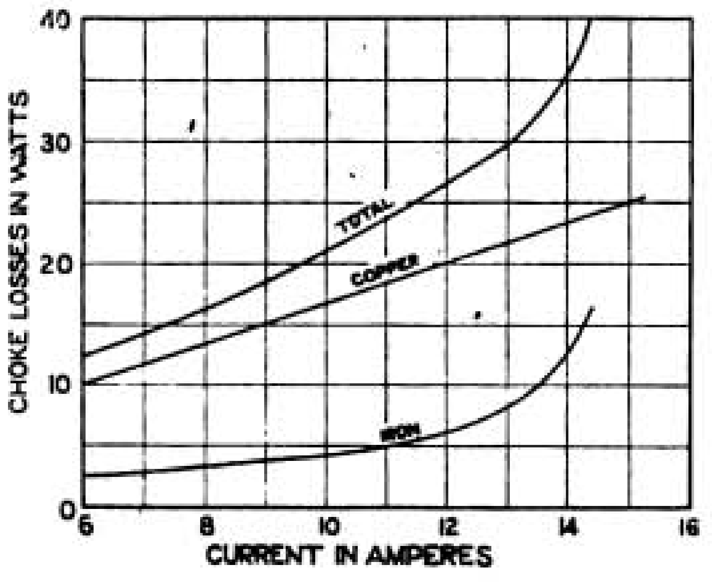


Fig. 2.

At the full power load the losses are :—

Copper losses at working load	20 watts
Iron losses at working load	6 ,,
Total	26 watts

We now pass on to the H.T. side of the transformer where exact measurement becomes more difficult owing to the presence of high-frequency effects :—

(*d*) *Condenser of primary oscillatory circuit.*—This is of fixed value (0·01 μF) and is of the multiple-section mica-copper foil type, mounted in oil.

The losses in this are almost entirely due to the high-frequency discharge ; those due to the charging current at 500 periods per sec. may be neglected. The value of the losses was estimated by taking the temperature-rise at the end of a half-hour run at full power and comparing this with a curve (Fig. 3) of temperature-rises obtained by the use of a special heater placed inside the case. Oil was kept moving to ensure uniform results.

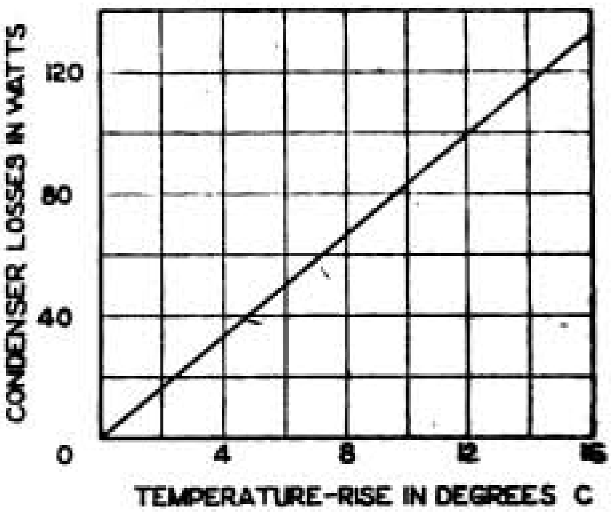


Fig. 3.

At the end of half an hour on full power with 600-metre high-frequency load, the temperature-rise was 4·0 deg. C., which, as may be seen from the curve, corresponds to a loss of 28 watts.

Since the high-frequency current at full power is of the order of 70 amperes, the effective high-frequency resistance of the condenser is only 0·0057 ohm.

(*e*) *Main spark-gap.*—The only method which can be applied here is one involving equal temperature-rises. A thermometer was fixed to a convenient part of the spark-gap case, and great care taken not to disturb either the thermometer or lagging used in connection therewith. Two separate half-hour runs at full power resulted in a temperature rise (as indicated by this thermometer) of 46 deg. C. in each case.

An attempt was made to employ a heat-substitution method, that is, to use a heater consuming a known amount of direct-current energy ; after several preliminary trials, however, it was abandoned as unlikely to give a reliable result. The arrangement shown in Fig. 4 was therefore set up with a view to introducing the equivalent heating effect at the proper part of the gap, namely, at the electrodes. The leads from the condenser to the gap were kept very short and heavy so that the whole of the energy minus transformer losses,

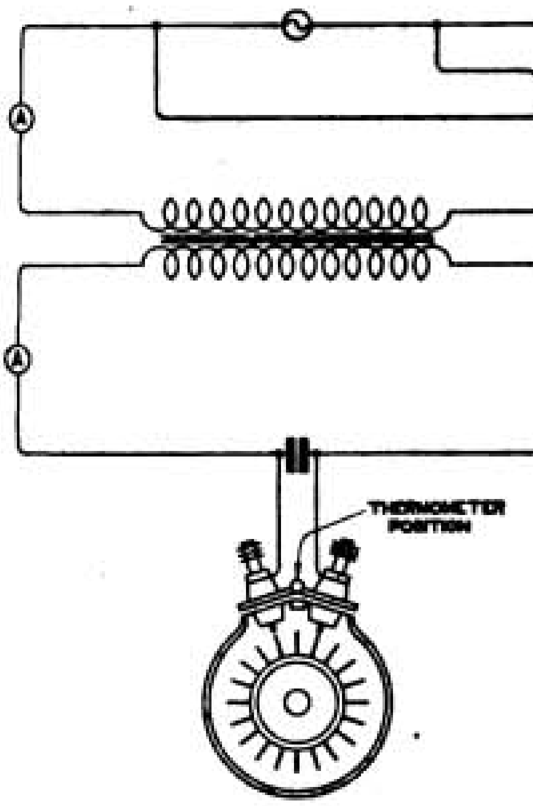


Fig. 4.

which had previously been determined, might be regarded as being dissipated in the gap. In this way a curve (Fig. 5) was developed giving the relation between watts turned into heat, and temperature-rise. Each point on the curve involved a half-hour run at full power.

From an examination of results obtained in this way it appears that after making allowances for heat conducted to the gap from the machine windings, the spark-gap has a loss of 410 watts and a mean effective resistance of 0·084 ohm.

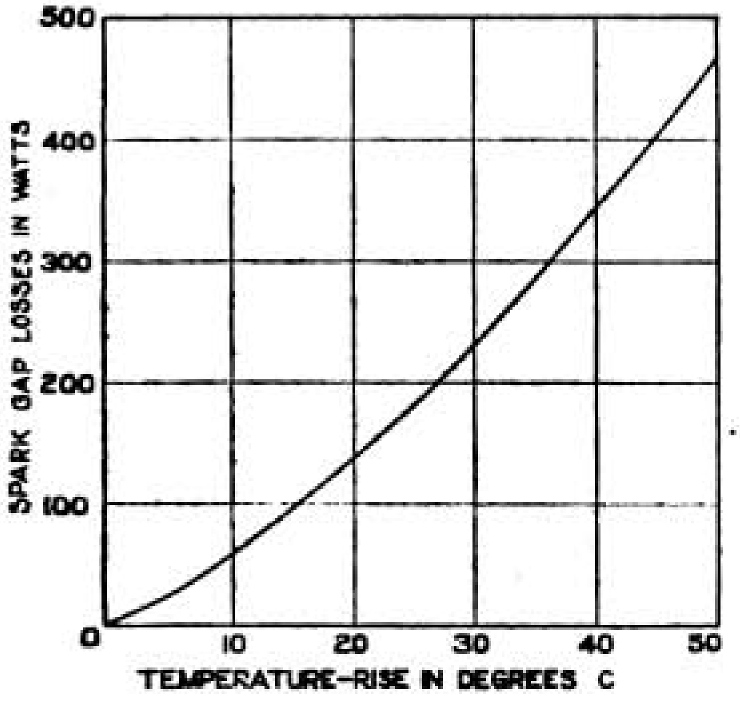


Fig. 5.

(*f*) The remaining parts of the primary circuit consist of comparatively low-resistance conductors, but the losses therein, as indicated by temperature-rise, are as follows :—

	Loss
Primary inductance (copper strip wound edgeways)	21·7 watts
Lead from condenser to switch (copper tube)	14·0 ,,
Lead from switch to inductance (heavy flexible)	7·0 ,,
Lead from inductance to switch ..	7·0 ,,
Leads from switch to spark-gap ..	14·0 ,,
Wave-change switch (estimated) ..	5·0 ,,
Change-over switch (estimated) ..	5·0 ,,
Total	73·7 watts

(*g*) *Artificial aerial.*—For test purposes an artificial aerial was employed consisting of a glass plate condenser in oil and having a capacity of 0·001 μF. The total length of lead, including "aerial" and "earth" connections, was 50 ft. The effective resistance of this arrangement was determined by inserting extra resistance of known values and noting the drop in aerial current when other conditions remained constant (Fig. 6). Curves were plotted, showing the relation between the added resistance and the reciprocal of the aerial current.

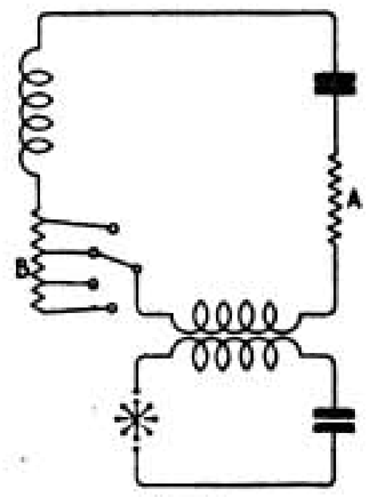


Fig. 6.

It must be remembered that these changes in the aerial circuit will be reflected back into the primary circuit to an appreciable extent unless the coupling is weak.

If the coupling is at normal value, the primary current will not be constant and hence the energy induced into the aerial circuit will be variable, with the result that the measurement of aerial resistance will be inconclusive.

It is obvious that if the coupling be tightened we shall be approaching the conditions which apply to an ordinary transformer, where the resistance in the primary can be regarded as being replaced by a resistance in the secondary, and can be calculated if the square of the transformation ratio is used as a multiplier. In other words, with tight coupling any reading of aerial resistance by the method proposed will give a fictitiously high value.

Curves are shown in Fig. 7 for various couplings, and it is found that when the primary and secondary are 18 cm. apart, a reliable result is obtained. By drawing a tangent to the uppermost curve at the point corresponding to the test current, we find that the effective resistance of the condenser, aerial inductance, ammeters and 50 ft. of lead is about 9 ohms.

The aerial-earth resistance at North Foreland is rather high on account of the chalky nature of the site. The full-power tests were, therefore, carried out with a series resistance which gave approximately the correct aerial current in order to imitate the actual working conditions.

IV. Power Balance Sheet.

Total power from mains 5·7 × 480		2,730
Losses in motor-alternator and field circuits.		
Motor: Armature copper	8·5	
Field	39·5	
Field regulator	11·0	
Total iron losses, windage and friction, including alternator	415·0	
	474·0	
Alternator: Rotor copper	6·5	
Field copper	149·0	
Field regulator ..	29·0	
Total iron losses ..	519·0	
Total motor-alternator losses ..	1,177·5	
Guard lamps..	85	
	1,262·5	
Errors of experiment	37·5	
		1,300
Wattmeter reading		1,430
Losses in transformer.		
Primary copper	13·2	
Secondary copper	18·8	
Iron	95·0	
	127·0	
Losses in choke.		
Copper	20	
Iron	6	
	26	
		153
Balance (power input to high-frequency primary)		1,277
Losses in primary high-frequency circuit.		
Condenser	28	
Spark-gap	410	
Inductance	22	
Leads	42	
Switch contacts	10	
		512
Balance transferred to aerial circuit		765
Losses in aerial circuit.		
Added resistance, $6{\cdot}6^2 \times 8$ ..	348	
Aerial condenser, two aerial ammeters, aerial tuning inductance, coupling coil, 50 ft. earth wire, $6{\cdot}6^2 \times 9$	392	
Losses unaccounted for	25	
	—	765

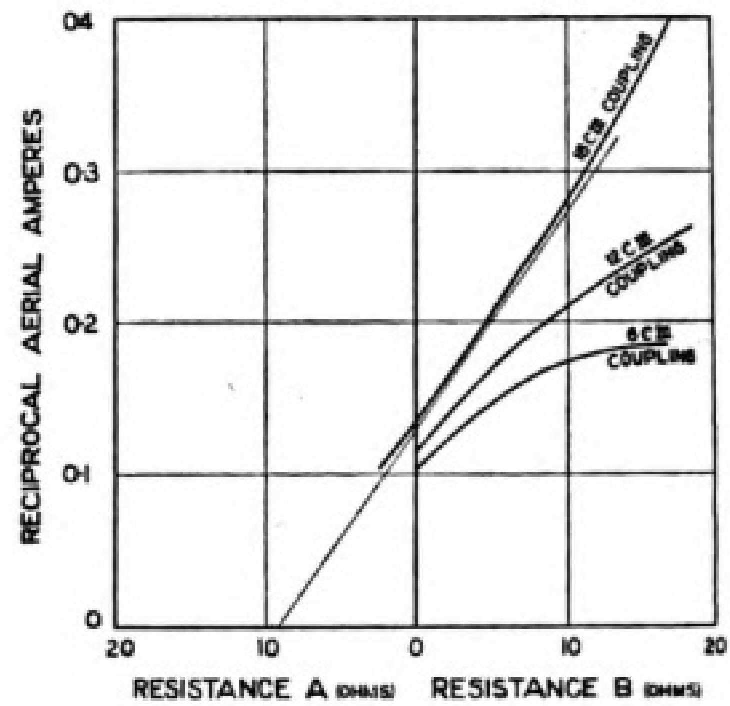


Fig. 7.

V. Results under Traffic Conditions.

As a result of tests extending over a period of two years, the reliable working ranges of the transmitter may be taken to be:—

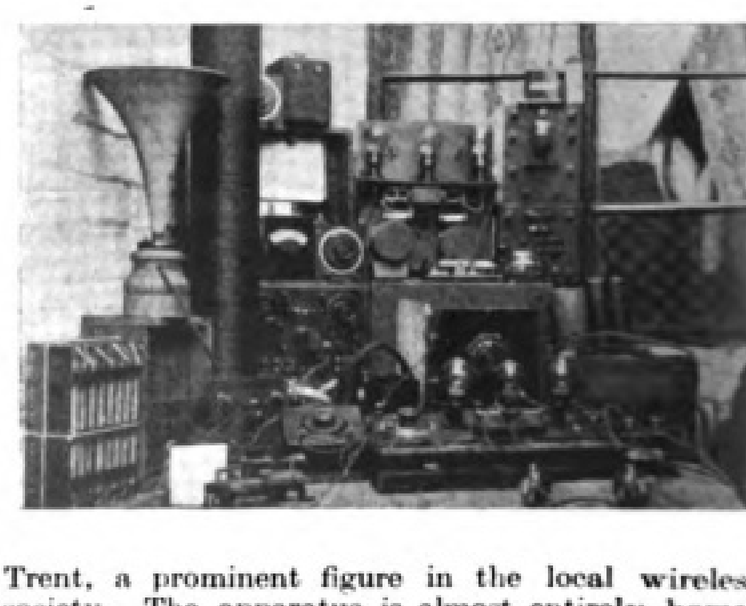
By day 6 H nautical miles.
By night 15 H ,, ,,

where H is the height of the transmitting aerial in feet above the sea level. These figures are for cases where signals are received without high-frequency amplification.

We are indebted to the Radio Commmunication Company, Ltd., for the loan of the photographs used in illustration of this paper.—[Ed.].

A STOKE-ON-TRENT STATION.

The accompanying photograph shows a neat station designed by Mr. A. H. Wilson, of Stoke-on-



Trent, a prominent figure in the local wireless society. The apparatus is almost entirely home-made, and is the result of a long series of experiments.

How to get the Best from Your Set

HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

By PERCY W. HARRIS.
(Author of "The Maintenance of Wireless Telegraph Apparatus.")

III.—THE SELECTION AND CARE OF ACCUMULATORS.

EVERY wireless enthusiast who decides to install a valve receiver is immediately faced with the problem of current supply for his valve filaments. In the case of some of the newer valves, known as "dull emitters," the current required to heat the filaments is considerably less than that required by the ordinary types, and can be supplied from large dry cells. In the majority of cases, however, the ordinary type of valve, taking about two thirds of an ampere, is used, and for these the only satisfactory source of current is the accumulator.

Accumulators are of two types. The first, and most generally used, consists of prepared lead plates immersed in an acid solution. The second, frequently known as the "Edison" type, contains nickel steel grids containing nickel peroxide and spongy iron immersed in a solution of caustic potash Each type has its advantages. A discussion of the relative merits is, however, beyond the scope of this article.

Probably there is no part of a wireless installation which gives more trouble to the beginner than the accumulator battery, and certainly no part better repays attention to its peculiarities. Its maintenance in good order will best be understood if we consider first of all the requirements of a good accumulator and the demands made upon it.

Take first the lead accumulator. Each unit of a lead accumulator supplies, when fully charged, a current at a pressure of about two volts for a time, which depends upon the strength of the current and the capacity of the cell. If a strong current is taken from the cell it will last for a shorter time than it would if it were weaker. Accumulators are therefore rated in ampere-hours, and if the capacity is marked on the cell as "80 Ampere-Hours," this means that it will supply a current of 8 amperes for ten hours, 4 amperes for twenty hours, 2 amperes for forty hours, and so on. Thus to find the length of time during which a particular current can be drawn from a cell, it is only necessary to divide the current in amperes into the total capacity in ampere-hours.

It must not be imagined from this that one can take a current of say 80 amperes for one hour. The rule above given only applies within reasonable limits, and the maximum safe steady current that can be taken from a cell for a considerable period without interruption is usually reckoned as about a tenth of its ampere-hour capacity. For the typical cell we have quoted, this would be about eight amperes. If we greatly exceed this figure the cell will be injured for reasons which will shortly be explained and the total capacity will work out at a considerably lower figure. Very short discharges at a much higher figure than that quoted can, however, be made without injury, as is done in the case of accumulators used for motor-car starters. The wireless man is only interested in the continuous discharge of his cells, and the above rule will be found a good one to work on.

Owing to the fact that accumulators are so largely used in motor work for ignition purposes, many cells are marked "ignition rating . . . . . ampere-hours." This figure is not the continuous discharge rating, but a special rating decided upon by the car manufacturers for the particular purpose quoted. It is exactly *double* the continuous discharge rating, and this fact should be borne in mind when purchasing and using such cells. When cells are purchased for wireless work, the purchaser should insist upon knowing the continuous discharge or "actual" rating.

Many people are under the impression that an accumulator actually stores electricity. Speaking in very broad terms, this is true, for electricity put into the cell can be subsequently withdrawn (or at least, a high proportion of it). Actually, however, the energy is stored in chemical form, the charging current acting upon the lead preparations on the positive plates,and negative plates in such a way that they are converted into substances, which, when the charging current is withdrawn, act with the acid and produce a current through a circuit connected to them. Electrical energy is thus first converted into chemical energy, and later, re-converted into electrical energy.

From the above explanation it will be understood that the plates and the preparations upon them need careful attention in making a cell. The total capacity of a cell depends upon the *total area of active material* in the electrolyte,or liquid in which the plates are immersed. Double the active plate area, and you will double the total capacity. Reduce the area of active material from any cause, and the capacity will be correspondingly reduced. This reduction of active area can very easily take place when the cell is badly handled, and is one of the chief causes of trouble amongst wireless men.

The reduction of effective area can take place in several ways. Too rapid a discharge will loosen the active material and cause it to fall to the bottom of the container, where it not only serves no further useful purpose, but will most likely short-circuit the plates if much is deposited. This excessive discharge rate will also cause the plates to expand and bend, which may develop into short-circuiting and general trouble.

A cell must never be left discharged for any lengthy period. As soon as the safe limit of discharge is reached (this will be explained later) the cell should be charged again without delay. Cells left in the discharged state will gradually develop upon their plates a white, practically insoluble coating of "sulphate" which reduces the active area and can only be removed by prolonged treatment and expert attention, and then only when the sulphating is not excessive. If a cell which normally has a capacity of say 80 ampere-hours has half of its active material covered with a coating of insoluble sulphate, the normal discharge rate of say 8 amperes may then prove excessive and may cause buckling and disintegration. Sulphating may also be caused by using too strong acid solution, by leaving the cells partially discharged for long periods, and by under charging.

(To be Continued.)

Experimental Station Design*

These articles, which will appear in alternate issues, are intended not only to be a complete guide to those new to wireless, but to give explicit details on the construction of all the components of the experimental station. Actual designs will of necessity in some instances be somewhat crude, in order that they can be made up without elaborate workshop equipment. Practical working instructions will be given where necessary for the help of those unacquainted with the more simple processes of instrument making. Of course, where good workshop facilities exist, the designs may be readily modified.

Economy is made an essential feature, bearing in mind always that where low-priced component parts can be obtained their use has been embodied in the designs. For those who do not desire to make their own apparatus, the descriptions will assist them in selecting the equipment for their stations.

The information contained in the first few articles under this heading is to help those new to wireless and whose first aim is to build a simple set capable of receiving broadcasted telephony and consequently may cover ground already familiar to many readers. The succeeding instalments, however, will advance by easy stages, and in the course of the series the construction of an elaborate station will be evolved.

VI. A SIMPLE TESTING BUZZER AND WAVEMETER.

FOR the purpose of setting the crystal to its most sensitive adjustment it is necessary to have a buzzer set up to produce feeble oscillations, and if arranged to transmit oscillations of a definite frequency an additional purpose will be served whereby the receiving circuit may be adjusted to the particular wavelength on which it is desired to receive, at the same time as the most sensitive point is found on the crystal detector. Such a transmitter of oscillations of definite frequency constitutes a wavemeter. As the two tuners described in the previous article were designed essentially for the reception of broadcasted telephony on 350 to 450 metres, a wavemeter designed to give oscillations on a wavelength of 400 metres will be particularly useful for the adjustment of such sets enabling all necessary adjustments to be made prior to the reception of the expected signals.

The inductance to be used for the construction of the wavemeter is that already described and shown in Fig. 4, page 328*, and a suitable condenser for use in conjunction with this inductance it is shown in Fig. 1. As it will be the object of most experimenters reading these articles to make their own apparatus, the construction of the condenser is given in precise detail and those with very little workshop experience are advised to take this as a practice exercise in which to gain a little skill in the manufacture of simple wireless apparatus. The materials required for making up the condenser are :—

1 piece of ebonite, 4″ × 1½″ × ¼″, with polished faces.
4 pieces of "ruby" mica, ¾″ × 1½″ × two thousandths of an inch thick.
4 6 B.A. × ⅝″ screws, countersunk heads.
4 6 B.A. nuts and washers.
1 4 B.A. × ¾″ screw, countersunk head.
3 4 B.A. nuts and washers.
4 No. 4 × ½″ wood screws, round heads.
Sufficient No. 38 to 40 gauge hard copper foil for making three strips, 1¾″ long × ⅜″ wide.

All the screws and nuts to be of brass and can be obtained from any ironmonger or together with the ebonite and mica from an electrical store, for a small sum.

The procedure for making the condenser is as follows :—Holding the ebonite in the vice with its faces wrapped with paper to prevent them becoming damaged, one of the long edges is carefully trued up with a medium file. A rule placed along it will indicate when it is perfectly true and the eye can

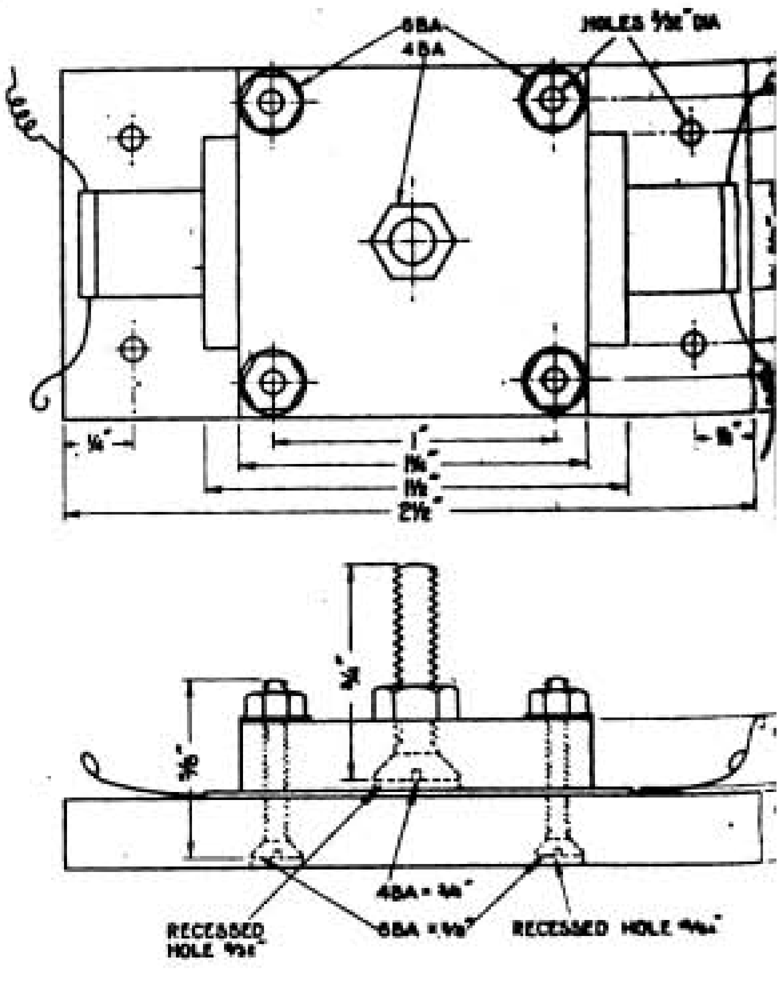


Fig. 1. Working drawing of 400 m. wavemeter condenser.

be used to judge as to whether it is at right angles to the faces. Next, with the aid of a square, mark off a scratch line across one end at right angles to the trued edge and carefully square this end up. Mark a scratch line again at right angles to the finished edge, exactly 2½″ from the trued end and holding the ebonite in the vice, saw off the spare portion, going as near to the line as possible but not sawing it away. Care must be taken on nearly

* *The Wireless World and Radio Review*, June 10th, 1922.

completing the saw cut that the remaining uncut portion does not snap. This edge is next trued up to the line and square to the longer edge. Measuring from the trued edge along the two ends mark off 1½" for the width and join the two points with a scratch line and file down true. To finish the edges, rub them on a piece of emery paper, which is tacked down to a piece of true wood, taking care to keep the ebonite standing vertically and at right angles to the emery paper, and giving even pressure along the whole edge. Eight holes must be made in this piece of ebonite as shown in the figure, which is drawn to scale. Those in the corners are for the No. 4 wood screws and a Morse twist drill No. 28, or approximately 7/64", will give the necessary clearance. After marking the position for the holes, small dots must be made with a sharp centre punch to act as a guide to the drill and so prevent it wandering over the smooth face of the ebonite when commencing to make the holes. To prevent the ebonite bursting out at the back whilst drilling through, it should be held in the vice with a piece of scrap ebonite or hard wood, clamped tightly against the back face. The No. 28 drill will also be suitable for making the other holes which are to give clearance for the four 6 B.A. screws. A little more care is required in the making of these holes than with the others owing to their nearness to the edge. It will be seen from the drawing that the heads of the 6 B.A. screws are recessed into the under side of the larger piece of ebonite. This is done with a No. 6 Morse twist drill, or 13/64", using these to hold the two pieces of ebonite together with screws and nuts, the other two can be put through accurately. A 5/32" hole is also made in this piece at the point of intersection of the two diagonals, to carry the 4 B.A. screw. A 9/32" drill will make a hole of suitable size to give clearance for its head. A good matt finish to the ebonite is obtained by rubbing the faces with very fine emery paper stretched tightly across the face of a small piece of wood, and by rubbing in small circles all the gloss will be removed, yet at the same time the surface will be entirely free from scratches. This treatment also improves the surface insulation. Having completed the ebonite portion, the next consideration is the mica, and in cutting it to size one must be careful not to split it or fracture the edges. The copper foil that serves for the plates must be cut very accurately to width, as any variation will materially alter the required capacity. In assembling, one piece of mica is placed on either side of a copper strip, then the other two strips with ends projecting out in the opposite direction to the first are placed in position, together with two more mica plates to protect the outer faces. The overlap, and this is important, must be precisely one inch and it must be seen that the edges of the plates completely coincide. When once the plates are in position the ends of the mica can be held down by finger nails while an assistant places the top ebonite plate in position. This completes the construction of the condenser except for making connection to the ends. The projecting foil must be carefully

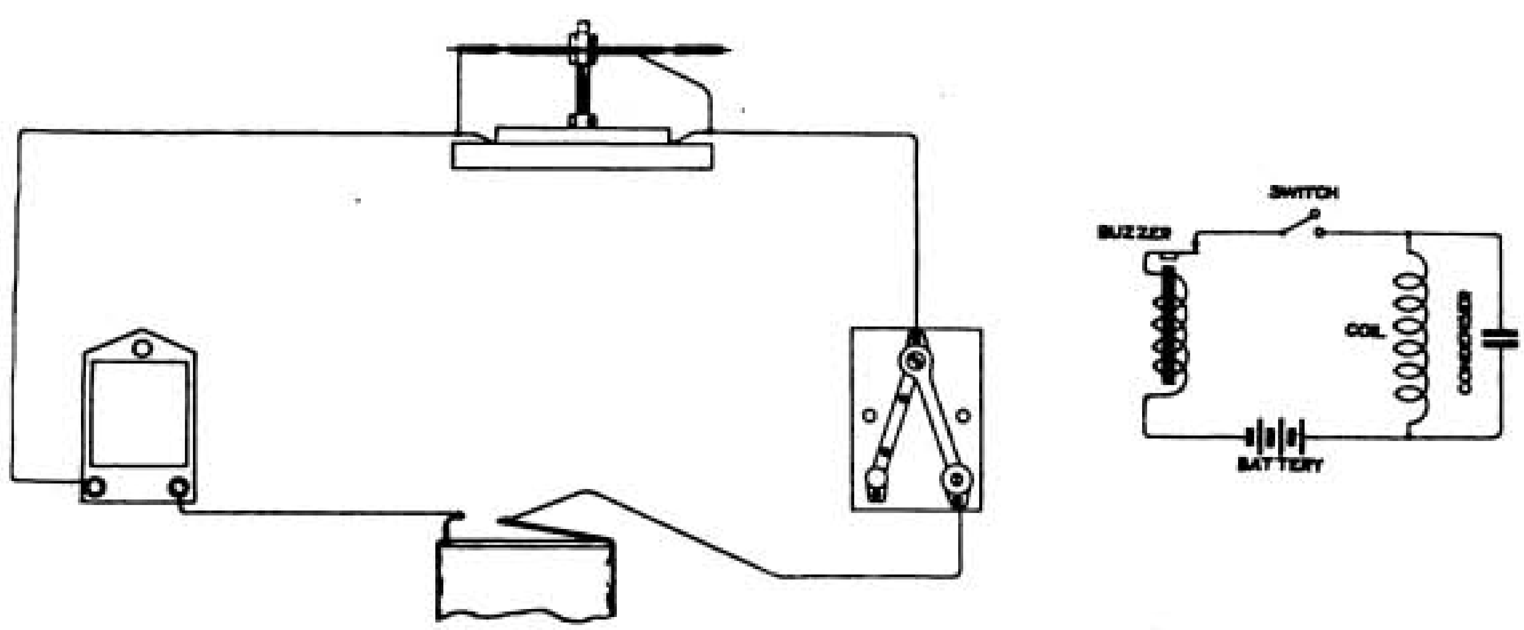


Fig. 2. Method of connecting up the tuned buzzer circuit.

taking care to get the depth uniform in each hole and no deeper than is necessary to prevent the heads from projecting above the surface of the under face. The remaining piece of ebonite is used for the construction of the top clamping-down piece, and the method of bringing down to dimensions, is as already described for the base piece, by working for trueness from the one edge that is already squared off. In order that the holes through its corners may coincide with those in the piece already made, the two pieces should be held together in the vice in the correct position and the holes drilled through into the smaller piece from those already made. Make two of the holes, and scraped and then thinly tinned, using resin or "Fluxite" for cleaning. The tinned ends are then wrapped round a piece of tinned copper wire, which projects through, with about ½" on one side and 4" on the other, and with a hot iron the solder can be made to run and fix the wire in position. The screw in the middle of the top of the condenser is for the purpose of holding the flat inductance coil which is clamped between two 4 B.A. nuts, with washers. The advantage of this form of mounting is that it prevents any stray capacity being brought near the coil, either by screws that may be in the woodwork near by, making a bigger capacity across the turns or by the coil itself, having a capacity through the earth to the other components of the circuit.

In the description of the construction of the coils it was mentioned that they might be wound with either single cotton or double silk-covered wire. Both wires will give nearly equal inductance and their values are made practically identical by immersing the cotton-covered wire inductance in paraffin wax and not so treating the silk-covered one. The ends of the inductance are soldered to the two shorter leads of the condenser which may be still further shortened in order that there may be no surplus wire which would increase the inductance of the circuit. Other leads are taken to a small buzzer, battery and switch, connected as in Fig. 2, and for the benefit of those unaccustomed to circuit diagrams the connections are also represented in the manner usual in wireless circuits, in order that they may acquire a little knowledge of the meaning of such diagrams. It is not thought necessary to give instructions on the making of a buzzer as it involves quite a lot of work and one of reliable make can usually be purchased for about two shillings. The contacts of the buzzer should be adjusted to give a note of high pitch, and this can be done by wedging small pieces of paper between the magnet ends and the armature, and the armature and its spring contact piece. The battery is of the type used for small pocket lamps, although if the buzzer is of good make it should be able to be operated from a single cell, in which case one of the large cylindrical type is to be recommended and will have a much longer life than a small pocket lamp battery. The components of the wavemeter may be mounted on a small board for the convenience of making the connections between the various parts permanent. This wavemeter is designed to give a wavelength of 400 metres and can be relied upon to be within plus or minus twenty metres, if the details with regard to condenser and inductance construction are carefully followed. An advantage of belonging to a Wireless Club may be pointed out here, for the finished instrument can then be tested against a standard wavemeter, usually of the "Townsend" type, which most clubs possess.

A few remarks in the method of operation may be necessary for the novice. Having installed his set and laid it out in the form shown in Fig. 5 of the previous article, he must place the wavemeter a few inches away from the flat coils, with the plane of the wavemeter inductance parallel to that of the coils in the aerial circuit. The buzzer is set in operation, and after having adjusted the crystal until a buzz is heard in the telephone receivers, the coils are moved relative to one another until the buzz is of maximum strength. The nearer the wavemeter is to the aerial tuning coils, of course the stronger is the buzz and one is cautioned against confusing an improved signal strength produced by the movement of a coil, if by its movement it is being brought nearer to the wavemeter coil. To obtain the adjustment of maximum sensitiveness on the crystal and the correct setting for the coils, the wavemeter should be moved farther and farther away from the set until the buzz in the telephone receivers is a minimum, and when any change is made in the circuit the sound disappears. When these adjustments are affected the buzzer may be switched off and the installation is ready to receive on 400 metres. As transmissions may be 50 metres either side of this adjustment, a very slight further movement of the coils will make the necessary change. Practice will soon acquaint the experimenter with the direction and amount of movement required to make the requisite increase or decrease of wavelength.

* * *

This completes the description of crystal receiving apparatus suitable for the reception of broadcasted telephony. Crystal receivers are only suitable for the reception of damped wave signals, such as those sent out by telephony and spark transmitters. Most ship and coast stations employ transmitters of the damped wave spark type and their signals will probably be heard during the adjustment of the apparatus as these stations usually work on a wavelength of 600 metres, though they are capable for particular purposes of using wavelengths of 300, 450 and 800 metres. Time signals are transmitted by the Eiffel Tower (call sign **FL**) on 2,600 metres and can be received on the set described by adding some ten extra coils, which are connected in the aerial circuit in the same way as the two for the short wavelengths, that is, in series. The times and mode of transmission of these time signals have been given from time to time in this journal and can also be found on pages 1,146 to 1,148 of the "Year-Book of Wireless Telegraphy and Telephony 1922," (Wireless Press, Ltd.). This book will also be found useful for identifying the stations whose call signs are heard, should the experimenter gain a knowledge of the Morse code, which he is strongly recommended to do as it considerably extends the scope and pleasure afforded by the set. As it usually takes some time to acquire a receiving speed of twenty words a minute, it is as well to commence a study of the Morse code in the first stages of experimenting or otherwise one is apt to acquire a habit of listening to signals without concentrating on what the signs signify and it becomes much more difficult at a later stage to concentrate and follow sounds which have hitherto conveyed nothing. If a cheap telegraph key is purchased, it may be connected in place of the switch shown in the diagram of the wavemeter circuit and used to practise the formation of the letters and to memorise their sounds. For the purpose of listening to the buzzed signal, the telephone receivers may be connected across the ends of the wavemeter inductance, which will then act as a shunt and prevent too much current being passed by the telephones, which would tend to reduce their sensitivity.

VII. SIMPLE VALVE PANEL.

The construction of a simple valve receiving set will now be considered. The making up of such apparatus involves a good deal of care but the reader is strongly advised to follow the drawings and instructions precisely and produce apparatus of good finish. The following parts will be required, and details for their assembly, together with working instructions, will be given in a subsequent instalment:—

Polished ebonite sheet, 6" × 6" × ¼".
2 ounces No. 22 S.W.G. tinned (or bare) copper wire.

2 ounces No. 22 S.W.G. "Eureka" resistance wire.
2 yards "Sistoflex" insulated sleeving.
20 pieces "ruby" mica, ¾" × 1½" × two thousandths.
4 valve stems with back nuts and washers.
1 O. B.A. terminal, tall type, with screw-on top, with back nut and washer.
12 4 B.A. × ¾" round-headed brass screws.
8 6 B.A. × ¾" ditto.
2 4 B.A. × 1" ditto.
4 1½" × No. 6 brass wood screws.
26 4 B.A. brass nuts.
8 6 B.A. ditto.
36 4 B.A. thin stamped washers.
12 6 B.A. ditto.
Strip of hard brass, 20 S.W.G. gauge 6" × ¾".

F.H.H.

(To be continued.)

A Broadcasting Receiver.

A TYPE OF MARCONI APPARATUS FOR GENERAL USE.

AT the present time when everyone, whether connected with wireless or not, is at least interested in the prospect of the early introduction of the broadcasting service, it may be of interest to readers to see photographs of the type of apparatus which it is likely will soon be supplied in quantities to listeners in. The instrument which we are illustrating here is a two-valve receiver manufactured by Marconi's Wireless Telegraph Co., Ltd., and specially designed to meet the requirements of the broadcasting service. Apparently every endeavour has been made by the manufacturers to render the apparatus as simple in operation as possible, so that no skill in the manipulation of the wireless apparatus is necessary on the part of the owner in order to get the best results from the instrument. Our illustrations show the set with the top open and lying on its side and also the same instrument closed with telephones and battery external to the set. We understand that

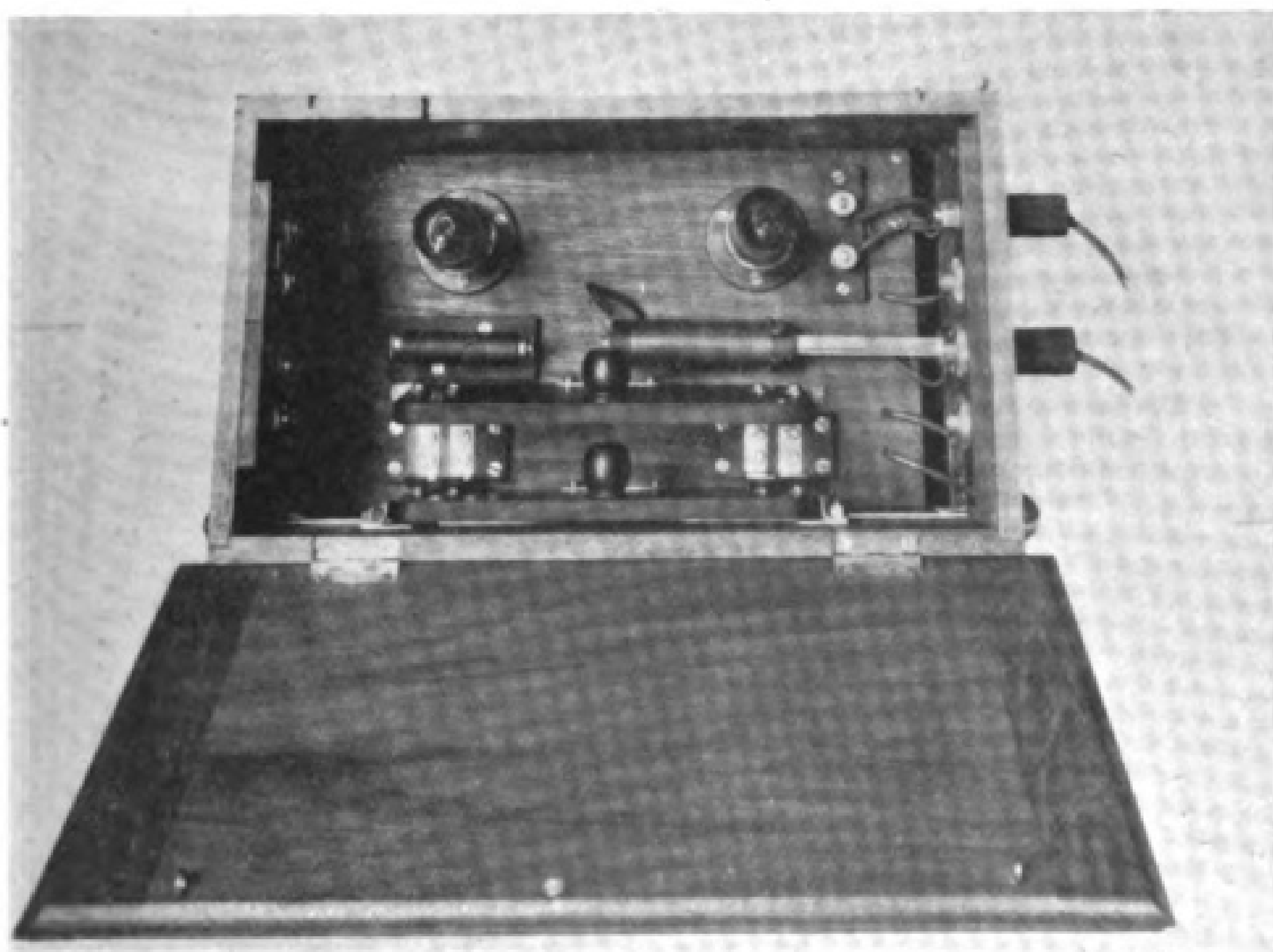


Fig. 1. A view of the Marconi Broadcasting receiver showing the internal arrangements.

the valves to be used will be either the ordinary French pattern when accumulators will be needed, or valves of the new low temperature type, the filament current for which can be obtained from dry cells, so that all that is needed will be two dry batteries, one for filament heating and the other supplying the plate voltage.

Looking down into the instrument with the lid open as in Fig. 1, the two valves can be seen side by side, whilst below the left-hand valve is a small cylindrical piece of apparatus which is the grid leak and condenser. To the right of this is the filament resistance, controlled by a knob protruding from the side of the box. Below these are two ebonite enclosed inductance slabs fitted with ebonite knobs for handling. The upper one of these is a spare whilst the lower is in operation in the position shown in the photograph. The connection is made by means of spring clips and the ranges are suitable to cover those allocated to the broadcasting of telephony. Plugs for the telephones allow for one or two pairs of telephones to be used at will and there are three separate plugs for the aerial wire, in order that aerials of varying lengths may be used where circumstances necessitate this being done. For fine tuning two plates connected to external knobs and arranged behind the slab inductances. The position of these with respect to each other and to the inductance slab can be varied and by so doing fine tuning can be obtained. The plate battery is located in the base of the instrument, a small door in the side of the box giving access to this. An interesting little booklet entitled "The **Marconiphone**" has been received by us from Marconi's Wireless Telegraph Company, which deals with the subject of broadcasting in a popular manner and describes types of receivers which they are putting on the market for broadcasting purposes.

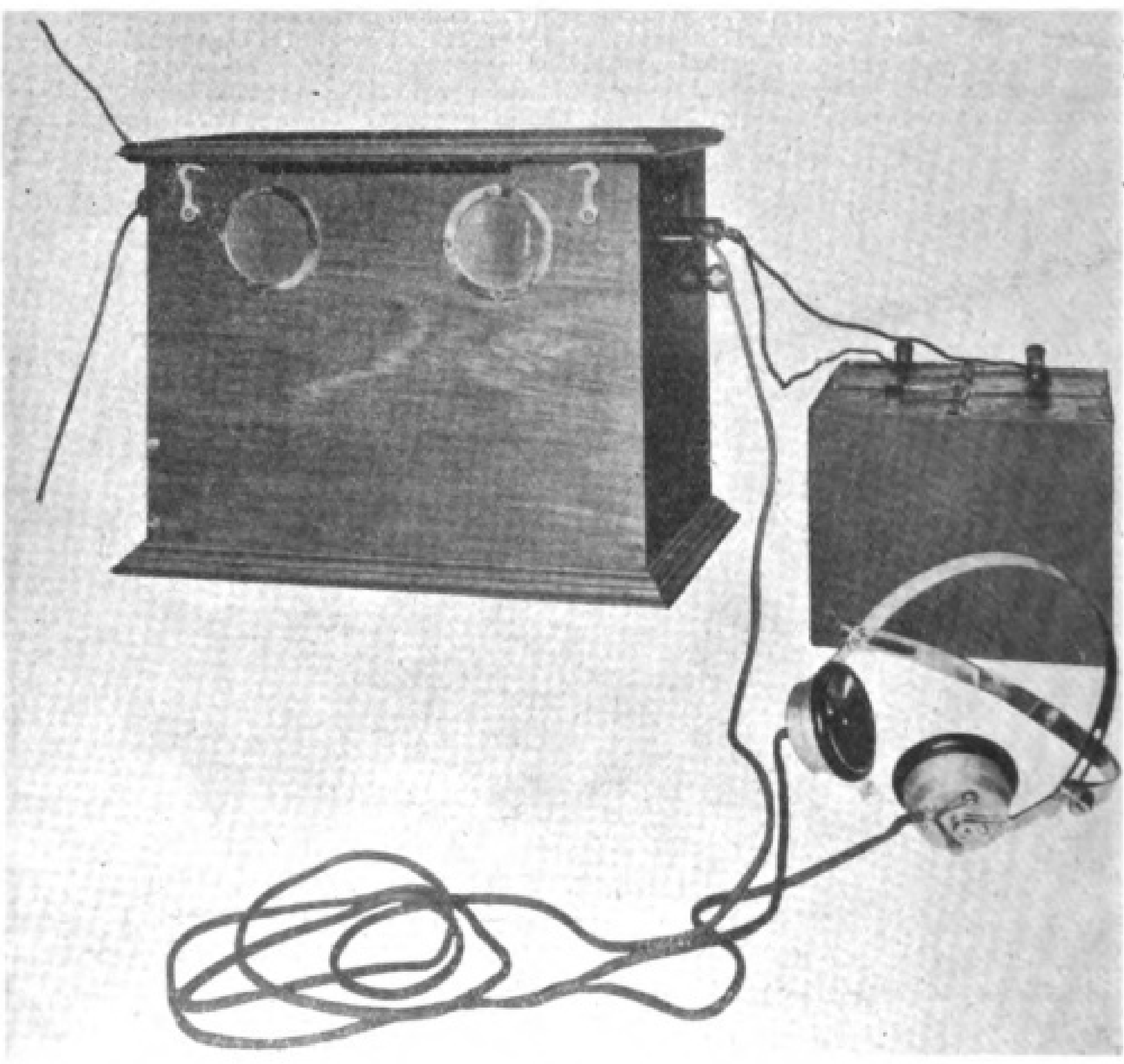


Fig. 2. General view of the complete instrument with telephones and battery.

Notes

Radio Instruments, Ltd.

Radio Instruments, Ltd., is the name of a new company formed for the production of wireless instruments of new design. Mr. J. Joseph, M.I.E.E., who has recently resigned his position as general manager for Mr. H. W. Sullivan, is managing director of the new company, and has been associated with the design and manufacture of wireless instruments for very many years. Mr. W. A. Appleton, M.B.E., M.I.R.E., late Admiralty Technical Research Officer at H.M. Signal School, Portsmouth, has been appointed Director of Research and Chief Designer to the company, which has an illustrated and descriptive catalogue in course of preparation. The works, offices, and show-rooms are situated at 12a, Hyde Street, New Oxford Street, London, W.C.1. A special department will deal with laboratory standards and radio measuring instruments, and the company will also advise on high frequency and radio work.

Radiola Wireless Telephone Parts Co.

Radiola Wireless Telephone Parts Co., Ltd. (182,102.)—Private company. Reg. May 27th. Capital £8,000 in £1 shares. Manufacturers, importers and exporters of and dealers in wireless telephones and telephonic and telegraphic apparatus, parts and accessories, etc. First directors: W. Mansfield and J. F. Little. Secretary: W. Mansfield. Registered office: 17, Brunswick Street, Liverpool.

Wireless Society for Dublin.

Referring to a note published in a recent issue Mr. H. L. Fletcher of School House, Oundle, Northants, notifies us that he is unable to reply immediately to all the communications he has received, and at present he is in communication with the authorities in the hope of getting the necessary permission for the formation of a Society some time in August of this year.

A Correction.

It is regretted that in the article on "Simultaneous H.F. and L.F. amplification," by Mr. Voigt, published in our issue of May 27th, Figs. 3 and 4 have accidentally become interchanged.

Amendments to List of Wireless Societies.
Omitted:

Sunderland Wireless and Scientific Association.
Technical College, Sunderland.
Wireless Society of Highgate.
13a, Sedgemere Avenue, East Finchley, N.2.
Sunderland District Wireless Society.
1, Dryden Street, Southwick-on-Wear.

Addresses incorrect, to be amended to:

Bristol and District Wireless Association.
10, Priory Road, Knowle, Bristol.
Leamington, Warwick and District Radio Society.
31, Archery Road, Leamington Spa.
Glasgow and District Radio Club.
40, Walton Street, Shawland, Glasgow.
Wallasey Wireless and Experimental Society.
106, Albion Street, New Brighton.

Personal.

Mr. G. G. Blake has recently been elected a Member of the Institution of Electrical Engineers.

Correspondence

To the Editor of The Wireless World and Radio Review.

Sir,—I was interested to see that Aberdeen has been selected as one of the proposed "broadcasting" centres. I wonder, however, if the authorities have taken into account the proximity of Stonehaven (GSW), which is about 14 miles from Aberdeen, and intend to take any steps to regulate the transmissions from this station during broadcasting hours.

At present when GSW is working I think I am safe in stating that telephony reception on *any* wavelength is almost impossible within a radius of 50 miles from the station, owing to the powerful harmonics which it radiates.

I am situated within 40 miles of Stonehaven and have tried various selective circuits but find it impossible to tune out the violent "bubbling and hissing" of the high speed transmitter, which works nearly continuously, and I know all amateurs in the Aberdeen district are similarly affected.

This afternoon the Dutch concert, which was coming through splendidly at 3 p.m., has since 3.10 been completely "wiped out" by him.

"Experimenter."

To the Editor of The Wireless World and Radio Review.

Sir,—May I be permitted to encroach on your valuable space in order to make an appeal to amateurs transmitting telephony to use the Phonetic Alphabet printed in the issue of *The Wireless World* for January 7th, 1922, when giving their call letters?

The majority of call letters seem to be given much too quickly and very indistinctly, and in these circumstances it is almost impossible to distinguish between the letters "Q" and "U" such as happened the other evening.

"Thermionic."

To the Editor of The Wireless World and Radio Review.

Sir,—In reference to Mr. William Le Queux's letter in last week's *Wireless World and Radio Review*, may I be permitted to say a word in defence of the amateur so severely criticised by him.

Personally I have not troubled a jot about the mysteries of the functions of valves, transformers, and various other paraphernalia necessary to the working of a valve reception set, but at the same time I have learnt sufficient to understand why and how a set works to enable me to carry out the experiments I set myself to do from time to time.

When it comes to telling friends and visitors (of which I get a goodly number) the functions of every piece of apparatus on the set, it is absolutely out of all reason, in the first place the said friends, etc., are, as a rule, ignorant of even the elementary principles of electricity and magnetism, and in my opinion, to tell them of the manner in which stations are allotted different wavelengths, and the said W.L. explained by simple analogy, and in the case of valve sets that the detector, as its name implies, detects the incoming signals and the others, if any, magnify them to the strength heard in the telephones, the said friends, etc., are far more satisfied than if one was to pile a ton of technical "lingo" into them; they may, I admit, go away amazed "at the wonderful knowledge of Mr. So and So" but the chances are that they would say the same thing (if that is any satisfaction to operator) if they are told in simple non-technical terms the way in which the set works.

There is only one thing the amateur who is contemplating installing, or who has already got a set, can do to obtain a working knowledge of wireless reception sets, and that is to join the local wireless society, the secretaries of which will always be pleased to enrol them and give all particulars of their respective societies.

L. W. BURCHAM.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—While reading the article on a simple C.W. and telephony transmitter by B. J. Axten in your issue of the 3rd inst., it occurs to the writer that a word of warning may be helpful to amateurs when deriving their transmitting power from A. C. Public Supply Mains used for their house lighting, and while the author may have used it successfully, his description of the supply in his district would lead one to suspect that his wireless knowledge was superior to that of the power circuit.

In all such cases it is advisable to emanate power for the transmission from a double-wound transformer to ensure that neither side of the A.C. source of supply is earthed elsewhere.

It is distinctly contrary to the regulations of supply authorities, insurance companies, the Post Office and the like to earth any point of a lighting installation fed from a public supply, notwithstanding that, as the author suggests, that this may be done through the resistance of a lamp and in the hands of the average amateur it is quite possible under abnormal conditions to burn out this particular lamp.

The regulations largely have reference to the prevention of electrolysis and the use of the double-wound current transformer suggested entirely obviates any transgression of the regulations referred to.

INTERESTED.

Books Received

How to Make Commercial Type Radio Apparatus, by M. B. Sleeper. (New York: The Norman W. Henley Publishing Company, 1922. Pp. 159. 7½" × 5". 75 cents.)

Calendar of Current Events

Saturday, June 24th.

WIRELESS SOCIETY OF HIGHGATE.
Field Day. Outing to Ken Wood.

Sunday, June 25th.

Transmission of Telephony at 3 to 5 p.m. on 1,070 metres by PCGG, The Hague, Holland.

Tuesday, June 27th.

Transmission of Telephony at 8 p.m. on 400 metres by 2 MT, Writtle, near Chelmsford.

Wednesday, June 28th.

NORTH MIDDLESEX WIRELESS CLUB.
7.30 *p.m.*—At Shaftesbury Hall, Bowes Park. Elementary Lecture for Beginners.
8.30 *p.m.*—Lecture, "Miscellaneous Applications of the Thermionic Valve," by Mr. W. Gartland.

Thursday, June 29th.

RADIO EXPERIMENTAL ASSOCIATION (Nottingham and District).
7.30. Room 74. Mechanics Institute. Meeting.
WALLASEY WIRELESS AND EXPERIMENTAL SOCIETY.
7.30 *p.m.*—Meeting.

Friday, June 30th.

WIRELESS SOCIETY OF HIGHGATE.
7.45 *p.m.*—At the Highgate Literary and Scientific Institution. "Elementary Theory of Wireless Telegraphy and Telephony," Part III, by Mr. J. Stanley.

Saturday, July 1st.

CROYDON WIRELESS AND PHYSICAL SOCIETY.
Meeting.

Sunday, July 2nd.

Transmission of Telephony from the Hague. PCGG, as above.

Monday, July 3rd.

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.
7.30 *p.m.*—Annual General Meeting for Election of President and Officers.

Tuesday, July 4th.

Transmission of Telephony from Writtle, 2 MT, as above.
ILKLEY AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At the Regent Café, Cowpasture Road, Ilkley.
8 *p.m.*—Lecture and Demonstration on "Short Wave Telephony Reception."

Wednesday, July 5th.

FOLKESTONE AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At Cave's Café, Sandgate Road, Meeting.

Secretaries of Societies are reminded that Notices of forthcoming Meetings must be received at least ten days before the date of publication of the issue in which the Notice is to appear.—[ED.]

A Rectifier for Alternating Current

A NEW INSTRUMENT FOR HOME CHARGING OF ACCUMULATORS ADAPTABLE TO ANY VOLTAGE

THE apparatus is designed to provide a current suitable for accumulator charging from alternating current public supply mains. Fig. 1 shows the outfit mounted in panel form, and Fig. 2 the circuit diagram. The mains are fed to a step-down transformer of the usual closed core pattern, and a simple polarised vibrator permits current only of the proper polarity to pass to the battery. The polarising of the armature is effected by the current from the battery on charge, and consequently it is immaterial as to the direction in which the battery is connected. If the battery is disconnected the machine ceases, for without polarisation the armature would be pulled towards the pole piece on each half cycle, and consequently at twice its normal speed of operation, and the natural period of swing of the armature prevents it oscillating at such a high rate. The natural period of oscillation of the vibrator can be adjusted through a limited range by means of a damping screw near the point of suspension, to make the apparatus suitable for use on circuits of various periodicities. Magnetic damping is provided by causing the lower end of the armature to cut the lines of force set up by the polarising coil, and thus allows for any temporary fluctuation of periodicity or interruption of current from the mains.

The instrument illustrated is marketed under the name of the "Homcharger," and the manufacturers claim that it can deliver a charging current equivalent to that of 8 amperes direct current.

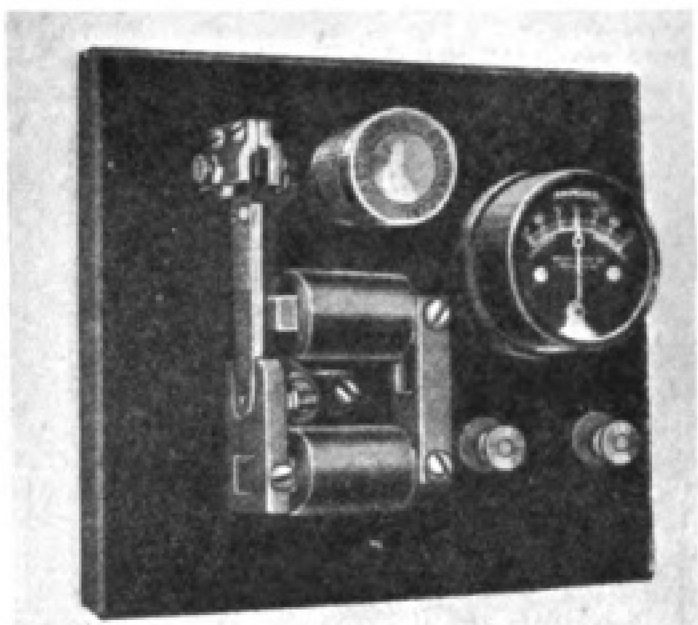


Fig. 1. An illustration of the instrument.

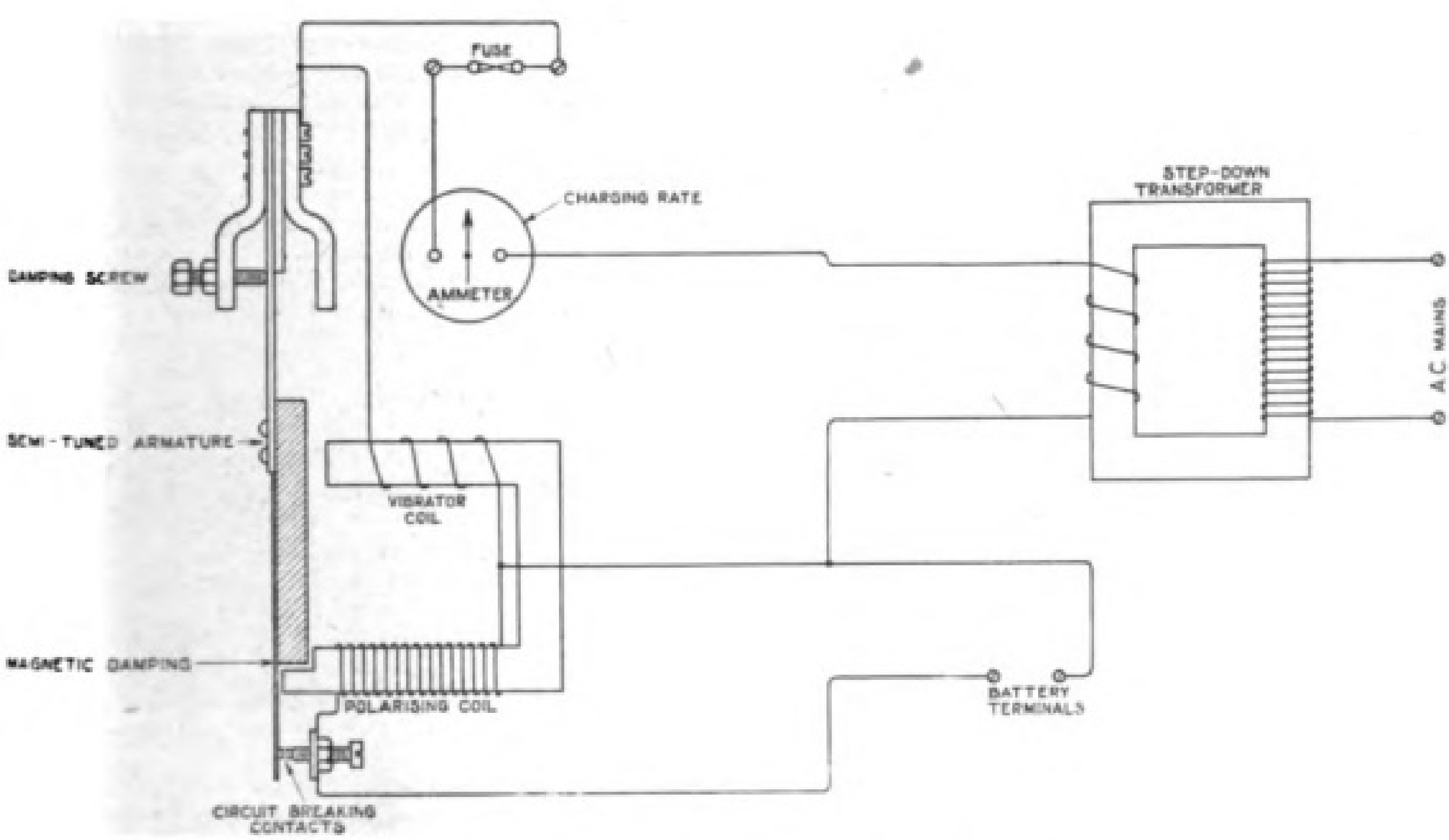


Fig. 2. Circuit diagram showing the method of wiring.

Wireless Club Reports

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. **The Editor will be pleased to consider for publication papers read before Societies. An Asterisk denotes affiliation with the Wireless Society of London.**

The South London Wireless and Scientific Club.*

Our meetings on Wednesday and Monday each week evidently "caught on," for our numbers have increased rapidly this last two or three weeks, and with the ever-increasing demand for expert practical and technical knowledge we hope that within a very short period to have created a new record.

The members have responded so well since our formation in November, 1921, that demonstrations, lectures, etc., have entirely eclipsed any idea that imagination may have credited us with, and we hope that we shall be able to further our activities of being such a live organisation, solely devoted to the amateur in South London.

Recently, our old friend, Mr. Walsh, gave us a very interesting lecture on "High Frequency," accompanied by practical demonstrations with a 10 in. spark coil, glass plate condensers, Oudin coils, etc., besides furnishing us with very interesting data regarding the construction formulæ for this type of wireless transmission, and to whom we must tender our very best thanks.

This lecture was followed by Mr. Wilkinson on "Cinematography," with special reference to kinematics, and this gentleman proved a most distinguished lecturer, as well as a very good linguist. Having dealt with the projection, manufacture, and taking of the cinematograph film, he then dealt with the theory of light rays, and altogether this was one of the best lectures we have as yet heard, and was certainly thoroughly appreciated by the members, and a vote of thanks was duly accorded.

Forthcoming events include every date up to July, and full details may be had of the Assistant Secretary, Mr. Ansell, 69, Larcom Street, S.E.17, as regards subscriptions, entrance fees, etc., or to the Headquarters, St. John's Institute, Larcom Street, S.E.17, where all meetings take place.

Leeds and District Amateur Wireless Society.*

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

A general meeting was held at the Leeds University on Friday, June 9th, Mr. A. M. Bage (Vice-President), taking the Chair at 8 p.m. The Chairman called upon Capt. F. A. Whitaker, R.E. (Vice-President), to deliver a lecture describing a six-valve cabinet set for reception on all wavelengths. Originally, Capt. Whitaker had hoped to embody a demonstration of telephony reception during the course of the evening's programme, but as Capt. Whitaker explained, he had been unable, owing to urgent business, to complete the necessary arrangements for transmission, etc.

Capt. Whitaker exhibited a complete receiver, entirely assembled in cabinet form at home. The set may be used for practically all wavelengths, the short wave and the long wave sets being complete separate units. A separate heterodyne is included in the cabinet for use, if necessary, on all wavelengths. The switching and mounting arrangements of the various inductances and capacities are unique; practically any circuit can be set up in a very few moments by the combination of switches, plugs, etc. If all valves are in use, the first three, of the E.S.2 type, amplify at radio frequency, these valves being coupled with either transformers, resistance-capacity or reactance-capacity couplings, according usually to the wavelength. Rectification is attained by means of the cumulative grid condenser and leak method with an "R" valve. Radio frequent currents from the separate heterodyne are introduced into the grid circuit of the rectifier with magnetic coupling, when receiving continuous wave signals. The rectified signals undergo two further magnifications at audio-frequency, before application to the telephone transformer, and so to the telephones or loud speaker. Elaborate precautions to guard against stray static fields have been taken, copper sheet being used extensively throughout the cabinet for shielding purposes. Separate filament and anode batteries are used for the H.F. side, the rectifier, the L.F. side and the heterodyne. Capt. Whitaker explained the function, construction, etc., of practically every component in the set from aerial to earth.

At the close of Capt. Whitaker's remarks, the Chairman opened a discussion, which proved very interesting and instructive. The performance of the set on the shorter waves was criticised particularly. After the discussion a vote of thanks was proposed to Capt. Whitaker, and was duly seconded and carried in the usual manner. The meeting then broke up to examine the very elegant apparatus on view. The set is undoubtedly one of the finest receivers existing in this country, both from the efficiency and workmanship points of view.

The proceedings terminated at 10 p.m.

Kensington Wireless Society.*

A general meeting was held at 2, Penywern Road, on Thursday, June 1st, when Mr. Axten gave a lecture on "A Simple Low-Power C.W. and Telephony Transmitter."

The circuit used was of the "auto-jigger" type, the microphone being in shunt with a few turns of the coil, and the key in the grid lead.

The power supply was 110 volts A.C. from the mains, no step-up transformer being used, rectified by an ordinary receiving valve, the lecturer stating that good results both on C.W. and telephony were obtained over short distances using an "R" valve for the power valve.

The complete apparatus was mounted on a small panel, which was handed round for inspection.

The lecture caused some discussion, several members giving their experiences with this and kindred types of transmitters.

After Mr. Axten had been accorded a hearty vote of thanks, the meeting was adjourned.

Hon. Secretary, Mr. W. J. Henderson, 2, Hollywood Road, S.W.10.

Wireless Society of Highgate.*

Hon. Secretary, Mr. D. H. Eade, "Gatra," 13a, Sedgemere Avenue, East Finchley, N.2.

The series of elementary lectures arranged by this Society was most successfully inaugurated on Friday, June 9th, when Mr. J. Stanley, B.Sc., A.C.G.I., gave the first of his lectures on the "Elementary Theory of Wireless Telegraphy and Telephony."

The lecturer confined himself to clearing the ground for his more advanced papers by going carefully over the fundamental electrical theory on which, of course, purely wireless work is based. He gave a brief outline of the electronic theory of matter, and by the use of interesting analogies gave useful and simple definitions of most of the electrical terms and units used in wireless work. Mr. Stanley then went on to the most important part of his lecture and dealt with the qualities of electric circuits known as "inductance" and "capacity" and gave a most lucid account of their nature and effects. He illustrated these terms by several interesting experiments and made these rather difficult conceptions quite clear to the uninitiated.

His lecture was followed throughout with great interest by those present, and at the conclusion a hearty and spontaneous vote of thanks was accorded him. Mr. Stanley will continue his lectures next Friday from the point reached on Friday last.

There was an excellent attendance at the lecture, 18 visitors being present in addition to the usual attendance of members. After the meeting six of the visitors signified their intention of joining the Society.

Enquiries regarding the series of lectures and demonstrations and as to membership of the Society will be welcomed by the Secretary, and he will be pleased to give any information to those interested.

Hounslow and District Wireless Society.*

Apparatus used at recent Hospital Fête demonstration.

The Wallasey Wireless and Experimental Society.*

Hon. Secretary, Mr. C. D. M. Hamilton, 24, Vaughan Road, Wallasey.

The 20th meeting of the present session was held on June 8th. On this occasion Mr. Flint gave a demonstration of spark-coil experiments. The lecturer performed many interesting experiments and explained the "whys and wherefores" of each one as he went along.

Mr. Flint also gave a short description of the construction of a spark coil, and the principle on which it operates.

On the termination of the lecture a hearty vote of thanks was passed.

Mr. Martin then gave a short description of the benefits of valve socket H.F. transformers as opposed to other types.

After the usual "Question and Answer" period the meeting terminated.

Members of the Hounslow and District Wireless Society.

Croydon Wireless and Physical Society.*

A meeting of the above Society was held on Saturday evening, June 3rd, 1922, at the Central Polytechnic. At this meeting, a formal lecture had not been arranged, but members had been asked to bring portions of their own apparatus which could be used in conjunction with the Society's aerial.

Several members accordingly brought apparatus, upon which some very good results were obtained, spark and C.W. signals, and telephony being received during the course of the evening.

The formal business, which was transacted at the commencement of the meeting, included a motion that ladies should be admitted to membership of the Society, on the same conditions as gentlemen. This motion was opposed by several members, but, upon being put to the vote, was carried.

The next meeting of the Society will be held on Saturday, July 1st, and the Secretary, Mr. B. Clapp. "Meadmoor," Brighton Road, Purley, will be pleased to hear from anyone interested in radio who is desirous of joining the Society.

Paddington Wireless and Scientific Society.

Hon. Secretary, Mr. L. Bland-Flagg, 61, Burlington Road, Bayswater, W.2.

At the second General Meeting of the above Society, which was held in the Electrical Lecture Room of the Paddington Technical Institute on the evening of the first of June, the attendance was good.

On this auspicious occasion it was fitting that our President should address the meeting, and when called upon to do so, our President responded in a manner both able and full of interest, speaking of the enormous amount of good the Society could do, individually, collectively, and for society generally, and the great part practical men played in the investigation of scientific problems. This led our President to the most important passage of his address, namely, do not believe that anything is impossible, rather should you strive to make it possible.

A hearty vote of thanks was proposed and very ably responded to by our members for Mr. Cooke's words of encouragement, and for the interest he is taking in our work.

Dr. J. H. Vincent, Vice-President, then addressed the meeting, speaking of the good the Society could do for its members, and the members could do for the Society.

A short paper was then read by Mr. L. Bland-Flagg on Inductance and Capacity, after which Mr. A. Hoban spoke a few words of advice to the junior members on the selection of circuits when they came to assembling the apparatus they are making in the workshop.

A number of questions were asked which were answered in a manner which left nothing to be desired.

The Hon. Secretary then read over the minutes of the last meeting, and presented the accounts which showed a good balance in spite of the heavy expenditure of the preceding month.

We had with us one new member in the person of Mr. Marley, B.Sc., and at the suggestion of the Hon. Secretary, Mr. Marley was elected Treasurer.

The meeting closed at 9 o'clock, after a very interesting and enjoyable evening.

Ilford and District Radio Society.

On Thursday, June 9th, the Society opened its second year with a lecture on "Broadcasting and its Reception." The meeting was well attended and a number of new members came forward.

The lecturer dealt with the subject in very simple terms in order that those who were new to W.T. would be able to follow.

The signals were traced, with exceedingly clear explanations, from the microphone of the transmitting station, through the ether to the aerial of the receiving station, and thence *via* various optional stages of amplification and detection, to the telephones.

During the course of the lecture speech and music were picked up from **2 FQ**, and made audible to the audience by means of a loud speaker.

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

Southampton and District Wireless Society.

Hon. Secretary, Mr. T. H. Cutler, 24, Floating Bridge Road, Southampton.

A meeting of the above Society was held on June 7th, at the Headquarters at the Kingsland Assembly Rooms. A good attendance was recorded.

It has been decided to add to Rule 5 that Associate Members can now be admitted; also each member will be allowed to bring a friend at the meeting once in six weeks, which I think will add to the already popularity of the Society.

Mr. Freeman gave a short lecture on "Hints and Tips," which was greatly appreciated by all concerned.

A very enjoyable evening was brought to a close at 9.45. Buzzer practice will be given from 9 to 9.45 in future.

Guildford and District Wireless Society.

Hon. Secretary, Mr. Rowland T. Bailey, 46, High Street, Guildford.

On Saturday, June 10th, by kind permission of H.M. Air Ministry, a party from the Guildford and District Wireless Society paid a very interesting and instructive visit to the London Terminal Aerodrome, Croydon. The party travelled to East Croydon by train, leaving Guildford at 12.50 p.m. All were in high spirits. The pass for admission was soon presented to the officials by Mr. F. A. Love, to whom the Society's best thanks are extended for his efforts in obtaining it, and the party found themselves under the command of a gentleman of ample proportions, bearing upon the breast of his blue jersey, L.T.A.27, who conducted them to the little house, from which the voice they had all heard here in Guildford on their own "sets" is transmitted. The wonderful working and operation of the whole station was explained at length by the chief operator, a very pleasant gentleman. who did not seem a bit upset at having to again explain that which he had doubtless explained to many other such parties. Unfortunately "atmospherics" were very bad, and listening in was a little disappointing, some speech, however, was heard. Suddenly a new interest was awakened when L.T.A.27 asked if the party would like to visit the hangars. For nearly an hour keen interest was centred on the machines that ply between England and the Continent. Alas! the visit was then over. The aforementioned gentleman, still in command, conducted them to the roadway, and they were gone. All the joys of the day were not yet over, tea had been arranged for in Croydon, and a right good tea it was, too, very kindly given by Ald. W. T. Patrick, J. P. (Chairman of the Society), and to him, after the "capacity" of the party had been satisfied, a very hearty vote of thanks was proposed, and needless to say was thoroughly supported.

On the whole the day was thoroughly enjoyed by all, and undoubtedly all were feeling much wiser on Sunday morning. The Society hope at an early date to be able to pay a visit to some other station in the neighbourhood.

The Secretary would be very pleased to hear from anyone who is interested in wireless or to introduce them to the Society's "set" which is open every Monday evening at 7 p.m., at 46a, High Street, Guildford.

Shrewsbury and District Radio Society.

At a meeting recently held, the following officers were elected :—

Chairman, Mr. T. Plummer, M.I.E.E., Supt. Engineer G.P.O., North Wales District; Vice-Chairman, Mr. A. E. White, B.Sc.; Hon. Secretary, Mr. W. Thomasson, 1, High Street, Shrewsbury; Hon. Treasurer, Mr. G. H. Greenberg; Committee, Dr. R. C. Salt, Messrs. C. L. Naylor and W. G. Tarrant.

Meetings at present will be held every month. The Secretary will be pleased to hear from those in the district who are interested in wireless and are desirous of joining the Society.

Questions and Answers

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Each question should be numbered and written on a separate sheet on one side of the paper only : Queries should be clear and concise. (2) Four questions is the maximum which will be accepted at a time. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.** *(7) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them to satisfy themselves that they would not be infringing patents.*

"W.G." (Scarborough) *asks if he should get* **PCGG** *and other telephony on a single-valve circuit.* (2) *For interpretation of* **FL's** *meteorological signals.* (3) *If time signals sent out by Moscow at 21.55 is G.M.T. or local time.*

(1) The set shown should give **PCGG** rather weakly. For enjoyable results H.F. amplification is desirable. (2) An explanation is given in the "Year-Book of Wireless Telegraphy, 1922." (3) See issue of April 22nd.

"L.P.M.S." (Lye) *asks re Fig. 12, page 726, February 18th issue,* (1) *If the circuit will work as well with a number of tappings taken off the A.T.I. to a rotary switch.* (2) *How the filament battery is wired up.* (3) *Windings for the A.T.I.* (4) *What is the range of the set.*

(1) Certainly. Some arrangement of this type or a slider to the coil is very desirable. (2) As in any two-valve circuit, we have shown recently, *e.g.*, Fig. 3. page 812, March 18th. (3) and (4) The range of the set of course depends on the size of coils. For a range of, say, 8,000 metres, coil might be 10″ × 7″ of No. 26 with a parallel condenser of 0·001 mfd.

"F.C." (Madrid).—(1) Your aerial of four wires in parallel from A to C will be very good if you raise the C end somewhat. It is undesirable to have the distant end so close to earth as you show it. (2) Either of the wires mentioned should be satisfactory. (3) The receiver will be all right if you put a condenser across the primary of the first inter-valve transformer. (4) About ¼ kW in the aerial. We cannot say what music you are likely to hear in Madrid. You should, of course, hear Eiffel telephonic programmes.

"CONDENSER" (Malton) *sends a circuit diagram and asks* (1) *For a criticism of it.* (2) *If it will receive* **PCGG, 2 MT, FL,** *on telephony.* (3) *Gauge of wire to use for winding honeycomb coils for wavelengths of 300 to 30,000.*

(1) There are some errors in your circuit as it stands. A similar type of circuit is shown on page 179 of the issue for May 6th and as this is given as the outcome of personal experience by Mr. Stephenson, the values have no doubt been found experimentally. (2) Yes. (3) You might use No. 28 D.C.C. for the smaller coils and 32 D.C.C. for the more bulky ones.

"AAC & ESSES AITCH" (Falkirk) *sends two specimens of wire which he proposes to use for the construction of a telephone transformer for 120 ohms Sullivan telephones and asks for windings.*

The wires are really too heavy for use on the primary. One is No. 32 S.S.C. and the other No. 36 S.S.C. Using the No. 36 you will require approximately 6 ozs. for the primary and with No. 32 as secondary you will need about 1½ ozs. This will make a very large transformer and consequently the core will need to be ½″ diameter × 4″ long.

"A.W." (Harrogate) *submits 5-valve amplifier circuit and asks for criticism of the H.F. transformers.*

You do not say for what wavelength your H.F. transformers are required. For your purpose, for wavelengths beyond about 1,200 metres, it is better to use the resistance capacity method, as transformers wound with many turns on the primary and secondary usually function as capacity couplers. We would suggest that if you use No. 38 wire and the 1½″ bobbin and wind about 35 turns in each connecting alternate slots in series you will have a useful transformer with an optimum wavelength of about 1,000 metres. See page 112, April 22nd issue, and lower portion of left-hand column on Page 133, April 29th issue.

"R.G.S." (Fulham) *asks* (1) *If it is possible to receive* **2 MT** *and* **PCGG** *on a frame aerial 3′ or 4′ in diameter.* (2) *For suitable circuit.* (3) *Which is the most efficient, the frame aerial, or one of four wires of about 10′, or one single wire of about 25 feet.* (4) *Whether a particular receiver is suitable for use on a small aerial.*

(1) Read carefully article on aerials in May 27th issue particularly the latter portion. (2) For circuit see page 199, June 25th, 1921, issue. (3) The 25′ aerial would probably be the most efficient provided it is in an upper story, but we strongly advise you to try and put up a few extra feet of wire and so obviate complications and many stages of amplification. (4) The receiver is a "Burndept Ultra III," and in our experience gives good signals on a small aerial such as you describe.

"C.E.G.B." (Kensington).—(1) Aerials should point in the direction of the propagation of waves in the case of the "L" type. With frames, their planes must be always in the direction of propagation. (2) and (3) Frames are quite unsuitable for transmission even over short distances as they do not provide for setting up any appreciable strains in the aether. Communication can of course be established between two frames over distances of a few feet by placing them parallel to one another. (4) Your frame aerial transmitting circuit is quite good as an oscillator but you would get the results you require, that is, communication over 300 yards, were you to use a small aerial of a few feet long in lieu of the frame.

"J.R.McC." (Paisley) *asks* (1) *Gauge of sample of wire.* (2) *Nature of insulation.* (3) *If it is suitable for winding telephone transformer for use with* 120 *ohm telephones in valve circuit.* (4) *Windings for telephone transformer using wire of sample submitted.*

(1) 34 S.W.G. (2) Single silk covered, although the covering has been somewhat damaged in unwinding. (3) The wire is scarcely suitable for telephone transformers as the primary would take up such a large amount of space. (4) You may try the following dimensions, open core 5″ long × ½″ diameter, primary wound on first up to a diameter of 2½″ without insulation between layers. Secondary for operating 120 ohm telephones to consist of about 2 ounces of the same wire.

"S.J.S." (Glasgow) *asks* (1) *If any of wires submitted are suitable for winding intervalve H.F. transformers.* (2) *Number of turns of* 36 *D.S.C. wire required to wind slab coil on* 1½″ *centre, tuning with four coils to* 200/8,000 *metres with* 0·01 *mfd. condenser.* (3) *Issue of "Wireless World" in which article on School Receiving set has appeared.* (4) *Value in microfarads of a milli microfarad.*

(1) All of the wires submitted are suitable for intervalve oscillation transformers. One single transformer wound with copper wire will not efficiently cover a wavelength range of 1,000 to 13,000 metres unless you intend to tune it. If the primary is to be tuned with a parallel condenser then wind the primary and secondary so that the coupling can be slightly loosened. If the primary is not to be tuned, wind primary and secondary over one another, giving the maximum coupling and for 1,000 to 1,700 metres use the shiny wire and put on about one sixth of an ounce for each winding, and for 1,500 to 3,000 metres use a quarter of an ounce for each. (2) A parallel condenser of 0·01 mfds. across your inductances will considerably reduce the efficiency. You should use a small condenser of air dielectric with a maximum value of 0·001 mfds. With this condenser wind your coils with (1) ½″ of single layer (not slab) for 200 to 300 metres. (2) ¾″ for 1,000 to 2,000. (3) 4″ for 3,000 to 5,000 and (4) 10″ for 7,000 to 8,000. As the larger coils are of awkward dimensions, you may try making them of the slab type but in this case we cannot give you actual data as the method of winding considerably varies the inductance obtained. The actual amount of wire will be less than with the single layer coils, when concentrated in the smaller space. (3) Page 389, September 17th, and page 465, October 29th, 1921, issues. (4) 0·001 mfd.

"F. B. & Co." (Bromboro) *asks* (1) *Whether his set is capable of receiving spark, C.W., and telephony, and if so, what range of wavelengths.* (2) *For inductance windings.* (3) *Whether set should be capable of receiving Dutch and Chelmsford concerts.* (4) *How can it be known when the set is oscillating.*

(1) From your diagram it is evident that the arrangement of the circuit is very well thought out and is capable of all classes of reception, the wavelength ranges depend primarily upon the windings of the H.F. intervalve transformers, but of course, if these are of the plug-in type, the range will depend upon your tuning inductances. The circuit is not the most efficient that can be adopted for the reception of telephony on wavelengths below 500 metres. (2) You do not give length of your inductance formers and you do not say exactly the wavelength range you require, but if you wind your 5″ former for 5″ along it with No. 26 D.C.C. wire, bringing out your five tappings at ½″, 1″, 2″, 3½″ and 5″, the aerial circuit will be tunable on your two-wire aerial from 600 to 2,500 metres. The reaction coil may be wound on your 3½″ former with 2″ of winding of No. 36 S.C.C. with tapping at ¼″, ½″, ¾″ and 1¼″ and 2″. (3) Suitable for Dutch concert, but you will need to make two smaller coils for 400 metre telephony reception and the precise values can easily be found by experiment. (4) It is very evident when the set is oscillating for if the reaction is very tightly coupled a shrill noise will be heard in the telephones and as the reaction is loosened a "breathing" noise can be heard, terminating in a click when oscillations cease. C.W. signals will be heard, spark signals will have a broken note and the set will seem particularly sensitive. When not reacting, no C.W. will be heard and the set will appear less sensitive and spark signals will be heard on their natural note.

"S.J.H." (W.C.1) *wishes to know* (1) *The names of the stations* **ABC, XYZ, GBA** *and* **GBB,** *whom he hears very clearly on his three-valve set.* (2) *Percentage superiority of duolateral coils over other types.* (3) *If H.F. amplification is as efficient on* 24,000 *metres as on shorter wavelengths, such as* 3,000 *metres.*

(1) See correspondence on page 238, of May 20th issue. (2) The system of winding is quite efficient. Other types of coils could be wound, having less self capacity but would be considerably more bulky. (3) H.F. amplification on long wavelengths is best accomplished by resistance capacity intervalve coupling and thus arranged is quite efficient.

"L.A.W." (Birmingham) *asks* (1) *If circuit submitted will give results.* (2) *What improvements he might make.* (3) *Whether a two-wire aerial* 30′ *high and* 45′ *long is suitable for crystal reception.* (4) *Whether low resistance telephones and telephone transformer might be used.*

(1) Yes, quite satisfactory. (2) No improvements with your present apparatus. (3) Yes. (4) Not recommended.

"CAMLACHIE" (Millwall) *has a crystal receiving outfit with which he gets very little success and asks for advice as to the probable cause of failure.*

Your drawing does not show exactly the way in which the instruments are connected together, but if correctly connected we see no reason why you should not at least hear ship and coast stations and Eiffel time signals and weather reports, and the experimental telephony transmissions by Marconi House. We do not think it possible for you to receive Moscow with a crystal receiver on so small an aerial. There would appear to be minor errors in the arrangement of your aerial and we would strongly advise you to read the Instructional Articles that are given in this journal, the previous ones being in the May 27th and June 10th issues.

"W.G.W." (Fulham).—Your list of components would appear to be quite suitable for building up a three-valve set, but we should advise to start with a receiver employing only one valve, and then having got that working satisfactorily, you may consider the addition of amplifiers and elaborate tuning circuits. We cannot advise you on the merits of the instruments produced by the various manufacturers. Explicit details for the making of a single valve set will be given shortly in the Instructional Articles.

"FOURTH HOUSE" (London) *asks the suitability of a specimen of wire for the construction of an aerial.*

The wire stated by you to be No. 18 phosphor bronze is, we believe, No. 16 S.W.G. copper. It will give quite good results, though, of course, be careful of kinks.

"G.B.W." (Sunderland) *wishes to add one amplifying valve to single valve set.*

The addition of a low frequency amplifier will give the best results and circuits showing the methods of connecting up have frequently been given in *The Wireless World and Radio Review*. Connect the primary of a low frequency intervalve transformer to your telephone terminals and bridge this winding with a 0·002 mfd. condenser. Take the ends of the secondary to the grid of the second valve and to L.T.—Connect the filament in parallel with the filament of the existing valve. The plate of the second valve is connected to one of the telephone leads and the other lead to the H.T. + terminal of your panel.

"MEGOHMS" (Snodland).—Do not connect your variable condenser in series with lead to crystal but transfer it to the aerial circuit, connecting either between inductance and aerial lead for reception below 600 metres or in parallel across the inductance for longer wavelengths. The potentiometer is not essential when using a silicon detector. Connect the detector and telephones in series and join them across the leads from the inductance. It is impossible for us to say wavelength range without precise details of the construction of the coil.

"RADIO" (Eastleigh) *wishes to know how to incorporate a four-electrode valve in a special receiver marked "Type 2843" and manufactured by the Marconi Company of Canada.*

The receiver is one apparently embodying separate circuits for short and long wave reception and we do not see how the four-electrode valve with its several tuned inductances, transformers and condensers can be conveniently fitted to the set. Very little practical data is available at the moment on the construction of sets using the four-electrode valve. We would advise you to carefully study the circuits given on pages 201 and 202 of May 13th issue. The merits of the various circuits are not known outside the research laboratories of the producers of this type of valve.

"E.C.S." (High Barnet) *asks (1) For the method of adding a note magnifier to his single valve set. (2) Number of turns of No. 28 D.C.C. wire required to give 250/600 metres on a former 3½" diameter. (3) location of experimental stations* **XYZ** *and* **ABC.** *(4) For constructional details of L.F. intervalve transformer.*

(1) As your telephone terminals are connected on the negative end of the H.T. battery you will need to either change them about or short circuit the telephone terminals and connect your intervalve transformer between the positive of the H.T. battery and the H.T. + terminal. The primary must be bridged with a 0·002 mfd. condenser. The remainder of the connections are as given to **"G.B.W." (Sunderland).** (2) Precise number of turns depends upon dimensions of aerial. Try 30 to 35 turns in the aerial circuit and 40 turns of your No. 36 on a 3" diameter former for reaction coil. (3) See reply to **"S.J.H." (W.C.).** (4) Make one of the type described in the first article of June 17th issue, winding primary and secondary with No. 46 S.S.C. wire and making secondary have twice the depth of winding as the primary.

"M.N." (Gosport) *has difficulties with regard to the erection of an efficient aerial and consequently proposes to adopt three-valve H.F. amplification. He wishes to know (1) Which is the more efficient, resistance capacity, or transformer coupling. (2) If the 3½" × 4½" ebonite tubes he has are suitable for the construction of H.F. intervalve transformers. (3) If we would advise him to adopt the circuit shown in Fig. 3, page 705, February 4th issue. (4) Whether grid condenser and leak rectification is necessary on the last valve.*

(1) Transformer coupling gives the better results up to 2,500 metres and beyond this wavelength the resistance capacity method is usually more convenient. (2) With the tightly coupled transformer windings it is not advisable to attempt tuning with a variable condenser. Your tubes are of rather large diameter for the purpose, but may be satisfactory if your transformers are well spaced. Make primary and secondary windings of exactly the same number of turns insulated from one another with a single layer of empire cloth. Use 50 turns for each winding for 300 metres, 150 turns for 600 metres, 450 turns for 1,000 metres, 800 turns for 1,500 metres, and 1,300 turns for 2,000 metres. Make both windings in the same direction or take off grid and plate connections from the same end of the coil. (3) and (4) The figure referred to can be well recommended, arranging potentiometer grid control for the second and third valves. Try a "soft" valve for the rectifier with separate potentiometer control. The potentiometers you have out of Mark III tuners may be used satisfactorily.

"H.G.W." (Bow) *wishes to know (1) and (2) If his set consisting of detector valve with reaction and note magnifier is suitable for the reception of the Dutch concert. (3) Why he has a difficulty in keeping his tuning constant during rain and (4) The source of telephony using call sign* **XYZ,** *which he states is stronger than* **2 MT.**

(1) and (2) Your circuit is in every way correct, and should give **PCGG** on a suitable aerial. (3) If your aerial is not well insulated it may be that the wet causes a partial earthing. Rain may actually run down your leading-in wire and make a thin stream of water to earth. Examine your leading-in insulator and study the points to be observed in aerial construction given in the article on Experimental Station Design, page 259, May 27th issue. (4) See reply to **"S.J.H." (W.C.1).**

"RADIO" (Barcelona) *asks questions relating to the suitability of his coils for tuning to Paris and short wave signals.*

Your basket coils would appear to be quite suitable for the reception of Paris but it is not possible to say what wavelength they will give without knowing the dimensions of your aerial. For reaction effects it is only necessary to couple one coil out of each of the two circuits which in themselves may consist of many coils. Basket coils give very satisfactory results and can be classed among the most efficient of compact tuning coils. You would do well to make up independent sets of coils suitable for the various wavelengths. We suspect that your difficulties are not in your tuning coils but in your circuit arrangements.

"G.E.T." (Enfield Highway).—(1) Your circuit is quite correct excepting that you have omitted the condenser across the primary of the first intervalve transformer which should have a capacity 0·002 mfd. (2) CQ means "All Stations." (3) See page 292, June 3rd issue.

"P.R.T." (Hemel Hempstead).—Your aerial tuning coil should tune up to about 4,000 metres on a two-wire P.M.G. aerial with parallel condenser of maximum value 0·001 mfd. (2) The two-wire aerial is to be preferred. (3) So few turns of wire would be required to tune to 100 metres and the number would so critically depend upon the capacity of the aerial that it is quite impossible to advise you, whilst a brief test would soon give the data you require. (4) A pancake coil to tune to 1,000 metres would not consist of 10 times either the turns or length of wire that gives 100 metres. Wavelength varies as the square root of the inductance, multiplied by the added and self-capacity of the circuit. Thus if the capacity is great a few turns of wire produce a much greater wavelength change than if the multiplying factor representing the capacity is small. Moreover, the inductance of a pancake coil is not precisely proportional to either the turns or length of wire. With inductances it is always so very easy to try various amounts of wire and notice what stations they bring in.

"RECRUIT" (Birmingham).—The 10 extra feet added to your 70 ft. single wire aerial should prove an advantage provided the joint is well soldered as you propose. Light flexible wire should be quite suitable for lead-in and earth wires. A perusal of the article on Aerial Construction on page 259, May 27th, issue will acquaint you with all the desirable properties an aerial should possess.

"G.E.D." (N.11.) *is designing a single valve set and wishes to know* (1) *Sizes of A.T.I. and reaction coils for wavelengths* 100/3,000 *metres.* (2) *Suitability of* 0·001 *mfd. condenser for aerial circuit tuning.* (3) *For a book indicating how to calculate relationship between aerial and reaction coil windings.*

(1) For a reacting receiver it is not necessary to use Litzendraht wire, as any damping that this stranded wire may obviate could have been compensated for by increased reaction coupling. Of course, with non-reaction receiving sets it is a distinct advantage to wind the inductances with wire having low H.F. resistance. To cover the range of wavelengths it would be preferable to employ a number of interchangeable coils as it is difficult to make a circuit oscillate on short wavelengths with a large amount of wire electrically connected and yet not included in the oscillating circuit. Exact windings depend upon aerial dimensions and you cannot do better than to determine the windings by experiment. (2) Quite suitable as would be the smaller condenser out of the Mark III tuner, the capacity of which is about 0·0004 mfd. and not 0·0025 as you state. (3) Tuned reaction circuits in general may consist of the same number up to half as many again as the turns in the aerial circuit. See "Radio Experimenter's Handbook," by Philip R. Coursey, Wireless Press, Ltd.

"T.R." (Preston).—The first gauge wire of the samples you submit is No. 38 D.S.C., which is hardly fine enough for the construction of a telephone transformer of small dimensions. If you have sufficient of this wire you might wind five ounces of it on a core of soft iron wires 4½" long × ⅜" diameter for the primary and over this one ounce of No. 30 S.S.C. for the secondary. As you propose using a crystal detector, the use of a telephone transformer is unnecessary and not to be recommended and unless you intend to take up valve working later on we should advise you to go to the expense of having your telephones rewound to 4,000 ohms. (2) The maximum capacity of your condenser is about 0·0009 mfd. (3) Yes, certainly, though you do not need the 4-volt battery unless your crystal is carborundum and then you will also need a potentiometer. (4) For circuit see Fig. 3, page 60, April 8th issue, omitting the potentiometer and battery if not applicable.

"A.A.W.G." (Walderslade) *asks* (1) *The best method of connecting a battery to a crystal set, and what crystal to use.* (2) *Wavelength range of a set.* (3) *Method of connecting a primary coil to set.* (4) *What is a potentiometer.*

(1) In your set put the aerial to the slider and the condenser to the top of the coil and not vice versa as shown. See Fig. 5, page 124, April 22nd issue. (2) Up to about 4,000 metres. (3) The rearrangement should be as in diagram (Fig. 1).

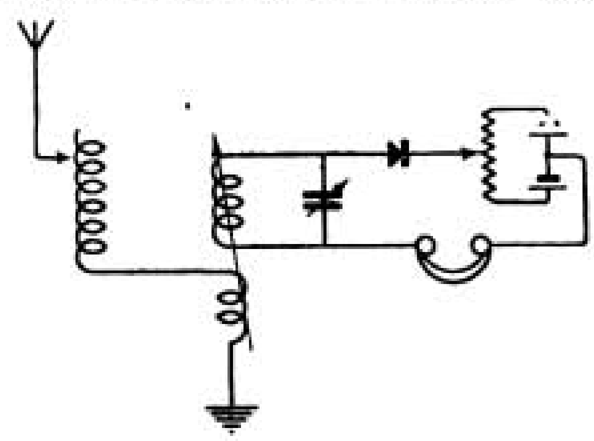


Fig. 1.

(4) A device for applying a variable potential on a crystal or other instrument. It consists of a resistance of about 300 ohms, fitted with a sliding contact and connected up as shown in the diagram.

"REACTION" (Malvern) *asks* (1) *Questions about a set sketched.* (2) *If the two wires of a twin aerial need be parallel.*

(1) The only way of getting sufficient variation of reaction with this arrangement would be to use basket coils for B and C. We cannot give dimensions as you do not state your wavelength requirements. The A.T.C. should be across both B and C. (2) No, but they should not be inclined at any great angle to each other.

"R.N.B." (Camden Town) *asks* (1) *For diagram of a single valve set suitable for telephony.* (2) *What he would be likely to hear.* (3) *If he could use honeycomb coils as basket coils, and if honeycomb coils would need a larger condenser.*

(1) A suitable circuit is shown in Fig. 1, page 335, June 10th issue. (2) Telephony in the London district; ships within about 100 miles and continental stations, such as the Eiffel Tower. (3) Honey-

comb coils may be used if desired. If so, the condensers need not be larger.

"C.E.P." (Pontypridd) *encloses a sketch of his receiver and asks* (1) *If the connections illustrated are O.K.* (2) *If not, what alterations are necessary to receive telephony.* (3) *If correct, what are the capabilities of the apparatus.* (4) *What telephones are suitable.*

(1) No. Connect as in diagram, Fig. 2. (2) As

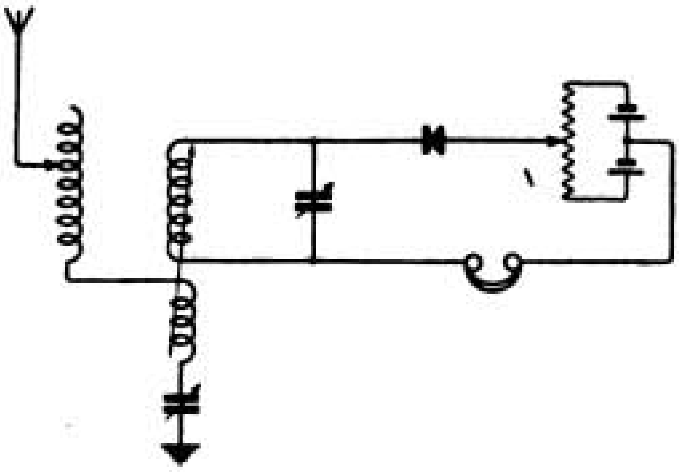


Fig. 2.

altered, the set will receive telephony from near-by stations. (3) Telephony range probably about 20 miles. (4) Any high resistance, resistance not less than 2,000 ohms.

"NIB" (London) *asks* (1) *If it is possible to get good results with a crystal and frame aerial 3 ft. square.* (2) *If a method of winding a frame aerial, which he sketches, is correct.* (3) *If results are impossible as suggested, what valve set we recommend.*

(1) Quite impossible unless you are in the immediate neighbourhood of a fairly high power transmitting set. (2) Method suggested is correct, provided of course the frame is made sufficiently strong mechanically. (3) This depends on results required. For London broadcasting one, or at most two valves with a certain amount of reaction should be sufficient. If greater distances are required three or four valves should be used with a frame set.

"H.C.G." (London) *asks* (1) *Re Fig.* 13, *page* 727, *February 18th issue, if slab inductances would do.* (2) *Dimensions of coils to tune from* 180 *to* 30,000 *metres.*

(1) Yes. Honeycomb coils would be much preferable for the longer wavelengths. (2) Assuming this is done, about eight coils will be required, with a mean diameter of about 2", the number of turns would run from 40 for the lowest to 1,000 for the highest wavelengths.

"V.R." (Grappenhall) *asks* (1) *For criticism of set.* (2) *What kind of telephones are suitable.* (3) *How to stop the sliders on the inductance coils cutting a ridge in the wire.*

(1) Set should give desired results, but would be better with an A.T.I. of about 4" diameter and No. 22 wire. (2) Any type with resistance not less than 2,000 ohms. (3) Carefully round the face of the plunger which rests on the wire, and do not use too great a tension on the controlling spring.

"C.N.G." (Pelton) *asks* (1) *If his set is correctly wired up.* (2) *What improvements could be made.* (3) *If he added a similar valve and panel would he get the Dutch concerts.* (4) *Must the grid and the valve panel suit your valve, or will any type of valve do.*

(1) Yes. (2) The use of two tuning circuits loosely coupled, instead of a single circuit, would be a distinct advantage. (3) The addition of a second valve with H.F. coupling should give you **PCGG**, but not very strongly. It is not necessary to have an additional filament resistance for the second valve. (4) The values of the grid leak and condenser depend upon each other. The type of valve, nature of the circuit, and the wavelength to be received. For average conditions and short to medium wavelengths use about 0·00005 to 0·0002 mfds.

"RADIOLITE" (Merthyr Tydfyl) *asks* (1) *If a five-valve amplifying set with a* 6 *ft. frame aerial,* 20 *ft. from the ground, will receive transatlantic high-power stations.* (2) *With a big frame aerial and two valves could he receive* **GLD**, *spark or Dutch concerts.*

(1) If the design of the set is good, transatlantic stations should be received under good conditions. (2) Very doubtful. You would get much better results with the use of an ordinary type long aerial.

"G.P.B." (Huddersfield) *asks* (1) *Will telephony be distorted if the aerial runs for about* 3 *ft. parallel with a water-spout.* (2) *Is H.F. amplification better than L.F. for telephony.* (3) *What should be the capacities of the condenser across the A.T.I. and reaction.* (4) *Will his circuit receive* **PCGG** *and* **2 MT**.

(1) No. (2) Yes, unless the L.F. resistance capacity amplification is used. in which the preference is determined by the kind of results required. *i.e.*, L.F. for very loud signals, H.F. for making very weak signals audible. (3) 0·0005 mfd. across the A.T.I. We prefer to omit a condenser across the reaction coil, but a similar value can be used if desired. (4) **PCGG** possibly. **2 MT** doubtful, owing to the smaller propagation efficiency of the shorter wavelength now used.

"IVY" (Birmingham).—(1) *Refers to Circuit Fig.* 2, *page* 154, *April 29th issue, and asks whether it would be more efficient to make use of the potentiometer for grid control instead of grid condenser and leak.* (2) *If it is possible to obtain a calibration card for a Marconi type* 16 *receiver.* (3) *Wire for intervalve transformer* 500 *to* 5,000 *metres.*

(1) Yes, potentiometer control should be quite satisfactory and if the valve is at all "soft" you might obtain better results. (2) We do not think so, as you no doubt purchased the instrument second-hand, but we should imagine that you would have no difficulty in calibrating the set yourself from a standard wavemeter or putting it in the hands of a laboratory that undertakes wireless calibration work. (3) For an aperiodic transformer with optimum wavelength of 2,000 metres use No. 40 S.S.C. "Eureka" wire winding a single layer on an ebonite tube former 5" long × 2" diameter for primary and a similar length of winding for secondary with empire cloth insulation between windings.

"S.G." (Manchester) *asks* (1) *For criticism of his three-valve set.* (2) *Should he use a series or parallel condenser on the A.T.I.* (3) *Data for his tuning coils.*

(1) The set appears O.K., but we should have expected a condenser across the primary of the H.F. transformer to improve results. You will

require practically no filament resistance with R valves and 4 volts. Any inefficiency may be due to (*a*) too large values for the A.T.C.; (*b*) unsuitably adjusted reaction; (*c*) inefficiency of the H.F. transformer; (*d*) wrong values of grid leak and condenser. (2) If possible avoid using any parallel capacity on wavelengths not exceeding 1,500 metres. Series capacity may be used on the shorter wavelengths with advantage. (3) We do not recommend honeycombs for the comparatively short range you require. We suggest for the A.T.I. 7″ × 4″ of No 24 with slider or tapping at ½″, 1¼″, 3″ and 5″, with variable series condenser of 0·0015 mfds. For reaction coil 4″ × 3″ of No. 24, with two or three tappings.

"E.H.C." (Ardingley College, Sussex) *asks for criticism of enclosed diagram of set.*

The whole set is of so unusual a type that beyond saying that it transgresses all accepted rules and that we are sure that it will give no results we can give you little help. We suggest that you study any text-book dealing with valve circuits.

"L.S." (Richmond). *For a crystal set to receive broadcasting, asks* (1) *If a former 3½″ × 10″ wound with 22 S.W.G. be suitable.* (2) *Would a fixed condenser give satisfactory results, and of what capacity should it be.* (3) *The wavelength range.* (4) *Should he receive Paris time signals.*

(1) Yes. (2) 0·0002 mfd. in series with the A.T.I., and 0·002 mfd. in series with the telephones may be used. (3) Up to about 600 metres. (4) No; to do this you would require a much larger coil, say 10″ × 8″ wound with No. 22.

"R.V." (Retford) *asks how he can have a broken French R valve revacuated.*

We are afraid this cannot be done as the expense of re-exhausting is so nearly as great as that of the production of a new valve that manufacturers are not prepared to undertake this class of work.

"RADIOSTAT" (Catford) *asks* (1) *What was the wavelength and power used by Marconi House telephony station for transmissions re Carpentier-Lewis fight.* (2) *Will the Marconi House station be one of the future broadcasting stations.* (3) *If it is true the P.M.G. has removed all restrictions regarding amateur aerials and relinquished the inspection of stations.* (4) *In a single valve circuit where the H.T. is 60 volts and L.T. 4·5 volts, with the usual P.M.G. aerial, how far could the howls of the valve be heard on another single valve receiver.*

(1) Approximately 1½ kW input, 352 metres. (2) This is not yet settled. The question of location and running of a transmitting station will be decided by the P.M.G. in consultation with the manufacturers interested. (3) No. Some lessening of the aerial restrictions has been promised, but it is unlikely that the inspection right will be abandoned. It will possibly be more rigidly enforced, particularly with a view to the elimination of radiating receivers. (4) Quite impossible to say. One or two miles is quite a possible distance.

"A.V.E." (Fulham) *asks what stations he should get with a single valve set.*

This depends, of course, entirely on the type of set. With a good set you should obtain telephony from stations within 50 miles, ship stations and high power European Stations. You might even get American Stations under very favourable conditions.

"A.J.H." (Harrow) *asks if a wireless set would be a practicable proposition in a situation 30 yards from a Metropolitan Station and from telegraph wires.*

We think it probable that useful results would be obtained, particularly with the aerial at right angles to the wires. You may have some trouble from inductance, particularly if much L.F. amplification is used.

"C.N." (Chesterfield) *asks* (1) *for criticism of a crystal set.* (2) *Windings for the tuner.* (3) *Resistance for the telephones.* (4) *Criticism of a valve set.*

(1) Bornite to be used with zincite, not alone. (2) About 8″ × 6″ of No. 22. (3) At least 1,000 ohms unless a telephone transformer is used. (4) Condenser (a) 0·0005 mfds. A grid leak is useless without a condenser across it. Telephones to be shunted by a condenser. Circuit otherwise O.K.

"C.C." (Chelmsford).—(1) The simplest way to reduce your wavelength would be to use a fixed A.T.C. of about 0·0002 mfds. in series with your present coil, which should, however, tune down to 300 metres as it stands if the switching is correctly carried out. (2) Signals from Writtle should be strong, and from London audible, but quite weak.

"M.R.N." (Oxford) *has a single valve long range receiver, and asks* (1) *Should he be able to receive telephony.* (2) *In what issue was a two or three valve amplifier L.F. suitable for the above set described.*

(1) This set is most efficient at longer wavelengths than are used for most telephony. London telephony should be audible, but will probably be weak. (2) Such a set has been described in detail recently. For a suitable circuit see Fig. 1, page 811, March 18th issue.

"L.W.T." (Sunninghill) *encloses a sketch of his aerial and asks if it would be efficient when used with a single or two valve receiving set; if not, what alterations would be necessary.*

The arrangement suggested should give fairly good results. It would, however, be better to keep the whole aerial further away from the house if it could be managed. For instance you might erect a mast near the receiving room and carry the wire from there direct to the mast at the far end of the building. Either a twin or single wire aerial may be used. A two-valve set would meet with your requirements.

SHARE MARKET REPORT

Prices as we go to press on June 16th, are:—

		£	s.	d.
Marconi Ordinary	.. ..	£2	11	0
,, Preference	.. ..	2	7	6
,, Inter. Marine..	..	1	13	0
,, Canadian	.. ..		11	4
Radio Corporation of America:—				
Ordinary	.. .. ..	1	1	6
Preference	.. .. ..		15	0