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THE WIRELESS WORLD

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TELEPHONY AND ITS APPLICATION TO WIRELESS: A SIMPLE EXPLANATION

By J. F. HERD, A.M.I.Radio E.,

Honoursman and Silver Medallist, C. & G. of Lon. Inst.

AT the moment when Wireless Telephony is perhaps the most fascinating branch of the radio science, a short and simple explanation of the principles of telephony generally, and their application to wireless in particular, may be acceptable to many readers of *The Wireless World*.

First, it is advisable briefly to consider the general principles of Sound.

Sound is due to mechanical vibration, and a "sounding" body is simply one which is vibrating at some rate lying between certain limits. The vibrations of this body cause corresponding vibrations in the air immediately surrounding it, which air, in turn, affects the air particles more remote from the original body. The vibration is thus handed on from particle to particle of air in the form of a "longitudinal wave," as it is called, which finally reaches the air adjacent to the ear. This air sets into vibration the tympanum or ear drum, whose vibration is finally imparted to the brain, the main seat of the senses, when it is appreciated as the sensation which we call sound.

All sounds have three distinctive characteristics :—

(*a*) Pitch.
(*b*) Amplitude.
(*c*) Timbre.

Pitch is simply the distinction between a high and a low note. It is governed by the frequency of the "sounding" body, or the number of vibrations it executes per second. The human ear responds to vibrations occurring between the rates of about 30 per second, as the lower limit, and an upper limit variously estimated at from 20,000 to 40,000. For most ears, however, the upper limit is more probably of the order of 10,000 to 15,000 per second, and, as a matter of fact, actual distinction of pitch ceases generally at about 4,000 per second—all vibrations beyond which rate have merely the effect of an indeterminate shrill noise.

Amplitude is simply the loudness of the sound, or the violence of the air wave reaching the ear. This will, of course, depend upon the violence of the original vibration and the distance the ear is from it.

Timbre or *quality* is rather difficult to define, but can best be described as that subtle characteristic which enables one to distinguish between sounds of the same pitch and amplitude emitted, say, by two different musical instruments or two different voices.

This depends upon the "harmonics" or "overtones," which accompany the main vibration.

It is well known that practically every vibration (mechanical or electrical), is accompanied by feebler "harmonic" effects, occurring at definite multiples of the fundamental frequency. As an example, a musical

instrument string vibrates as a whole, causing the main " pitch," and also vibrates in sections, causing the main vibration to be accompanied by harmonic vibrations at exact multiples of the main frequency.

If we represent a simple vibration by a " sine curve," the effect of harmonics is to modify the shape of the curve, the degree of modification depending upon the frequency and amplitude of the harmonics present, and also upon their phase with respect to the main curve, starting at some arbitrary point.

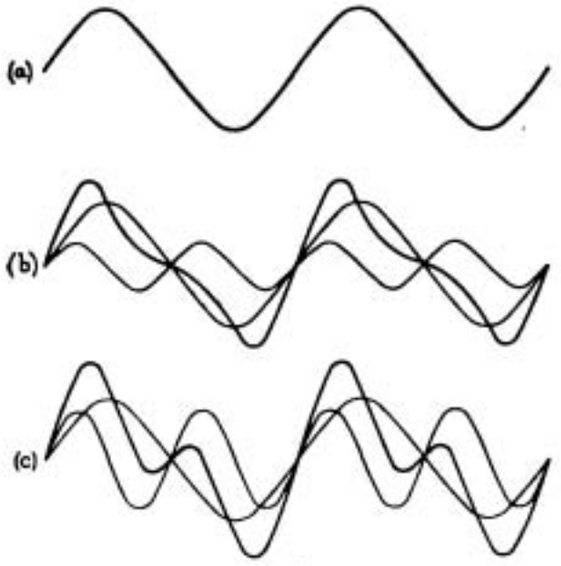

Fig. 1.

Modification of Wave-form due to Harmonics.

Full consideration of the effect of harmonics is beyond the scope of a short paper, but a simple example can be seen in Fig. 1, where (*a*) shows a simple sine curve of frequency *n*, (*b*) how that curve is modified by the pressure of a moderate " first harmonic," of frequency $2n$; and (*c*) the considerable modification due to a strong " first harmonic."

The variations possible with other harmonics are, of course, endless, but from this simple case it can readily be imagined how the presence of harmonics will alter the form of the fundamental sound wave.

Von Helmholtz has stated very fully the characteristic qualities that are imparted to a sound by the presence of various harmonics, and without considering these in detail, it will suffice to say that the harmonics present with human speech are very numerous, and cause the sound waves of speech to be of an extremely complex nature.

Any system which aims at reproducing the human voice (such as the telephone), must necessarily *reproduce these harmonics, and in their correct degree*, or the reproduction is defective and speech indistinct.

For purposes of illustration in this article, however, speech vibrations will be represented by simple sine curves, it being borne in mind that they are actually of the more complex form already indicated.

Any system of telephony must consist essentially of an arrangement whereby the air waves due to speech act upon a suitable diaphragm and cause it to vibrate. These vibrations produce electrical variations which are communicated, by wire or wireless, to the distant receiver and cause its diaphragm correspondingly to vibrate, thereby reproducing the sound which originally vibrated the first diaphragm.

(The telephone receiver being already a familiar piece of radio apparatus, a knowledge of its principles and operation is assumed.)

This was first practically accomplished by Alexander Graham Bell, using the circuit of Fig. 2. Speaking into the instrument, say at A, causes its diaphragm to vibrate in accordance with the sound. This varies the distance between the diaphragm and pole pieces, and therefore also varies the flux

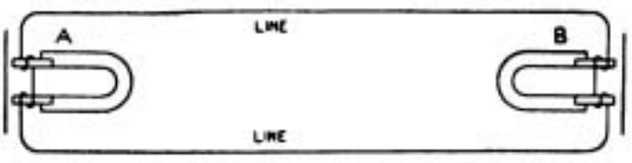

Fig. 2.

Original telephone circuit, using double-pole Graham Bell instrument for transmission and reception.

through the pole pieces and through the coils wound over them. This flux variation causes the induction of e.m.f's., which, in turn, cause currents to traverse the lines and distant receiver. The pull on the diaphragm at B is thereby varied, that is, the diaphragm at B vibrates similarly to that at A, and speech is reproduced.

It will be observed that here the same type of instrument is functioning at A as a generator or dynamo, and at B as a motor.

The e.m.f.'s generated by this means are very small, and the range of the system was therefore limited. This caused experimenters to look for a more efficient transmitter, later forthcoming in the microphone, due originally to Prof. David Hughes, also famous for his type printing telegraph apparatus.

In its present form the microphone consists essentially of two carbon plates, the space between them containing loosely packed carbon granules. One of the carbons is frequently the actual vibrating diaphragm, as in the Ericsson type of microphone, illustrated in Fig. 3.

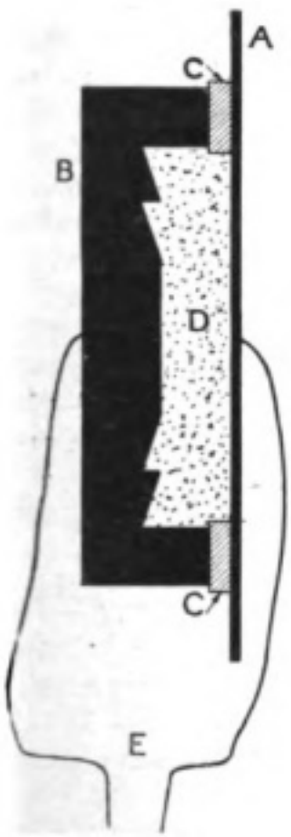

Fig. 3.

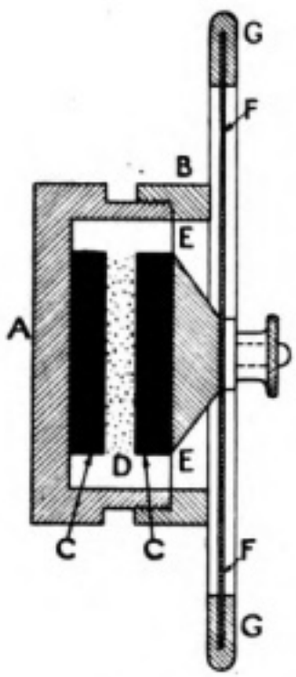

Fig. 4.

Fig. 3. General construction of "carbon granule" microphone (Ericsson type.) A *Carbon diaphragm,* B *Carbon block,* C *Wool ring,* D *Carbon granules,* E *Connections (usually completed through the case.)*

Fig. 4. Construction of "Solid Back" microphone. A *Back of brass cell,* B *Cover of brass cell,* C *Carbon,* D *Carbon granules,* E *Secondary mica diaphragm,* F *Main diaphragm,* G *Rubber ring.*

The carbon granules are normally in loose contact with each other, and with the main carbons. Speaking into the diaphragm causes it to vibrate, and therefore to vary the pressure on the granules. As a result, the electrical resistance of the arrangement varies, and any current normally traversing it will be correspondingly varied.

Fig. 4 illustrates another type of microphone now in very extensive use. It consists of a small brass cell, with a carbon piece fixed to its back. The cover of the cell contains a small mica diaphragm, to which the other carbon, mounted on a small brass piece is fixed. The interior of the cell is lined with paper. A large mica diaphragm is screwed to the brass piece on which the vibrating carbon is mounted. The vibrations of this main diaphragm are thus communicated to the secondary mica diaphragm and carbon, thus varying, as before, the pressure on the carbon granules lying loosely between the carbon plates.

This type of microphone is usually called the "solid back," from its first mode of assembly, but it is now frequently assembled in a light aluminium case to form what is known as a "capsule" or "inset," to be placed within the heavier mouthpiece case. These capsules are readily interchangeable in event of a microphone failure, which is a great convenience in maintenance.

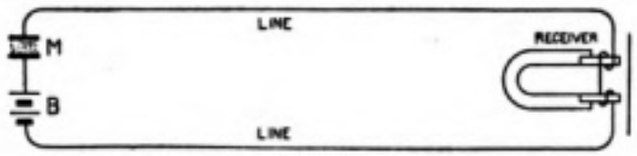

Fig. 5.

Simple one-way speaking circuit using microphone M *and battery* B *connected to line.*

The application of the microphone to a simple telephone circuit is shown in Fig. 5, and its operation explained by Fig. 6.

When no speech is occurring, the microphone granules are in a normal state of pressure, as shown in Fig. 6 (*a*). The whole circuit has a normal resistance as in Fig. 6 (*b*). Through the circuit there is, therefore, a normal steady current, as in Fig. 6 (*c*), which,

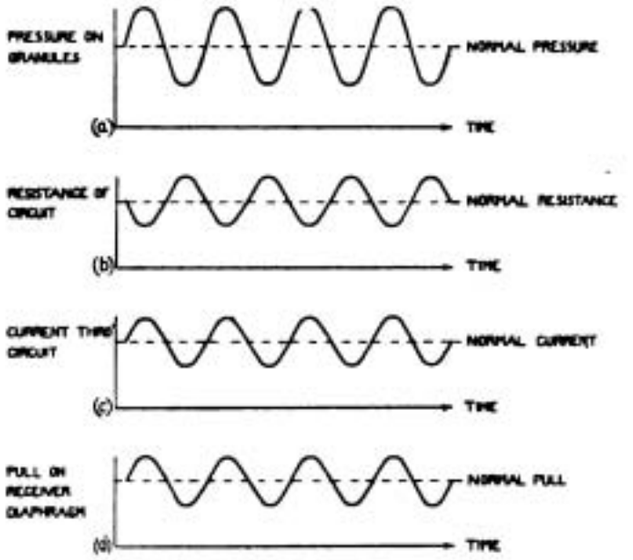

Fig. 6.

along with the permanent magnet, causes a steady pull on the receiver diaphragm. All these steady values are shown by dotted horizontal lines.

Speaking into the diaphragm causes it to vibrate, producing variation of pressure on the granules as shown by the curve of Fig. 6 (*a*.) This varies the resistance of the circuit as in the curve of Fig. 6 (*b*), and gives rise to the current variations shown in Fig. 6 (*c*). The pull on the diaphragm is thus varied as in Fig. 6 (*d*), causing it to vibrate in accordance with speech.

In the arrangement shown the microphone resistance is only a part—and frequently only a small part—of the total circuit resistance. Variation of microphone resistance, therefore, can only cause a comparatively small percentage variation of the total circuit resistance, and consequently only a small variation of current.

This is remedied in modern practice by joining the microphone in series with the low resistance primary of an open-cored transformer or induction coil (as it is usually called by telephone engineers), thus causing the normal microphone resistance to form *almost the whole of the resistance* of the circuit in which it is joined.

Variation of microphone resistance will thus cause large percentage changes of the total circuit resistance, with correspondingly enhanced fluctuations of current.

The type of induction coil mostly used in ordinary line telephones, consists of a core of iron wires wound with a primary of about 1 ohm resistance. The secondary is usually of about 25 to 35 ohms.

An open magnetic circuit is essential, as the primary current is unidirectional.

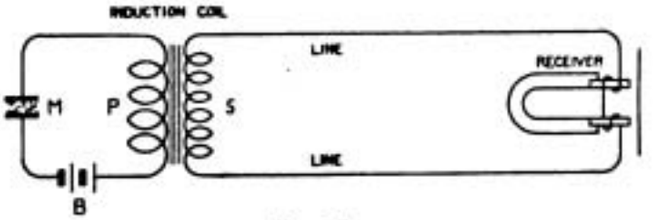

Fig. 7.

One-way speaking circuit using microphone M, *and open-core transformer or induction coil.*

Such a coil is very different from the induction coil, or Ruhmkorff coil of spark wireless practice, and does not give anything like the voltage step up that the wireless reader might be inclined to associate with its name. Its prime function, indeed, is not so much that of voltage step up, but to ensure that the microphone is in a circuit of low and of constant resistance.

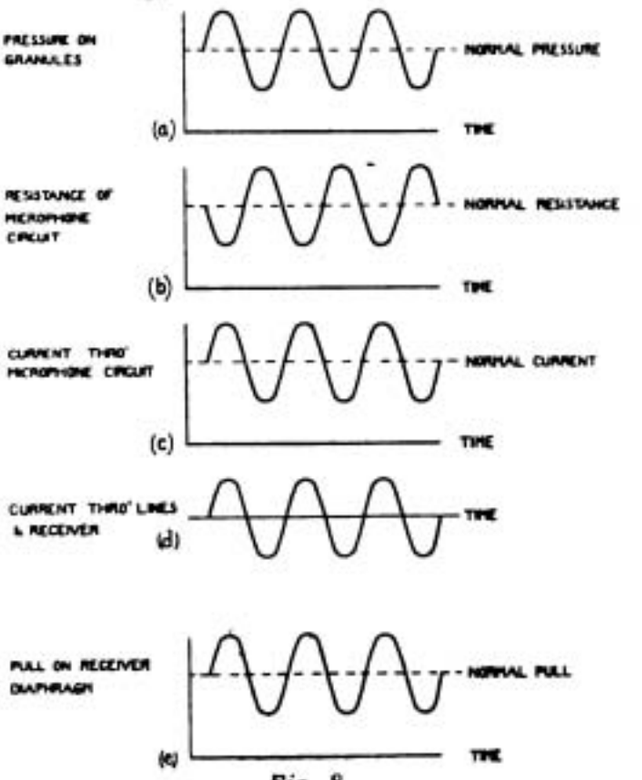

Fig. 8.

The arrangement of a circuit for one way speaking, using an induction coil, is shown in Fig. 7, and its operation in Fig. 8.

In this case there is no steady current in the line circuit, but the receiver diaphragm is in a normal state of steady strain due to the pull exercised by the permanent magnet.

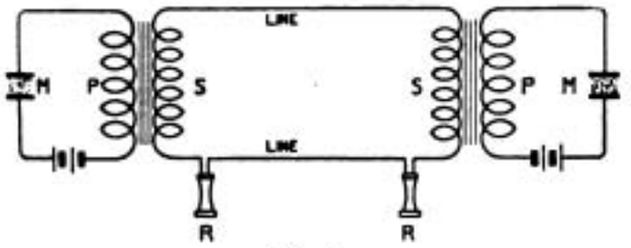

Fig. 9.

Practical telephone circuit for two-way speaking.

Speaking into the microphone causes wide variation of the primary circuit resistance, and therefore large fluctuation of primary current, as in Fig. 8 (*b*) and (*c*). These current fluctuations cause the induction, in the secondary, of e.m.f.'s., which give rise to currents, as in Fig. 8 (*d*), which vibrate the receiver diaphragm, as in Fig. 8 (*e*).

Fig. 9 illustrates a practical working telephone circuit for two-way speaking, the arrangement shown being typical of the conditions actually existing between two subscribers when connected at the exchange. The speaker's voice is reproduced in *his own receiver* as well as the distant one, and it is the hearing of this speech that gives the circuit the "live" sensation, of which one is readily conscious when connection is established at the exchange. The calling and clearing arrangements of ordinary exchange circuits are not shown, as such are hardly relevant to this paper.

In more modern exchange practice, batteries are not provided at each subscriber's end, the requisite power being obtained from a common or central battery of accumulators at the exchange. Consideration of these arrangements, likewise, are not relevant to this paper.

Before leaving the subject of line telephony, however, it is advisable briefly to consider its disadvantages and limitations.

The main factors militating against the clear telephonic reproduction of speech are :—

(*a*) Attenuation.
(*b*) Distortion.

The former is simply the diminution of the varying currents finally available at the receiver, resulting in the weakening of speech, although articulation is perhaps quite clear. Attenuation is due to ohmic resistance and leakage (particularly the latter), and can now be minimised in well-designed circuits of good insulation.

Distortion is much more serious, and is due chiefly to the capacity of the wires, which (being effectively *in shunt* to their resistances), virtually allows the higher frequency harmonics to leak, as it were, so that they are not received at the distant end. (It should be remembered that the reactance of a condenser, being $\frac{1}{2\pi nC}$, *decreases* with increase of frequency, and may be quite small for the higher frequency harmonics).

As a result, speech, although perhaps of loud volume, is lacking in clearness.

This difficulty is rather inherent to line circuits. It is now greatly minimised by the insertion of "loading" inductances, between the wires, to neutralise the capacity, but a perfectly distortionless line circuit is not yet achieved.

The potential advantages of radio telephony can readily be imagined when it is recalled that as a transmission medium the æther is distortionless.

The application of telephony to wireless will be considered in a further instalment of this article.

(To be continued.)

A SIMPLE VARIOMETER

By H. C. Cooper.

FOR amateur use the variometer has the advantage that it is cheap compared with a variable condenser, which it may replace. A number of different designs have appeared in *The Wireless World*, most of which require carefully made former to wind them on and are then subject to the disadvantage of the wood or cardboard shrinking and the wire becoming loose. The type here described is of the pancake variety, and when the winding has been impregnated with wax is rigid enough for most purposes, or the mounting may be slightly altered and the winding placed behind a panel with only the knob projecting through. It has the advantage of extremely free movement owing to its small weight and absence of sliding contacts.

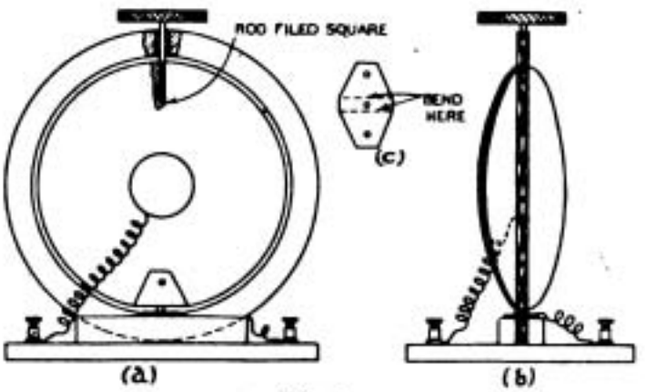

Fig. 1.

Most amateurs have probably now got formers for winding pancakes or, in any case, these are easily made and have been described in these columns. The variometer in question was wound on a former of 1·25 in. diameter, with 15 pins of $\frac{3}{16}$ in. diameter, using No. 36 S.W.G. double cotton covered wire.

It was first wound to a diameter of $4\frac{7}{8}$ in., this being 190 turns, taking 163 ft. of wire.

Two turns of string were then wound on and after leaving sufficient wire for connections the winding was continued to a diameter of 6 in., 260 turns, 244 ft. The winding was then impregnated with paraffin wax in the usual way and the pins and string removed.

The two coils were then mounted as shown in Figs. 1 (a)and (b), side and end elevations respectively.

The spindle at one end presents no difficulty and a $\frac{1}{8}$" brass rod is used, with a bush of any suitable material in the outer coil. The rod has an ebonite knob and pointer, if desired, on its end, and the other end is filed square and then sealed into the small coil with wax. Owing to the fact that pancakes must have an uneven number of pins there will not be a hole opposite for the spindle.

A thin brass plate is therefore cut out, Fig. 1 (c), and a small pin screwed or soldered into the centre of it. The plate is then bent where shown and clamped to the smaller coil by a screw and nut, the former passing through the coil after the wires have been displaced to allow of this.

The central pin fits into a hole in another brass plate, which is screwed to the wood blocks holding the large coil.

A small washer is placed here to hold the small coil at a suitable height and to let it turn freely.

The four wires are best brought to terminals mounted in ebonite bushes on the base.

The instrument can now be used either alone as a variometer or with the addition of variable condensers as a coupler or tuner and reaction coil.

Its most useful application is with a resistance capacity-coupled amplifier which, if properly arranged, does not need a reaction coil.

By means of a series of fixed condensers and pancake inductances a continuously variable wavelength range is now obtained.

If it is desired to get a larger amount of wire on the variometer it is only necessary to wind more pancakes and mount them side by side in the same way as the single one has been described.

WIRELESS APPARATUS X-RAYED

THE accompanying photograph of a Marconi Type 16 Crystal Receiver set taken by means of X-ray apparatus may be of interest to readers. The photograph was taken by Mr. Lees-Milne, of Nantwich, who was good enough to send it in for publication.

Those familiar with this receiver will see that it has been photographed from the back and shows the A.T.C. (top right-hand corner), Billi-condenser (to left), Reactance Coil (bottom left-hand corner); other parts easily recognised are the potentiometers and the micrometer gap.

In June last Mr. G. G. Blake, A.M.I.E.E., read a paper before the Wireless Society of London on a "Simple Wireless Telephone Set," when X-ray photographs which he had taken of the set he described were used to illustrate the lecture.*

Much waste of time and labour might often be saved in the location of faults, especially in complicated sets, if it were possible to X-ray the apparatus before opening it up to locate the offending part.

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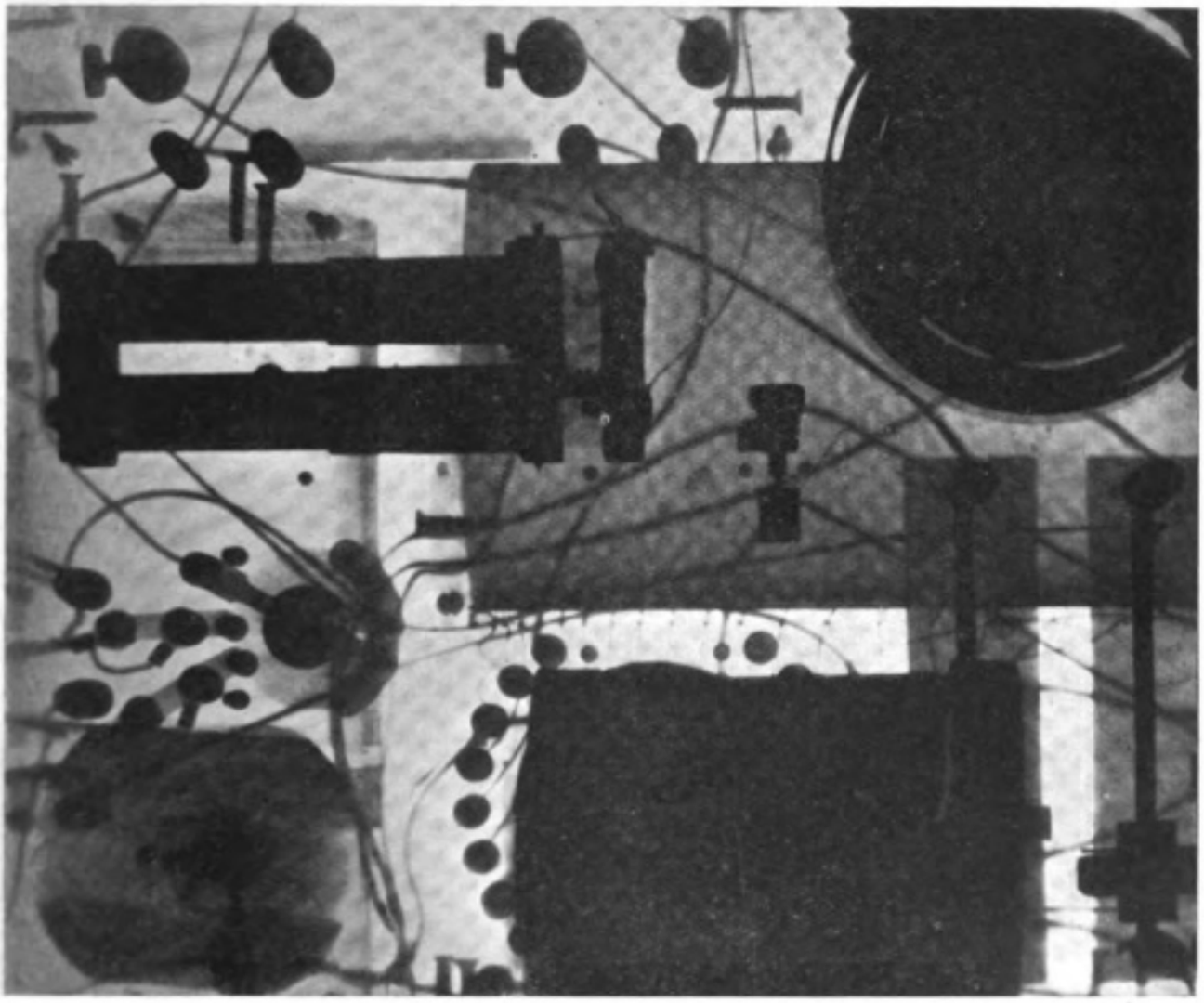
* See *The Wireless World*, July 24th, 1920, pp. 316-322.



A Marconi Type 16 Crystal Receiver Set

DR. J. ERSKINE-MURRAY, F.R.S.E.

President of the Wireless Society of London, 1921

THE GREATEST PROBLEM IN RADIO*

By Major J. Erskine-Murray, D.Sc., F.R.S.E.

I HAVE to give you something in the nature of a Presidential address. I fear that for some of you it may, perhaps, prove an exercise in mental gymnastics, but, at the same time, it is a subject so intimately connected with the welfare of wireless telegraphy, and, indeed, of communications throughout the whole world, that you will, perhaps, put up with me if some of it is rather technical. There are, however, no mathematics. That is one good thing. I have given this address the title of "The Greatest Problem in Radio," and with very few exceptions those of you who are accustomed to listen in will be able to guess what that is. The problem is to prevent unwanted signals from rendering the wanted signals unreadable. You all know that problem. It has been with us since the beginning and it is still here, perhaps worse than ever. In the early days, when there were only two or three stations on the whole globe, I remember realising this. We were using plain aerial sets at Poole, one of the first two stations ever erected. I remember realising that the enormous advantage possessed by radio telegraphy over line transmission, in that any station in any part of the globe within range of it could receive its signals, was, also, a terrible limitation if we wished to have two or three lines of communication across that same part of the globe. So I actually started experiments on the first partial solution of this problem. We never got very far with them for other reasons, but they were started. I am rather proud of the fact that in 1899, when there were still only two or at most five wireless stations in the world, I had already formulated the problem in the words :—"The difficulty in wireless is not to *receive* a signal, but to keep one *out*."

You can practically always make arrangements to *receive* a signal, but to keep one *out*, if it is anywhere near your wavelength, is the difficulty, especially if the power is greater than you are working on.

There are three partial solutions :—

(1) The Directional Solution, *i.e.*, the limitation of the angle in which the radiation is sent out, or from which it is received.

(2) The Selective Solution, *i.e.*, the rejection at the receiver, of all unwanted signals.

(3) The Organisational Solution, *i.e.*, the agreement between all radio-telegraphists to use only such wavelengths, types of waves, and radiated powers as conform to some scheme devised so as to allow of the freest possible use of wireless within any given area, through the minimisation of chances of interference.

(1) The Directional Partial Solution.

The first is the Directional Solution; that is to say, the limitation of the angle of the earth's surface from which you receive, or to which you transmit. Supposing a station T_1 (Fig. 1) is transmitting to a station R_1, and another station T_2 is transmitting to another R_2, in that case if you can limit the angle for each of the transmitting stations to something like that shown by the shaded portions in Fig. 1, signals can be heard within that area but not outside it. Thus, you see that, whatever the wavelengths be, the two pairs of stations can work without any great

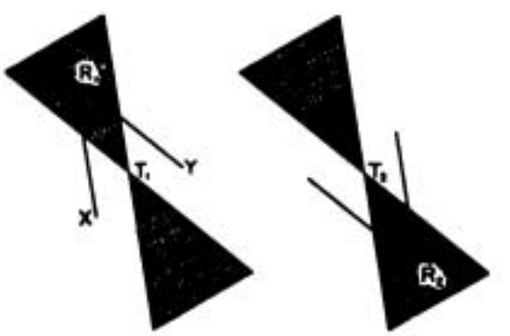


Fig. 1—Directive Transmission and Reception.

* A Presidential address delivered before the Wireless Society of London, on Tuesday, March 1st, 1921.

trouble ; or, similarly, if R_1 be the receiving station, if you can limit your reception to an angle like that indica ed by X Y, nothing will be received from the station T_2, and if R_2 is the second receiving station it will receive nothing from the station T_1. So

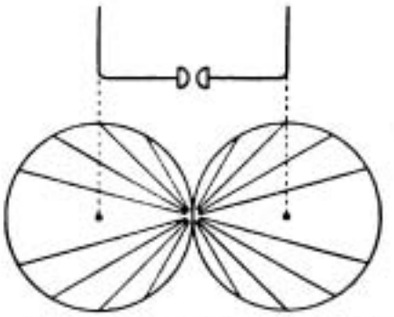


Fig. 2—Two spaced Aerials with Polar Curve of Radiation.

you will have two independent lines of communication. Directional transmission and reception then, as we call it, is really simply a question of limiting the angle over which you transmit or receive.

For directional transmission we must have aerial systems which give more radiation

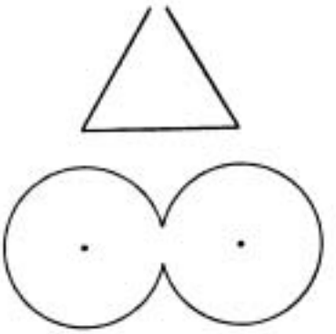


Fig. 3—Triangular Aerial with Polar Curves.

along one line than in any other. Thus we have, first of all, two vertical aerials with a spark gap between them, as in Fig. 2, which also indicates the shape of the polar curve of radiation from such an aerial system, in which the radial lines are proportional to the amount of energy which is being radiated in that direction. There were also the aerials of Artom, open at the top and forming a triangle, as indicated in Fig. 3. Ferdinand Braun used three aerials, and there are various other types ; for instance, Marconi used an aerial something like that shown in Fig. 4,

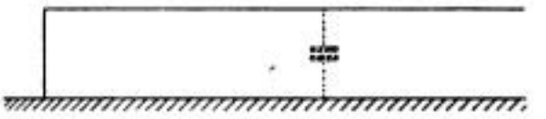


Fig. 4—Marconi Bent Aerial.

a long horizontal aerial with a short upright. That gives a curve not exactly like Fig. 2, but rather unsymmetrical. It is practically an incomplete coil, the horizontal part forming a capacity, as shown by the dotted lines in Fig. 4. Now these are mainly useful for transmission. The ordinary receptional aerial for reducing the received angle is

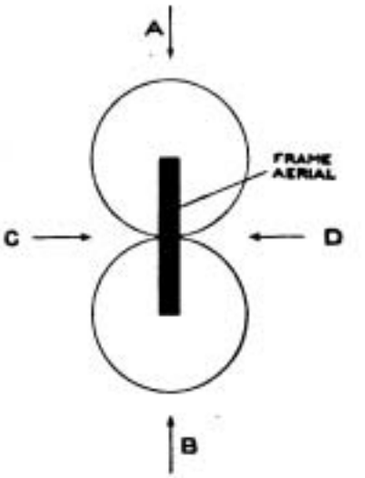


Fig. 5—Frame Aerial with Polar Curve.

a single coil, and that again receives from this figure of 8 diagram, Fig. 5. That is to say, you will receive strongly from two directions, A and B, and very weakly, or not at all, from C and D. By turning it about you can keep out unwanted stations.

There is also a closed aerial with tuned uprights (Alexanderson), and two triangular aerials with one vertical aerial (Bellini-Tosi) Fig. 6. All these types give a directional effect to the radiation ; that is to say send out more power in some directions than in others. In general, the energy diagram showing the strength of radiation in different directions is either a figure of 8 or a heart shape, as shown at the right of Fig. 6 ; but many curious and involved forms are possible if the phases of the currents in the various branches of the aerial are varied.

The form in which you have the coil with the vertical aerial tuned to it gives you the directional diagram of Fig. 6. The trouble about this form is that it is very difficult

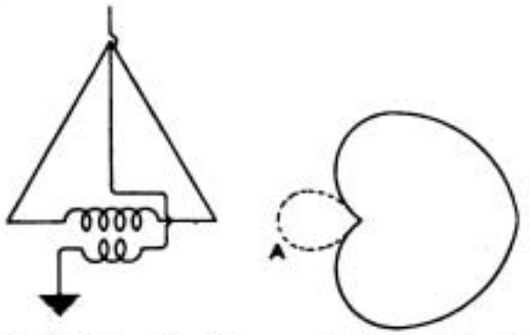


Fig. 6—Combined Loop and Vertical Aerial with Polar Curves of Radiation.

to get the two currents in the right phase, and if you do not, you get a little pip A on the diagram. If you have various combinations of aerials for direction transmission, and arranged the phases, you get a variety of curves. For instance, as shown in Fig. 7, with a number of maxima with minima in between.

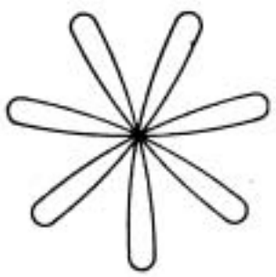


Fig. 7.

Now we come to what are called ground aerials. Of course, people have used them since the beginning of time. In 1898 we stuck one down; we did not transmit with it, but used a coherer for reception. We got quite good signals, but Mr. Rogers, in America, has recently been working on the subject, and has, no doubt, got very good results, but I do not think the theory has been explained. The explanation, to my mind, is exceedingly simple. When you put up an ordinary vertical aerial you put it up vertically because the lines of electric force which you wish to receive are vertical, or nearly so. If A B, Fig. 8, is the surface of the earth, the lines of electric force are somewhat as shown at F_1 in the air. In the earth the lines of force F_2 are practically horizontal; therefore, the right way to arrange your aerial in the earth is horizontal, because the lines of electric force are also horizontal. I think that is a new explanation, but if it is not I have not seen it so far, and it is very simple. I do not think there is anything wrong with it.

(2) The Selective Partial Solution.

The second is called the Selective Solution, which most people look upon as *the* solution, but it is not the final one, although it is a great help, as is the Directional Solution.

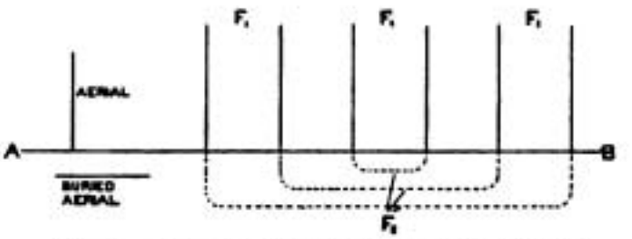


Fig. 8—Lines of Force in the Air and Earth.

The Selective Solution is the rejection of unwanted signals at the receiver and depends almost wholly upon resonance. Now resonance is a wonderful thing. If occurs in daily life. Many of you have not noticed it, but the next time you dance, or sit in a church, and hear the organ play, you can easily find the effects of resonance. It is a very simple thing. It is just the application of properly timed forces to the moving objects which have natural rates of vibration.

[*An experiment was then shown with two pairs of weights hung at opposite ends of a stretched horizontal cord in order to demonstrate the effects of resonance between the springs having similar periods of vibration.*]

We have high-frequency and low-frequency tuning, and one or two other peculiar things. One is called the rejector, a secret patent of the Navy's which was published about two months ago, and which embodies a very interesting principle. I think I need hardly go into that. Those of you who

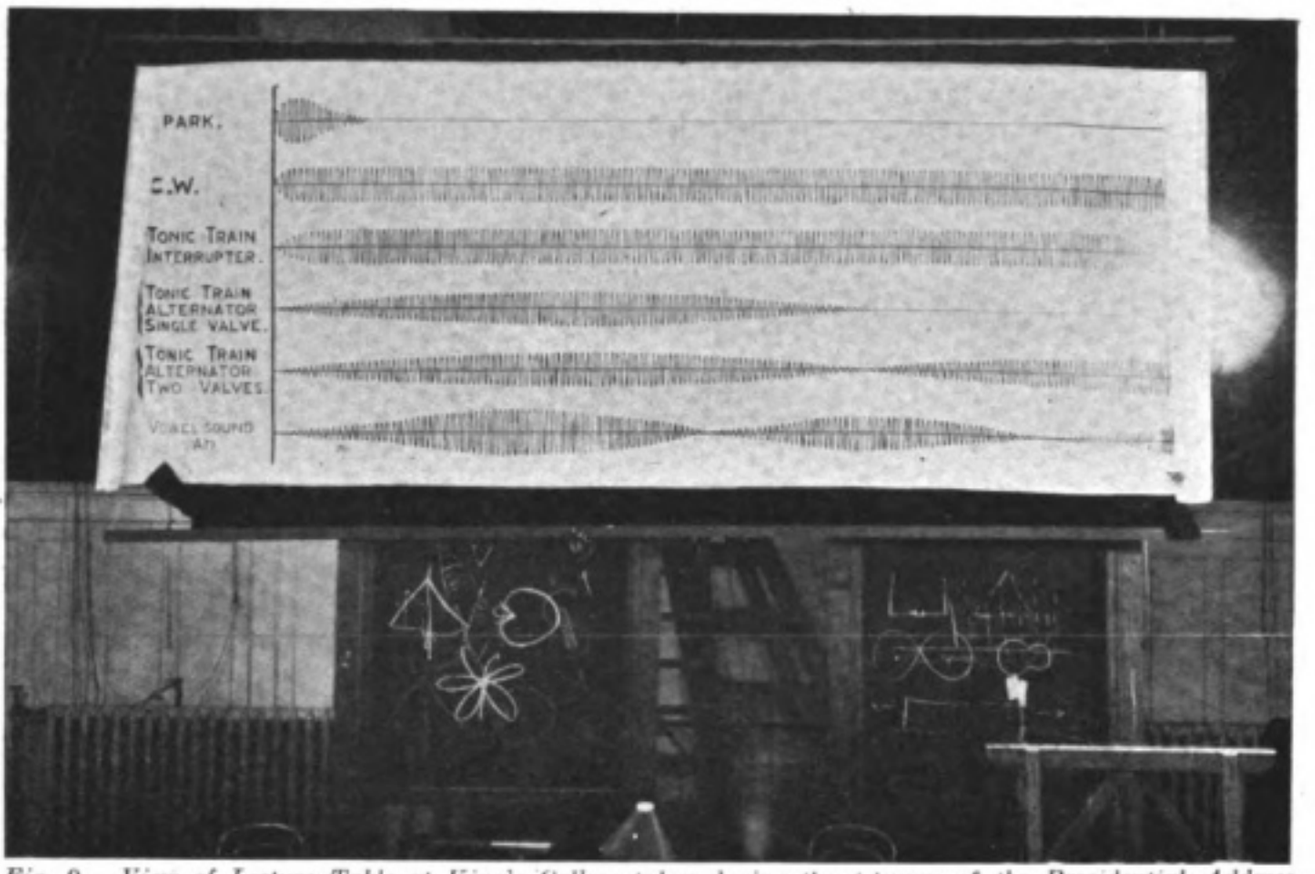


Fig. 9.—View of Lecture Table at King's College taken during the delivery of the Presidential Address, and showing a portion of the large wall chart to compare different types of waves.

are particularly interested can buy the patent at the Patent Office. It is a bit difficult, but it is a circuit which rejects one wave and allows all others to go through.

Now we ought to classify waves by the amount of interference they cause, or the amount by which they render the other signals unreadable. Those of you who have listened and are reasonably expert operators, can read the signal that you wish to read, even if there are half-a-dozen other people talking all the time. So long as their notes are a little different, you can hear the one you want to hear. The reason for that is this : It is pretty well shown in the diagram, Fig. 9. At the top there is a " spark " wave with the damping of about 0·1. The whole diagram represents a one-thousandth part of a second, and the frequency of all these waves is 200,000 per second. I wish I had drawn the amplitude of that spark oscillation a little bit bigger. The spark note is a thousand per second. There is one wave on the left of the diagram and another two yards beyond the right-hand end of the diagram. The next curve down is the C.W. wave on the same frequency (*i.e.*, 3,000 metres wavelength). The next curve represents interrupted C.W. It dies off before the end, and if it is radiated you will hear the note just as you would with the spark, but it is a different type of note. The next one would give you 2,000 beats per second when rectified, which is a high note. The lowest line of all is the wave which would transmit the sound A H. It has three beats of decreasing amplitude, and in each of those beats there are something like 66 waves.

Now, if you have spark waves, there is a long time between the occurrence of one spark and the occurrence of the next, as at A Fig. 10, so that any number of different spark waves, B, can come in between without being obliterated or mixed up at all.

But if you take the C.W. case you have quite a different matter, as indicated in Fig. 11.

The continuous wave signal C continues all the time, so that if somebody else comes in, as at D, the two waves will get mixed up.

Not only that, you get what is called a "wipe out" effect, which is a most trouble-

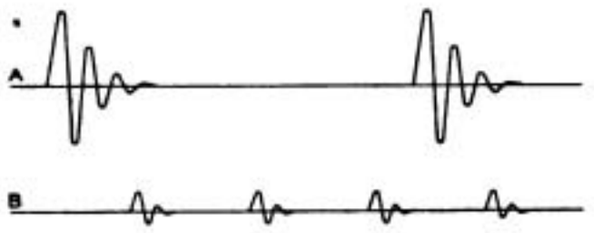


Fig. 10—Simultaneous Reception of Two Spark Signals with Different Notes.

some thing. It is due partly to the fact that we use valves for reception, and that the proper working of the valve depends on the voltage on its grid. If a strong signal—I do not say a loud one—comes along, it may make the grid of your valve so negative that the signal you wish to receive is inaudible.

It seems impossible at present to get over this difficulty, and with radiotelephony the case is worse, as the wipe out is continuous if it occurs at all.

[*An experiment was then shown with two spring-suspended weights coupled to appropriate indicators to illustrate the forma-*

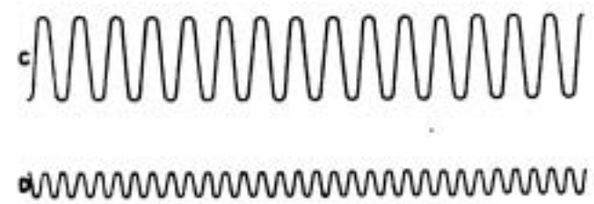


Fig. 11—Simultaneous Reception of Two C.W. Signals.

tion of beats when the frequencies of vibration of the two weights and springs were nearly equal.]

You are all very interested in wireless telephony, and so am I. I remember prophesying just before the war that within ten years we should have wireless telephony across the Atlantic. This has since been accomplished. It is not safe to make prophesies usually, but that worked out all right. The rest of the prophesy was that in so many years we should be able to call up from an ordinary telephone exchange any place such as New York or Bombay, and so on. This has not yet actually come into operation, but there is no reason why it should not, except that the wireless telephone causes more interference than ordinary signalling, the reason being that the modulation of the high-frequency waves by the super-position of the speech waves introduces a variation of amplitude which is equivalent to damping.

Referring again to the lowest curve in the chart shown in Fig. 9, the frequency of the oscillations is 200,000 per second. These oscillations are modulated by the sound A H, having a frequency of about 2,000 per second. During the first beat there are only about 33 waves from the maximum point to the minimum, and also from the start to the maximum. Do you realise that that means a damping not good enough for a second-rate spark station? You cannot get away from it. The better your modulation, and the more efficient your wireless telephone is, the worse the interference. Of course, the chart shows you complete control, and no wireless telephone at present gives that, since only about 20 per cent. of the energy is modulated. The more efficient your modulation of the energy, the worse effects you will get as regards damping.

For instance, if a frequency of 2,000 per second is superimposed on a frequency of 100,000 the length between minima is only 50 cycles, during which time the wave grows from minimum to maximum amplitude and back again to the minimum. This is equivalent to a decrement of 0·2; that is to say, the decrement is as great and the interference as bad as if the station were radiating highly damped spark waves. On longer waves the case is worse. Take, for instance, a frequency of 15,000 cycles (which is a 20,000 metre wave) and again superimpose a spark wave of 2,000 cycles. As each beat now only contains 7·5 high-frequency waves, the damping is

extremely bad—worse, in fact, than plain aerial transmission—and, in addition, the persistency of the high-frequency waves would give much distortion of speech. Telephony should, therefore, obviously be restricted to short-wave working—and even on short waves it cannot be very much better than spark. In the cases given it has been presumed that the power goes from zero to a maximum for each acoustic wave. This is not usually the case, hence the figures given represent somewhat extreme values of the decrement.

Interrupted continuous waves like telephony involves a decrement which is greater the higher the note produced. High-speed telegraphy produces a result of the same nature even when on C.W., both, of course, being very much worse as regards interference on long waves than on short.

In addition to these causes of interference, which we look upon as unavoidable, there are harmonics and subsidiary waves produced in many transmitters. These, however, are all avoidable and can be reduced by a proper design of apparatus. Among instrumental methods for the reduction of interference must be mentioned limiting valves and rejectors. There is one point in this connection that I want to mention. Supposing

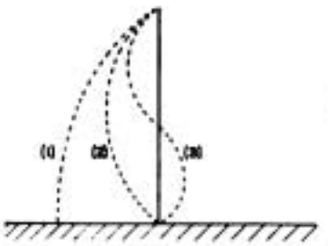


Fig. 12—Curves of Current Distribution in Aerial for Various Harmonics.

you take a vertical aerial which has a current curve, as something like that shown by (1) in Fig. 12. The first harmonic has a current distribution curve like that shown by (2). There is no current of this frequency flowing at the base of the aerial, and therefore the ammeter in the earth wire would not measure it, but there would be radiation

Now I shall describe a new method of measurement, which I hope will be of interest, especially to those who are professionally engaged in wireless. It is a method that I have devised of determining the decrement of a distant station. Two equal coils are fixed at 45 degrees, Fig. 13. The coil A is placed with its plane in the direction of the trans-

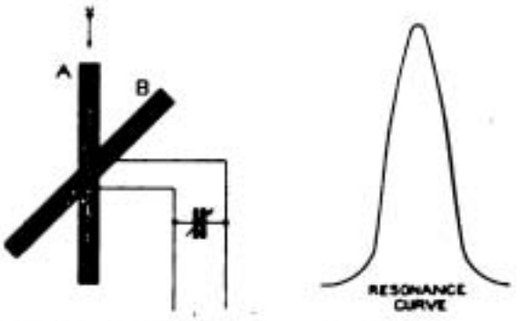


Fig. 13—Method of Measuring the Decrement of a Distant Station.

mitting station. The coil B is then tuned to the incoming signal, the capacity of the tuning condenser being C_0. Coil A will receive the maximum amount of energy it can take up, and coil B will get less in the proportion of $1 : \sqrt{2}$. Coil A is then detuned to give the same strength of signal as that in B. We will call the value of the condenser C_1. The effect of the detuning is that the representative point is moved down one side or the other of the resonance curve. Next, detune A in the other direction, so as to get the same strength of signals again. Call the value of the condenser C_2. Then the sum of the decrements of transmitter and receiver is equal to $1{\cdot}57\,\frac{C_1 - C_2}{C_0}$ Thus, by determining the receiver decrement locally and deducting it from the result, the decrement of the distant station can be calculated.

(3) The Organisational Partial Solution.

We have now the third solution to consider, and though it is not a purely technical solution, it is extremely technical in its nature. I mean the Organisational Solution; that is to say, the agreement between all radio-

telegraphists not "to tread upon each other's toes." It is a simple thing in theory, but like all that is big in connection with wireless telegraphy, it has to be international and is very difficult to arrange. But we must have a code of manners.

[*An experiment was shown to illustrate that waves do not interfere with one another in the medium through which they are propagated. The surface of some water was projected on to the ceiling, and waves were set up on it by allowing one or more drops of liquid to fall on to the water surface. These waves were reflected by the sides of the containing vessel and crossed one another without distortion.*]

The experiment shows that the interference is not due to the waves breaking up one another in the æther. The trouble occurs in the receivers.

It may surprise some of you to know that if you work out all the wavelengths there are between, say, 1,500 metres and, say, 30,000 metres, supposing them to be spaced as close as you possibly could for the best modern working (say, not much less than one per cent. apart), there are only about 270 waves to go round the whole world for all purposes. Even if waves down to 200 or 300 metres are included, there will not be more than 400 or 500 different waves, and yet we have to parcel these out amongst all stations within range of one another.

The Organisational Solution, therefore, is absolutely essential. Consider two pairs of stations acting as separate radiotelegraphic lines, and let us determine the conditions necessary for minimum interference between them. These conditions are determined at the receiver, since undesired waves such as harmonics, which may interfere in the reception, can be suppressed in the transmitter. Assuming, however, that everything has been done to ensure the purity of the radiation, there are still many important quantities which must be regulated before we can guarantee that the operation of the two lines of communication can be carried on simultaneously with freedom from mutual interference. Thus, if A B and C D, Fig. 14, be two lines of communication near one another, and for the moment leaving out the additional feature of Directional working, the transmitting waves of the stations being λ_a, λ_b, etc., it is clear that no station near B must send on λ_a except its own corresponding station A. Similar considerations in regard to the other stations show that the waves must be allocated in groups to localities so that each receiving station is surrounded by stations which transmit on waves differing from that which the receiver is to receive.

Fig. 14.

The power radiated from each station also must be roughly proportional to the distance over which the transmission has to take place. You cannot have a 100 kilowatts station for working between here and Ealing. If you do, you are going to jam up millions of square miles in order to signal a distance of ten miles. Of course, you must make allowance for tropical climates, and similar difficulties in transmission or reception.

The wavelength also must be related to the distance. This must be provided for in some properly thought-out scheme, because short waves are damped out much more quickly in passing over the surface of the earth than long ones. It is further very much easier to put power into a long wave if you have a big enough aerial. The purity of the wave radiated by the transmitter also must come up to some definite standard. This solution is not so serious to you as to the people who have to allocate waves to the new stations which are being put up. If we could wipe out all the existing stations and start again with a new scheme, we should have something

quite definite to go upon, and we could arrange that interference would be very much less than it is at present. All that we can do now, however, is to agree that in future all stations put up shall conform to a proper scheme devised to give the greatest possible freedom of operation to itself and to all stations in its neighbourhood.

Conclusion.

None of these three partial solutions is alone sufficient to enable wireless telegraphy to do the work of point-to-point communication with regularity and freedom of operation. The first and the second, the Directional Solution and the Selective Solution, can be nullified by the blaring notes of the "radio hog"—the person who uses far too much power and upsets everybody else. The third, the Organisational Solution, is really our only certain hope of being able to carry on. We want a policeman to regulate the traffic, and we must not blame the Post Office or other authorities if they, in doing so, occasionally put up their hands and stop us. The problem is absolutely international. It would be to the advantage of all interested and connected with radio telegraphy if everybody would agree to what is practically a code of manners in the use of power, wavelengths and purity of waves for every station according to the distance it has to transmit and receive and the position in which it is situated.

In putting these considerations before you I hope that I may stimulate you to give what you can of your thought, ingenuity and experiment to such subjects as the "wipe-out" in continuous waves, the limits of interference in radio telephony and generally to the furtherance of the solution of the greatest problem in radio.

TRANSATLANTIC TESTS

THE PRIZE-WINNING DESCRIPTION

By W. R. Wade.

Below we publish the article which has gained the prize offered by Messrs. Burnham and Company for the best description of apparatus used in the attempt to receive the signals from American Amateurs in the recent competition organised by this magazine in conjunction with the American Radio Relay League.

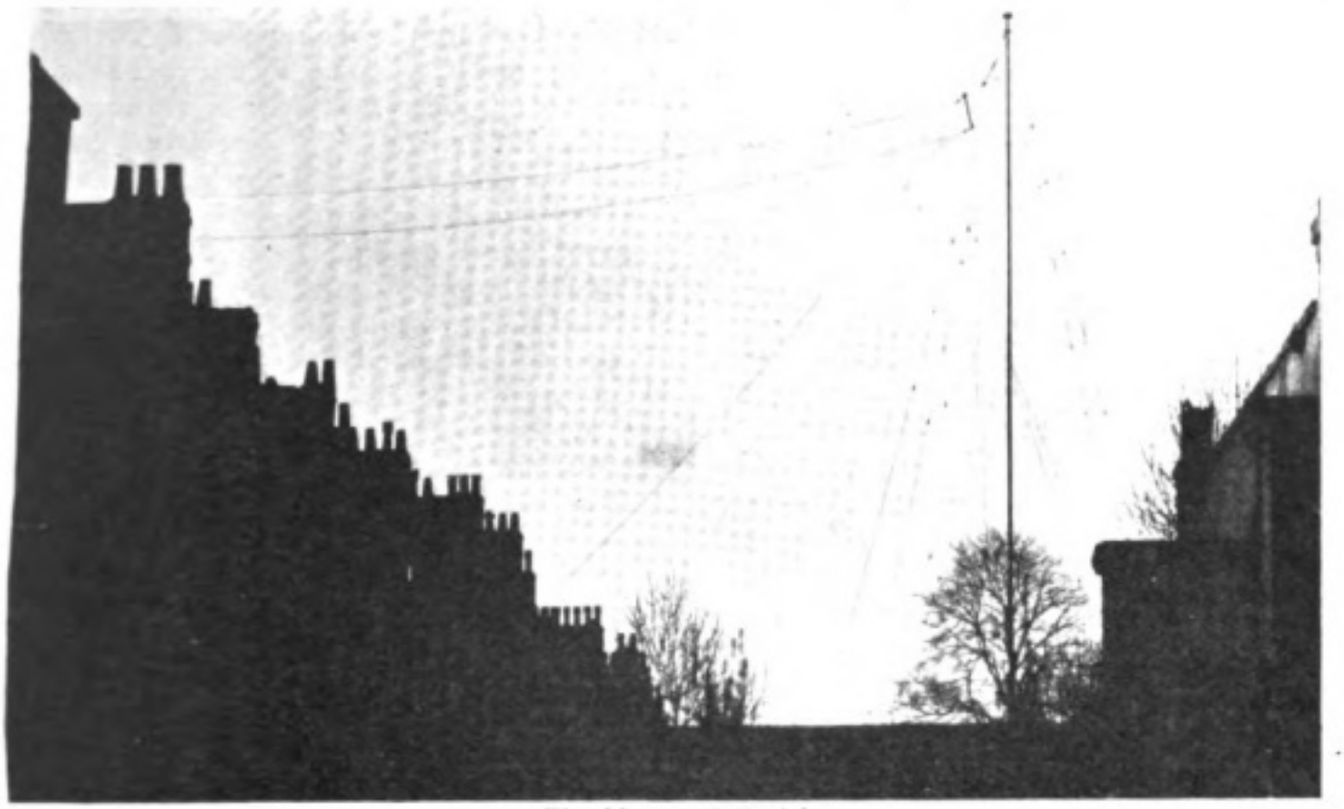
OWING to atmospherics and radiating waves from valves, probably local, on account of their intensity, reception was almost impossible, and it is quite likely that the signals recorded are not the American amateur signals at all. They were, however, on 200 metres wave and were continuous wave signals. The receiving set had not only been calibrated with a wavemeter, but a local transmitting station, with a 200 metre calibrated set, sent out signals on several occasions, and it was found that the receiving station was in perfect tune.

On February 4th atmospherics were not bad, and all was fairly quiet until 3.15, when many valves started radiating; only a few, however, were objectionable, and these are marked down for destruction before the 21st inst., when it is hoped I shall have a better chance.*

It is almost impossible to give any estimate of the strength of the signals as so few were received, but I should call them very weak and only just readable.

The commercial stations which interfered with the reception of signals were transmitting on waves above 600 metres, so it was probably a harmonic of their wave which caused the trouble.

* *Mr. Wade here refers to the experiment conducted by the American Radio Relay League on this date.* —Ed.



The Mast and Aerial.

The ship stations were not well tuned and caused severe jambing.

The set was not placed in a cabinet but laid out on a board, so that all parts were easily accessible. The aerial circuit consists of a variable condenser in series with the aerial and a lattice-wound coil as primary inductance, also connected to the earth lead.

The *Aerial*, shown in the accompanying photograph, is semi-directional for America, and is a flat top twin wire L-shaped aerial of seven-stranded enamelled copper wire, stretched on spreaders 9ft. long, and 45ft. long and 60ft. high, with a single wire lead in, and is the full length allowed by the P.M.G. It is very well insulated and shows no leakage on a sensitive galvo until over 50 v. are put into it.

The *Earth lead* is connected to the water mains, but has an additional connection to a copper wire laid 3ft. deep in the ground following the line of the aerial above.

The *Secondary* circuit, included in the diagram of connection, is coupled to the oscillator, and consists of a secondary lattice-wound coil with a variable condenser, a coupling coil to the oscillator, a vacuum valve detector, with grid condenser, grid leak, and the usual L.T. filament battery of 6 volts and resistance, and 50 volt H.T. battery.

The *Oscillator* forms part of the secondary circuit and consists of grid and anode inductances, attached to the coupling coil of the secondary inductance, a large variable condenser to adjust the beat frequency and a small vernier condenser to adjust the beat to the critical point, and a vacuum valve oscillator, served from the same batteries as the detector.

The 5-step *Amplifier*, with intervalve resistance couplings, is of the usual type, and is coupled to the secondary circuit by means of primary and secondary tuned coupling coils, each fitted with a variable condenser. These coils are lattice-wound and are of equal value. The first and three subsequent valves are amplifiers and the last, a soft valve, is

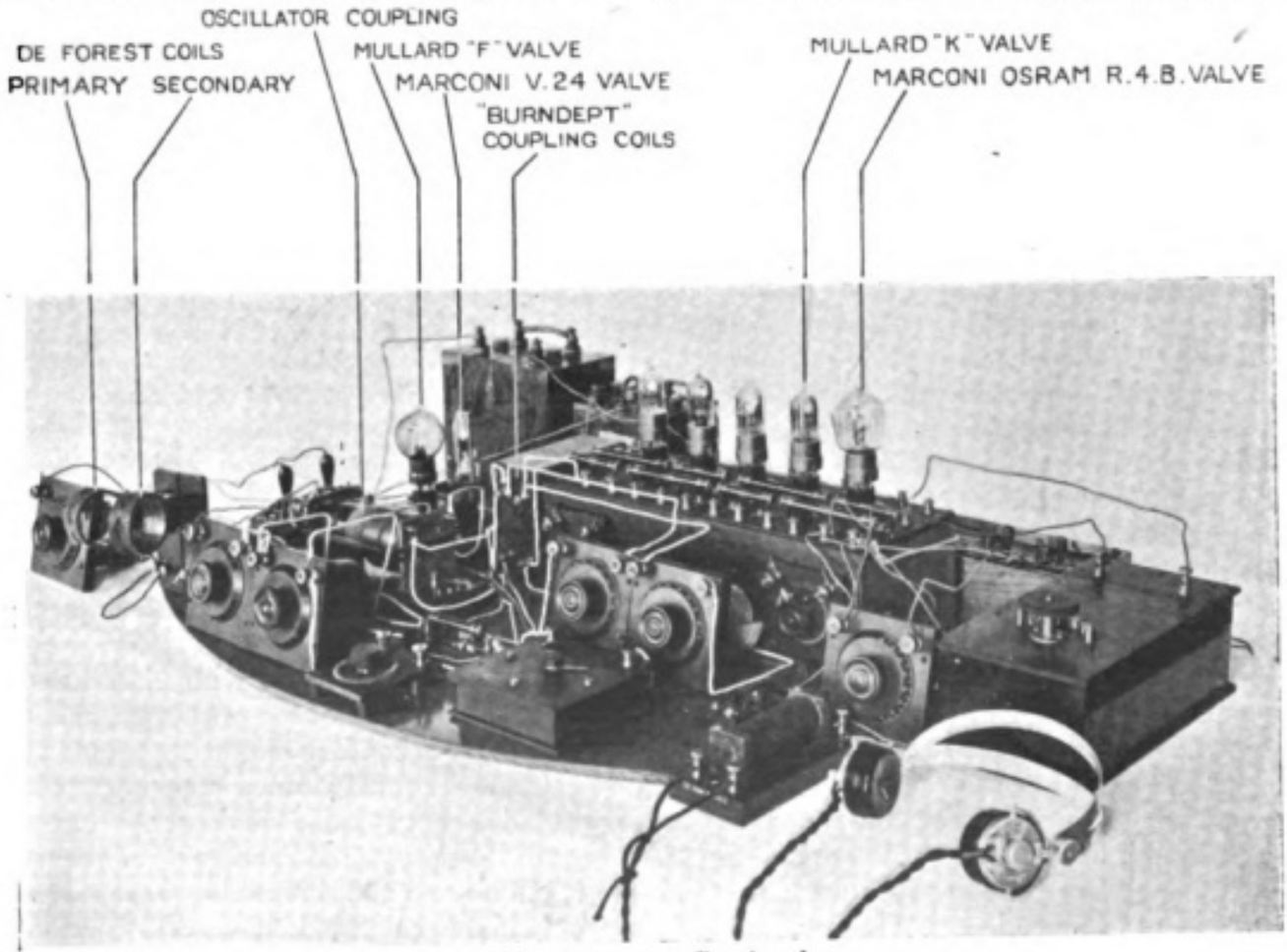
the rectifier, and is controlled by a separate filament resistance ; the amplifier also has a separate filament resistance. The whole of the valves are fed from a 4-volt filament lighting battery and an anode battery of 120 volts. The telephones are of 120 ohms and are used with a transformer. There are two condensers across the telephones, a variable and a fixed ; the fixed is provided with a short circuiting switch.

A large number of different Valves were tried, and the final selection was: for the detector, a Mullard F. ; for the oscillator, a Marconi V.24 ; for the amplifier, 4 Mullard K. valves ; and for the rectifier a Marconi Osram R.B. 4. At first sight these looked a mixed lot, but for some reason or other they gave the best results in this circuit.

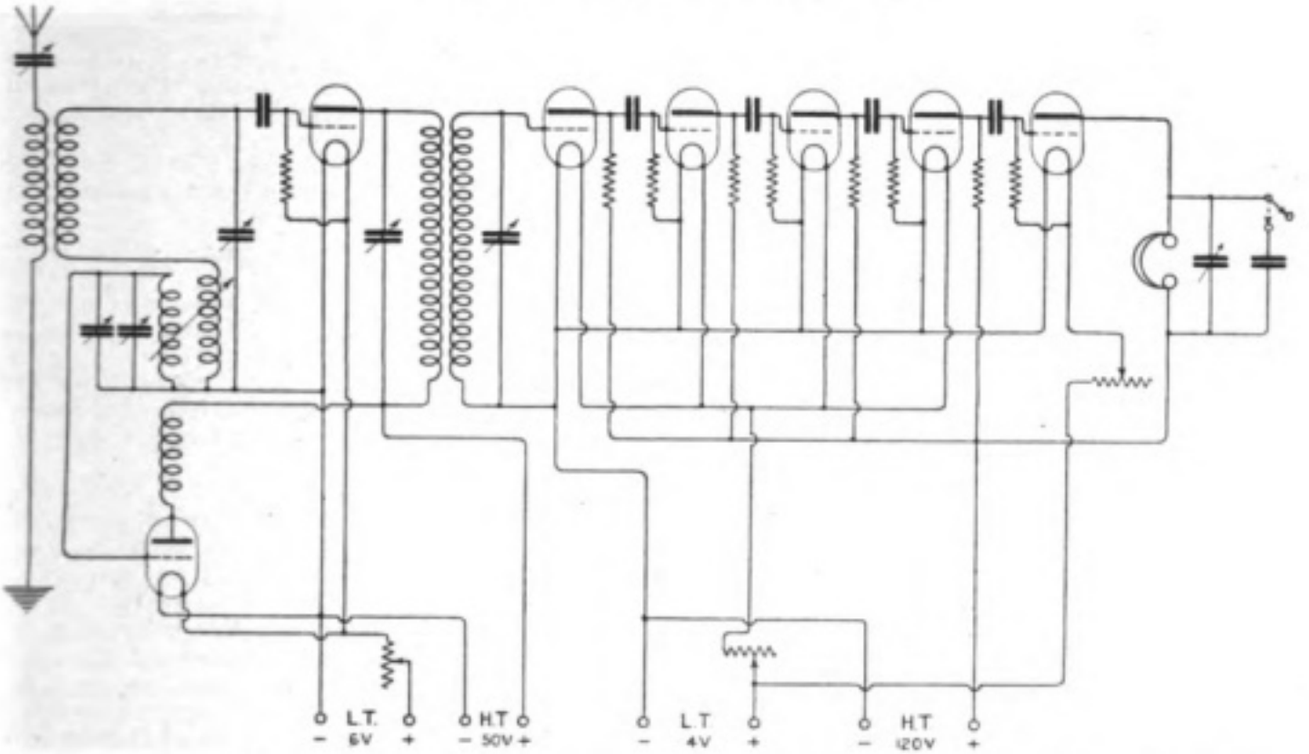
The set used was not a bought one, but a home-made affair, quite crudely constructed and more efficient than ornamental. The parts used were supplied by the following firms :—

Primary and secondary lattice-wound coils, made by De Forest, were supplied by Messrs. Burnham and Co. The amplifier coupling lattice-wound coils were Messrs Burnham's "Burndept" coils. The oscillator, grid, anode and coupling coils were home-made. The condensers and rheostat were ex-Disposal Board, rebuilt. The V.24 valve and holder, the grid condenser and leak, the resistances and leaks and other parts were from Messrs. The Marconi Scientific Instrument Company, The Marconi Osram R.B. 4 valve, was supplied by Messrs. Burnham and Co., the Mullard F., 4 Mullard K. valves, valve bases terminals, 4 accumulators, 2 high-tension batteries, Brown's telephones and telephone transformer, as well as other materials and all the wire were supplied by Messrs. King and Co., of Bristol.

The station is situated on almost the highest point of Clifton, Bristol, within a few hundred yards of the Suspension Bridge, the chains of



The Apparatus Employed.



which bridge used to span the Thames at Hungerford. The bridge is 300 ft. above the tidal river Avon, and the station is on about the same level. At a point about a mile away and on the same level as the station, there is, looking west, an uninterrupted view of the Bristol Channel. It has been noticed on several occasions that when particularly good signals are received the river is on the flow.* The station is surrounded by houses, but as the aerial is well above them no screening has been experienced. Although the station is so near to the Suspension Bridge the signals do not seem to be influenced by the huge mass of metal of which the bridge is built.

In conclusion, I am much indebted to my friend, Mr. A. L. Megson, of the Wireless Society of London and Chairman of the Manchester Radio Scientific Society, for coming to Bristol to help me to receive these tests, and also to Mr. Maurice Burchill, of the Bristol Wireless Society, for his assistance in receiving the test signals and for sending me test signals for tuning purposes.

Although the tests, as far as I am concerned, have been a failure, chiefly on account of the want of consideration, or the gross ignorance of other amateurs, probably local ones, in preventing me from hearing the signals, I have derived a considerable amount of experience which will help me in the next test.

The photograph illustrates the three-valve, low frequency amplifier which Messrs. Burnham and Company are awarding to Mr. Wade.

* *Perhaps some readers could suggest an explanation of this phenomenon or quote similar experiences* —Ed.

WIRELESS CLUB REPORTS

The Wireless Society of London and the Annual Conference of Affiliated Wireless Societies.

The Second Annual Conference of Wireless Societies affiliated with the Wireless Society of London was held at the Royal Society of Arts, John Street, London, W.C.2., on March 1st, 1921, at 3 p.m., Major J. Erskine-Murray, D.Sc., President of the Wireless Society of London, being in the chair.

The minutes of last year's Conference were read and confirmed.

The President.—I have one or two announcements to make. These are in regard to demonstrations for which invitations have been issued to the members of the Conference. One is at Marconi House, at 5.30 p.m., and is a cinematograph demonstration of matters in connection with Wireless Telegraphy. There is, I believe, only room for about 40 people, so that there is an alternative demonstration which some of you may prefer to go to, by the R. M. Radio Company, at 18, Whitefriars Street, E.C., at the same hour, where Mr. Rivers-Moore will demonstrate a new design of set which he has running there, of 1½ kilowatt, and various other things of interest to wireless people. The third announcement is that we have arranged an informal dinner at Romano's at 6.45 p.m., for which the tickets are 7s. 6d., and at which we shall be delighted to see any of the delegates who are present here if they care to come, but it is necessary that they should let us have their names so that we can let the Restaurant know the number of people coming. There are some ladies coming, so that if any of you have attached ladies please let us know.

The Conference was then opened by the President. (See next issue of *The Wireless World* for full report.)

At the conclusion of the Conference tea was served, after which parties adjourned to the demonstration held at Marconi House by the Marconi Company, and to the R. M. Radio Company, at Whitefriars Street.

At Marconi House a cinematograph exhibition was given illustrating the use of the Marconi Wireless Telephone in directing aeroplanes in cross-channel flights. It was shown how bearings were taken on the aeroplane from several land stations simultaneously, and the actual position deduced therefrom sent by wireless telephone direct from the controlling direction finding station to the pilot of the aeroplane. The use of a wireless equipment with a fire brigade was also illustrated.

At the R. M. Radio Company, Mr. Rivers-Moore, exhibited many types of wireless apparatus. A keen interest was taken in the newly designed amateur apparatus which the Company is now manufacturing, a special department having been established to cater for amateur wireless requirements. A demonstration was also given of the Company's 1½ kilowatt equipment under working conditions.

At 6.30 p.m. those who had accepted the invitation of the President to join in an informal dinner assembled at Romano's Restaurant. The party consisted of about forty Conference Delegates with their friends. During the dinner it was announced by the Chairman of the Wireless Society of London, Mr. F. Hope-Jones, that it was the intention of the Society's Committee that the dinner should become a regular event to follow the Annual Conference, and that tickets would be sent out in future with the invitations to the Conference.

A meeting of the Wireless Society of London was held on Tuesday, March 1st, 1921, at King's College, Strand, London. The President opened the meeting by calling upon the Hon. Secretary to read the minutes of the last meeting. These were read and confirmed, and the announcement was then made by the President that the following Societies had been affiliated with the Wireless Society of London :—

Lincoln and District Amateur Wireless Society,
Folkestone and District Wireless Society,
Leeds and District Wireless Society.

A Presidental Address was then delivered by the President, entitled "The Greatest Problem in Radio." (See page 9 in this issue.)

At the conclusion of the Address, **Admiral Sir Henry Jackson**, addressing the meeting, said : Ladies and gentlemen, I call upon you to join with me in giving a hearty vote of thanks to our lecturer, Major J. Erskine-Murray. What he has said to us brings home to many of us the troubles of the war and how to get over those troubles, and he has made some very practical remarks about interfering with other stations and the limitations of the power of stations. He has also mentioned a code of manners which was perhaps wanting in some of us, and his remarks may come home to us. But it is really a serious matter, this interference, and I notice it every night on going to my telephone and finding these continuous C.W. waves covering everything. We ought to think about others. I think our President has put things very plainly before us, and I think you will all agree with me that he has given us a very valuable and interesting lecture. (*Cheers.*) I hope you will join with me in giving him a vote of thanks in the usual manner. (*Cheers.*)

The President : I thank you very much, ladies and gentlemen. I know that I have been, to a certain extent, rather severely technical, but, at the same time, I felt that it was my duty to lecture as I have done. (*Cheers.*)

The President then announced that the following persons who had been ballotted for had been duly elected :—Members : Harold I. Walker, Reginald T. Williams, Lewis MacEwan, B.Sc., E. J. Neal, William Gosheron, George E. Morley, E. D. Taylor, Z. H. Taylor, Lieut. V. Matsuki : Associate member : E. A. Dwitz.

The meeting adjourned at 9.30 p.m.

The next meeting of the Wireless Society of London will be held on Monday, April 4th, at 8 p,m., at the Royal Society of Arts, John Street, Adelphi, when a paper will be delivered by Dr. Robinson, M.Sc., of the Royal Air Force, entitled "Some Acoustical Effects in Wireless."

The North London Wireless Association.
(Affiliated with the Wireless Society of London.)

The Association's fifteenth meeting was held on Friday, March 4th, 1921, Dr. Knight in the chair. After the minutes of the last meeting had been read and approved, Captain W. R. H. Tingey was called upon to give his promised lecture and demonstration on "Single Valve Reception." Before commencing, Captain Tingey said he wished to thank the Association for giving him the opportunity and pleasure of lecturing before them. Commencing by pointing out the advantages and disadvantages of various circuits for the reception of Spark, C.W. and Telephony, Captain Tingey gave many useful hints. He put special emphasis on the necessity of having one's circuits as simple and straightforward as possible. Simplicity, he said, was one of his fads, and he had endeavoured to combine it with efficiency in the designing of his own instruments.

Captain Tingey had brought his own apparatus, amongst which were his well-known long wave receiver, and also his experimental valve panel. He gave many interesting demonstrations, and especially proved the efficiency of heterodyne reception. He also used his audience as an aerial, and got quite good signals on the long wave receiver. A 3-valve amplifier and Brown Loud Speaker were used in order that all present could hear the signals.

At the conclusion the President said he felt sure that everyone had enjoyed the lecture and the interesting demonstrations, and he would ask the members to accord a hearty vote of thanks to Captain Tingey. The vote of thanks was heartily responded to.

The Association is fortunate in having the use of a very efficient aerial kindly placed at its disposal by Messrs. Auckland and Son.

Major Basil Binyon, O.B.E., has been elected a Vice-President.

The Association is making good progress, and its membership has been exactly doubled. Arrangements have been made for a series of progressive instructional lectures and discussions, which are to commence directly after Easter.

All enquiries for particulars of membership, etc., will be gladly answered by the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

Manchester Wireless Society.
(Affiliated with the Wireless Society of London.)

At the weekly meeting on February 23rd, at the Albion Hotel, Piccadilly (Mr. J. McKernan in the chair), Mr. P. G. Thomason, late of the Royal Naval Reserve, gave a lecture on "Aerials." After explaining the purposes of an aerial, and describing the early designs of Hertz and those of Sir Oliver Lodge, whose discoveries in radiotelegraphy are not sufficiently recognised by the general public, and the long vertical wire of Marconi, the lecturer enumerated the types of aerial in use to-day, and laid down the lines upon which he considered the amateur should erect his aerial and supporting masts, particular stress being put on height, good insulation and tautness, to avoid swaying, since this has a marked effect on the modern sensitive receiving apparatus by altering the capacity of aerial to earth. Considering the length of the standard aerial allowed to be used by amateurs in this country it was most efficient when erected vertically, as it then had an equal directional effect in all directions. The directional effect of aerials and the factors tending to cause the same were explained, and the types of aerials in use at the big wireless stations, such as Clifden, Poldhu, and Carnarvon, were described in this connection.

At a general meeting on March 2nd at the headquarters, Albion Hotel, Piccadilly, Manchester (Mr. J. McKernan in the chair), Mr. E. Samuels was elected Hon. Secretary in the place of Mr. Y. W. P. Evans, retiring. The Chairman paid a grateful tribute to Mr. Evans, whose work had placed the success of the Society on a firm basis, and announced that as some slight recognition, Mr. Evans had been elected an honorary member.

Mr. R. Hallam (late wireless operator on the "R. 34") then delivered a highly instructive discourse on "Workshop Hints as applied to Wireless Telegraphy." The working and finishing of ebonite, the lacquering of brass, and the making of many small parts, were all fully described. Much could be done with a hand drill, and for some purposes, *e.g.*, winding watch receivers, it was more suitable than a lathe. The best method of constructing a variable condenser was given, and the lecturer concluded by explaining his method of overcoming various troubles met by the amateur. In the discussion which followed many interesting points were raised, including the working of ebonite when heated, and the polishing of it by heating it when pressed into close contact with a highly polished surface, such as tinfoil.

On the 9th March, at the College of Technology (Mr. J. C. A. Reid in the chair) Mr. J. McKernan delivered a lantern lecture on "The Construction of Electric Motors." Starting with the theory of the subject, the earliest and the modern types of electric motors were described, and the various processes in their manufacture, repair, and maintenance were dealt with. The subject was made quite clear by many working models and parts shown by the lecturer and by an excellent series of lantern slides,

Hon. Secretary, Mr. E. Samuels, 1, Parkwood, Victoria Park, Manchester.

Wireless and Experimental Association.
(Affiliated with the Wireless Society of London.)

At a meeting of the above Association on Wednesday, February 23rd, the points to be brought before the Convention of Amateur Wireless Societies by the Association were decided upon and Messrs. A. W. Knight, W. Gosheron, and Heather were elected to be the Association's representatives.

At the meeting on March 2nd, the Chairman detailed much of what had happened at the Convention, and how nearly all the points put forward by our Society had received attention and full discussion. We were glad to learn that the representative of the authorities who had attended the meeting had no word of censure or even of criticism for the amateur wireless man during the

year, indeed it was hoped that some of the severities of the conditions imposed might be relaxed. It was hoped that the fees also would be reduced, but this, it was pointed out, was a matter for the Accountant General's Department. However, the promise was made that the subject would be reviewed, or at least representations made in the proper quarter.

Mr. Kennedy, the equipment engineer, produced a French crystal receiving set which it was intended to instal as part of the Association equipment, and a diagram of its connections was made on the blackboard.

Croydon Wireless and Physical Society.

(Affiliated with the Wireless Society of London.)

The March meeting of the Croydon Wireless and Physical Society was held on Saturday, 5th, at the Central Polytechnic, Croydon. The demonstration by Messrs. Creed and Co. of their Automatic Wireless Receiver and Printer drew a large number of visitors, some coming from as far as North London. Preliminary trials elicited the fact that the transmitting station we relied upon for automatic sending was being hand operated, and the operator is to be congratulated upon for the regularity of his working which enabled us to receive a large proportion correctly. Mr. R. E. H. Carpenter gave a lucid and detailed description of the various instruments, in such a manner that his audience was easily able to follow him through the technical details. A vote of thanks to Mr. Carpenter and his assistant, Mr. Woodman, was carried with applause at the termination of the proceedings.

Leeds and District Amateur Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting was held at 7.30 p.m. on Friday, March 11th, at 23, Great George Street (Headquarters). Mr. J. E. Tindall, B.A., B.Sc., occupied the chair. A most interesting lecture was given by Mr. S. Kniveton, F.R.M.S., entitled "My Amateur Receiving Station at Normanton." The lecture was illustrated by lantern slides, which rendered the lecture very clear even to the absolute beginners. Mr. Kniveton showed how easy it was for anyone to construct a receiving set at a small cost and capable of excellent results. The lecturer stated that on one set he constructed, using a single valve, he has heard at least two of the American stations. He also briefly explained the methods of calculating inductance and capacity.

Over thirty members were present, and they proved a very keen and interested audience. At the end of his lecture Mr. Kniveton invited questions and discussion.

A very hearty vote of thanks was accorded Mr. Kniveton, and he has promised to give another lecture on "Wireless and Meteorological Conditions." The Society anticipates holding an exhibition of amateur wireless apparatus in the near future.—Hon. Secretary, Mr. H. T. Sayer, 23, Great George Street, Leeds.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the North Middlesex Wireless Club was held on Wednesday, March 9th, at Shaftesbury Hall, Bowes Park. The President (Mr. A. G. Arthur) was in the chair, and he first called on the Hon. Secretary to report on the recent Conference, at which he had been one of the delegates. Mr. Savage then outlined the various suggestions made by the delegates from the societies represented, and dealt particularly with the replies of Commander Loring, who was present at the Conference as representative of the Post Office.

The Secretary then asked for nominations for the positions of officers and committee to be ballotted for at the next meeting, to hold office during the ensuing year, and several names were handed in.

Members then turned their attention to the show of instruments which had been arranged, and the several owners were kept busy explaining details of construction to those interested. Three new members were enrolled.

For particulars of the Club apply to the Hon. Secretary, Mr. E. M Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21.

Derby Wireless Club.

(Affiliated with the Wireless Society of London.)

On February 19th papers were read by Mr. A. T. Lee on "Types of Inductances," and by Mr. S. G. Taylor on "Crystal Receivers." The discussion which followed showed that the papers were much appreciated.

On March 2nd a paper on "A Small Spark Transmitter" was read by Mr. S. G. Taylor, explaining both the theory and practice of small sets suitable for amateur construction. Mr. G. Lowe followed, with some interesting notes on "Morse," tracing its development from the early forms of multiple needle signalling devices.

The next meeting will be held on April 9th, when Mr. S. G. Taylor will read a Paper on "Simple W/T Calculations."

The Committee will be pleased to receive suggestions for papers and names of speakers for the next programme of meetings that is now being arranged.—Hon. Secretary, Captain W. Bemrose, Littleover Hill, Derby.

Folkestone and District Wireless Society.

(Affiliated with the Wireless Society of London.)

During the past month this Society has made rapid strides towards success, and is gradually placing itself on a firm and influential footing. Two very interesting lectures have been delivered—(1) "The Theory of the Coherer Set," by Mr. A. H. Ullyett, F.R.G.S., A.C.P., etc., and (2) "Brown's Relay," by Mr. A. G. Mills.

The monthly general meeting was held on Wednesday, March 2nd, at 8 o'clock p.m., Mr. Ullyett taking the chair. The minutes of the previous meeting having been read and confirmed, the Secretary was called upon to make his report, *re* headquarters. Owing to the difficulty experienced in obtaining suitable premises, it was decided, with the kind permission of the Chairman, to utilise the lecture room of the Sandgate Schools, pending further enquiries being made. Mr. A. G. Mills was unanimously elected Vice-Chairman. Five gentlemen were elected to membership.

WIRELESS CLUB REPORTS

It has been decided to hold a public exhibition of wireless apparatus towards the end of the forthcoming season. Any suggestions for the exhibition will be greatly appreciated.

Full particulars of the Society may be obtained from the Hon. Secretary, Mr. H. Alec. S. Gothard, 8, Longford Terrace, Folkestone.

Brighton Radio Society.

(*Affiliated with the Wireless Society of London.*)

A special general meeting of the Society was held on February 24th, 1921, at 8 o'clock p.m., at 44, Buckingham Road, Brighton, for the purpose of discussing certain urgent business.

Following upon the proposal put forward by Mr. Volk at the last meeting, Mr. W. E. Dingle was elected to be President, Mr. Volk being appointed to the office of Vice-President.,

Mr. Dingle then took charge of the proceedings, and discussed at some length the question of the offer of a new Club-room at 44, Buckingham Road. It was finally decided that this should be accepted and, acting upon the suggestion put forward by Mr. C. H. Bingham, a voluntary fund was at once opened for the purpose of raising the amount of money necessary for the purchase of certain items of furniture.

It was further decided that future regular meetings should be held at the new headquarters fortnightly on Thursdays, at 8 o'clock p.m., and that the Club-room will be accessible to members every Friday evening subject to arrangement with the Hon. Secretary.

The President proposed that a rule and membership card should be drawn up for the approval of the members. This was agreed to by the members present, and the work of preparing it was left in the hands of the Executive Committee, the rough draft to be presented at the next meeting.

The meeting adjourned at 10 p.m.

Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full details as to membership, etc.

Plymouth Wireless Society.

On the 18th ultimo a meeting was held, Mr. R. S. Menhennet in the chair. Those present were fortunate enough to hear a splendid lecture delivered by Mr. W. S. Templeton, M.A., B.Sc. A.M.I.E.E., on "Relativity."

The lecturer explained the fundamental postulates of relativity, and showed the effect of them on our conceptions of space and time; how our measurements of time and space intervals depend upon the velocity of our frame of reference.

The hypotheses put forward independently by Fitzgerald and Lorentz was dealt with and its bearing upon the famous experiment of Michelson and Morley.

Passing from the restricted theory of relativity to the general theory as given by Einstein, the lecturer explained some of the results derived from it and the predictions made by Einstein, which have since been verified by experiment, especially the deflection of the beam of light in passing through a gravitational field.

The lecturer explained that Newton had not been proved to be wrong as some writers have asserted, but that his view was only a first approximation to the truth. It behoves how to examine all our physical theories in the light of Einstein's principle and discover how they must be modified to fit in with experience.

The lecturer asserted that the general theory of Relativity is the greatest achievement accomplished by human thought since the days of Newton, and that Einstein had secured for himself a place among the immortals.

This concluded one of the best lectures ever delivered to the Society since its foundation. Mr. Templeton was thanked in the usual way, and has promised to deliver another lecture shortly.

Falmouth Wireless Club.

A Wireless Club has been formed in connection with the Day Continuation School at Falmouth.

The Principal of the above, Mr. J. L. Rodger, B.Sc., A.M.I.E.E., has been elected President, and Mr. Murray Hill will act as Hon. Secretary.

The Club members meet on Wednesday evenings at the Old Grammar School.

The Hon. Secretary will be glad to receive catalogues of wireless apparatus, etc., at The Old Grammar School, Killigrew Street, Falmouth.

(Owing to pressure on our space, we are compelled to hold over a number of Club Reports. Ed.)

WIRELESS TELEGRAPHY & TELEPHONY BY CONTINUOUS WAVES.

A course of six lectures on "Wireless Telegraphy and Telephony by Continuous Waves" will be delivered by Professor J. A. Fleming, M.A., D.Sc., F.R.S., on Wednesdays, at 5 p.m., beginning April 27th, 1921, at University College, Gower Street, W.C.1.

The Course is open both to members and non-members of the University. Fee, £2 2s.

Application for detailed syllabus and tickets of admission should be made to Walter W. Seton, M.A., D.Lit., F.S.A., University College, London (Gower Street, W.C.1.).

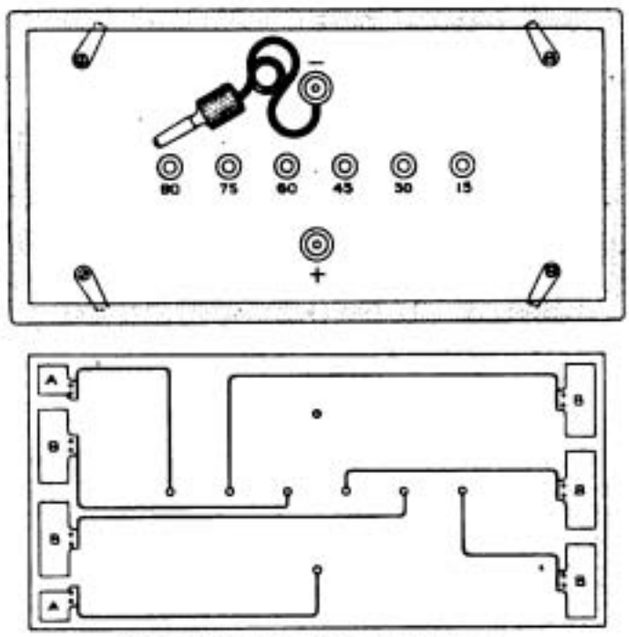
The range of subjects to be covered by the course of lectures includes: Alternators for the production of undamped Oscillations; Arc Generators; Thermionic Valve Generators: Reception of Continuous Waves in Wireless Telegraphy; Wireless Telephony; Methods of controlling by Microphones the Oscillations produced by Thermionic Generators in the transmission of Speech; Radiostations for the production of Continuous Waves; General Lay-out of stations; Transmitters and Receivers for long and short distance Radiostations; Aircraft Signalling.

HIGH-TENSION BATTERIES

A NOVEL METHOD OF CONNECTING UP SIEMEN'S 15-VOLT CELLS

A READER of *The Wireless World* describes a very neat and efficient method of connecting up Siemen's 15-volt cells. Formerly he had connected the positive and negative terminals of each block of cells by means of brass plates soldered on to the battery terminals, and the necessary tappings were taken off with insulated wire to a switch. It was found that the wires hanging loose caused noises, and a further disadvantage was the trouble which the soldering gave and the difficulty experienced when it was desired to replace a defective battery.

The way in which these difficulties were overcome is as follows : A set of six batteries of 15 cells each is fitted into a wooden box made up for the purpose. To the lid of the box, which was made in the form of a panel of ebonite, pieces of $\frac{1}{4}$" brass, $\frac{1}{8}$" thick, are fixed by a screw so that the ends of the brass remote from the screws can be turned round to fit into grooves in the sides of the box, into which the panel-lid is slightly countersunk. The object of this is to hold the lid down in position. The figure shows the top and underside of the panel-lid. A and B are pieces of spring brass screwed to the underside of the panel-lid, so as to press down on the terminals of the cells. Leads are taken from these to plug sockets as indicated. The brass contacts marked A are intended to make contact with one terminal only, whilst those marked B will bridge over two terminals, positive and negative, arranged to come side by side.



Top and underside of panel-lid.

LIGHTING VALVE FILAMENTS WITH A.C.

Working with the receiving set described in *The Wireless World* of April 17th, 1920, I found that I could entirely dispense with the 4-6 volt accumulators, and, instead, light the filament of the valve with A.C. from the lighting mains of the house.

This is quite a simple matter. First of all, connect to the mains the primary of a low-voltage transformer, of the bell-ringing type, with 4-6 volts on the secondary. Then connect this secondary to the valve circuit exactly where the accumulator would normally be placed. The potentiometer may be removed, but can remain in if desired.

Contrary to expectations, there is silence in the telephones, without the slightest humming, whilst signals come in just as loud as ever. The explanation is that the tuned circuit, on the plate side of the valve, responds to the high frequency of wireless signals, but not to the very low frequency of the A.C. supply (this in my case was 50 cycles).

This method seems applicable for any H.F. magnification, provided, of course, that the telephones and detector are put in shunt with a tuned circuit. Otherwise, the humming will drown out all signals.

M. Moye.

WIRELESS METEOROLOGICAL REPORTS ISSUED FROM AIR MINISTRY AND ABERDEEN

1. On and after 1st March, 1921, the synoptic reports issued by W/T from the Air Ministry and Aberdeen are as follows :—

AIR MINISTRY.

Call Sign	-	GFA
Wavelength	-	1400 m. continuous wave
Times of issue	-	0205 G.M.T.
		0805 ,,
		1405 ,,
		1905 ,,

ABERDEEN.

Call Sign	-	BYD
Wavelength	-	3300 m.
Times of issue	-	0230 G.M.T.
		0830 ,,
		1430 ,,
		1930 ,,

2. The reports are sent in the code recommended at the third meeting of the Commission for Weather Telegraphy held in London in November, 1920. The message consists of three parts :—

(i) Surface observations and cloud reports.
(ii) Upper winds (speeds in miles per hour for the present).
(iii) Upper air temperatures and humidities.

In the first part of the message the index figures for each station are followed by groups of five figures, giving the surface observations and the cloud observations for the station.

In the second part of the message the index figures for each station are followed by three groups of five figures, giving the upper wind for that station at three selected heights.

In the third part of the message the index figures for each station are followed by a number of five-figure groups, giving the temperature and humidity and pressure at different heights.

For security the second part of the message is preceded by the word "PILOT," and the third part of the message by the word "TEMP."

3. If I_1I_1 I_2I_2 I_3I_3, etc., are the index groups of stations, then the symbolic form of the message is :—

I_1I_1 BBBDD FwwTT cbWVH ALaNh RRjjr C_1ddVV
I_2I_2 BBBDD, etc.
I_3I_3 BBBDD, etc.
Pilot I_1I_1 $h_1$ddvv $h_1$ddvv $h_1$ddvv
I_2I_2, etc.
I_3I_3, etc.
Temp I_1I_1 BBTTH, etc.
I_2I_2 BBTTH, etc.
I_3I_3 BBTTH, etc.

The meaning of the letters "jj" varies with the time of report and between coast stations and inland stations. From coast stations figures giving the state of the sea and the visibility towards the sea are inserted for "jj." From inland stations in the reports at 0700 the minimum temperature during the night is inserted for "jj," and for reports at 1800 the maximum temperature during the day is inserted for "jj."

A hyphen – (Morse signal – . . . –) is used in the place of any missing figure.

4. In the list of stations given below the coast stations are marked "S" and inland stations are marked "L."

5. The letters used in the symbolic representation of paragraph 3 have the meanings given below :—

BBB — Barometer in millibars and tenths (initial 9 or 10 omitted).
DD — Direction of the wind near the ground on the scale 01—32 (Code 1).
F — Force of the wind on the Beaufort scale. (Forces above 10 reported as 9 in telegrams with the actual force in a word at the end, *e.g.*, force 10 is reported at the end as "storm ten"; force 11 as "storm eleven.")
ww — The actual weather at the time of observation, with which is combined, whenever possible, the general character of the weather. (Code 2.)
TT — Temperature of the air in whole degrees Fahrenheit.
c — Characteristic of barometric tendency during the period of three hours preceding the time of observation. (Code 3.)
b — Amount of barometric tendency in the same period of three hours expressed in half-millibars. For tendencies 10—19 the *second* figure only is reported and 33 is added to the wind direction number. For tendencies 20—29 the second figure only is reported, and 67 is added to the wind direction number. Tendencies greater than 29 are reported as 29. (Code 4.)
W — The weather in the interval since the preceding time of report. (Code 5.)
V — Visibility, or distance at which objects can be seen in daylight (or at which lights can be seen at night). (Code 6.)
H — Relative humidity of the air. (Code 7.)
A — Form of *predominating cloud lowest* in the scale of cloud forms. (Code 8.)
L — Amount of sky (0—10) covered by cloud of form A and of all forms of the same layer as A, if "a" refers to a different layer.
a — Form of *predominating cloud highest* in the scale of cloud forms when more than one type of cloud exists. (Code 8.)
N — Total amount of sky covered with cloud (scale 0—10).
h — Height of base of lowest cloud present. (Code 9.)
RR — Rainfall in whole millimetres. (Code 10.)
jj — See paragraph 3.
r — Time of commencement of rainfall (precipitation). (Code 11.)
C_1 — Form of cloud observed by nephoscope for special cloud reports. (Code 8.)
dd — Direction of the wind in the upper air on the scale 01—36 (*i.e.* degrees from North divided by 10 and rounded off to the nearest whole number (00—calm).

VV — The relative speed of clouds as determined by nephoscope, and such that if "h" is the height of the cloud in metres the actual speed "vv" in kilometres per hour is obtained from the equation

$$vv = \frac{h}{1{,}000} \times VV$$

h_1 — Height at which the upper wind is reported.

dd — Direction of the wind in the upper air on the scale 01—36.

vv — Speed of the wind in the upper air in miles per hour.

Note.—The speed of the upper air will continue for the present to be given in m.p.h. as the introduction of kilometres per hour involves certain changes which it has not yet been possible to carry out.

BB — Barometer in whole millibars (initial 9 or 10 omitted).

6. The necessary codes are given in the following tables:—

LIST OF STATIONS FROM WHICH REPORTS ARE SENT, WITH THEIR INDEX NUMBERS

Index No.		Index No		Index No.	
01	LERWICK (S)	28		55	Benson (L)
02	Orkney (S)	29		56	Larkhill (L)
03	STORNOWAY (S)	30		57	Andover (L)
04	Wick (S)	31	Birr Castle (L)	58	Farnborough (L)
05	Castlebay (S)	32	Baldonnell (L)	59	
06	Nairn (L)	33	HOLYHEAD (S)	60	Kew (L)
07	ABERDEEN (S)	34	Liverpool (S)	61	CROYDON (L)
08		35	Shotwick (L)	62	Biggin Hill (L)
09	Leuchars (L)	36	Manchester (L)	63	Clacton (S)
10	MALIN HEAD (S)	37	Howden (L)	64	Shoeburyness (S)
11	RENFREW (L)	38	Spurn Head (S)	65	Grain (S)
12	Leith (S)	39		66	Lympne (L)
13	Eskdalemuir (L)	40		67	
14	Goswick (S)	41		68	
15	TYNEMOUTH (S)	42	Castle Bromwich (L)	69	
16		43	Nottingham (L)	70	SCILLY (S)
17		44	CRANWELL (L)	71	Falmouth (S)
18		45	YARMOUTH (S)	72	Plymouth (S)
19		46	Pulham (L)	73	Portland (S)
20	BLACKSOD POINT (S)	47	Felixstowe (S)	74	GLASHOT (S)
21		48		75	Beachy Head (S)
22	Donaghadee (S)	49		76	Dungeness (S)
23		50	VALENCIA (S)	77	GUERNSEY (S) (1 a.m. and 1 p.m.) or
24		51	Roche's Point (S)		
25	Flamborough (S)	52	PEMBROKE (S)	78	JERSEY (S) (7 a.m. and 6 p.m.)
26		53			
27		54	ROSS-ON-WYE (L)		

Note I.—The stations used at present are shown in capitals.

Note II.—The letter L means that the maximum and minimum temperatures are reported in the fifth group at 0700 G.M.T. and 1800 G.M.T.

Note III.—The letter S means that the state of the sea is reported in the fifth group at 0500 and 1800 G.M.T.

WIRELESS METEOROLOGICAL REPORTS

CODE 1 (DD).

Code for reports of wind direction to indicate the "tens" figure in the Barometric Tendency.

Direction.	Barometer Tendencies of 9 or less.	Barometer Tendencies of 10—13.	Barometer Tendencies of 20—29.
	Code Numbers for Wind Direction.		
Calm	00	33	66
N. by E.	01	34	67
N.N.E.	02	35	68
N.E. by N.	03	36	69
N.E.	04	37	70
N.E. by E.	05	38	71
E.N.E.	06	39	72
E. by N.	07	40	73
E.	08	41	74
E. by S.	09	42	75
E.S.E.	10	43	76
S.E. by E.	11	44	77
S.E.	12	45	78
S.E. by S.	13	46	79
S.S.E.	14	47	80
S. by E.	15	48	81
S.	16	49	82
S. by W.	17	50	83
S.S.W.	18	51	84
S.W. by S.	19	52	85
S.W.	20	53	86
S.W. by W.	21	54	87
W.S.W.	22	55	88
W. by S.	23	56	89
W.	24	57	90
W. by N.	25	58	91
W.N.W.	26	59	92
N.W. by W.	27	60	93
N.W.	28	61	94
N.W. by N.	29	62	95
N.N.W.	30	63	96
N. by W.	31	64	97
N.	32	65	98

CODE 2 (ww).

Code for weather at actual time of observation and general character of weather.

Fine or fair (Cloud 0-5)	Cloud decreasing	00
	No apparent change	01
	Cloud increasing	02
	Visibility over 50 kilometres	03
	With solar or lunar halo	04
	After fog or mist (or dust storm)	05
	After rain or drizzle	06
	After snow or sleet	07
	With or after thunder and lightning in neighbourhood	08
	After thunderstorm	09
Cloudy or Overcast (Cloud 6-10)	Cloud decreasing	10
	No apparent change	11
	Cloud increasing	12
	Visibility over 50 kilometres	13
	With solar or lunar halo	14
	After fog or mist (or dust storm)	15
	After rain or drizzle	16
	After snow or sleet	17
	With or after thunder and lightning in neighbourhood	18
	After thunderstorm	19
Fog or mist	Just begun — Clear in zenith	20
	Just begun — Apparently overcast	21
	Intermittent — Clear in zenith	22
	Intermittent — Apparently overcast	23
	For some time — Becoming thinner — Clear in zenith	24
	For some time — Becoming thinner — Apparently overcast	25
	For some time — Clear in zenith	26
	For some time — Apparently overcast	27
	For some time — Clear in zenith	28
	Becoming thicker — Apparently overcast	29
Passing Showers	Slight with rain	30
	" hail or rain and hail	31
	" sleet	32
	" snow	33
	Heavy with rain becoming better	34
	" rain	35
	" rain becoming worse	36
	" hail or rain and hail	37
	" sleet	38
	" snow	39
Drizzle	Slight occasional	40
	" continuous	41
	" but increasing	42
	Moderate but decreasing	43
	" occasional	44
	" continuous	45
	" but increasing	46
	Thick but decreasing	47
	" occasional	48
	" continuous	49
Rain	Slight occasional	50
	" continuous	51
	" but increasing	52
	Moderate but decreasing	53
	" occasional	54
	" continuous	55
	" but increasing	56
	Heavy but decreasing	57
	" occasional	58
	" continuous	59

Snow or snow and hail	Slight occasional	60
	,, continuous	61
	,, but increasing	62
	Moderate but decreasing	63
	,, occasional	64
	,, continuous	65
	,, but increasing	66
	Heavy but decreasing	67
	,, occasional	68
	,, continuous	69
Sleet or rain and snow	Slight occasional	70
	,, continuous	71
	,, but increasing	72
	Moderate but decreasing	73
	,, occasional	74
	,, continuous	75
	,, but increasing	76
	Heavy but decreasing	77
	,, occasional	78
	,, continuous	79
Hail or rain and hail	Slight occasional	80
	,, continuous	81
	,, but increasing	82
	Moderate but decreasing	83
	,, occasional	84
	,, continuous	85
	,, but increasing	86
	Heavy but decreasing	87
	,, occasional	88
	,, continuous	89
Thunder-storm	Slight without hail	90
	,, with hail	91
	Moderate without hail	92
	,, with hail	93
	Heavy without hail (without gale)	94
	,, with hail (without gale)	95
	,, without hail (with gale)	96
	,, with hail (with gale)	97
Line squall	Line squall without hail	98
	,, ,, with hail	99

CODE 3 (c).

Code for characteristic of barometric tendency.

0 = 0 or +	Steady or rising	The barometer is now higher than, or the same as, 3 hours ago.
1 = + 0	Rising then steady	
2 = + −	Rising then falling	
3 = − + or 0 +	Falling or steady then rising	
4 = Unsteady +	Unsteady but rising	
5 = −	Falling	The barometer is now lower than, or the same as, 3 hours ago.
6 = − 0	Falling then steady	
7 = − +	Falling then rising	
8 = 0 − or + −	Steady or rising, then falling	
9 = Unsteady −	Unsteady but falling	

CODE 4 (b)

Code for amount of barometric tendency.

If the figure taken from the barograph (half millibars per three hours) is *less than* 10, the figure itself is reported whether the tendency is up or down.

If the figure taken from the barograph is one of the numbers 10, 11 . . . . . 19 the second cypher is reported and the wind direction modified by adding 33 (see Code 1).

If the figure taken from the barograph is one of the numbers 20, 21 . . . . . 29 the second cypher is reported and the wind direction modified by adding 67 (see Code 1).

If the figure taken from the barograph is greater than 29 report the figure 9 and add 67 to the wind direction number, *i.e.*, numbers greater than 29 are reported as 29.

CODE 5 (W).

Code for past weather.

Without precipitation	0 = Fair or fine (b or bc).
	1 = Cloudy.
	2 = Overcast continuously.
	3 = Fog or mist.
	4 = Thick fog.
Precipitation	5 = Passing showers.
	6 = Rain or drizzle.
	7 = Snow or sleet.
	8 = Hail or rain and hail
	9 = Thunderstorm.

In using this code the number should be taken which describes the most important feature of the past weather not already reported by the two figures for "present weather" and "general character." This is usually the largest number of the scale appropriate to the occasion. In any case in which the two figures for "present weather and general character" describe fully the past weather also, then the appropriate single past weather figure should be reported in confirmation; *e.g.*, in the case of heavy continuous rain without fog or mist, the present weather figures would be 59 and the past weather figure would be 6.

CODE 6 (V).

Code for visibility.

Code No. for Telegm.	Letter.			
0	X or A	Objects not visible at	50	yards
1	B or C	,, ,,	200	,,
2	D	,, ,,	550	,,
3	E	,, ,,	1,100	,,
4	F	,, ,,	2,200	,,
5	G	,, ,,	4,400	,,
6	H	,, ,,	4½	miles
7	I	,, ,,	7½	,,
8	J or K	,, ,,	18½	,,
9	L	Objects visible above	18½	,,

The letters refer to objects at the following distance and a letter is used to indicate that the object with which it corresponds is visible. If object A is not visible the letter X is used.

Object.	Distance.
A	25 yards
B	50 ,,
C	100 ,,
D	200 ,,
E	550 ,,
F	1,100 ,,
G	2,200 ,,
H	4,400 ,,
I	4½ miles
J	7½ ,,
K	12½ ,,
L	18½ ,,

Fog or f scale (for entries of "weather").

Object Visible.	Entry in Register.	Description.
X	8f	Very dense fog.
A	7f	Dense fog.
B	6f	Thick fog.
C	5f	Rather thick fog.
D	4f	Fog.
E	3f	Moderate fog.
F	2m or 2z	Mist or thick haze.
G	2m or 2z	
H	1m or 2z	Slight mist or haze.
I	1m or 1z	
J, K, L	No entry of f or z.	

CODE 7 (H).

Code for Relative Humidity.

Code Figure.	Relative Humidity.
0	95—100 per cent.
9	90—94 ,,
8	80—89 ,,
7	70—79 ,,
6	60—69 ,,
5	50—59 ,,
4	40—49 ,,
3	30—39 ,,
2	20—29 ,,
1	10—19 ,,

The code figure can be obtained directly from the table readings of the dry bulb and wet bulb thermometers by means of table of H.O. 2a.

CODE 8 (A, a, c_1).

Code for form of cloud.

Code Number.	Form of cloud.
1	Ci.
2	Ci. St.
3	Ci. Cu.
4	A-Cu.
5	A. St.
6	St. Cu. (or Mammato-Cumulus).
7	Nb.
8	Cu. or Fr. Cu.
9	Cu. Nb.
0	St. or Fr. St.

CODE 9 (h).

Code for height of base of lowest cloud.

Code Number.	Height of base of cloud.	
0	0— 50 metres	0— 150 feet.
1	50— 100 ,,	150— 300 ,,
2	100— 200 ,,	300— 600 ,,
3	200— 300 ,,	600—1,000 ,,
4	300— 600 ,,	1,000—2,000 ,,
5	600—1,000 ,,	2,000—3,000 ,,
6	1,000—1,500 ,,	3,000—5,000 ,,
7	1,500—2,000 ,,	5,000—6,500 ,,
8	2,000—2,500 ,,	6,500—8,000 ,,
9	no low cloud	no low cloud.

CODE 10 (RR).

Code for amount of rainfall.

For amounts of 0·7 millimetres or more report the amount to the nearest whole millimetre, *e.g.*, 17·2 mm. reported as 17.

For amounts 0·1 to 0·6 mm. use the following code:—

91	0·1
92	0·2
93	0·3
94	0·4
95	0·5
96	0·6
97	Some rain but not measurable.
98	More than 90 millimetres.
99	Measurement impossible or unreliable.

CODE 11 (r).

Code for time of beginning of rainfall.

0	no rain.
1	0—1 hours before the time of observation.
2	1—2 ,, ,,
3	2—3 ,, ,,
4	3—4 ,, ,,
5	4—5 ,, ,,
6	5—6 ,, ,,
7	6—8 ,, ,,
8	8—10 ,, ,,
9	above 10
—	no observation.

CODE 12 (S).

Code for state of sea and character of swell.

0	no swell	Calm or slight sea.
1	moderate swell	
2	heavy swell	
3	no swell	Moderate sea.
4	moderate swell	
5	heavy swell	
6	rather rough sea.	
7	rough sea.	
8	very rough sea.	
9	mountainous sea.	

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) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (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.**

S.H. (Woolwich) *encloses a diagram of his set (Fig. 1) and asks (1) For a general criticism, especially regarding the optimum wavelength for the C Mark IV amplifier, and concerning a condenser which he proposes to put across the H.T. battery. (2) Whereabouts in the set could he instal a reaction coil for C.W. reception. (3) He has made a frame aerial with 30 turns of 30 S.W.G. in a 4' frame spaced 1 cm., but can get no signals. He asks why this is, and whether the frame is all right, and what wavelength it would tune to with a 0·001 mfd. condenser. (4) If his receiver should get signals from U.S.A., and also long-wave European stations if tuned to their wavelengths.*

(1) The set is all right, but the amplifier is a low-frequency amplifier and therefore works equally well on all wavelengths. The condenser X will help a little, but not much.

(2) For C.W. reception cut out the crystal and use H.F. terminals, best with a condenser and leak in series with L. Insert the reaction coil in series with the plate of the first valve and place 0·003 mfd. condenser across the transformer coil in this plate circuit to by-pass H.F. currents.

(3) The resistance is much too high. Use very much thicker wire, *e.g.*, 16 S.W.G., or, better, 7/24 S.W.G. Further, at least one stage of H.F amplification is necessary (or good condenser and leak rectification with reaction). A frame of the dimensions you specify would tune to about 700 ms. with a 0·001 mfd. condenser.

(4) Yes; U.S.A. signals will be difficult but should be possible with a good condenser and leak rectification.

W.H.D. (Elvet Moor).—(1) In common electrical practice the term rectified current is used for current consisting of unidirectional impulses only. In wireless practice, however, it is more commonly used (as in your reference to Bangay) for any change in the average current in a circuit caused by the impression of H.F. currents upon it. Rectification in a wireless sense may even be regarded as the transformation of radio-frequency currents into audio-frequency, though the term itself is very unfortunate when used in this connection.

(2) As you suggest, rectification is quite possible with a crystal not possessing unilateral conductivity if a potentiometer is used; the only essential point is that the characteristic must possess definite bends at one or more points.

(3) Yes, quite correct; *cf.*, Fig. 5, page 7 — a cycle of an A.C. corresponding to two half periods.

J.P.R. (Reigate) *encloses an elaborate circuit—a diagram of an "arc and spark receiving set." The diagram shows variable H.T. batteries and grid condensers without leaks. He asks (1) For a criticism of the circuit; if unsuitable, for a suggestion for another two-valve circuit. (2) If the enclosed circuit will receive C.W. and telephony. (3) If a crystal detector could be advantageously inserted in the spark circuit. (4) If V.24 valves could be used to*

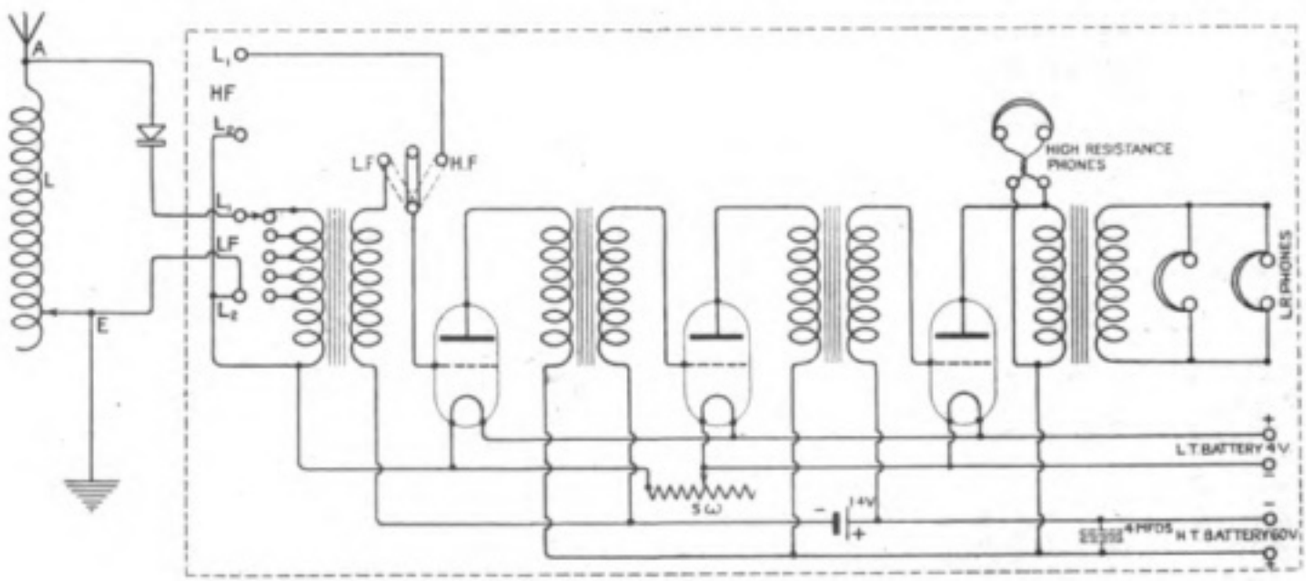


Fig. 1.

good purpose, and if any of the variable condensers could be dispensed with.

(1) The above-mentioned features of the circuit show that it has been designed for soft valves. With hard valves a variable H.T. battery is unnecessary and a grid leak essential. We think that the circuit is out of date and unnecessarily complicated. See reply to **J. T. (South Shields)** in the issue of January 8th, page 730, for a suitable two-valve receiver circuit. The closed circuit for your receiver would take the place of the frame aerial circuit.

(2) Yes, with soft valves; otherwise doubtful.

(3) We hardly think so.

(4) Only with grid leaks. As regards the condensers we advise you to start afresh rather than simplify the circuit.

C.E.B. (Branksome Park) *sends a sketch of a receiver (Fig. 2) and asks (1) For the inductance of the coupler windings, and to what range they will tune. (2) What is the cause of noise in the telephones. (3) If we can suggest a better circuit. (4) How to tune for telephony—*

(1) Coil A = 8″ × 5″ of No. 28 = 15,000 mhys.
Coil B = 7″ × 4½″ of No. 32 = 14,000 mhys.:

(2) You do not give enough information for us to say.

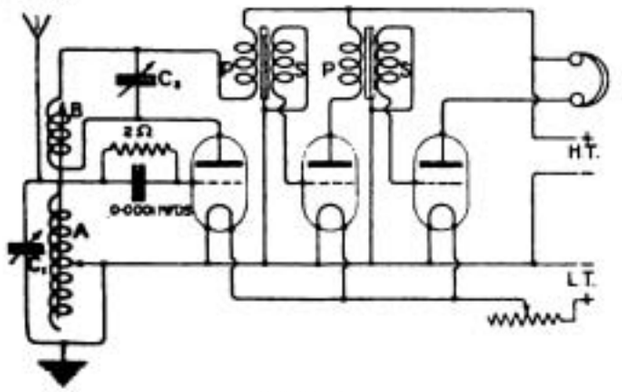


Fig. 2.

(3) The set is fairly good, but the condenser C is hardly necessary. The set will tune to about 4,000 ms. without it; if used it should not exceed ·0003 mfds. The condenser C_2 is not required across B, which is only functioning as a reaction coil. Put C_2 across the primary of the first iron-cored transformer to bye-pass H.F. currents. When using an auto-heterodyne arrangement of this type a grid condenser and leak is undesirable and is better omitted.

(4) Weaken the coupling till the set ceases to oscillate.

M.P. (Bussum) *asks for data for intervalve L.F. transformers for use with (a) a French valve, (b) a V.24 valve.*

In either case windings of ½ and 1½ oz. of No. 44 will be about right. The exact values are not very critical

M.G.S. (Edinburgh) (1) *Sends a sketch of an aerial* (Fig. 3) *for criticism.* (2) *Sends sketches of two suggested types of variable condenser (Fig 4a and b) for criticism.* (3) *Asks how to eliminate the commutator ripple from a D.C. supply used for H.T. purposes.* (4) *Asks if a Mark 3 receiver L.F. amplification would be any use for the Trans-atlantic tests.*

(1) The aerial is very fair, but use much longer spreaders than 2′ 6″. The results should be rather better with the instruments at the other end.

(2) The tubular type should be fairly satisfactory if carefully used, but would not be capable of very

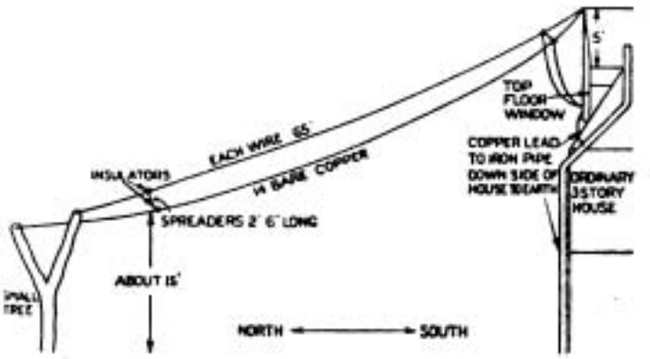


Fig. 3.

accurate calibration. We do not like the disc type, partly because the capacity would be very small until the distance between the plates was very small, and also because in the latter case the variations of capacity on screwing down would be very irregular owing to the inequalities in the screw bearing, etc.

(3) Earth each main through a large and reliable

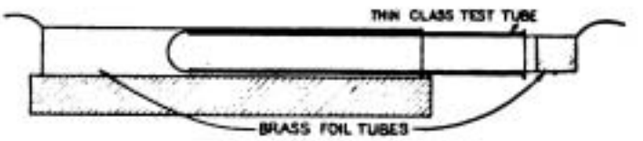


Fig. 4. (a.)

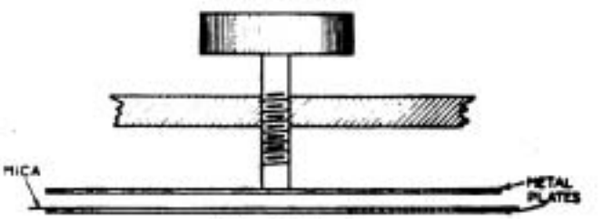


Fig. 4. (b.)

condenser. Also put a big condenser across the mains.

(4) No, you are unlikely to get results without H.F. amplification.

C.W.H. (Sydenham).—(1) No.

(2) Something of the kind will appear shortly.

(3) Possibly FL (Paris), but cannot identify from data given.

(4) Chelmsford is not giving telephony programmes at present, as the station is engaged on other work for an indefinite period.

G.D.A. (Hungerford) *asks (1) Could the discharge from a special induction coil be adequately rectified and levelled to supply a current of a few milliamps at about 400 volts for wireless telephony.* (2) *Would*

a small 8-pole permanent field magnet, continuous current generator wound with very fine wire, coupled to a motor worked from filament batteries, be sufficiently stable for telephony. (3) For any information as to the generator used in the R.A.F. W.T. telephone sets.

(1) An arrangement of this type has been tried and is used by De Forest for telephony. While of possible utility for telegraphy, it is very difficult to arrange for telephony, owing to the irregularity of the coil discharges. A transformer of A.C. with a rectifying valve is quite a workable solution.

(2) There is no theoretical objection to this, but the practical construction would be very difficult, and it would not be easy to get enough power output at the required voltage.

(3) Various generators have been used: D.C. machines of fairly normal construction for voltages, we believe, up to 1,000. We cannot identify the particular sets you are thinking of from the information you submit.

A.W.F. (Stone) *has three transformers marked as follows:* (1) *Earth to valve with 8 terminals marked* OP_2 OP_1 *OS OPS* OP_3 *IP IS* OP_4. (2) *Intervalve with 4 terminals marked OS OP IS IP.* (3) *Valve to telephones with 4 terminals marked OS OP IS IP.*

These transformers are for a low-frequency amplifier. P and S signify primary and secondary, I and O the beginning and end of the windings respectively, the first transformer having a variable primary. Connect up as for an ordinary double note magnifier on these lines.

A.C.B. (Putney).—(1) *Can only get signals in his single circuit crystal receiver when the A.T.C. is shunted. He asks why this is.* (2) *Asks if it would be advantageous to interspace the plates with paraffined paper and bring them closer.* (3) *Gives a diagram of a single valve receiving circuit, and asks if it would be satisfactory.* (4) *Asks if on application he can get his ordinary license extended so as to allow him to use valves.*

(1) Your A.T.C. has far too small a capacity.

(2) Certainly, bring them closer. Paraffined paper is a doubtful expedient, but you might try it. Alternatively increase the number and size of plates or make an additional block condenser to bring the capacity value up to 0·01 mfds.

(3) A very tricky circuit. With extremely loose coupling very good results might be obtained. Your condenser will do for the closed circuit but the A.T.C. should be 0·01 mfds. The circuit would be unlikely to be sanctioned by G.P.O. as the aerial would be very likely to radiate.

(4) Yes.

ACTONIAN (Acton).—Your best course of action depends on whether you are more interested in results or in the means by which they are obtained. We would advise you, in any case, to get some experience of your subject before spending a lot of money on elaborate sets. Why not, in the first instance, join a wireless club? With regard to your queries:—

(1) Amateur receiving sets can be installed to operate with certainty at moderate wavelengths (up to about 8,000 ms.). Owing to P.M.G. limitations as to aerial, longer wavelengths become increasingly difficult to receive. You should bear in mind that "ready-made" receivers are apt to go wrong, and the faults are difficult for a beginner to locate.

(2) Yes, at the cost of additional complexity.

(3) We believe you will find the apparatus offered by each of our advertisers trustworthy. It would be difficult, and as you will appreciate, undesirable for us to advise one maker's goods in preference to any other's.

(4) Bangay is the most suitable book that we know. We think you will not go far in W.T. without a mastery of first principles.

GRID (Herts) *gives a diagram of a circuit on the lines of the April 17th "Crystal receiver with valve amplifier," but showing a grid condenser and leak. He asks* (1) *For criticism of the circuit, and corrections in the coil windings if necessary.* (2) *What valve he should use.* (3) *Could a glass tube* ($6\frac{1}{2}'' \times 2'' \times \frac{1}{4}''$) *be used as the dielectric of one of the variable condensers by covering the outside with foil and the inside with metal tube, giving a total overlap when closed of the same length as the glass.* (4) *What would be the approximate wavelength range of this circuit.*

(1) The grid condenser and leak are unnecessary, as you are employing other means of rectification. The circuit is otherwise correct, except for values (see below).

(2) You have a very wide field of choice. Probably R type would be suitable, but only 4 volts are required on the filament. You should arrange your filament battery accordingly.

(3) The capacity would be far too small for the values you specify.

(4) Up to about 2,500 ms. (aerial). Your A.T.C. is too small; it should be 0·01 mfds. Your reactance coil is too large. Wind with No. 26 S.W.G. and it will then tune to the same wavelength as the aerial.

J.K.W. (Liverpool).—(1)We cannot give you the maximum wavelength when you only state that your inductance "tunes alone to 600 ms." You must furnish its inductance value, or particulars to enable us to calculate it.

(2) This is very difficult to predict. With a 100ft. aerial and a crystal set operated skilfully, you might expect, under average conditions (*a*) to hear a ship at night at a range of 100 miles. (*b*) To hear such stations as Cleethorpes, Poldhu, Cullercoats, subject to tuning being satisfactory.

(3) For the best results with crystal use a two-circuit receiver. At any rate, your condenser is far too large. You would do well to employ it in series with your A.T.I. and wind some extra coils to bring the latter up to higher inductance.

(4) A rotary make-and-break is the usual type of interrupter for C.W. reception. It could go in the earth lead of the receiver quite satisfactorily.

J.C.H. (Fairhaven).—(1) Your aerial is somewhat screened by the house, but should enable you to receive large European stations satisfactorily with a good single valve circuit.

(2) Inductance is about 42,000 mhys. The wavelength depends on the circuit.

(3) The diagram is fairly sound, but connect one end of your A.T.I. to earth, one slider to the aerial and the other slider to the grid condenser. We note that you use dry batteries and a Leclanche

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SOME NOTES ON WIRELESS RECEPTION

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

WHEN endeavouring to pick up wireless signals we are most usually concerned with obtaining the loudest possible sounds in our telephones with the simplest possible apparatus. Unfortunately, such methods are not entirely without their attendant disadvantages, and it is the purpose of this note to indicate some ways in which these can be avoided, at least in part.

Of course, if merely a simple receiver with crystal detector is employed, there are no particular troubles to be contended with, but difficulties are apt to arise when valve detectors are used. I am referring in particular to the radiation that almost always takes place when receiving C.W. signals by the heterodyne method, or one of its modifications.

When a single crystal detector is used in the well-known manner, the crystal acts in the main as a rectifier of the high-frequency potential differences applied to it from the tuner circuits. Since such a detector is only available without further addition for receiving "spark" signals, there is no question of the necessity of local oscillations and consequent radiation. Of course, when all factors are considered there must always be *some* radiation from a receiving aerial when signals are being heard, since the mere fact that sounds are perceived in the telephone means that there must necessarily be small high-frequency currents flowing in the aerial wires—these high frequency currents being induced in the aerial by the action of the passing aether wave. The mere presence of these currents, however, in the system of elevated aerial wires—whether or not they are being utilised by the detector—means that aether waves are being *established* by these currents and radiated from the aerial, just as such waves would be established by larger high-frequency currents set up in the same aerial, when it is used for ordinary transmission purposes. These currents, however, are very small, and ordinarily their radiation effects are not appreciable, although it is often possible to detect the presence of the radiation of waves from them, given suitable conditions. This phenomena is usually termed "re-radiation" from the receiving aerial.

The case is somewhat different when we are concerned with the reception of C.W. signals, as unless some form of "tikker" or "chopper" is employed at the receiver or transmitter, it is usually necessary to make use of the heterodyne principle in one or other of its forms. As is well known, the main principle of the heterodyne consists in the combination of a locally generated high-frequency oscillation with the incoming high frequency current, the frequencies of the two currents being slightly different so that beats are set up by their interaction. In the original form of heterodyne the local oscillations were set up by means of a separate source of high-frequency currents, included in a circuit entirely distinct from the receiver itself, but feebly coupled thereto. It was found long ago that this arrangement could be simplified when three-electrode valves

were used for detector, by combining together into the one valve the functions, both of detector and local oscillation generator. This arrangement is usually referred to as "Autodyne" reception (as distinct from the above-mentioned separate heterodyne—or simply "heterodyne"), since the oscillations are set up in the receiver itself. One of the simplest circuits for autodyne reception consists merely of a tuning coil joined between the aerial and earth, with sometimes a variable condenser in parallel for long wave reception, and the grid and filament terminals of a detecting valve joined across the same coil—a grid condenser and leak, or a grid potentiometer being interposed to ensure adequate operation of the valve as a detector. In the anode or plate circuit of the valve, a reaction coil is included, which is magnetically coupled to the aerial loading coil so as to provide the necessary retroaction between the grid and anode circuits to enable the valve to set up oscillations so that beats may be formed with the incoming oscillations.

It is obvious from the most cursory inspection of this circuit that these local oscillations are traversing the whole of the actual receiving aerial circuit, and therefore that they will cause aether waves to be radiated. This radiation will be very much stronger than the "re-radiation" referred to above, and will take place the whole time that the valve is in operation quite apart from whether or not any signals are being received. All other receiving stations in the vicinity of the receiver that is radiating in this manner will be able to hear this continuous radiation, and if attempting to work on or near the same wavelength will experience interference from it. Apart altogether from any question as to whether the use of such apparatus is permissible under the amateur licensing conditions in force in this country, every user of it should bear in mind the work that others may be carrying out, and therefore avoid all such possible causes of interference.

By using an inductive coupling between the aerial circuit and the above arrangement, some improvement is possible as regards reducing the unwanted radiation; while still better results are possible from the use of a separate heterodyne inductively coupled *not to the aerial circuit* but to the secondary circuit of the receiving tuner as shown in Fig. 1. Unfortunately, such an arrangement involves the use of more apparatus than the simple autodyne, while it is also more difficult to adjust until one becomes accustomed to

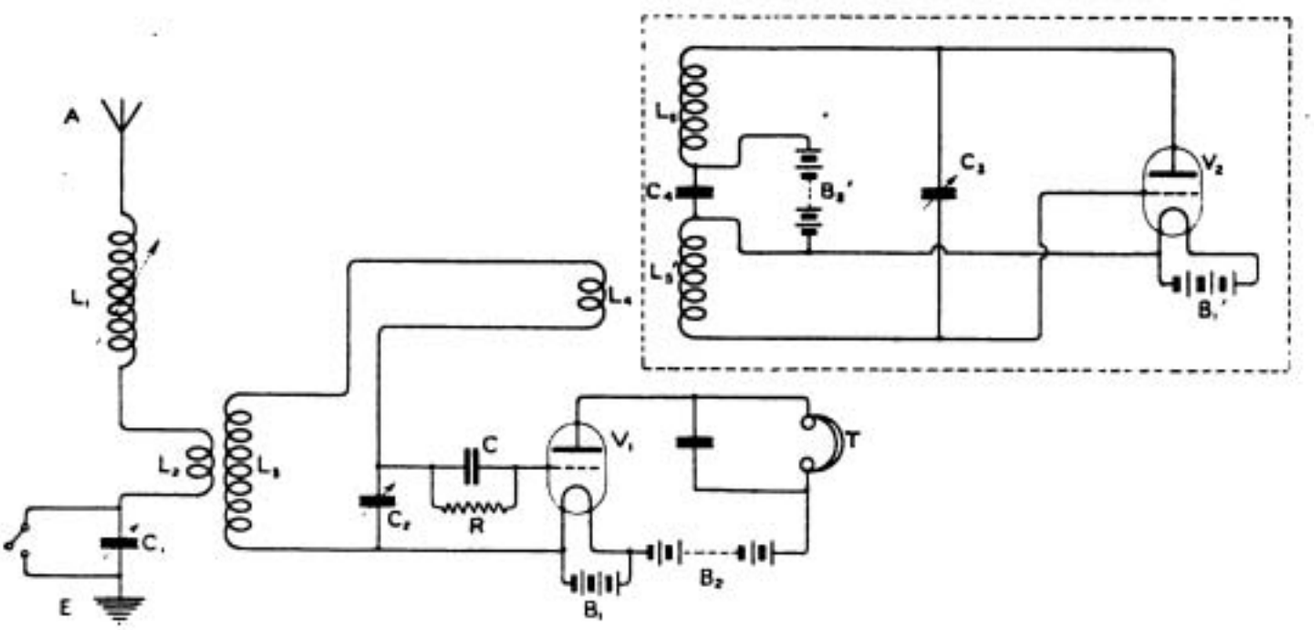

Fig. 1.

the best ways of effecting the tuning operations. In Fig. 1, L_1 represents the variable tuning inductance for loading up the aerial to the required wavelength, and C_1 the aerial series tuning condenser, which may be cut out of circuit if not required, or alternatively connected in parallel with the aerial circuit. The coupling between the aerial circuit and the closed tuned secondary circuit L_3 L_4 C_2, is shown as provided by the coupling coil L_2, but if preferred this may be omitted and the coupling provided by placing the coils L_1 and L_3 in inductive relation to one another, as is generally done in most "loose-couplers." If, however, the circuit is required for long wave reception, the large quantity of wire necessary on both coils L_1 and L_3 often renders difficult a proper adjustment of the coupling between them unless they are placed several feet apart—in which case adjustments may generally be effected most easily by the use of the additional coupling coil L_2, consisting of a few turns of wire wound on a suitable former, and placed fairly close to the coil L_3. V_1, T, C, R, B_1, B_2 constitute an ordinary form of detecting valve circuit with grid condenser and leak. In series with the secondary circuit, L_3 C_2 is placed a second coupling coil L_4, containing a few turns of wire only, and provided with suitable leads for enabling it to be brought some little distance from the remainder of the receiving apparatus, and placed in inductive relation to the separate heretodyne unit, which is indicated inside the dotted lines.

The heterodyne unit consists simply of an oscillating valve circuit, preferably provided with its own filament and high-tension batteries. The circuit shown is a simple one to use for the purposes of this heterodyne unit, and consists of a coil L_5, the winding of which is divided in or near the centre into two parts L_5 L_5', with the blocking condenser C_4 of the order of 0·01 mfd., connected between them and across the H.T. battery B_2'. Tuning is effected by the variable condenser C_3, joined in parallel with the whole coil L_5 L_5'.

The object of providing the separate coupling coil L_4 in the secondary circuit is primarily to enable it, and the heterodyne, to be separated from the remainder of the receiver, so as to prevent accidental coupling of the heterodyne to the aerial circuit, and consequent increase of the undesirable radiation.

Unfortunately, not even this arrangement will entirely cure the trouble, as there will still be *some* heterodyne radiation from the aerial since there is a small coupling, through the receiver windings, between the aerial and the oscillating valve. Unfortunately, too, the circuit involves much more trouble in adjustments and tuning up, and hence is not nearly so easy to operate as a simple autodyne. As, however, it is a step in the right direction of reducing the unwanted radiation, its use is recommended. A little practice in adjustment will render its use much easier. Various other circuits have been suggested by different workers to overcome this radiation, but the majority are in principle similar to the one just described.

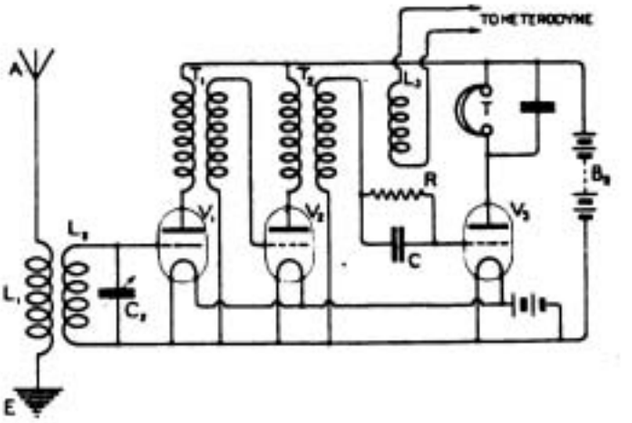

Fig. 2.

In order to secure a really effective elimination of the heterodyne radiation when receiving, it is necessary to remove the point of application of the heterodyne oscillations further from the aerial. This can, to some extent, be accomplished by coupling the heterodyne oscillator to the *output*, or plate circuit, of the receiving valve shown in Fig. 1, instead of to the secondary circuit L_3 L_4 C_2. With a single detecting valve, however, this method is scarcely practicable. It is workable,

however, when two or more valves are used for reception, the first one or two being employed exclusively for high-frequency amplification, and the heterodyne oscillator coupled to the series immediately before the detecting valve. In Fig. 2, the heterodyne is shown as coupled on to the grid circuit of the detecting valve V_3, which is the third valve in the series, the first two of which, V_1 and V_2, are employed for high frequency amplification. Similar arrangements for use with resistance-capacity coupled, or other arrangements of multi-stage amplifiers, will be obvious from this diagram.

It is suggested that the use of some such circuit as the one here suggested would be found efficacious in reducing the heterodyne radiation almost to zero, provided that accidental couplings between the heterodyne and the aerial circuits are avoided; and that by the use of some such circuit we shall be able to receive all the signals we wish to without in any way interfering with the work of others in our vicinity.

It may, perhaps, be thought that the seriousness of the effects of this heterodyne radiation have been overemphasised in the above, but this view may be modified when it is recollected that many tests have shown that the radiation from a *single valve* used as a direct coupled autodyne receiver can cause serious interference to other stations at distances of over 5 miles from the receiving station where the oscillating valve is in use.

TELEPHONY AND ITS APPLICATION TO WIRELESS: A SIMPLE EXPLANATION

By J. F. Herd, A.M.I.Radio E.

(*Continued from page* 5 *of last issue.*)

The essential principles of radio telephonic communication, as at present generally practised, are shown in Fig. 10.

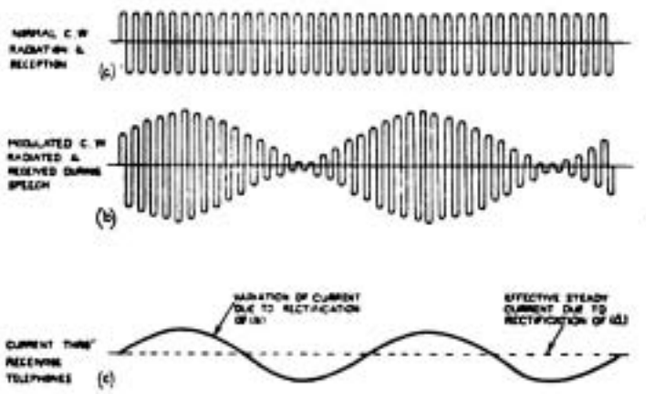

Fig. 10.

The arrangement consists of an ordinary C.W. transmitter, which, when no speech is occurring is simply radiating its normal C.W., as in Fig. 10 (*a*). A tuned and *non-oscillating* receiver will be affected in the same manner, so that Fig. 10 (*a*) also represents, to a different scale, of course, the result in the receiving aerial. Rectification of these continuous and unheterodyned oscillations (by either valve or crystal), will effectively cause in the receiving telephones a steady current as shown in Fig. 10 (*c*).

Speaking into the microphone at the transmitting station must now cause the amplitude of the radiated C.W. to be varied, this *variation* of amplitude (or crest value of each oscillation) *being in accordance with the speech.* This condition is shown in Fig. 10 (*b*), which will also show the nature of the oscillations which are now set up in a tuned receiving aerial.

Rectification of these vocally modulated oscillations will now cause the current through the telephones to be varied, as in the curve of Fig. 10(*c*). This low frequency or audio frequency will follow the variation of the amplitude of the received oscillations, and will therefore be in accordance with speech.

This vocal modulation of the radiated C.W is secured by several different methods. With the first C.W. transmitters, using arcs, the usual practice was to insert the microphone directly in the aerial, so that variation of microphone resistance automatically caused variation of radiated amplitude. With powerful arc transmitters the ordinary types of microphone, already described, were quite unsuitable, and many cumbrous devices were produced to deal with the heavy currents involved. The development of the valve transmitter has now rendered it possible to effect the modulation in low voltage and low current circuits, so that ordinary microphones can be employed, and the arrangement of inserting the microphone in the aerial circuit is now employed in only the lowest powered sets.

A simple C.W. valve transmitter is shown in Fig. 11.

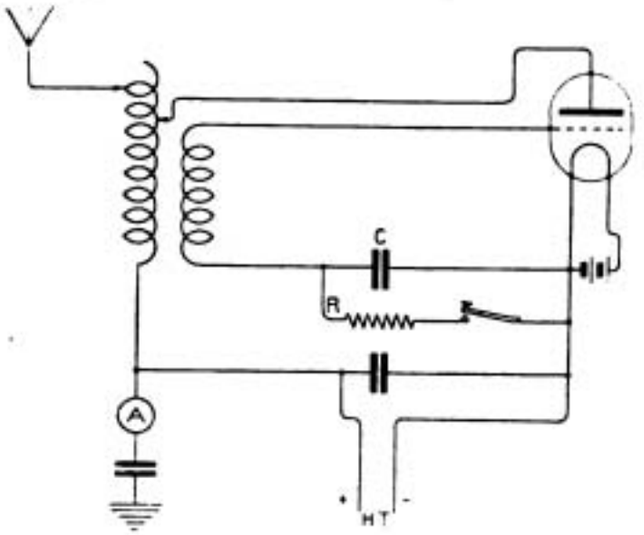

Fig. 11.
Simple C.W. Valve Transmitter.

It consists of the ordinary reaction circuits, with either a variable or a suitable fixed coupling. When the key is open the grid, wholly insulated from the filament by he condenser C, acquires a negative potential of sufficient value entirely to stop the anode current. Closing the key shunts C by a suitable resistance R (dependent upon the valve and the voltages in use), thus allowing the mean grid potential to assume some less negative value so that a current is started in the anode circuit and the usual reactions occur, setting up continuous oscillations in the aerial indicated on the hot wire ammeter A.

A single-valve transmitter of this type can be very easily modified for telephonic transmission, as shown in Fig. 12.

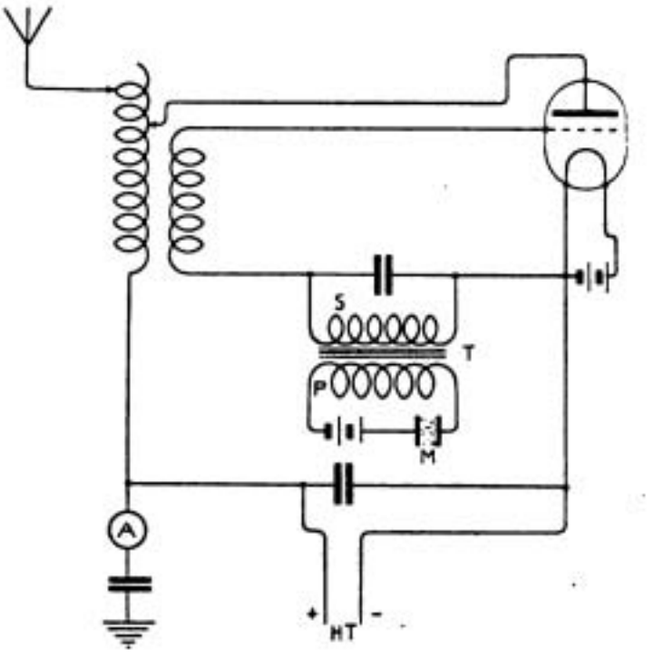

Fig. 12.
Simple One-Valve Telephony Transmitter.

In this case the high resistance secondary S, of the transformer T, replaces the resistance R of Fig. 11. Fig. 12 thus amounts to Fig. 11, with the key permanently closed, while, of course, an operating key can quite well be inserted, if desired, for Morse, being closed for telephony.

The aerial of Fig. 12 thus continuously radiates C.W., as in Fig. 10 (*a*).

Speaking into the microphone M, Fig. 12, varies the current through the primary P, of the transformer T. This causes vocal frequency voltages to be induced in S, and these are impressed upon the grid of the valve, through which they vary the amplitude of the anode current and of the aerial oscillations, thus fulfilling the conditions of Fig. 10 (*b*).

This method of modulation is only suitable for short ranges, but, as it employs only one valve, it is suitable for amateurs as an initial

and not too expensive venture in radio telephony.

Fig. 13 illustrates an arrangement of modulation which has been used with great success both in this country and America. Developed originally in this country for aircraft purposes (as described by Major C. E. Prince in Journal I E.E., Vol. 58, page 377), it has since been used extensively, both for aircraft and ground station purposes.

This system depends on the fact that if a steady anode voltage be applied to a C.W. transmitter, continuous waves of uniform amplitude will be emitted (as in Fig. 10 (*a*)). Any change that occurs in this anode voltage will immediately be reflected in a change of the radiated amplitude, and if the voltage be caused to vary rhythmetically in accordance with speech, the amplitude of radiation will fluctuate in like manner, as in Fig. 10 (*b*).

In Fig. 13, the left-hand part is simply an ordinary C.W. transmitter, with the key permanently closed, and a highly inductive iron-cored choke inserted in the H.T.

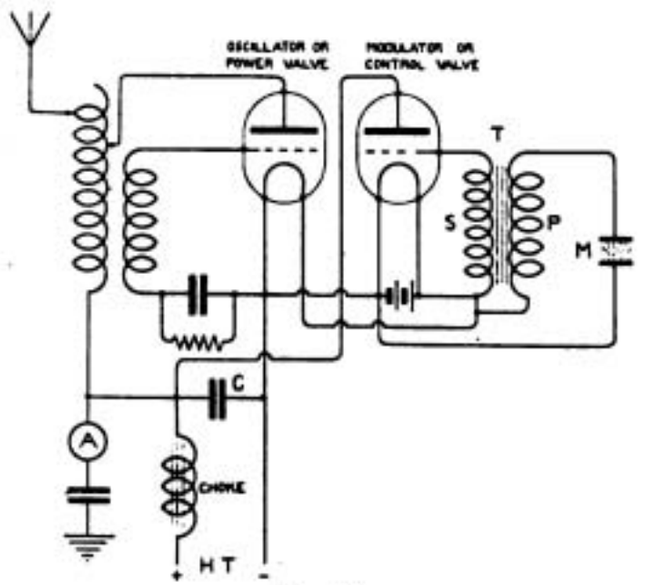

Fig. 13.

Telephony Transmitter using separate Oscillator and Control Valves.

positive lead. The associated valve is usually known as the power valve or oscillator.

The microphone is joined, through its transformer (for the usual reason), to the grid circuit of another valve known as the control valve or modulator. Speaking into the microphone causes e.m.f.'s varying at vocal frequency, to be impressed upon this grid circuit. This naturally tends to cause corresponding fluctuations of anode current in the power valve. These fluctuations are, however, opposed by the large inductance of the choke, and set up across the choke a varying P.D. This varying P.D. of the choke is systematically added to or subtracted from the normal H.T. voltage, already active in the circuit. As a result, the P.D. between the plates of the reservoir condenser C, varies at vocal frequency, and causes the necessary low frequency variations in anode current, and therefore, also, of the radiated C.W.

For small or moderately powered sets, this arrangement gives very good modulation, and has many advantages, one being that it can be applied very easily in the form of a separate unit or attachment to an existing C.W. transmitter. The ordinary filament battery is used in some cases, as shown in Fig. 13, to excite the microphone circuit. When used with larger valves employing more than say 6 volts for filament incandescence, a separate microphone battery is usually employed. A further refinement of the method consists in inserting a low frequency amplifying valve between the actual valve to which the microphone is joined and the oscillating system. This causes wider fluctuations of H.T. voltage in the oscillator circuit, and therefore more effective modulation of the C.W., with consequent increase of speech range.

If it be desired to hear one's own speech in transmitting (usually known as "Side Tone" the aerial circuit can be re-arranged as shown in Fig. 14, and a pair of headgear telephones joined across the earth-lead condenser. This re-arrangement of the aerial system is necessary to maintain the insulation of the H.T. positive lead from the earth, as this insulation would, of course, be nullified by the telephones.

With this arrangement excellent indications are afforded of the working of the set. On switching on the H.T. a steady reading should

immediately show in the hot wire ammeter. This indicates the normal C.W. radiation, *i.e.*, that the oscillator valve and associated circuits are working correctly. Speaking into the microphone should now cause one's own voice to be reproduced in the telephones, indicating that the control valve and its circuits are functioning.

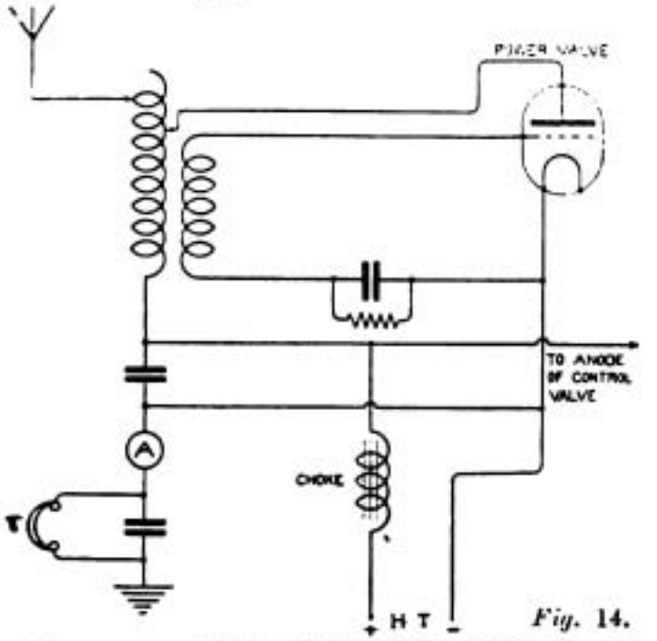

Fig. 14.

***Rearrangement** of Aerial Circuit for "Side Tone."*

For the reception of wireless telephony any ordinary spark receiver is suitable. This, of course, is due to the fact that although the initial generation is C.W., the modulation causes the actual radiation during speech to be broken up at voice frequency, so that a heterodyning receiver is not necessary. If, indeed, a receiver with reaction coupling be used, the reaction *must* be short of causing the aerial permanently to oscillate, or the received speech is greatly distorted. It is a common failing with inexperienced operators, particularly in receiving telephony for the first time, to push the reaction too far.

With wireless telephony, indeed, the only distortion that occurs is due to the instruments and not to the essential medium of transmission as in line practice. This immediately emphasises the vast possibilities of wireless telephony, and so great is this advantage that one is certainly justified in saying that if speech is ever to be transmitted over very great distances it will certainly be by wireless and not by wire or cable.

The transmission systems described, suffer from the disadvantage that they necessarily involve switching, to change over from "send" to "receive." Duplex wireless telephony (by which speech both ways can occur simultaneously, or the listener can immediately "chip in," as in an ordinary telephone), is a particularly difficult problem. This is due to the difficulty experienced in shielding the receiver, so that it is not maintained in permanent oscillation by the much more powerful transmitter oscillations. This, as already explained, would immediately distort speech.

Several methods of effecting this have already been described, but at the moment these can hardly be said to be commercially practicable. Certainly none of them are in daily use in this country, and on the air routes, civil and military, where telephony is in daily use, the ordinary switching arrangements still prevail.

The problem, however, is of fascinating interest, and is one of the more important fields for research by radio workers.

NOTES

Wireless Concerts.

As a development of the Hague Concerts, a scheme has now been inaugurated under which Mr. Herman Darewski, the composer, will give the Nederlandsche Radio Industrie the opportunity of transmitting by wireless from their station at the Hague his latest musical successes. The concerts are expected to reach a radius of 500 miles from the Hague. Transmissions take place on Sundays from 2 p.m. to 5 p.m., G.M.T., and Thursdays from 8 p.m. to 11 p.m., G.M.T., on a wavelength of 1,100 metres.

Wireless and the Boat Race.

In connection with the Oxford and Cambridge Boat Race of March 30th, wireless telegraphy was used on a launch which followed the crews, keeping in touch with a fixed wireless station installed near Barnes Bridge. The station was able to keep the spectators in the neighbourhood well informed of the progress of the race by relaying the wireless reports by megaphone.

SECOND ANNUAL CONFERENCE OF WIRELESS SOCIETIES.

The Second Annual Conference of Wireless Societies affiliated with the Wireless Society of London was held at the Royal Society of Arts, John Street, W.C.2, on March 1st, 1921.

Major J. Erskine Murray, D.Sc., F.R.S.E., President of the Wireless Society of London took the chair at 3 p.m.

The minutes of last year's Conference were read and confirmed, and the President made a few announcements with regard to the arrangements for the afternoon and evening. (See p. 20 of our last issue.)

The agenda before the meeting was as follows :—

(1) That it be suggested to the Postmaster-General that he makes use of the Societies in policing the ether in transmission and also heterodyne radiation in receiving.

(2) That a list of all (amateur) holders of transmitting licences should be issued by him to the President or Chairman of each district Society with the object that these licences should be kept under confidential supervision by the Wireless Society of London through their affiliated Societies.

(3) That application should be made to the Postmaster-General for (*a*) Relaxation of the strict qualifications at present demanded of holders of transmitting licences. (*b*) Increase of the present limits of length of aerials, and (*c*) Reduction of fees for transmission and reception.

(4) Inter-Society Relay Organisation.

(5) Possibility of regular telephone transmission from a high-power station to include all matters of interest to amateurs and to be on different definite wavelengths for calibration purposes.

(6) That one of the conditions on which transmitting or receiving licences are granted should be that the holder must be a member of a recognised wireless society.

(7) That the Conference be held at different provincial centres annually.

The above matters were put down for general discussion at the request of one or more of the affiliated societies and did not necessarily represent the views of the Committee of the Wireless Society of London.

Opening the Conference, **the President** said : We are very glad to see you all here to-day, because we think our deliberations will lend very much to the general progress and amenity of our science and our own organisations. Certain of the societies affiliated have not been able to send delegates. Many of them would have to come a long way and railway fares are a serious matter nowadays. The Derby Wireless Society, the Edinburgh Wireless Society, the Glasgow Wireless Society and the Sussex Research Society all send good wishes to the Conference, and regret that they are unable to send delegates. The Wireless Society of Hull sends a letter, in which the Secretary says :

I very much regret that it has been found impossible for this Society to be represented at the forthcoming Conference on March 1st, which I trust will be successful from all points of view. I am, however, asked to send the following resolution, which was passed at a meeting of members held on February 24th : "The members of this Society are of the opinion that the present regulations of the Postmaster-General for transmission licences, namely, with regard to the speed of sending and receiving required, and as to the object of being strictly for research work, should be modified to enable more members to obtain the necessary licences for transmission." Please be good enough to read this letter at the Conference.

There is also a letter from the Preston Scientific Society, Wireless Section, as follows :

In reply to yours of the 21st inst., I am sorry to say that we shall not be able to send any delegates for the forthcoming Conference this year, but hope to succeed in doing so for the next one. With regard to the matter for discussion, I wish to say, on behalf of the Committee, that all affiliated societies should be permitted by the Postmaster-General to instal and use a transmitting installation for the benefit of amateurs and members who are qualified for research in wireless telegraphy. The power need not exceed 10 watts, as specified by the Post Office for private amateur installations and club use. I have also to tender my thanks on behalf of all members for all correspondence, etc., relating to radio movements, of which you have kindly notified us. Wishing you every success for the future.

These are two somewhat different propositions, though they both bear on transmitting licences. The opinion of the Hull Society is that the regulations should be somewhat relaxed, and the suggestion from the Preston Scientific Society is that each society should have a transmitting licence for the use of all its members, presumably in rotation, and according to regulations.

A number of matters have been put down for general discussion at the request of one or more of the affiliated societies, and do not necessarily represent the views of the Committee of the Wireless Society of London. These things are as they have been received from the various affiliated societies, and I shall ask any member of the Society which has made the suggestion, who may be present, to say something with regard to it. The first is brought forward by the Peckham Wireless Experimental Association, and is :

(1) That it be suggested to the Postmaster-General that he makes use of the Societies in policing the ether in transmission, and also heterodyne radiation in receiving.

Is any member of the Peckham Society here ?

Mr. Knight (Wireless and Experimental

Association): That wording is not quite ours, and what we said is this: it is to keep our own doorsteps clean. It is based on the following two items: There was an amateur who held a receiving licence. He constructed a 4-inch spark coil and proceeded to signal to his chum, only a quarter of a mile away, using a plain aerial. The chum went round and fetched the coil, and transmitted the answer from his end. Circumstances made it possible for our Secretary to exact a promise that this experiment would not be repeated, and we have reason to think that it has not, but there are other enthusiastic amateurs, and we shall enjoy a more peaceful possession of the ether if we deal faithfully with them by roping them into an association where they will learn better.

Mr. C. F. Phillips (Wireless Society of London): I think it is absolutely necessary that some steps should be taken to draw the attention of these amateurs, who use valves for reception, to the necessity for keeping them from oscillation during reception of such well-known transmissions as the Dutch Concert and others. On Sunday afternoon last I was listening in, with an amplifier, to the Dutch Concert, and I counted interruptions from, I suppose, 10 or 12 distinct different valves, some of them howling for very prolonged periods. One I traced. It was about four miles away, and the gentleman who was endeavouring to use it did not know that in order to receive you should keep the valve from oscillating, so he kept it steadily oscillating for some eight or nine minutes.

The President: The second item is really closely connected with the first, and I think I might read it and take the two together. I think there are several societies which have sent in much the same suggestion. It is:

(2) That a list of all (amateur) holders of transmitting licences should be issued by the Postmaster-General to the President or Chairman of each district society, with the object that these licences should be kept under confidential supervision by the Wireless Society of London through the affiliated societies.

That is that a list of all holders of transmitting licences should be kept under confidential supervision by the Wireless Society of London through the affiliated societies. That is practically what it amounts to. It is again a case of the societies assisting the Postmaster-General, if possible, in keeping the ether a bit quiet, for their own benefit firstly, but no doubt it will also be for his benefit and the benefit of the Services as well. Will someone who sent up this suggestion perhaps speak to it? The Greenwich Wireless Society is among those who proposed it.

Mr. W. Burnham (Wireless Society of Greenwich): On behalf of Greenwich, their wording was also "receiving licences" as well as "transmitting licences," so that every recognised wireless society assuming that the Postmaster-General will recognise the affiliated wireless societies—should know of all people who were operating wireless, either transmitting or receiving, in its district. With regard to receiving, we have already mentioned why it is necessary to keep people, who are receiving by valves, under some sort of control. With regard to transmitting, most people who have transmitting licences have had to go through a stiff examination, and they know what is what, but, on the other hand, they are inclined to be, perhaps, somewhat selfish. For instance, talking about this famous Dutch Concert, last Sunday afternoon there was an amateur transmitting, either using tonic train or C.W., on and off during the whole time of the Dutch Concert, on approximately the same wavelength. That is a case of selfishness, because most amateurs throughout the country are straining their ears to hear the elusive Dutchmen, and if any official of the Wireless Society had been listening he might have been able to warn this man to keep clear. Then again, the Greenwich Wireless Society is closely connected with the Royal Observatory, and the Astronomer Royal is very keen about local interference, both as regards transmission and the use of valves for receiving, because on their big aerial they pick up a great deal of probably unnecessary interference, and they use the wireless reception there for very intricate calculations, and do not want to be interfered with more than can possibly be helped.

The President: There is a third suggestion which also bears on a similar subject, which I will read:—

(3) That application should be made to the Postmaster General for (*a*) relaxation of the strict qualifications at present demanded of holders of transmitting licences, (*b*) increase of the present limits of length of aerials, and (*c*) reduction of fees for transmission and reception.

Shall we take (*a*) first? Will someone who desires the relaxation there proposed say something on the subject.

Mr. Heather (Wireless and Experimental Association): Speaking for the Peckham Society, I think the qualifications might be modified to a certain extent in the way of Morse and technical. You might have a man on research work intending to do real research work, but apparently because he cannot do the speed of 12 words a minute, however clever he may be technically, the Postmaster-General says that he will not grant him a licence until he can do a bit of key-punching and prove he can do 12 words a minute.

Mr. M. Child (Wireless Society of London): With reference to the remarks of the last speaker, I do not think the Postmaster-General makes it compulsory for the experimenter to do that speed. He can employ a qualified operator to carry out the necessary Morse work, and from experiences I have had, I am not at all in favour of reducing the standard of efficiency for transmitting licences as regards Morse work. I think it is very important that the 12 words a minute standard should be kept up.

Mr. W. Burnham (Wireless Society of Greenwich): I agree entirely with Mr. Child, because I think it is absolutely necessary that Morse should be thoroughly known and the qualifications understood in order to prevent interference.

Mr. Knight (Wireless and Experimental Asso-

ciation): I suggest in that case that the man who is the best key puncher might be the very weakest reader, so that he would stand a better chance of getting his licence granted than a fully qualified man.

Mr. L. F. Fogarty (Wireless Society of London): It seems to me that it boils down to this, that if a scientific man wants to make investigations of a certain phenomenon, is he, in order to indulge his desires in that direction, to upset the whole of the rest of the world. If he is not entitled to do that, then he must get somebody to do the Morse for him, or else he must qualify on the Morse side so that he does not make himself a nuisance to everybody else.

Mr. W. E. Dingle (Brighton Radio Club): With regard to the relaxation of the qualifications, I do not think myself that it is impossible for any body to attain a speed of 12 words a minute. Any man can do that in about a month, and if he joins a society he will soon accomplish that result. I do not think anybody can carry out any research work in wireless unless he has a certain amount of qualification for the key and is able to read.

Mr. Boyd (Sheffield and District Wireless Society): I would like to speak on behalf of those who are interested in wireless telephony. We have in our Society members who want to experiment purely on telephony, and apparently their Morse is bad. They do not want to be good at transmitting or receiving Morse, and it seems rather hard lines that they should be denied a transmitting licence when they want to use the telephone only. I agree, certainly, that if you want a transmitting licence for spark, your qualifications ought to be at least 12 words per minute, but I do think those interested in telephony ought to have a transmitting licence for telephony only, without any Morse qualifications whatever.

Mr. R. H. Klein (Wireless Society of London): I understand that Morse is necessary even with the telephone, because to telephone you must be able to read Morse to prevent interference with anybody else. If you cannot understand Morse you cannot read a Government station calling you if you are causing interference, and that is the idea of insisting on knowing Morse, even with the telephone only.

Mr. M. Child (Wireless Society of London): I am not quite sure whether I am in order, but it has occurred to me, on this question of telephony, whether, possibly in the future, it might not be possible for the Post Office to grant us a separate wavelength on which people could test out telephonic apparatus. That is a matter really for the future, and I only suggest it now purely tentatively as a means of getting over the difficulty of Morse qualifications.

The President: The second suggestion in this section is (*b*) **increase of the present limits of length of aerials**. Will the delegate speak who made that suggestion?

Mr. Prior (North London Wireless Association): As representing the North London Wireless Association I should like, on their behalf, to thank you for the invitation to the Conference this afternoon. The subject my Association wishes to draw attention to is, whether it would be possible to approach the Postmaster-General on the question of increasing the transmitting power at present allowed to amateurs in general, and also to increase the length of the aerials permitted. I think we all, more or less, suffer under the present restrictions one way and another, but I cannot see what harm would result if the Postmaster-General could be persuaded to grant an increase of, say, a further 100 ft. on the length of our aerials, making the limit 200 ft. As regards transmitting power, of course, that is a different matter, and possibly there is a certain amount of justification in the restrictions laid down, but I think that that might also easily and safely be increased a little more. There is one other item I have been asked to call attention to, and that is, whether it would be possible to approach one of the leading companies to carry out organised transmission of speech and music for amateurs in general.

The President: That comes in under another item on the agenda, and perhaps you will speak on it then.

Capt. de A. Donisthorpe (Wireless Society of London): With regard to the restriction of aerials, I think there should be some increase allowed in the length of aerials for amateurs who are only using crystal and low-frequency valve circuits. Perhaps some standard could be drawn up for the different types of apparatus which amateurs use in this connection. There are still quite a number of amateurs who use a crystal receiver of the very limited dimensions allowed, and I fancy their results cannot be very satisfactory.

Mr. Knight (Wireless and Experimental Association): There are one or two members of our Association who have approached the Postmaster-General for permission to lengthen their aerials, and it has been granted.

Mr. Hollingsworth (Manchester Wireless Society): With regard to the increase of power, the attitude of my Society is that, if possible, more power should be granted to responsible members of the Society rather than to casual amateurs, with the idea that the Society should be recognised as something more than a mere casual amateur, both as doing better work and also being able to keep more easily under control matters relating to the length of aerials. A great many amateurs put up aerials in extremely inconvenient places, where they are probably rather inefficient for reception, and very possibly, if we got a slight increase in length of aerial the question of a greater strength of transmitting power would not be such an urgent one, because, instead of saving on the power end, we could save on the aerial end.

Mr. Dingle (Brighton Radio Club): At the last Conference, Capt. Loring agreed that the Postmaster-General would not act on the strict interpretation as to the actual length of amateurs' aerials. That was reported in *The Wireless World*. In fact, I know of one case in our own district in which an extra length has been granted.

Mr. Haye (Cardiff and South Wales Wireless Society): With reference to the matter of limiting transmission, and the length of aerial, I was this morning speaking to the Member of Parliament for

our district, and I put our case to him and asked if he would be prepared to help us by bringing the matter to the notice of the House and seeing what he could do to make the Postmaster-General relent a little. He promised he would do his best in the matter, but he wanted some very definite information on the subject. He said that if transmission is allowed to everyone he feared the Bolshevist element would very soon make full use of the opportunities given them, to the detriment of the country. Of course, I tried to explain to him in the limited time at my disposal that anyone, before getting a licence, had to satisfy the Postmaster-General of his British nationality and had to swear to keep the contents of all messages private. Somehow, he did not quite see the point of my argument, and he wanted some very definite information on the subject before he would move in the matter, and if we can supply him with the information respecting our wants I think we can secure his aid if we consider that it would be of any use to us.

The President: The next point is (*c*) **Reduction of fees for transmission and reception.** These, I presume, are Post Office fees for licences.

Mr. Heather (Wireless and Experimental Association): With reference to fees, I might perhaps relate my own personal experience. Some little while ago I had the pleasure of being granted permission to use 10 watts by the Post Office, and paid two guineas. I later applied for, and they kindly granted me, 50 watts, but now they have charged me another three pounds. The original amount was for the initial fee in connection with the issue of the licence and the annual charge, or some such name as the Post Office gave it, and now, within two months—I admit 50 watts is very convenient for experimental purposes—I have to pay another three pounds for another initial fee and another yearly fee.

The President: So that you have two licences?

Mr. Heather (Wireless and Experimental Association): No. Apparently the 50-watt licence cancels the previous one, and if all amateurs are going to fall into the same trap as I have, the fees ought to be reduced if possible.

Capt. de A. Donisthorpe (Wireless Society of London): With regard to the fee for receiving, which is ten shillings a year, I have not seen anything definite about it. I get one or two chits from the Post Office saying that ten shillings is due each year, but I have not seen any confirmation of such a tax being imposed on wireless amateurs. I should have thought that a nominal fee for registration of ten shillings to start with would be sufficient in the case of receiving. I do not know about transmitting, because I have not gone in for that myself.

Mr. Hollingsworth (Manchester Wireless Society): It might be pointed out that if, as suggested, the Postmaster-General could be persuaded to allow the policing of the ether by wireless societies there would be no further need for a fee, because it is stated that the fee is for the purpose of registration and annual inspection. I have had one annual inspection, and my impression was that it was not particularly efficient. A junior clerk came round and asked for the aerial wire, and when I told him I used a closed coil aerial he looked blank. Then he asked for the earth wire, and I said I had not one, and he looked blanker still. He went away and said that if they wanted any more information they would write for it (Laughter). I think the Postmaster-General is not giving us very efficient inspection, and the societies could give him something better than that.

Mr. Rivers-Moore (Wireless Society of London): I think most amateurs feel a very decided irritation over the whole matter, because there seems to be no real rhyme or reason for these charges for inspection. We quite understand in the early days of wireless telegraphy that there was a great advantage in being able to know where wireless stations were, but in these days, if Mr. Bolshevist wants to do anything he can put a loop aerial under his plaster, and with the greatest ease he gets all he wants in the way of valve apparatus, so that from that point of view licensing is entirely ineffective. Annual inspection has recently been sprung upon us, but it has been pointed out to be singularly inefficient and ineffective for the same reason. If only some really reasonable claim were put forward as to why the Post Office should insist on these regulations and rules and taxes and licensing fees, I am quite sure the Societies would consider it and put it before their members, and if it were reasonable and justifiable one would agree and pay up with goodwill. I feel strongly that something of that kind is required to make the matter proper and straightforward. With regard to the size of aerials, I think the present regulations simply put a premium on the more wealthy individual. So long as a man can afford to buy a 3, or 5, or 7-valve amplifier he can do with a small aerial, but if he can only afford a crystal, and has not much money to spend, he is hampered because he cannot have an aerial big enough to give him satisfactory results. It does not matter to the Post Office whether a man is working with a crystal receiver or whether he is working with an expensive valve apparatus. It is a question of the amount of money he has to spend before he can get busy.

Mr. G. G. Blake (Wireless Society of London): If a man were granted a licence to work with an extra long aerial, and he used crystals when he got the licence, there is nothing to say he will not later on get some valves and start using them, and if he uses a valve on a longer aerial he will cause much more interference. The Post Office wants some guarantee that he will not do that.

Mr. Haye (Cardiff and South Wales Wireless Society): With regard to the length of the aerials, a small aerial using an amplifier, is all right for reception but with regard to transmission, a man who is fighting against long odds, where local conditions are very bad, simply cannot get anything with 10 watts and a 100 ft. aerial. In my case, I am at the bottom of a valley with land all round me one thousand feet high, rich in mineral ores and buried metal in the form of gas and water mains, and how can I get a decent range with 10 watts with the ordinary Post Office aerial? It is past my comprehension. That is really why

I mentioned just now the question of trying to persuade the Postmaster-General to relent in individual cases, if not in the case of all, and to take into consideration each man's difficulties, and where the difficulties are great to make some regulation to allow a longer aerial. I applied for eight months before I got a 200 ft. aerial.

The President: But you got it?

Mr. Haye (Cardiff and South Wales Wireless Society): Yes.

Mr. Child (Wireless Society of London): With reference to this matter of cost, the point which impresses me more than anything about the injustice of it, is the question of charging an extra fee for apparently, as I have letters to show, the amount of power one is using. Supposing one employs 10 watts, one pays a guinea a year. Then there is to be a *pro rata* scale apparently according to the number of watts employed. That does not appear to me to be the right thing or the fair thing. I think it is quite a wrong basis upon which to make these charges. It virtually means that it is the man who is wealthy, and who wants to use half a kilowatt, who can pay this fee and does not feel it, but a small man who has no money, or very little, who wants to use a quarter kilowatt for a few experiments, has got to pay a proportionately larger fee. It does not seem to me the right system at all to charge on the basis of the power the man is employing.

Capt. de A. Donisthorpe (Wireless Society of London): I should like to know if this is a tax or a charge for inspection.

The President: The next item on the programme is:—

(4) Inter-Society relay organisation.

Mr. P. R. Coursey (Wireless Society of London): I do not wish to speak from the point of view of being a Committee member of the Wireless Society of London, but merely as representing a number of views which have been sent to me on this point, and, I believe, have been sent in to the Secretary by a number of other societies to be put on the agenda. I do not feel personally that we need anything comparable with the American Radio Relay League, as we have a very efficient Wireless Society, with affiliated societies in other parts of the country, and there seems no need for a separate League. If inter-society communication is necessary—and I personally do not see why it should not be done—it would seem to me largely a matter for organisation between the various societies. There is no reason, if the Post Office did not object, why the official set of a given society or club should not be used for communicating with other societies on certain occasions, but I should hardly think personally that the Post Office would be willing to grant an indiscriminate use of such facilities for general conversational work. It might conceivably be employed for practical purposes and for, perhaps, occasional use for telephony and transmission of music, and also for announcements between various societies with regard to meetings to be held and papers to be read, and anything of that sort. In this country there hardly seems the necessity for anything approaching the American League, which is definitely out to transmit amateur messages from one side of the country, or from one part of the country to the other. I believe such a relay was experimentally tried before the war with the wireless stations then existing, and there is no real reason, with the number of transmitting stations in existence now, why it should not be done at the present time if the Post Office does not object, and if there is a need for it, but the whole point seems to be that if it were used indiscriminately it would cause a great deal of delay and unnecessary interference.

Mr. Selby (Burton Wireless Club): This matter was brought before our Society, and at the time I regarded it unfavourably, for the simple reason that I am afraid that, with the small power allowed for transmitting stations, the stations would be too far apart to get a relay through to any distance. Possibly, round London and going north for about fifty miles it might be possible, but beyond that I am afraid that transmitting stations are much too far apart to be able to carry the messages through. Before the war we got through to beyond Sheffield. The messages passed through our station successfully, but beyond Sheffield they got lost somewhere. Nevertheless, the scheme was successful and very interesting, and, perhaps, in the course of a month or two, when there will possibly be more transmitting stations and licences granted, it will be possible to arrange for another relay.

Mr. P. R. Coursey (Wireless Society of London): With regard to that it would seem that, with continuous wave work, it would be possible at the present time. With regard to the issue of the whereabouts of the various transmitting licences in the country, if a list were issued we should be in a better position to say whether a relay would be possible at the present time.

Mr. G. G. Blake (Wireless Society of London): One point is that we are each of us given a licence at the present time with the names of one or two other stations to whom we are permitted to communicate, but we may not communicate with any others. I do not know how we shall get over that difficulty.

Mr. Haye (Cardiff and South Wales Wireless Society): With regard to what has been said as to a relay from London through Sheffield, we are complaining that 10 watts is not sufficient for our own experiments. Since we have a member of the Post Office with us this afternoon, if we complain too much perhaps he might be inclined to knock our power down a little. I do not think it is really necessary to increase the 10 watts, because we in England are under entirely different conditions from those in America. The Americans have got vast spaces of ground, where 5 kw. will not interfere with anything, whereas often, around London particularly, 10 watts interferes with commercial stations considerably.

Mr. Boyd (Sheffield and District Wireless Society): Inter-communication has already been established between Sheffield and other societies, and I think, if we could organise a night or nights to have this relay organisation, it would be an interesting thing for all wireless societies, because

I suggest there would be other people besides ourselves who would like to know, that in case of abnormal conditions, such as a revolution, shall we say, or an enemy invasion, a wireless chain could be established throughout the country, an amateur chain, that is to say.

Mr. Knight (Wireless and Experimental Association): Dealing with that point, I think the suggestion put forward is an excellent one, but the Postmaster-General says that our stations must not be used for the transmission of communications.

The President: Now we come on to the next item, which is:—

(5) The possibility of regular telephone transmission from a high-power station to include all matters of interest to amateurs and to be on different definite wavelengths for calibration purposes.

More than one Society has made that suggestion.

Mr. E. Blake (Wireless Society of London): I am very glad this question is on the agenda because it appears likely to lead to a result which, some time ago, seemed rather remote. The Marconi Company has before the Post Office an application for a temporary licence to carry out a somewhat humbler programme for amateurs than is suggested on the agenda. The licence has not been refused, but the Post Office require some very good evidence that such a programme would be really welcomed by amateurs, and have suggested that we should obtain the views of the Institution of Electrical Engineers or of the Committee of the Wireless Society of London. It occurred to me that if some general expression of opinion could be expressed in the form of a resolution this afternoon it might possibly satisfy the gentlemen with whom we are dealing at the Post Office. The intention of the Marconi Company was to transmit for a mere half hour or so once a week. We do not feel justified in asking for more than that, and we are proposing to divide it between C.W. telegraphy and telephony, employing, say, two wavelengths. We also propose to transmit during each programme such physical quantities —aerial current, power input, wavelength and so on —as may be useful to the amateur research worker. This idea, no doubt, will be much more useful than the observation of unknown quantities. The "matters of interest to amateurs" I am not sure about, and I do not see how it could be managed without very close co-operation between the people who are running the station and the amateurs; but that can be settled afterwards if we get permission. In any case, we shall emit carefully measured waves for calibrating purposes.

Mr. Prior (North London Wireless Association): I should like to say that my Society is anxious that some scheme of this kind should be organised, and that we are willing to co-operate as much as we can in bringing it about.

The Hon. Secretary (Mr. Leslie McMichael): I hope that arrangement can be made.

Mr. Phillips (Wireless Society of London): On behalf of the Greenwich Society, would it be in order to move that a resolution be passed thanking the Marconi Company for their effort to help in this direction, and in particular pointing out how very useful calibration waves would be. Telephony would be of interest, and C.W. would be of interest, but calibration waves, with a statement of the intensity used for transmission, would be extremely valuable for research.

Mr. Dingle (Brighton Radio Club): I have much pleasure in seconding that proposition, and might I say that in regard to the recent tests which the Marconi Company sent out prior to the transatlantic test, all the members of the Society of which I am President made an effort to obtain them on a 200-metre wavelength, and in most cases they were successful, and if we are able to calibrate certain parts of our apparatus, etc., it would be a most useful thing to every society in the kingdom.

The President: I think, gentlemen, from my own point of view I should say it would be extremely useful to amateurs to have a chance of standardising their wavelengths and knowing roughly the sensibility of their receiving apparatus, and, therefore, I think that possibly one of you might care to move a resolution thanking the Marconi Company, through Mr. Blake, for their suggestion. The ether is terribly full, and any such scheme would have to be done in the evening, and it could only be done once a week, as Mr. Blake suggests, but it would be interesting, and it would tend to raise the general level of amateur work, giving the current at the transmitting station, the distance away and the wavelength. I think C.W. and the rest of the programme is very much more important than telephony, although the latter, perhaps, is more amusing.

Mr. Phillips (Wireless Society of London): May I propose such a resolution of thanks to the Marconi Company?

Mr. Dingle (Brighton Radio Club): I will second that proposal.

Mr. A. A. Campbell-Swinton (Past President, Wireless Society of London): I have much pleasure in supporting that. Both Paris and Lyons send out calibration waves, but they are mostly fairly long waves, and the Marconi programme might, perhaps, deal with shorter waves in addition. At any rate, I think it would be a very nice thing if we could have something of that kind.

Mr. E. Blake (Wireless Society of London): I shall have much pleasure in conveying your kind resolution to the Marconi Company. One trouble in regard to the matter is that we shall have to ask for a definite power, and we hardly know what power to suggest. Some of the clubs are situated as far distant as the north of Scotland, and the power usually allowed at the present time, being of the order of 10 watts, would not be very helpful for telephony. The wavelengths, of course, would have to be of the order of 200 metres or 400 metres, but we shall have to fall in with the views of the Post Office with regard to this and the time of transmission and so forth. I hope, however, before the scheme is definitely formulated, to communicate with the Wireless Society of London, so that we may eventually put forward a plan likely to be of general utility and interest.

Mr. P. R. Coursey (Wireless Society of London) In regard to the last remark of Mr. Blake, it would

be interesting to point out that in the 200-metre transmission arranged by the Marconi Company before the recent transatlantic reception test, the lowest power signals, which I believe employed transmission powers of 250 watts at most, were read strongly on the south coast of France. A station at Nice reported very loud signals on 200 metres wavelength.

The President: You see, gentlemen, we have got a standard to come up to. You will have to read at Wick or Thurso, and you will have to read with something like 20 watts in London.

We now come to the next item, namely,

(6) That one of the conditions on which transmitting or receiving licences are granted should be that the holder must be a member of a recognised wireless society.

Mr. Lloyd (Sheffield and District Wireless Society): I do not know if this resolution has emanated from other societies, but it certainly came from Sheffield, and I am very anxious that we should have the credit of it, because I think one thing we ought to do is to get on the right side of the Postmaster-General, if we can, and we must realise that in using wireless at all we have the power to make ourselves a confounded nuisance to a great many people, and also to be dangerous to the State. That being so, it is necessary for the Postmaster-General and for the Government to make restrictions, and we are in the happy position now, the matter being so young, that probably anything we suggest will be heard. We could not offer suggestions to the Chancellor of the Exchequer as to what he ought to do about income tax, for instance, but we can suggest things in regard to wireless that would help us and also help the Government. In Sheffield we are bothered with these outsiders, but I do not think it is so much selfishness as lack of knowledge, we will say, that causes most of the disturbance, and we feel in Sheffield that if we could only get hold of these enthusiastic persons and get them into the fold of the Sheffield Wireless Society, we could teach them better manners. That would strengthen the position of the Sheffield Wireless Society, and the position of all societies, and if we could only persuade the Postmaster-General to make it a condition of the granting of licences that there should be membership of an affiliated society, well, look what possibilities it opens! The membership would go up tremendously (*Laughter*). I do not think it necessary to say anything more about that, but I want to say just a word about the policing of the ether. I suggest that if this is going down as a resolution, or if it is going down on the Minutes in any shape or form, we must be very careful. These Minutes, whatever goes down in writing, will come up against us. It will be used in evidence against us at some time perhaps, in fifty or a hundred years, and if it happens to come out that there is no such thing as ether, look at the position we shall be in! (*Laughter.*) With regard to telephony, I hope that if the Marconi Company is good enough to do something it will include telephony, and I will tell you why. Telephony makes wireless very interesting, and if you can make a subject interesting it goes so very much better, and it is just for that reason that I think, if telephony can be introduced, it will help the whole of wireless work.

Mr. Rivers-Moore (Wireless Society of London): With regard to getting on the right side of the Postmaster-General, I do not know how much members realise the exact position. We talk about restrictions and interferences and so on, but we have got to remember that in this country the dissemination of messages and the communication of all kinds of messages is a Government monopoly. The Postmaster-General is very touchy on that subject, and members want to be very careful how they put forward proposals which involve the transmission of messages from one point to another. Anything of that sort which is proposed must be done extremely tactfully, and very carefully, or else we shall find one of these days that the Postmaster-General———

The President: That applies to a previous subject. If you have anything to say as to whether a holder of a licence ought to be a member of a recognised society we shall be pleased to hear it. We certainly do want to hear more on this subject as to whether we ought to ask the Postmaster-General to insist that a person who obtains a licence should be a member of a recognised wireless society. Of course, such things do occur in other businesses. People are not allowed to practise medicine without being members of a recognised medical society, and the same thing is practically true, although perhaps not legally true, of many vocations in which there is a ruling institution or association which settles the terms of work, etc.

Mr. Hughes (Bristol Wireless Association): I should like to say a few words in support of Sheffield. As far as we are concerned in Bristol there are a large number of amateurs experimenting with wireless telegraphy who are not members of the Society, and on the last occasion when we held the transatlantic test we experienced a lot of jamming whom we did not know of. I think it would be a good thing for all societies if amateurs who are granted a licence could be roped into the societies.

Mr. Boyd (Sheffield and District Wireless Society): In supporting this resolution from Sheffield, I should like to say that we have endeavoured there to lay down the law that all applications for licences should go through the Society. We know exactly what the Postmaster-General wants, and we can deal with the applications considerably more efficiently than if individuals deal with the matter for themselves. This resolution, I take it, is simply an amplification of this rule. A person writes to the Postmaster-General for the grant of a licence, and the Postmaster-General replies that he must become a member of a wireless society, and that the application must come through the society.

Mr. L. F. Fogarty (Wireless Society of London): I do not think it will be possible for us to ask the Postmaster-General to insist and demand that every person applying for a licence shall be a member of a recognised wireless society unless the wireless

societies are prepared ultimately to be responsible for that member. If they insist upon his being a member of a wireless society, and that society is willing to accept him as a member, then if he misbehaves himself afterwards, the wireless society ought in some way to be responsible, otherwise there would not be much in it. It would be a rather one-sided kind of argument otherwise. Personally, I do not think we can really ask the Postmaster-General to insist on that. It is like taking away the liberty of the subject to some extent.

Mr. Frank Hope-Jones (Wireless Society of London): I agree with the last speaker. When first I heard the suggestion made it seemed to me quite futile to bring it forward because it does appear to interfere with the liberty of the subject, but at the same time I thought it was an excellent subject for discussion here, particularly as our views will go forward and go out a good deal beyond the four walls of this room. I do not suppose that any society would object to taking responsibility for the behaviour of its members, which the last speaker seemed to fear. I think there is a good deal to be said for the proposal, although I hesitate to consider that it is within the pale of practical politics, or can be, to-day. Here is one case, although perhaps the representative of the Experimental Association of Dulwich will speak on it better than I can, but it appears in one or two of their letters. One of the members of this Society has worried the authorities considerably by asking for permission for every little change which he made in his receiving gear. One day he said he did not know how he could disturb every listening station by a badly adjusted valve. As his permit included valves it was in the officials' mind to withdraw his licence, but the secretary was able to give the officials an undertaking that this man would be instructed thoroughly on the point and his licence was saved. I think it should be possible for the affiliated societies throughout the country to save the Postmaster-General and his officials a great deal of unnecessary work and troublesome trivial correspondence about details. It would be a counsel of perfection if we could rope in every applicant for a licence as a member of a society and to go through our little school before he troubles St. Martin's-le-Grand, but, as I say, I do not consider it is practical politics at the moment although I think there is a good deal to be said for it. The subject forms a most interesting discussion and I hope we shall hear more of it.

Mr. Phillips (Wireless Society of London): I think if this resolution were amended in some particular it might come within the region of practical politics. I do not suppose the Postmaster-General can be persuaded to force people to become members of societies. We can take that as a foregone conclusion, I think, but when you apply for a licence you have to give references. If the Postmaster-General made it known that he would accept as one of the referees a recognised wireless society—to ask the prospective holder of a licence to give a recognised wireless society as one of his referees—then, perhaps, the society would accept some responsibility for the licence holder.

Mr. G. G. Blake (Wireless Society of London): That seems all very well in towns, but how about if we take the whole of England as the district that we have under discussion. There may be some man in the Hebrides, where there is no wireless society within reach and it would be very difficult for him to be able to do any research work although he would be well out of the way where he could not do any harm to anybody. It would seem rather hard to make him join a society before he could get a licence.

Capt. H. Tingey (Wireless Society of London): I suggest that he forms a wireless society himself, with just a few people round about. (*Laughter.*)

Mr. L. F. Fogarty (Wireless Society of London): That would have the advantage that a man would be able to recommend himself to the Postmaster-General. (*Laughter.*)

Mr. Knight (Wireless and Experimental Association): If the management of our Society came to an official agreement I think they would gladly assume the responsibility of keeping their flock in order, and although we do not suggest that membership of a society should be an indispensable preliminary to the granting of a licence, we do deferentially suggest to the authorities that their replies to applicants might carry the advice to join an approved society and might even go so far as to indicate one.

Mr. Haye (Cardiff and South Wales Wireless Society): With reference to the remark as to people living in the Hebrides and miles away from any wireless society. In the case of the South Wales Wireless Society, we have members living 80 miles distant from our headquarters, and some of them are enthusiastic enough to travel that distance and back again to attend a meeting of one and a half or two hours' duration. I should not think there would be any difficulty at all in referring a person applying for a licence to the nearest wireless society. Our Treasurer informs me that we have a reduced subscription for such members who live at a great distance; corresponding members they are called and their subscription is only 5s.

Mr. G. G. Blake (Wireless Society of London): How is the society in that case to get to know the merits of the man if he lives so far off? You cannot expect him to come hundreds of miles when he is only doing the thing for a hobby, and how are you going to know enough about a man to be responsible for him in the future?

Mr. Haye (Cardiff and South Wales Wireless Society): With regard to that, I might say that before we make any applicant a member he has to attend in person, and, of course, his qualifications are very quickly determined and his admission to membership determined accordingly.

Mr. Lloyd (Sheffield and District Wireless Society): It has been suggested that the Sheffield request should be altered. I may say that we have no objection to altering it in the manner proposed, so that it should read that the society should be given as a reference.

Mr. Phillips (Wireless Society of London): I mean the resolution should read to the effect that the Postmaster-General should express his

willingness to accept as a referee a recognised wireless society.

Mr. Lloyd (Sheffield and District Wireless Society): Most of the points raised we have experienced in Sheffield, but they have not troubled us. We have country or corresponding members, and they come in from a great distance, as much as 30 miles, and we keep in touch with them. It has also occurred to me that there is one little point that is in our favour, and as there are a number of secretaries here they might consider doing the same thing. We have roped in—to use a phrase already mentioned—the representative of the Postmaster-General into our Society--(*laughter*),--so that we get to know something about these things. It has helped us very much.

Mr. Knight (Wireless and Experimental Association): With regard to the last speaker's remarks, in one or two cases I believe the Postmaster-General has accepted the signature of our secretary as a reference.

The President: Let us now consider the last item on the programme, that is

(7) That the Conference be held at different provincial centres annually.

Mr. Savage (North Middlesex Wireless Club): It has occurred to me that it would add much to the value of these conferences if they could be held at different times in different towns. As far as our Club is concerned we are quite content for the Annual Conference to be held in London. It suits us very well, but in discussing the matter recently with some wireless friends from the north they gave it as their opinion that one conference held in the north of England would be of more value to club life than a dozen conferences held in London. The same thing, no doubt, applies to the Midlands and the west of England. Before closing my remarks, I would like to say that my Committee have requested me to tender thanks to the Wireless Society of London for the regular supply of literature received, and the welcome given to our Club members by the Society at its meetings.

The President: This is a fairly serious matter.

Mr. Lloyd (Sheffield and District Wireless Society): Speaking as a Sheffield member, we feel that there is less inconvenience in getting to London probably than to any other centre, at the present time. I think there is hardly sufficient interest to go outside London. It is not like the big engineering societies and chemical societies, where there are a large number of members in the provinces in each of the large centres. If you went to Birmingham or Sheffield or Manchester or Liverpool or any of the large towns you would have considerable difficulty in finding accommodation for a large number of wireless people, and London is the most get-at-able place in the country.

Mr. Frank Hope-Jones (Wireless Society of London): I am rather relieved personally to hear that the general opinion of the meeting appears not to have taken the form of a strong request that the Conference should be held in various provincial towns in turn all over the kingdom. From the executive point of view it would be distinctly difficult. You must remember that the subscription to the Society is a small one, that its business is conducted by volunteer officers, and unless and until we have a permanent building and a permanent paid staff it would be distinctly a problem to convene conferences in one town after another. We are not big enough to rival the British Association or any one of the great societies who hold conferences in the provinces. At the same time, the Committee was most anxious to hear your views on the subject, and had there been a strong wish to the contrary, desperate efforts would have been made to have conformed to it if we could have done so.

The President: We have a representative of the Post Office here, Capt. Loring, who deals, I believe, to a large extent with the matters which we have been discussing. I should appreciate it very much if he could be persuaded just to say a few words on the points which have been raised.

Capt. Loring: I am sure you will not expect me to answer all the points which have been raised this afternoon. When I came here I had seen the agenda, and I had come with, so to speak, preconceived ideas. I have no doubt that the proceedings of the Conference will come to the Post Office in the ordinary course, and you will be able to reconsider all the things you have said before they come to be put down in print. I have no doubt that your arguments will then be even stronger on the various points that have been raised, and they will go through my hands in the natural course of events. Then I shall be able to remember what has been said here and support a good many of the points that have been made. I propose just to read from the agenda, and very briefly to supplement what preconceived ideas I had. The first matter is the policing of the ether. Though the Post Office would be quite prepared to investigate any complaint made by a licensee of interference or other inconvenience caused by a breach of the conditions of his licence by another licensee, I do not think we can go so far as to invite the assistance of amateur wireless societies to act as police of the ether, even as against other amateurs. The Government, although I hear this afternoon that it is very inefficient, has its own organisation for this work. It is, however, obviously to the interest of amateur licensees to see that the present good relations between the Post Office and its licensees is maintained. If it were found that certain amateurs were exceeding the conditions of their licence, the effect would certainly be prejudicial to the amateur movement. I am glad to say that so far there has not been the slightest indication that that is the case. I must say we have had no trouble with amateur licensees as a whole, although I am very pleased to hear that you have all suffered from the inconveniences of interference, and therefore, will probably have sympathy for the Government, but as a matter of fact we have had no complaints at all, practically, of any interference by amateurs with the Government services, which is extremely satisfactory. When we come to the question of asking the societies to police the ether for us it is a very big and difficult one, and there is a good deal more in it than meets the eye. Coming to the second point on the agenda, that the President or Chairman of each district

society should be supplied with a list of holders of transmitting licences, there are 150 transmitting licences and over 4,000 receiving licences, and I do not think we should have any fear in giving the London Society a list of the transmitting stations, confidentially, if they promised not to publish them. You could pass them round to the affiliated societies. I do not think, however, we could go into the question of giving you a list of the receiving licences. There are 4,000 of them, and it would be a tremendous business to keep the list up-to-date, and moreover, I think it would be unnecessary. It seems to me that it would be better if the amateurs themselves furnished the London Wireless Society with particulars of their stations for publication in the organ of the Society, and thus form your own lists. That does not seem to be an impracticable proposition as time goes on. Another of our difficulties is that, supposing we licence a gentleman who does not want his name to be published, it is rather unfair to him if we gave his name against his will to the controlling society. That is rather a difficult point, but we will have it considered.

As regards the relaxation of qualifications, the qualifications are the considered recommendations of a specially appointed Government Committee, and I do not think they would be reconsidered unless there was some fresh development of the general wireless situation. I see no prospect of that at present. Somebody did a moan about Morse. Even in America they have to do 10 words a minute before they can get a licence, and we are asking for 12. There is not very much in it, and I certainly could not myself support any relaxation of the qualifications of the amateur licensee for transmitting purposes.

As regards the increase of aerials, it is a convenience to us, generally speaking, to have a standard type of aerial, and I think the fact that anybody who can present a reasonable case for a larger aerial has it considered, and, in 99 cases out of a 100, granted, really meets the situation. At any rate, we cannot alter the standard aerial without calling together again the Government Committee that decided it. It is not only the Post Office that is concerned in these things; it is the other people, but I have not heard this afternoon a single grouse, not a real good one, against the size of aerials. The aerial that was decided upon was tried experimentally in various parts of England by the Engineer-in-Chief of the Post Office, and was found to be a good aerial for crystal reception for ordinary purposes. As I tell you, if anybody wants a specially big aerial for special purposes, or is in a very unfavourable position, we are quite prepared to consider that application, and I think you will generally find that it is granted. At any rate, I do not know of any case in which it has been refused.

As to reduction of fees, that really does not affect me very much. I am not very much concerned with fees, which is a matter for the Accountant-General, but the charge at present is based upon the expenditure to the Post Office of licencing the wireless stations, but no doubt, when the considered report of this Conference is available that matter will be reconsidered. One gentleman has said that he paid two pounds for 10 watts, and another three pounds for 50 watts, making five pounds in all, and that does seem a little bit expensive, and these points require to be raised and considered. I am not offering you, however, any hope that the fee will be reduced, but if you can make out a very good case and put it to the Post Office through the London Wireless Society, I am sure all these points will be considered in a reasonable spirit.

Before I came down here I really did not understand what the inter-Society relay organisation was, and the only note I have made with regard to it is that there would be no objection to stations communicating with each other, provided they did not exceed the terms of their licence (*Laughter*). That is really the only thing I could write. But there again, it is one of the points that have been raised, and will appear in the considered report of the Conference, and we shall then have the opportunity of going into it.

As to the possibility of regular telephone transmission, that will be favourably considered by the Post Office when it is put forward, but we do not altogether like it coming from the Marconi Company, as it puts us in rather an awkward position. It would come very much better from the Wireless Society. The Marconi Company's representative will, I am sure, understand what I mean. The application will be much easier for us to deal with if it comes from an organisation like the Wireless Society than from a firm. We cannot give the Marconi Company preferential treatment over any other firm, so that if they asked for permission to send out for half an hour every week, half a dozen other companies could come along, and we should have to give them similar permission, whereas if the Wireless Society of London were to apply it would make it much easier for us.

The question of wavelengths is a very difficult one because, at the present time, it is not easy to find wavelengths which do not interfere with genuine work, and the Marconi Company will be the first people to admit that, because I think they will realise the trouble they have had with the communications with Paris and the difficulties there. It is very difficult to find a wavelength which can be put to a certain definite purpose without interference, and with regard to the short wavelengths which amateurs are using now, we must all remember that there is a distinct tendency nowadays for making a much greater use commercially of very short waves, and that is another thing we have to guard against and watch in the future.

As to the suggestion that applicants for licences must be members of a recognised wireless society I, like Mr. Hope-Jones, think that it is practically an impossibility for the Postmaster-General to consider such a proposition at all, but listening to what was said this afternoon, there are some things in favour of it. I do not know that we can ever make amateur wireless workers into a trade union. I know you cannot lay bricks without being a bricklayer, but I think it would be very difficult

for us to make the condition that applicants for licences should be members of a recognised wireless society; but I have not considered it at all.

I think that is about all I have to say, unless there is any particular question I have not touched on that I can answer. Somebody asked about separate wavelengths for telephony, and Mr. Child suggested that this might be brought about in the future. Just at the moment, however, we have not any wavelengths for anything. I think that is all I have to say, unless there is any particular question anybody would like to ask. (*Loud applause.*)

Mr. Lloyd (Sheffield and District Wireless Society): May I ask if Capt. Loring is a member of the Wireless Society of London?

The President: Yes; he is one of our Vice-Presidents. (*Laughter.*)

Capt. Loring: I do not know who I am supposed to be this afternoon.

Mr. Frank Hope-Jones (Wireless Society of London): I think the last speaker has really hit the nail on the head. You may have noticed an apparent lapse or omission in regard to the speech which Capt. Loring has made. You might have expected a formal vote of thanks from the Wireless Society of London to Capt. Loring for having attended, as he has done, this afternoon, but inasmuch as he is a Vice-President we feel it is a privilege that he is one of us, and we are most fortunate in that respect, that we have such goodwill at St. Martin's-le-Grand, a gentleman who will interest himself in our pursuits, which, after all, are mainly a hobby. One of our speakers this afternoon stated that he had buttonholed the Hon. Member for his district, but I am very glad to say that as a Society with a large body of affiliated societies we do not need to bother Members of Parliament by adding to their multifarious duties by buttonholing them or lobbying them at Westminster, or anything of the kind. We have something a great deal better when we have the Postmaster-General himself practically represented here, although in an unofficial capacity. I think I am voicing the feelings of the Conference when I thank Capt. Loring most sincerely for his attendance this afternoon.

The President: The formal business of the Conference is now concluded, unless anyone happens to have anything further to bring up.

The proceedings of the Conference then concluded.

TEST TRANSMISSION FROM WAKEFIELD

Below we are able to publish a summary of reports received by Mr. H. Burbury from various localities, of the reception of the C.W. and telephony tests transmitted from his station, **2 AW**, Grigglestone, Wakefield, on March 8th and 9th. A few details of the transmitter are also given.

TRANSMITTER.

Aerial.—70 feet span, 90 feet lead, L-shaped height of horizontal part, 55 feet; down lead passes close to an earthed lead roof for 20 per cent. of its length about the middle of its span. Directive, if at all, to N.E.

Power.—Aerial amps. Telegraphy, O.S.; Telegraphy, 0.75. Input, 80 milliamps at 700 volts.

Valves.—Mullard "B," *i.e.*, "R" valves pumped hard.

Control.—R.A.F. control valve circuit, same number of control as power.

The transmitting helix is of large diameter, wound with a stranded wire made at home of 20 No. 36 D.S.C., twisted evenly.

The following brief summary of results may be of use to those who listened:—

DOVER. Telegram only to say that speech was heard. No further details. Receiver, 2-valve; 1 H.F. amplifier; 1 rectifier with reaction.

SUTTON.—C.W. received quite easily, and text of messages given correctly. Telephony could hear a voice, but could not distinguish words. Receiver, 1 valve; 160 miles.

DARTFORD.—C.W. and telephony successful; "Every word easily understood." Receiver, 2-valve; 1 H.F. 1 rectifier with reaction; 160 miles.

WOOLWICH.—C.W. strong "a yard off the telephones," but practically no signs of speech. Receiver not stated; 158 miles.

RICHMOND.—Apparently received C.W. very, very weak, and also the carrier wave; but is doubtful; 155 miles.

HAMPSTEAD (1).—Received fragments of C.W. enough for us to identify. Complaint of interference; no details of receiver. 155 miles.

HAMPSTEAD (2)—Nothing. Complaints of interference; no details of receiver; 155 miles.

EARL'S COURT.—Jammed up; no details of receiver; 155 miles.

WESTMINSTER.—Did not pick it up till speech was on; this was clear enough to recognise the voices of the people talking, but words were not got owing to weakness. We have been told the names of three different people who spoke.

Receiver.—Aerial 20 feet long and not more than 20 feet above the instruments. Two tuned H.F.; one rectifier, 2 L.F.; 157 miles.

RUGBY.—C.W. quite strong. Telephony better on March 8th than 9th. Gramophone records for Wednesday given correctly. Receiver, 2-valve; 84 miles.

GUILDFORD.—C.W. just readable; carrier wave strong, but no speech. Receiver, Marconi 7-valve 55F (newest); 175 miles.

MALTON (YORKS.).—Nothing. Receiver, Marconi 7-valve, pattern not stated; 43 miles.

2 FQ and local friends report having received both transmissions, including telephony.

In Surrey and Kent the transmissions were easily read, using one valve for telegraphy and three for telephony.

WIRELESS CLUB REPORTS

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter 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 of unusual or special interest read before Societies.

The Wireless Society of London.

A meeting of the Society was held on Monday, April 4th, at the Royal Society of Arts, John Street, W.C.1., when Dr. J. Robinson, M.Sc., gave a paper on "Some Acoustical effects in Wireless."

We have been asked to announce that owing to illness the Hon. Treasurer, Mr. L. F. Fogarty, has been unable to deal with letters recently addressed to him by members, but it is expected he will be able to resume his activities in the course of a week or two.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

On March 17th, at the College of Technology, and March 24th, at the Headquarters, Albion Hotel, Piccadilly, Manchester, the President, Mr. J. Hollingworth, M.A., B.Sc. (Eng.), delivered two lectures on "Direction Finding." The aim of Directional Wireless was explained both as regards position finding and the reduction of interference between wireless stations. The theory and means of obtaining directional effects were shown by reference to the earliest and the modern systems. By means of many diagrams and his own directional finding apparatus the lecturer demonstrated practical working.

Hon. Secretary, Mr. E. Samuels, 1, Parkwood, Victoria Park, Manchester.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

The third annual general meeting of the North Middlesex Wireless Club was held at Shaftesbury Hall on March 23rd, the President being in the Chair. The President first called on Mr. Savage to read his report as Hon. Secretary and Treasurer, who announced that the total membership was now 59, 22 new members having been elected during the year, and 11 having resigned. During the year under review, a number of instruments had been purchased and several schemes had been inaugurated for the benefit of members. Among these was an arrangement by which the Club's instruments could be loaned to members, which had proved very popular. The financial position of the Club was satisfactory, there being a balance in hand of £12 14s. 4d. The report being adopted, a vote of thanks to the Committee was moved by Mr. F. Hilton, and duly carried. A vote of thanks to Mr. A. G. Arthur, the President, was moved by Mr. A. J. Dixon, and seconded by Mr. Savage, to which Mr. Arthur responded. Mr. Arthur was then proposed as President for the ensuing year by Mr. Savage, and seconded by Mr. Godfrey. Mr. Savage was proposed as Secretary by Mr. Godfrey, and seconded by Mr. Dixon. It having been decided to elect a separate Treasurer, Mr. A. Saville was proposed for this position, and seconded by Mr. Dixon. All the above officers were unanimously elected. The Committee were then balloted for, and the following were declared elected:—Messrs. Coleman, Dixon, Evans, Gartland, and Midworth. Mr. Holton was again chosen to act as Installation Officer, and Mr. W. Macadie as Librarian. Mr. Beckman was elected as Chairman to preside at meetings in the absence of the President. This ended the business of the evening, and the meeting closed. Particulars of the Club may be had from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, N.21.

City and Guilds Wireless Society.

(Affiliated with the Wireless Society of London.)

At a meeting of the Society Mr. W. H. Andrews lectured on "Commercial Crystal Receivers." The lecturer described very clearly various English, French, and American ship receivers.

On March 9th, Mr. L. J. Swan gave an interesting lecture on "H.T. Batteries," in which he described different types of batteries he had made and the difficulties he had encountered, exhibiting a very compact accumulater unit giving 100 volts. Other members having contributed their experiences in this direction, the meeting was closed.

On March 4th, members of the Society spent a very enjoyable hour at the works of the Marconi Scientific Instrument Co., listening in on a 7-valve amplifier which Mr. Carpenter very kindly "worked" for our benefit. The following morning a party paid a most interesting visit to the Wireless Laboratory and Examination Room of the Inspector of Wireless Telegraphy's Office at the General Post Office where we saw the recording apparatus of the Berlin service and several other installations. The thanks of the Society are due for the courtesy and kindness shown us on both occasions.

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting of the Society was held on Thursday, March 24th, 1921, at Dartford Grammar School, Dartford.

In the absence of the President, the Chair was occupied by Mr. J. R. Smith, Vice-President, the total number present being 10, including one new member. The minutes of the last meeting were read and confirmed, and the proposed alterations in the Society's aerial were fully discussed.

The Society's delegate at the recent Conference explained by means of blackboard sketches "Direction finding as applied to the aeroplanes," being a detailed account of the method used on the London to Paris and Brussels service, particulars of which were shown to the delegates by means of cinematograph films at Marconi House. A sketch of a direction finding circuit was also shown and explained.

Hon. Secretary and Treasurer, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

The Radio Scientific Society.

(Affiliated with the Wireless Society of London.)

An extraordinary general meeting of the Society

was held at the City School of Wireless Telegraphy, 61, High Street, Manchester, on March 23rd, 1921.

For some time it has been felt desirable to place the Society on a better footing, and the meeting was called with this object in view.

The first point to be considered was the Secretary's resignation, which was accepted with regret.

Mr. Whitehouse being appointed new Secretary it was decided to return to the Society's old headquarters at 61, High Street, Manchester, and to discontinue the use of the rooms which had been very kindly furnished by the Y.M.C.A.

A Technical Committee was appointed to deal with technical questions, and to prepare the Society's summer programme.

A resolution regarding new members was adopted,

"Any new member may be one interested in Radio Telegraphy, and shall join as an associate member, but shall not be admitted to full membership until he shall have read a paper of merit before the Society, the paper to lie within the sphere of Radio Telegraphy."

It was decided to form the Society into an advance and an elementary section, and meetings to be allotted to each section alternately. Also to allocate evenings during the week to experimental work with the Society's aerial.

The meeting was concluded by a demonstration of mechanical recording of Wireless Signals conducted by Mr. Halliwell and Mr. Grocott.

All communications should be addressed to Mr. H. D. Whitehouse, 16, Todd Street, Manchester.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting of the Association on March 9th, Mr. A. W. Knight in the chair, members were asked if anyone on the previous evening had heard Lieut. Burbury, of Grigglestone, Wakefield, but no satisfactory replies were forthcoming. It had been suggested by Mr. Horwood that London wireless men should act as hosts to visiting provincial delegates to the next Conference, and the suggestion was put in train to come up in time for good notice to be given, and the whole thing organised for next year. A patent specification for X stopper was read and discussed, and several other wireless nuts were cracked and the kernels extracted.

At a meeting of the Association at the Central Hall on March 16th, the Secretary was instructed to express the thanks of the meeting to the President. Mr. W. Le Queux, for his efforts to give us early advice of a forthcoming wireless trial, which, though not carried out entirely as prearranged, gave some of our members quite a lot of good listening practice.

Mr. Voigt then gave a most illuminating lecture on the construction and use of logarithmic tables, and if members do not in future work out their microhenries that way it will be because they prefer the slide-rule. A general discussion then followed on the elimination of howling in Mark IV amplifiers.

The Amsterdam Thursday concerts still seem to evade most of us.—Hon. Secretary, Mr. Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The regular fortnightly meeting of the above Society was held on Friday, March 11th, 1921, at Dartford Grammar School. Dr. Miskin presided with Mr. J. R. Smith, Vice-President. There was a good attendance of members, one new member being enrolled.

The minutes of the previous meeting having been read and confirmed, the delegates who were in attendance at the recent conference, gave a detailed account of the various items discussed.

The President announced that the Governors of the Dartford Grammar School had stated their approval of the Society being accommodated at the school, which accommodation is admirable for the Society's requirements. The headquarters of the Society are, therefore, finally established. Opportunity was taken to test the aerial now erected.

The President brought a 2-valve resistance receiving panel, W.R. 160, as made by Messrs. F. O. Read & Co., which with an ordinary home-made tubular inductance coil wound with 28-gauge enamelled wire and aerial tuning condenser, has received on wavelengths from 600 to 15,000 metres. Some good readable signals were received on this instrument.

A crystal detector, with A.T.I., was also tried, the results naturally not being so good as with the valves. The test proved that some slight alteration is necessary in the aerial, with a view to obtaining signals of maximum strength.

The Society anticipated rapid developments now that definite accommodation has been procured, and all interested are invited to communicate with the Hon. Secretary and Treasurer, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

The Wireless Society of Hull and District.

(Affiliated with the Wireless Society of London.)

A meeting of the committee was held on February 24th, when several matters came up for discussion, one of which was the methods to be adopted to increase the membership of the Society. The Hon. Secretary outlined a scheme which he had in hand, and also made a suggestion that an advertisement should be inserted in the local press. This, however, was held over until the next meeting. The Hon. Treasurer presented a financial statement which showed a balance in hand of £2 0s. 10½d., which was considered satisfactory. A meeting of members was held later under the chairmanship of Mr. G. H. Strong (President). There was a rather poor attendance. The Hon. Secretary mentioned that it was found impossible for the Society to be represented this year at the Conference of Affiliated Societies to be held in London on March 1st, but on the proposition of the Chairman and seconded by Mr. Jephcott, the following resolution was passed, which the Hon. Secretary was instructed to forward to the Conference:

"The members of this Society are of the opinion that the present regulations of the Postmaster-General for transmission licences, viz., with regard to the speed of sending and receiving required, and as to the object of being strictly for research work,

should be modified to enable more members to obtain the necessary licences for transmission."

Business over, an interesting discussion took place on detector circuits, rendered more interesting and instructive by the use of blackboard diagrams drawn by the Chairman.

More members are required for this Society, and the Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull, will be pleased to supply full particulars on application.

The meetings are held fortnightly on Thursday evenings at the Metropole (Marlborough Room), at 7.30 p.m. There is a students section for members under 18 years.

Borough of Tynemouth Y.M.C.A. Amateur Wireless Society.

(Affiliated with the Wireless Society of London.)

On Wednesday, March 16th, a meeting of the above Society was held in the Y.M.C.A. North Shields, when the Hon. Secretary, Mr. L. L. Sims, gave a paper on "High Power Wireless Stations."

He commenced by briefly outlining the developments of long distance wireless, and later described the general characteristics of some of the well-known high-power stations, including Carnarvon, Towyn, Poldhu, Clifden, Glace Bay and Stavanger.

A splendid set of lantern slides dealing with these stations, were kindly lent by Marconi's Wireless Telegraph Co., Ltd.

A vote of thanks to Mr. Sims, and to the lanternist, Mr. Geo. Littlefield, was proposed by Dr. Jas. A. Hislop and heartily endorsed by all present.

Hon. Secretary, Mr. L. L. Sims, Y.M.C.A. Wireless Society, North Shields.

Brighton Radio Club.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held in the Club Room at 8 p.m. on Thursday, March 10th, 1921, Mr. W. E. Dingle in the chair.

Mr. Dingle related his experiences at the Conference of Affiliated Wireless Societies held in London recently, giving a detailed outline of the procedure followed.

The draft of rules was then submitted by the Executive Committee for final approval, and with certain amendments was ultimately passed, and the work of securing printers' estimates, etc., left in the hands of the Executive Committee, who were asked to produce these at the next meeting.

It was then decided to elect two auditors annually, and Mr. G. Smith was proposed by Mr. C. H. Bingham and seconded by Mr. W. Rogers. Mr. Smith accepted the office.

Mr. R. H. Rogers was also proposed by Mr. C. H. Bingham to fill the office of second auditor, and seconded by Mr. F. C. Longstaff. Mr. Rogers accepted the post.

It was decided that an audit should be held in March of each year.

There were five new members elected. There being no further business the meeting was adjourned at 10 p.m. until Thursday, March 24th, 1921.

Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full details as to membership, etc.

Birmingham Experimental Wireless Club.

A highly successful exhibition of wireless apparatus was held by this Club on March 2nd and 5th at the Club-room, the City School of Wireless Telegraphy, Corporation Street.

The ingenuity of the members was apparent from the number and quality of their exhibits. The practical demonstrations of the 1½ kw. Ship Set by Mr. J. Briggs, and of X ray apparatus by Messrs. Philip Harris & Co., aroused the keen interest of the visitors, of whom nearly 350 were admitted on the two days. Some interesting exhibits were made by Messrs Halliwell and Good; Messrs. The British Thomson-Houston Co.; Messrs. H. P. R. Wireless, Ltd., and Messrs. Beresford Bros. Excellent signals were obtained, and made audible to all by an amplifier and loud-speaker.

On Wednesday, March 30th, a lecture is being given by Mr. P. R. Coursey, B.Sc., A.M.I.E.E., on "Wireless Telephony for Amateurs."

The Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham, will be pleased to hear from intending members.

Borough of Tynemouth Y.M.C.A. Amateur Wireless Society.

On March 2nd the meeting of the above Society took the form of a general discussion, the main topic being the conversion of the Mark III short wave tuner.

Mr. Geo. Littlefield led the discussion, and with his own Mark III ably illustrated the method of conversion.

On March 9th the Hon. Secretary, Mr. L. L. Sims, gave a Paper upon "Field Wireless," splendidly illustrated by lantern slides kindly loaned by Marconi's Wireless Telegraph Co., Ltd.

After giving a brief outline of the early types of sets used, the speaker dealt with the more modern types of apparatus, namely, "The Automobile, Cart, Cavalry, and Trench Sets."

A vote of thanks was proposed by Dr. Jas. A. Hislop.

Hon. Secretary, Mr. L. L. Sims, Y.M.C.A Wireless Society, North Shields.

The Stockport Wireless Society.

At the meeting of the above Society held at the Technical School, Mr. Woodyer delivered an interesting lecture on the "General Design and Construction of Wireless Receivers." Dealing with the subject in a precise manner, Mr. Woodyer gave the constructional details of receivers varying from vest pocket size to the more usual type of laboratory instrument.

Mr. Woodyer will lecture at the next meeting which will be held on Thursday, March 10th, at the Technical School.

The Hon. Secretary, Mr. J. J. McLachlan, 25, Greek Street, will be pleased to hear from intending members.

Portsmouth and District Wireless Association.

The business meeting held on March 3rd, at which Mr. Atherton presided, showed a very promising outlook for the Club's future, and apparatus is now being purchased for experimental work by the members.

Members have been bringing their own sets to the Club-room for demonstration, and one by Mr. Bridge, made entirely by himself, and which was carried in a large attache case, gave excellent signals on the Club aerial.

Mr. Priest brought a compact set on which the F.L. clock ticks were heard, and German spark stations on 600 metres.

Both members have heard telephony on these sets.

The usual buzzer practice is held when the opportunity occurs.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

Plymouth Wireless Society.

At a general meeting of the above Society held on the 4th instant Mr. W. J. Lewarn was elected Chairman, the vacancy occurring through Mr. R. S. Menhennet's resignation.

On the 18th instant the Principal of the Municipal Technical College (Mr. W. S. Templeton, M.A., B.Sc., A.M.I.E.E.) read a further Paper on the subject of "Relativity," dealing more particularly with "Einstein's General Principle" and its important results.

The Radio Society of South Africa.

An ordinary general meeting of this Society was held at the University, Cape Town, on the evening of February 25th, 43 members being present. The Chairman (Professor A. Ogg), after declaring the opening of the new session, outlined the immediate policy which the Committee had framed, including the grading of members, the allocation of call signs, the printing of the constitution, by-laws, etc., the examination of members requiring certificates, recommending the issue of the Postmaster-General's licence, and the opening of branches.

Elections to fill vacancies on the Provincial Committee then took place, Mr. H. P. Trainor being elected Vice-Chairman, and Mr. W. H. Perrow, M.I.E.E., Elective Member.

The Chairman then called upon Mr. H. E. Penrose to deliver his lecture, "Construction of Amateur Apparatus." The lecturer, with the aid of tuning coils, a variable air condenser, and a potentiometer constructed by Mr. J. S. Streeter, explained the fundamental requisites of an elementary type of receiving instrument using a crystal detector. The advantages of different types of aerials were given, and the necessity for a good "earth" and well-soldered joints was emphasised. Various methods of connecting up the components were described, and details were given whereby low resistance telephones should be used with satisfaction. Mr. Streeter was then called upon to explain the methods employed in the construction of the apparatus exhibited.

Meetings of the Society are held on the last Friday of each month. Any person interested desiring information should communicate with the Provincial Hon. Secretary (Mr. A. T. Stacey), P.O. Box 2055, Cape Town.

Bishop's Stortford College Wireless Society.

It has been decided that meetings shall be held on Sundays in future, this being the only day which is free to all members of the Society.

A meeting was held in the Lecture Room on March 6th, when the President, Mr. E. M. Stienon, gave a most interesting lecture on "Valve Amplifiers." His lecture was profusely illustrated by graphs, formulæ and diagrams on the blackboard, and after he had been thanked for his lecture, buzzer practice was given as usual by Mr. Hayward.

On March 13th a meeting was held in the Lecture Room, when two new members were elected. Mr. W. R. Brachett then gave a lecture more especially for the benefit of novices, on "Wireless Receiving Instruments and their Functions in Crystal Reception." He demonstrated his lecture by practical experiment, explaining each instrument in the clearest manner, and was heartily thanked for this much-wanted lecture.

A meeting was held in the Lecture Room on March 20th. During the past week Messrs. Stienon, Blomfield and Gormy had erected the Club aerial, and it was hoped that a set would soon be in working order. There was a large attendance, and Mr. A. H. Blomfield read his Paper on "Single Valve Reception." During the course of his Paper Mr. Blomfield gave a very complete outline of the theory of heterodyne reception, also touching upon direction finding.

Luton Wireless Society.

On Wednesday, February 9th, the usual fortnightly meeting was held. Buzzing practice as usual preceded the lecture given, on this occasion, by the Hon. Librarian of the Society, Mr. E. Porter. The subject was "Poulsen Arc Transmission." With the aid of diagrams the lecturer explained the method used, and simple theory, and the advantages and disadvantages compared with other methods of transmission. Great interest was shown and discussion followed.

The telephony and music in connection with the Efficiency Exhibition at Olympia was received on the Society receiving set, and members and visitors took advantage of the opportunity to hear the demonstration which was received with good audibility on the single-valve receiving set.

On Wednesday, March 9th, the Hon. Secretary addressed a good attendance on "Wireless Transmission of Telephony." Following a description of the valve as a generator of oscillations, the method of modulating the carrier-wave was shown. Successful experiments followed.

Membership of the Society is increasing very satisfactorily, greater interest is shown, and next session promises to be even more successful than the one which is terminating.

Wimbledon and District Wireless Society.

On Saturday, March 5th, 1921, a large gathering of ladies and gentlemen, interested in wireless telegraphy, attended the inaugural meeting of the

Wimbledon and District Wireless Society, held at the Technical Institute, Gladstone Road, Wimbledon. The Secretary of the Society, Mr. Marshall, traced the origin of the Society and need for such an organisation in the district, giving suggestions which he hoped would be adopted with regard to the operations of the Society in the future.

Mr. H. Nutton, A.M.I.E.E., A.I.M.E., temporarily in charge of the meeting, referred to the importance, especially in the initial stages of the Society, of securing the services of a president who should understand the circumstances surrounding the Society generally, and expressed the belief that he could heartily welcome the Society on behalf of the Wimbledon District Higher Education Committee, to hold their meetings in the building. Mr. Nutton proceeded to introduce the president for the year, Mr. W. A. Harwood, who, on rising, thanked the Society for making him president for the ensuing year, and said he hoped that at the back of the minds of the Executive Committee of the Society, who had chosen him as President, was the idea of reflecting honour upon the Wimbledon District Higher Education Committee. He gave a short outline of the history of wireless telegraphy as applied to the Institute, and reviewed the improved status of wireless operators, and the change in their qualifying examination, which, in his opinion, was to some extent due to the action of the Higher Education Committee in approaching the Board of Education. A vote of thanks was moved by Mr. Ballhatchet, and seconded by Mr. Howard.

During the evening, by permission of the Postmaster-General, wireless signals from Eiffel Tower, Poldhu and ships at sea were made plainly audible throughout the large hall.

The next meeting of the Society will take place on April 9th, when Mr. Onwood, a member of the Society, will give a short paper on the H.P.R. receiver, followed by a demonstration and discussion.

Forty members have already been admitted to membership of the Society. Intending members are invited to communicate for further information, with the Hon. Secretary, Mr. W. G. Marshall, c/o Technical Institute, Wimbledon, or 48, Warren Road, Merton, S.W.19.

The Lowestoft and District Wireless Society.

The inaugural meeting of the above Society was held on Tuesday, March 15th, at Bridge Road, Oulton Broad, at 7.30 p.m.

The following officers were elected :— President, Mr. C. Chipperfield ; Hon. Secretary, Mr. L. Burcham ; Committee, Messrs. Savage and Trent.

Arrangements were made to convert a shed, lent by the President, into a permanent headquarters. The construction of a single valve receiver for the use of members is to be commenced as soon as the necessary alterations to shed are completed, permit to be applied for in the meantime. The rules, etc., were then discussed and it was decided to fix the age limit at 18 years, but enthusiasts under that age who wish to join will be admitted as associates at the committee's discretion. An annual subscription of 10s. 6d. to be made by each member, the year commencing March 1st, 1921, and any persons wishing to join after September 1st will be charged a fee of 5s.

The President also made an offer of the use of the lathes, etc., at his works by full members for the making of apparatus.

Meetings will be held at Messrs. Chipperfield's Works, Bridge Road, Oulton Broad. Full particulars will be gladly furnished by the Hon. Secretary, Mr. L. Burcham, "Gouzeacourt," Chestnut Avenue, Oulton Broad, Suffolk.

Stoke-on-Trent Wireless and Experimental Society.

The Second Annual General Meeting was held on Tuesday, March 22nd, at the headquarters, 17, Brunswick Street, Newcastle, Mr. A. H. Wilson in the chair.

Votes of thanks were passed to Mr. Wilson for his services as chairman and hon. treasurer during the past year, and to Mr. G. H. Adams for acting as hon. secretary.

The Secretary then submitted his report, which was accepted. The following propositions were made and carried unnaimously :—

That Mr. F. E. Wenger, M.C., be re-elected President. That the following be re-elected Vice-Presidents :— Mr. F. Blake and Mr. A. Lees-Milne, of Wybunbury. That Sir William G. V. Goodwin, ex-Mayor of Newcastle, be asked to become a Vice-President.

Mr. A. H. Wilson was elected Chairman and Hon. Treasurer, and Mr. G. H. Adams, Hon. Secretary. The Committee formed consisted of the President, Vice-Presidents, Treasurer, Secretary, and Messrs. S. Wilkinson, F. Jenkinson, Jones, J. Warburton, A. Hackney and G. Mottershead Mr. Wilkinson and Mr. Jones were appointed Hon. Auditors.

After other business had been discussed, Mr. Jones proposed "That in future this Club be called 'The Stoke-on-Trent Wireless and Experimental Society.'" This was seconded by Mr. Adams and carried unanimously.

North Wales.

Those interested in the formation of an amateur wireless society in North Wales are invited to communicate with Mr. G. S. Whale, The Wireless College, Colwyn Bay.

Hounslow.

Mr. A. J. Rolfe, of 20, Standard Road, Hounslow, informs us that he and some friends are anxious to start a wireless club in their district. Will those interested kindly communicate with Mr. Rolfe ?

West Hartlepool.

It is proposed to form a Wireless Club for West Hartlepool and district. Those interested should write to Mr. R. L. Howey, 33, Grange Road, West Hartlepool, Co. Durham.

Lancashire and Cheshire.

The formation of Wireless Clubs in many branches of the Y.M.C.A. in Lancashire and Cheshire is contemplated. Will those interested please communicate with Mr. L. Ramsbottom, British Motor Buildings, 230, Deansgate, Manchester.

THE MAKING OF WIRELESS APPARATUS

A WAVEMETER FOR SHORT WAVES

Construction and Calibration.

NOW that a certain amount of amateur wireless transmission is allowed on short wavelengths, it is necessary to have a wavemeter by means of which to adjust the transmitter wavelengths. Such a wavemeter can be cheaply and efficiently constructed if the following instructions are carried out.

The instrument we propose to design will have a wavelength range of approximately 140 to 240 metres, and will consist of a small variometer inductance and a fixed capacity condenser. In series with the inductance will be a small pocket-lamp bulb, for indicating C.W. tuning. Two terminals connected one either side of the condenser will be provided, so that either a crystal clip and telephones, or a buzzer and dry cell, may be connected across the condenser.

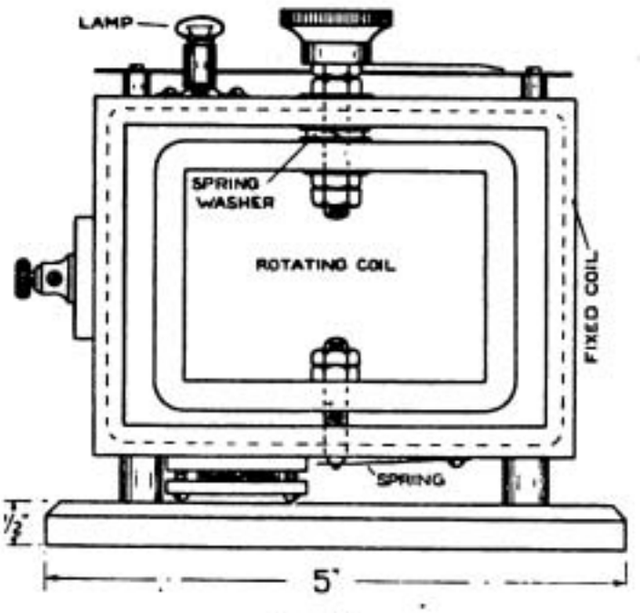

Fig. 1.

A general arrangement of the instrument is given in Fig. 1. From this it will be seen that the principal part is the variometer, which consists of two rectangular formers, pivoted one inside the other and mounted on a small stand. Details of the fixed and rotating formers are shown in Figs. 2 and 3.

The fixed former (Fig. 2) should be made up in box form, with no top or bottom. The wood used should be 2 inches wide by $\frac{1}{4}$ inch thick, and the lengths should be such that

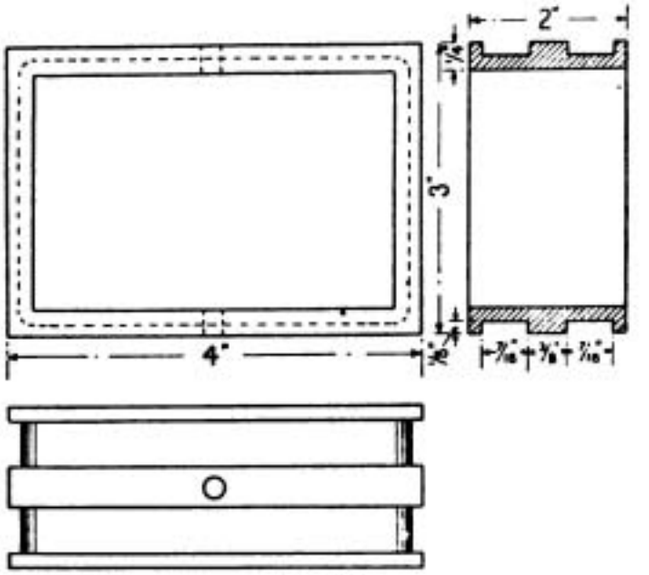

Fig. 2.

when mounted up—either dovetailed or nailed end to end—the inside dimensions should be $3\frac{1}{2}$ inches by $2\frac{1}{2}$ inches. Two parallel grooves should be made in all four sides in which the winding may be placed. The grooves should be $\frac{3}{8}$ inch apart, $\frac{7}{16}$ inch wide and $\frac{1}{8}$ inch deep. A $\frac{3}{16}$ inch hole should be drilled exactly in the middle of each of the two long sides through which the rotating coil spindles pass. A piece of clock spring, $\frac{1}{4}$ inch wide and $1\frac{1}{2}$ inches long, with a small hole punched near one end of it, should be mounted so that the small hole is exactly over the centre of one of the spindle holes. This spring acts as a bearing and rubbing contact, through which connection is made to one end of the rotating winding.

The rotating former (Fig. 3) may be a wooden block or a rectangular frame similar to the fixed former. We will consider the latter alternative. Use $\frac{1}{4}$-inch wood, $1\frac{1}{4}$ inches wide, and so joined together, either

dovetailed or nailed end to end, that the outside dimensions are 3 inches by 2¼ inches. This frame need not be grooved. In the middle of the two long sides a hole should be drilled into which the $\frac{3}{16}$-inch spindles can be screwed. The two spindles should be $\frac{3}{16}$-inch diameter threaded. The bottom one should be 1 inch long, and should have a short 30 degree taper at one end. This taper point works in the small hole in the clock spring, described above, and shown in Fig. 1. The top spindle should be 1¾ inches long (provided $\frac{3}{16}$-inch nuts can be obtained, $\frac{1}{8}$-inch thick). The assembly of this unit, fixed and rotating formers, will be clear from Fig. 1

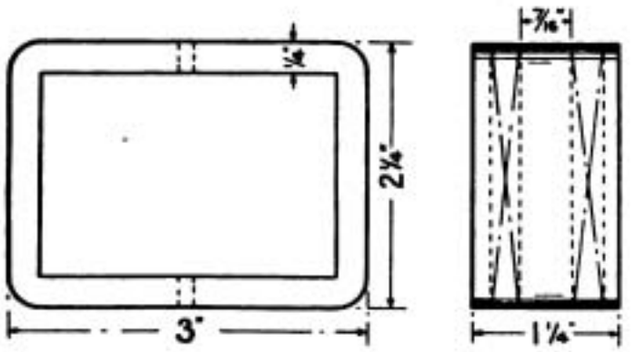

Fig. 3.

When the formers are complete and the spindles and nuts and spring washer obtained, the unit should be mounted and tried for mechanical working. If satisfactory, dismantle and proceed with the winding. For this we require 35 feet of No. 22 D.C.C. wire, about 4 ozs. The rotating former should have 6 turns one side of the spindles and 5½ turns the other; this allows the two ends to come one against each spindle. Make the wire fast to the former against the top spindle and wind on almost 6 turns; cross over to the second section just before reaching the top spindle again and wind 5½ turns in the same direction as the first section, and finish off against the bottom spindle. Secure the end of the wire in a looped piece of tape over which the turns are wound and the last turn taken through the loop, which is pulled tight to grip the wire.

Commence winding the fixed former at the bottom left-hand side, and wind almost 10 turns in the one groove, finishing off against the bottom spindle, to which this end of the wire should be connected. The start of this section should be on the outside of the groove, and the finish on the inside, and the winding should run in an anti-clockwise direction. The winding in the second groove should be 9¾ turns, starting at the top left-hand corner on the inside of the groove, and running round the former in an anti-clockwise direction and finishing on the outside of the groove at the bottom left-hand corner.

The start of this second section is connected to one side of the lamp filament, and the other side of the filament connects to the top spindle of the rotating former. Check the direction of the winding of the two sections of the fixed former to see that they are in the same sense and will not oppose one another magnetically. The winding in the grooves may be covered over with paraffin wax to the level of the wood, or the sides may be completely covered with very thin wood.

When the two formers are finished and the lamp-holder is mounted, the variometer may be finally built up.

Mount a small terminal board, with two terminals, on one side, as shown in Fig. 1.

The condenser and the method of calibrating the set will be described in the next instalment.

(To be continued.)

Previous articles in this Series have dealt with the following subjects:—

A Single Valve Long-Range Receiver.

How to make a Direction Finder.

A Frame Aerial Receiving Set.

The Construction of Condensers.

Inductance Coils.

A Separate Oscillator for C.W. Reception.

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) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (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.**

C. L. U. (Brighton) *sends a sketch of a circuit (shown in Fig. 1) by which he has seen it stated that speech was transmitted three miles in 1902. He asks (1) For size of spark to be used. (2) If the circuit would work.*

This method is apparently intended to work by low frequency induction, no spark being used, and the coil break being dispensed with. The method would be exceedingly inefficient, and we do not think that any results would be obtained without the use of a much larger aerial and more power than is allowed by the P.M.G.

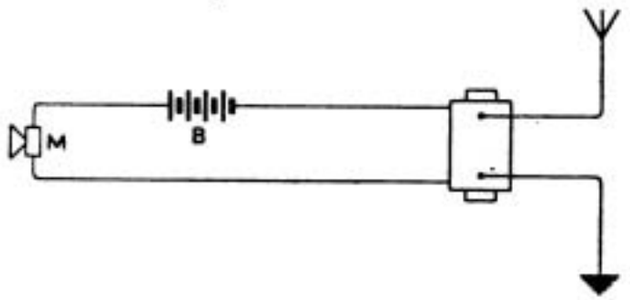

Fig. 1.

SPARE-TIMER (Braintree).—(1) The set is all right, but might be improved by connecting the crystal to the end of the slider, or, better still, to another slider on the coil.

(2) We cannot understand this effect, which appears to be due to some irregularity in the circuit. It is possible that the slider may not make equally good contact along the whole of its travel.

(3) It is most disadvantageous to double your aerial back on itself as the potentials induced by signals in adjacent parts of the wire tend to oppose each other.

(4) Honeycomb coils, as we have often remarked, are only different from other coils in their construction. The inductance of any two coils in series is the sum of their inductances and the mutual inductance between them, which may be either positive or negative. To cover all wavelengths, a series of coils would be required as the self-capacity of the individual coils and the capacity between them would otherwise come into play. The design of a variometer to cover all wavelengths is outside the scope of these columns. Your circuit should show the A.T.C. in the aerial lead, otherwise it is diagrammatically correct.

F.A.S. (Gravesend).—(1) Diagram correct.

(2) This is quite impossible to say; possibly you will succeed in transmitting a few miles, but the valve you suggest does not appear from its characteristic to be very good for transmission.

(3) Maximum 750 ms. approximately. Minimum uncertain.

(4) Quite suitable, and capable of receiving the same wavelength, but you should use a condenser across your telephones (about 0·003 mfds.). A variometer in your aerial circuit would be an improvement, as you are not using a variable condenser.

A.L. (Soham) *asks about nine questions under five headings. We give a number of replies.*

(1) The coils are single layer.

(2) We see no reason to doubt the accuracy of the writer's statement as to what he used. Coarser wire than No. 38 would certainly be preferable.

(3) If No. 30 wire, and mean diameter 4", about 3,500 ms.

(4) Leclanché cells are not suitable for valve working, as with the comparatively heavy currents required they are inefficient and polarise so quickly that adjustment of the valve to a sensitive point would have to be made almost every minute.

(5) The H.T. battery you suggest, though not very good, would probably give some results.

(6) Roofing slate would be possible, but not very good for a valve panel, owing to the ease with which it absorbs moisture. If you use it, dry it well and then shellac it all over, including the edges, and insides of the holes.

J.E.W.G. (Watford) *asks (1) How to connect up an ignition coil for transmission with certain specified apparatus. (2) For criticism of a set.*

(1) See Fig. 2.

(2) As well as we can judge with the little information you give us as to the sizes of your coils, you would probably do better by putting coil *B* in series with the jigger primary, and the variable condenser across the jigger secondary; the rest of your gear remaining as in the sketch.

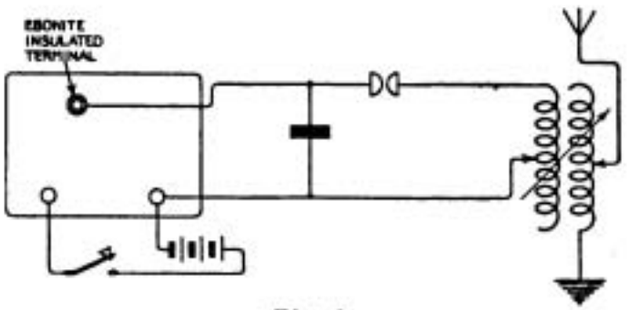

Fig. 2.

QUESTIONS AND ANSWERS

K.E.W. (Kristiania).—(1) and (3) The list of apparatus you submit is not very suitable for a good receiver. The sketch (Fig. 3), which necessitates the use of further apparatus, is about the best that we can suggest.

(2) The frame aerial might be No. 18, or equivalent in stranded wire. 2-slide inductance of No. 22.

(4) The set will not be very efficient without more than 1 valve for amplification.

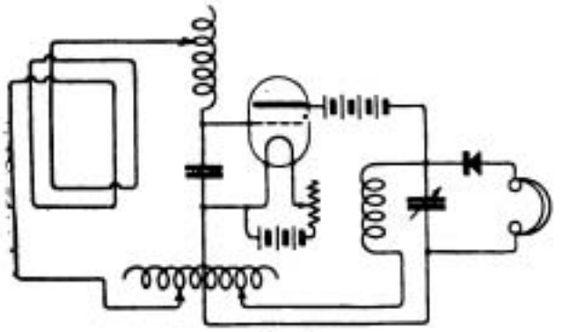

Fig. 3.

T.H.W. (Cambridge) *asks for help with a two-valve and crystal receiver, which is giving serious trouble from noises in the telephones.*

Telephone noises of the type you mention are not caused by any particular type of circuit. Setting aside the possibility of a loose connection, which you have tested for, the most likely causes are (1) a defective valve, (2) defective batteries, especially H.T., and (3) an intermittent break or short circuit in a transformer or the telephones.

S.J. (Birmingham).—The system you propose to use is, of course, not radio-telegraphy in the usual sense of the term, but we think you should apply to the Secretary of the G.P.O. in the usual way, submitting a sketch of your proposed apparatus and asking if a permit is necessary.

With your proposed system you will only get sounder reception in the telephones; the results would probably be better with some interrupter, either on the transmitter or receiver sides.

L.S.T. (Huddersfield) *asks* (1) *For criticism of an aerial circuit.* (2) *Why a certain crystal receiver gives no signals from the outside, but will pick up a buzzer not connected with it.* (3) *For capacity and inductance of the aerial.*

(1) Satisfactory, provided that the wires are spaced several feet apart.

(2) The circuit sketched is O.K.; the lack of signals must be due to bad connection, bad earth, or similar cause. The buzzer result is not uncommon.

(3) You do not give enough data for us to give capacity: probably about 50 mhys. and 0·00015 mfds.

A.E.B. (Sheffield).—(1) The aerial sketched will probably be fairly efficient, though an L aerial is preferable to a T, when the amount of wire is limited by the P.M.G.

(2) Interference from the telephone wires should not be great, but we doubt very much whether you will get permission to use the standards.

(3) Satisfactory; make a soldered connection.

(4) Quite correct.

G.T. (Birmingham) *asks various questions about a telephone transmitter.*

The set you sketch is interesting, but it is unnecessarily complicated, and would therefore probably need much skilled experimental work to get even fairly efficient. A modulator valve is unnecessary and wasteful with such low powers; yours is shown without any plate voltage. Your oscillation valve should have a closed tuned circuit in the plate lead, and you will probably find a circuit in series with your H.T. battery easier to manage than a shunt circuit. Either of the valves you mention is a good oscillator. The plate voltage should be about 100. The condenser C, if retained, might be 0·001 mfds.

AMATEUR (Palmer's Green) *asks* (1) *For the connections of a simple crystal receiver, capable of receiving spark and telephony.* (2) *If a three-wire inverted L aerial be suitable for this set. It is 50 ft. long and the wires are 18 ins. apart. It is in the loft at the top of a house, under slates.* (3) *What would be the wavelength of the set.* (4) *Would it be possible to receive the Marconi Concerts with this set.*

(1) See Fig. 1, page 662, of the issue for December 11th. The condenser should be about 0·0003 mfds.

(2) The aerial will be too much screened to be very efficient. The wires should be separated by considerably more than 18 inches.

(3) With the dimensions, as in the answer referred to, probably about 3,500 ms.

(4) Yes.

L.R.C. (Ilford) *asks* (1) *Will there be an article shortly on how to build a receiving set suitable for beginners.* (2) *What is the longest distance a good set can receive from.* (3) *Are there any binding cases for "The Wireless World," and, if so, what is the price of them.* (4) *A good book on Wireless for a beginner.*

(1) A set suitable for beginners was described in the issue for December, 1919.

(2) It depends on conditions. Transatlantic stations can be received with crystals on large aerials. On a P.M.G. aerial the high-powered European spark stations should be audible.

(3) Yes. See advertisement pages.

(4) Bangay's "Elementary Principles."

F.D.C. (Cambridge).—(1) The set is quite satisfactory—as is indicated by the results you get.

(2) Yes, but no telephony is being sent out from Chelmsford at present, the station being engaged on commercial work.

(3) Meteorological reports on 1,650 metres at 1200 and 2200.

(4) Put a variable condenser, maximum capacity ·0005 mfds., across the jigger secondary.

EBONITE (Clapham) *asks* (1) *For general criticism on a suggested resistance amplifier.* (2) *Is a condenser (·0001 mfds.) sufficient to set the amplifier oscillating for reception of C.W.* (3) *The approximate consumption of H.T. current and why it should be heavier than with a L.F. transformer amplifier.* (4) *Special precautions advised when laying out the set.*

(1) Quite a good set. There is no necessity to connect the grid leaks through the potentiometer to earth.

(2) Quite. Much less will probably be required.

(3) 10-20 milliamps. This type does not necessarily require more current than others.

(4) There are no special precautions necessary with this type of set—the only difficulties you are likely to meet with are in the making of suitable resistances.

CARBORUNDUM (Monkseaton) *asks* (1) *The wavelength of a coil* $10\frac{1}{2}'' \times 5\frac{1}{2}''$, *wound with No.* 24, *with a* 0·0005 *mfd. condenser.* (2) *The wavelength of a* 50′ *twin aerial plus A.T.I.* 6″ × 6″ *of No.* 20 *and jigger primary* $10\frac{1}{2}'' \times 6\frac{1}{2}''$ *of No.* 22. (3) *Whether the ratio of length to diameter of a coil affects its efficiency.* (4) *If* 800 *ohms. is too high resistance for a potentiometer for use with carborundum, and if so, if improvement would be obtained by using an* 8-*volt battery instead of* 4 *volt.*

(1) About 4,000 ms.

(2) About 3,000 ms.

(3) In general, no.

(4) The resistance is not high enough to be inefficient. If it were, increasing the battery voltage would not improve matters.

ELECTRON (Kenilworth) *is designing a set to work up to* 20,000 *ms., and asks* (1) (*a*) *If space is available, whether single-layer coils are best for his purpose.* (*b*) *In such coils, if the primary should be able to slide right inside the secondary.* (2) (*a*) *If he uses a dead end switch whether he can tune down to* 500 *ms.* (*b*) *If a dead-end switch is necessary on both coils, or only on the secondary.* (3) *What size of formers are recommended.* (4) *What gauges and type of wire shall he use, and the number of turns on each coil.*

(1) (*a*) Yes. (*b*) This is certainly advantageous, though such tight coupling may not be necessary.

(2) (*a*) Yes. (*b*) Yes.

(3) Quite arbitrary.

(4) The design of a complete set is outside the scope of these columns. See articles in the issue for February 5th of this year and following numbers for general principles of the design of such a set and for suitable inductance and capacity values.

AMATEUR (Birmingham).—(1) Your suggested circuit is wrongly connected. See Fig. 1, page 662, December 11th issue. (We think a constant reader should be able to sketch the connection of a single circuit crystal receiver without help.)

(2) Maximum wavelength about 3,000 ms.; minimum about 250 ms.

(3) Yes, if properly connected up.

(4) Add this coil to the aerial circuit; reply (2) assumes this done.

55 D. (Cambridge) *asks* (1) *How to wind a* 3′ *square frame,* 7″ *deep, for reception with a* 0·002 *condenser up to* 16,000 *ms., with a* 55*D amplifier.* (2) *How to fit a variable reaction to a French L* 1 *amplifier.*

(1) As you do not wish to use a loading coil you could wind the frame with wire of, say, No. 20, spaced 7 turns to the cm. We should prefer, however, to use a loading coil, with fewer turns further spaced on the frame. For tappings divide approximately in the ratios of the squares of the wavelengths required.

(2) For diagram see Fig. 1, page 597. You could break the plate lead of any of the first 3 valves, introducing a coil variably coupled to your tuned circuit induction.

N.J.W. (Cambridge) *asks* 2 *questions about a set and* (3)*Could he get a single ear telephone say of* 1,000 *ohms converted into a relay, if carefully and accurately done by experts.* (4) *Would a coherer be of any use with a Morse writer for taking down Press from* FL BYC MPD, *etc., using one valve for rectification and one for amplification.*

(1) About 4,000 ms.

(2) ·00008 mfds.; this condenser if used in the aerial circuit should be in parallel with the A.T.I., in any case it is too small to be of much use.

(3) This could possibly be done, but it would probably be almost as easy and cheap to make or buy a relay of normal type, and the results so obtained would be far superior.

(4) No; it would be almost impossible to make it work at the required speed.

J.S.N. (Streatham) *sends a sketch of a one-valve set, and asks* (1) *The correct capacities of the two condensers.* (2) *If there is anything wrong with the circuit.* (3) *If a crystal detector inserted as shown would be worth trying.* (*The crystal shown in shunt across the reaction coil and is itself shunted by a potentiometer.*)

(1) A.T.C. (Parallel) about 0·0003 mfds.
Grid condenser 0·00005 mfds.
Blocking condenser 0·002 mfds.

(2) and (3) The circuit is quite good, except for the crystal detector, which is quite useless as shown. For a possible way of using a crystal with valve, see the circuit on page 65 of the issue for April 17th.

(4) Not unless the set is to be used over very wide ranges of wavelength.

H.W. (Manchester).—(1) Your diagram shows the lead-in wires making a sharp bend with the aerial. This is very bad practice; you should sacrifice aerial length if necessary to avoid it.

(2) Your diagram might give a satisfactory receiver, but it looks rather mixed up. We suggest:—

(*a*) Aerial connected to the slider of long coil.

(*b*) One end of the long coil connected to one slider of the short coil.

(*c*) One end of the short coil earthed and connected to condensers and telephones.

(*d*) The other slider of the short coil connected to condenser and crystal.

(3) Up to about 4,000 ms.

(4) You might receive Chelmsford if your set is in good order and well adjusted.

N.E.K. (Brussels) *asks* (1) *What should be the ratio of transformation of air cored intervalve H.F. transformers.* (2) *If a carborundum detector could be used as a grid leak.* (3) *What is the best way to convert an* 8-16 *mfds. condenser and iron-cored chokes to D.C. mains to cut out noises.* (4) *For particulars of the Glace Bay station; wavelength, type of set, hours of service, Press service.*

(1) 1·1 ratio is most usual.

(2) No; too low.

(3) Put one choke in series with each main and condenser across the delivery terminals.

(4) 8,000 ms.; valve set; service continuous for commercial purposes, but practically no Press.

NOVICE KEEN (Newcastle).—(1) The inductance you describe is quite suitable for a loading coil of a frame aerial set.

(2) R valves could be used instead of V24 valves for the above. You might get as good results with 3 R valves instead of 4 V24 valves, employing 80 volts H.T. and 4 volts on the filament.

(3) See reply to **A.A. (Chelsea)** for a diagram of a 2-valve frame aerial receiver. The throw-over switch from the aerial to the frame is of course unnecessary. The valve amplifier can be modified so as to comprise more valves by obvious means, and any other form of amplifier can equally well be employed.

(4) Sample a = 32 S.W.G.
b = 34 S.W.G.
Both are somewhat fine for receivers.

S.H.P. (Great Bookham) *asks* (1) *For criticism of a single circuit sketched.* (2) *The wavelength with an A.T.I. of 9" × 6" with No. 24 wire.* (3) *If a variometer would improve the circuit.*

(1) Simple, but fairly efficient.

(2) About 3,000 ms.

(3) No. Little use, your A.T.I having two sliders.

S.F.B. (Oundle).—(1) Iron or steel wire would have a much higher H.F. resistance than copper, and would therefore not be suitable.

(2) (*a*) About 14,500 microhenries.
(*b*) About 8,700 ,,

(3) $L = \frac{\pi^2 n^2 d^2 l K}{1{,}000}$

where L = inductance in mhys.
n = No. of turns per cm.
d = diameter in cms.
l = length in cms.
K = Nagaoka's factor

K is tabulated in Nottage's "Inductance and Capacity" in terms of d/l.

Typical values are d/l	·25	·50	·75	1·0	2·0	3·0
K	·9	·81	·75	·69	·53	·43

SPARK (Durham).—(1) Your diagram shows no H.T. on the plate of the second valve: this is quite enough to explain absence of results.

(2) The space between plates is not stated for the condenser B. The condenser C = 0·0005 mfds.

(3) 400,000 mhys. A.T.I. (26 S.W.G.) Secondary inductance 30 S.W.G.

N.H. (Huddersfield) *asks* (1) *For criticism of the circuit sketched.* (2) *Will the circuit give good results.* (3) *Will a loading coil placed in the secondary circuit increase the wavelength.* (4) *What crystal would you recommend for use without a potentiometer.*

(1) Connections are incorrect. See Fig. 6, page 500, October 2nd issue, and many other crystal circuits.

(2) Yes, if altered as suggested, tuning condenser = 0·0005 mfds. at maximum.

(3) Yes, say 6" × 3" of No. 28, wavelength should then reach 3,000 ms.

(4) Zincite-bornite is a good one.

R.C.C. (Willesden) *has a short-wave receiving set in which the A.T.I. and A.T.C. are both at their maximum when tuned to 600 ms. He asks for particulars of an inductance to add to the aerial so as to bring the adjustments well on the instruments.*

An A.T.I. of 10" × 6" wound full (single layer) of No. 24 should be ample for 3,000 ms. with a P.M.G. aerial. Probably your A.T.C. is too small. Try shorting it.

J.G. (Coventry).—(1) The "c" and "d" terminals on an amplifier A Mark 4 are for use with a grid condenser and leak.

(2) You could probably obtain a Signal Service handbook giving you the wiring diagram.

(3) YN is Lyons—15,000 ms.

(4) The primary of a loose-coupled valve set being included in the aerial circuit, is tuned with the aerial.

C.W. (Broadstairs).—The description and sketch of your set is so vague that we can hardly help you at all. It is impossible to tell how your instruments are connected up, and we think your lack of success is due more likely to a wrong method of connection than to the comparative badness of your situation. An additional loading coil will increase your wavelength range, but will not improve results on short waves.

H.C. (Doncaster) *asks* (1) *What results to expect with a specified aerial and a circuit as sketched.* (2) *If the aerial is suitable for long wave C.W. reception on a valve set.*

(1) The aerial is tolerably good, but results would be almost nil with the connections as shown. For best connections see Fig. 4, page 758, in the issue for January 22nd.

(2) Yes, with a suitably designed set.

C.S.A. (Edinburgh).—(1) Do not use thinner than No. 24 unless absolutely unavoidable.

(2) It depends on the circuit, about which you say nothing. For a two-circuit receiver of normal type with a closed circuit condenser of 0·0005 mfds.—about 4,000 ms.—with a suitable A.T.I.

(3) Certainly; for range as in (2) use about 6" × 12" wound with No. 24.

(4) Yes.

R.E.C. (Harringay).—(1) The circuit is of fairly suitable type, but we do not like the arrangement of the plate circuit, which would be better as jn Fig. 4:—

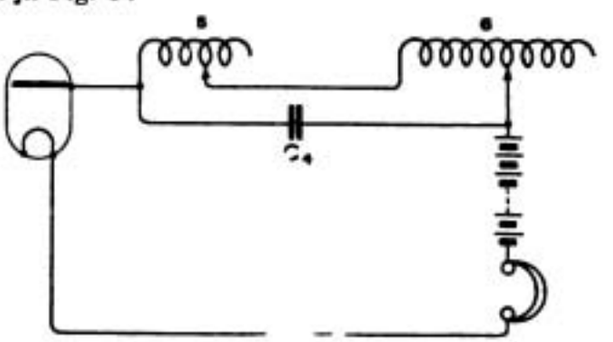

Fig. 4

C_1 should be not less than ·005 mfds. C_2 and C_4 should be not greater than ·001 mfds. C_3 should be not greater than ·0001 mfds. We should recommend

the addition of a reaction coupling between the plate and grid circuits.

(2) Altered as suggested, about 2,500 ms.

(3) Yes.

(4) See above.

R.C.R. (Woolston).—The set you propose, though of simple type, should be fairly efficient, and the dimensions suggested are suitable, except for the aerial, which should, if possible, be longer and with fewer than 5 wires in parallel. Separate your wires as far from each other as possible.

T.D. (Newcastle) *asks* (1) *How much wire and how many tappings should be given to the reactance coil to make the wavelength up to* 16,000 *ms., using* 32 *enamelled wire if the tuning coil has two pounds of No.* 26 *enamelled copper wire.* (2) *Is black enamelled wire good enough for both coils.* (3) *What diameter should the reactance coil be, if the tuning coil is* 6″. (4) *Which is the better aerial for the set,* 100′ *single or* 70′ *double.*

(1) Try about 4″ × 6″, with about 4 tappings.

N.B.—Your suggested A.T.I. former, 6″ × 4″, will not take two pounds of No. 26 and will not give anything like 16,000 ms.; use a former of, say, 8″ × 18″. Even then you will require a small parallel condenser.

(2) Yes, if the coils are carefully wound, but we should prefer with silk insulation.

(3) See above.

(4) Immaterial.

W.E.D. (Knightsbridge).—(1) Connect as shown in Fig. 5.

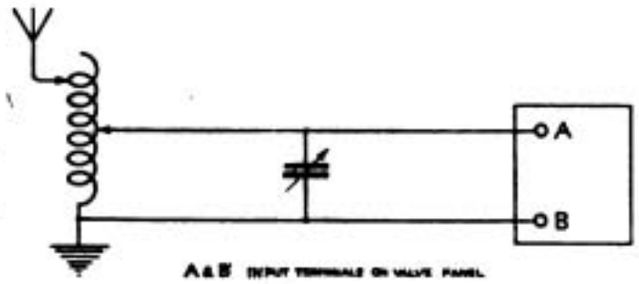

Fig. 5

The crystal is of no use with this arrangement without the addition of further gear.

(2) No.

(3) The receiver will be more selective with an additional A.T.I., enabling looser couplings to be employed.

(4) Impossible to say, as you do not give the gauge of wire with which your slider is wound.

C.O.P. (Ilkley).—(1) No.

(2) Make an A.T.I. about 12″ × 8″ and wind with No. 22 wire.

(3) No. Connect up as in Fig. 2, page 790, of the issue for February 5th, using your own coil in place of the two there shown.

(4) Carborundum is very good for general purposes.

J.E.P.L. (South Africa).—(1) We do not quite understand your proposed switching arrangements. Assuming that they are correct, your circuit is one which would be extremely tricky to work, but might give good results on critical adjustments.

(2) Your aerial circuit should tune to nearly 4,000 ms., and your secondary to about the same wavelength. Minima uncertain. A grid leak (3 megohms) is required across C_3. If you get poor results try omitting the condenser across the reactance and using few turns and close coupling of the latter.

(3) 4,000 ohms would probably do.

W.W. (Aboyne).—(1) You do not state the thickness of plates: assuming this as 2 mms., the capacity is about 0·0007 mfds.

(2) You could obviously make as above, but with about half the number of plates.

(3) The circuit is quite unsuitable. Connections should be as shown in Fig. 6.

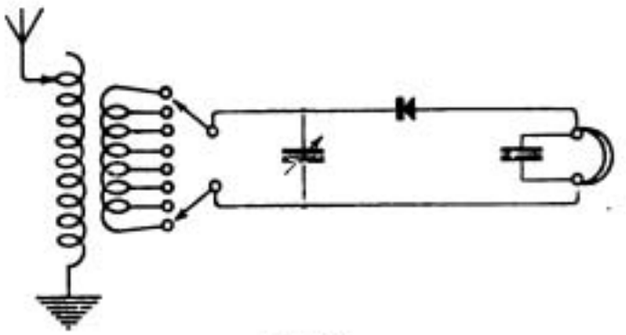

Fig. 6.

Rewind the primary with No. 24 and the secondary with No. 26; this will give a wavelength of 4,000 ms., which will be quite sufficient.

(4) The coil can be used as an additional A.T.I. if desired.

H.R.H. (Oxford).—The question as to which of the aerials you propose is the best depends chiefly on which gives the greatest clearance between the wires and the roof. From your sketches your present aerial appears best in this way and therefore is preferable to the other, in which you gain a few feet in height at the expense of increased nearness to the roof.

A CORRECTION.—In the article "A Valve Transmitter for the Experimenter," on page 866 of the March 19th issue, Fig. 1 should read Fig. 2, and Fig. 2 should read Fig. 1.

SHARE MARKET REPORT.

The Wireless Group has been fairly steady and has shown a slight improvement during the last fortnight. Prices as we go to press, April 8th, are :—

Marconi	Ordinary	£2 - 1 - 3
,,	Preference	£2 - 1 - 3
,,	Inter. Marine	£1 - 6 - 3
,,	Canadian	6 - 0

Radio Corporation of America :—

Ordinary	9 - 6
Preference	11 - 0

The WIRELESS WORLD

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THE HAGUE CONCERTS

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

IT is probably in no sense an exaggeration to say that the enthusiasm of the average radio amateur or experimenter in wireless telephony far exceeds his interest in all other branches of wireless work. The ability not only to actually speak and carry on conversations with æther waves as the only connecting link, but also to pick up complete orchestral concerts and enjoy them in our own home adds to this keenness for radiotelephone work.

In the past we have been treated to occasional radiotelephone concerts from one of Marconi's Wireless Telegraph Co.'s stations at Chelmsford, when special experiments and tests have been in progress, while the more regular transmissions from Surbiton in connection with the exhibit of the same firm at the recent Olympia Exhibition were also a source of enjoyment to many. For some time past the Nederlandsche Radio Industrie have been adding to the above and other concert programmes by a series of telephonic transmissions, sent out for periods of two or three hours regularly, at first on one evening a week, and later twice a week. The power used for these transmissions was, however, small, and the concerts were therefore difficult to pick up. The power used for these transmissions has now been increased to 100 watts, and will shortly be further increased by the installation of a 250 watt Mullard valve. In view of the widespread interest taken in these "Dutch Concerts" it may, perhaps, be of further interest to illustrate some of the apparatus used for the transmissions. Fig. 1 shows an outside front view of the works of the Nederlandsche Radio Industrie at the Hague, from which the transmissions take place. The aerial can just be seen over the building, but Fig. 2 is a view showing the

Fig. 1. Front view of the Works of the Nederlandsche Radio Industrie at the Hague.

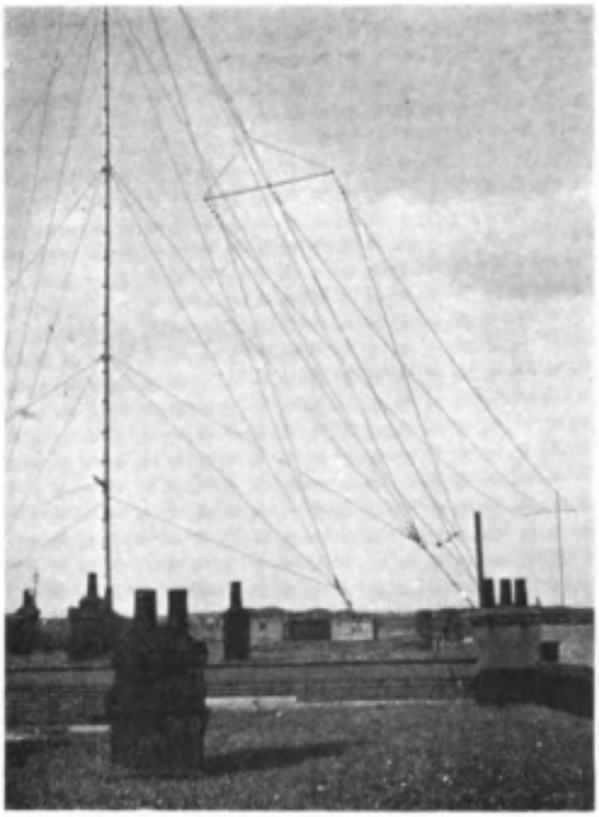


Fig. 2. A clearer view of the Aerial.

aerial more in detail, taken from the roof. The aerial consists of three wires approximately 150 metres (500 ft.) long each, and is stretched across a road.

The station earth connection consists of about 24 metres (80 ft.) of iron pipe sunk in a well, but it is thought that probably this connection is not a perfectly uniform one. Receiving stations listening in to the concerts have frequently reported considerable variations in intensity from day to day, and it is considered likely that variations in the efficacy of the earth connection may be a contributory cause. Such variations may arise with the height of the tide and consequent changes of the salinity, and therefore of the conductivity, of the well water brought about by the percolation of sea water into the well. This, however, is a question that could fairly easily be investigated, and extended observations of the signal intensity received from this station would therefore be of interest, especially if they showed a periodicity depending upon the moon and tides.

The actual transmitting apparatus is illustrated in Fig. 3, in which the transmitting valve can be clearly seen at the top of the panel. The valve shown is nominally of 100 watts capacity, but its output is being pushed up to 150 watts by using an anode supply voltage of 1,000 volts. This valve is shortly to be replaced by a 250 watt Mullard valve, when a greater output should be obtained.

The phonograph which is used for transmitting some of the musical selections can also be seen in this illustration, the usual horn being replaced by a tube in which the transmitting microphone is mounted, a second microphone being placed on the table near the phonograph. No separate modulating valve is employed, but a special patented form of grid control is used, details of which, however, are, unfortunately, not available for publication.

Arrangements have been made by Messrs. Burnham & Co. with the Darewski Publishing Co., through the kindness of Mr. H.

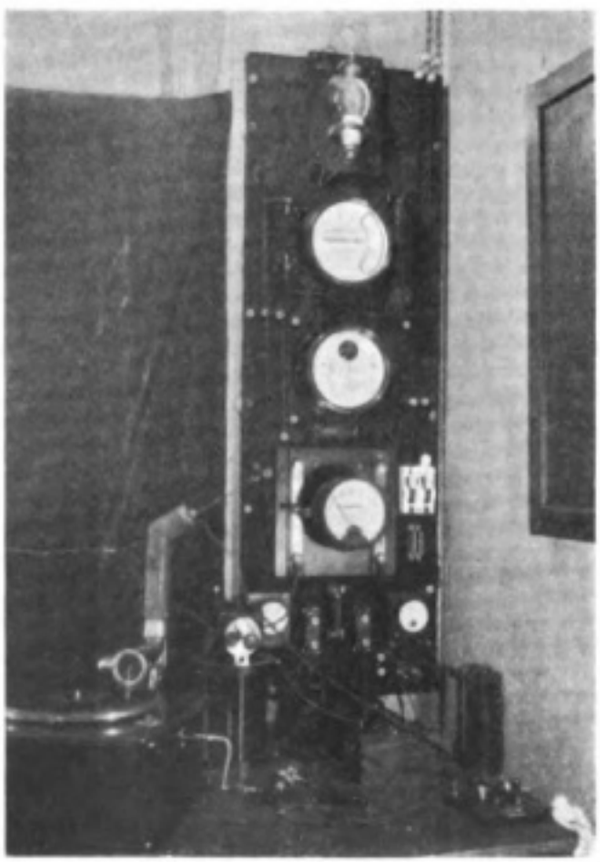


Fig. 3. The Transmitting Apparatus.

Darewski, for the supply to the transmitting station at the Hague of phonograph records of all their newest publications, so that selections from the latest English music will be available to all within the radius of the transmitting station. It is expected also that loud-speaking receiving apparatus will be installed so that the British troops in Cologne can be entertained by the same means.

The phonographic selections sent out by this station are also interspersed with selections by a small band, and by four mandoline performers; occasionally also some singers take part. The orchestra and singers perform under a large funnel or horn which contains the microphones connected to the transmitting apparatus, so that the voices and music modulate the radiated power in the usual way.

Although they may be heard over a range of roughly 500 miles round the Hague, these concerts are addressed primarily to British wireless experimenters, as is evidenced by the introductory C.W. messages addressed to all British amateurs with which they are prefixed. These messages usually also ask for reports of the reception of the concerts to be forwarded to Messrs. Burnham & Co., Deptford, who are the British agents for the Dutch Company.

As regards the reception of the concerts, they have been heard satisfactorily over considerable ranges using but a single detecting valve, but such a simple receiver is not recommended for reliable work. Even at Aberdeen, some 500 miles from the transmitting station the signals have been heard on a single valve, but this must be put down more as a freak reception, or as due to some particularly favourable circumstances inherent to the neighbourhood—an assumption that is not altogether unwarranted in the light of other results obtainable in this district. In general it is advisable to use at least one high-frequency amplifying valve in front of the detector valve in order to obtain satisfactory reception, while, of course, one or more stages of low-frequency amplification (*i.e.*, note magnification) may be added after the detector valve when it is required to operate a loud-speaking receiver. A limited amount of reaction may be employed if desired, but the greatest care must be taken in its use to *avoid self-oscillation* of the set. If this takes place not only is the reception of the speech prevented but its reception by others for many miles around is also seriously interfered with. This point with regard to the avoidance of autodyne receivers cannot be too strongly emphasised, and every effort should be made to discourage their use. Naturally, when first searching for the station, or when listening to the C.W. signals, it is necessary to use the heterodyne method, but unless an entirely non-radiating receiving arrangement is employed with a separate heterodyne and appropriate couplings to prevent the oscillations reaching the aerial circuit,* the use of an oscillating receiver should be restricted to as short a time as possible. As soon as the signals are heard the reaction should be loosened, so as to stop the oscillations. Not until this is done can the speech, etc., be received properly, although in favourable circumstances some of it may be distinguished. It is much preferable, however, to instal an extra amplifying valve rather than to jam other receivers in the vicinity.

As regards possible receiving arrangements, any good high-frequency amplifier suitable for the wavelength (1,150 metres) may be used, together with a detecting valve of the usual type. Such a receiver may be purchased complete or may be built up from the necessary component parts.

The circuit arrangement shown in Fig. 4 is a simple one that gives good results, although not necessarily the best possible one to employ. It consists of an aerial loading coil L_1 having an inductance of about 500—700 micro-henries connected between the aerial and earth terminals, and having a tuning condenser C_1 in parallel with it. This condenser should have a maximum value not exceeding 0·001 mfd., while it should be kept as small as possible consistent with tuning the coil used to the required wavelength of 1,100 to 1,150

*See article in last issue of *The Wireless World*.

metres. Across the tuning coil are joined the grid and filament leads of the first valve V_1 in the anode circuit of which the anode resistance R_1 is connected. The reaction coil L_2, in series with the second valve, should have at least as large an inductance as L_1 and is preferably somewhat larger.

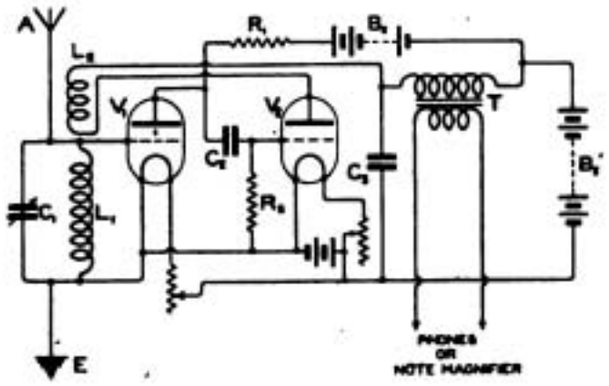


Fig. 4.

The loading and reaction coils may conveniently be of the multilayer type—Honeycomb, Duolateral or "Burndept"—but may also, if preferred, be wound up as single-layer coils as the wavelength is not high. Convenient dimensions for such windings are as follows :—

For loading coil :—

Diameter = 4 in.
Wire = No. 22 S.W.G., d.c.c. copper
Length of winding— (single layer) = about 4 in.

For reaction coil :—

Diameter = 3 in.
Wire = No. 30 S.W.G., d.c.c. copper
Length of winding— (single layer) = 4 in.

The resistance R_1 may be of 50,000 ohms. resistance or less, depending upon the valve in use and the H.T. battery voltage available, bearing in mind the fact that the higher R_1 is made the higher must be the voltage of the H.T. battery, if the valve is to work at the same point of its characteristic.

The intervalve coupling condenser C_2 should be about 0·0002 mfd. capacity, while the grid leak R_2 may have a resistance of 1 to 2 megohms. The blocking condenser C_3 may have any convenient value exceeding about 0·003 mfd.

In place of the head telephones the input transformer of a note magnifier may be joined up so as to enable a loud speaker to be used. The use of a note magnifier, in conjunction with the detecting valve alone, is not usually sufficient to ensure good reception without the high frequency amplifying valve as well.

In using the receiver the reaction coil L_2 may be coupled to the tuning coil L_1 until oscillations are set up, and the wavelength varied until the whistle of the C.W. note is heard. The *reaction should then at once be reduced* until oscillations cease, when, by slight careful retuning, the telephony should become audible.

While describing the above circuit as a possible simple workable arrangement, it should be understood that it is not necessarily recommended as the best possible one. Every experimenter should investigate this point for himself and determine the details that give the most satisfactory results at his station and with the valves that he customarily employs, bearing always in mind the necessity to avoid both heterodyne radiation as much as possible when searching for the C.W. signals, and the use of any form of heterodyne when listening for the telephony itself. The former may be diminished by coupling the receiver to the aerial circuit and by other means already pointed out in these columns, and the latter by switching off the separate heterodyne if one is used, or by reducing the reaction of an autodyne until the oscillations stop.

Finally, the writer wishes to express his thanks to Mr. W. Burnham, to whom he is indebted for the loan of the photographs illustrating this article, and for some of the information contained herein with regard to the Nederlandsche Radio Industrie.

REACTION VALVE CIRCUITS

By Frederick J. Rumford.

IN the past thirteen years of his experimenting on receiving and transmitting circuits, the writer considers the six described below as being the best reaction valve circuits he has met to date. These have been fully tested in practice.

Fig. 1 is considered the best that has come to light in his experiments. As will be seen, a vario-coupler and two variometers are employed, and the arrangement of the circuit eliminates the necessity of having the H.T. batteries and telephones in the oscillating circuit. As will be seen,

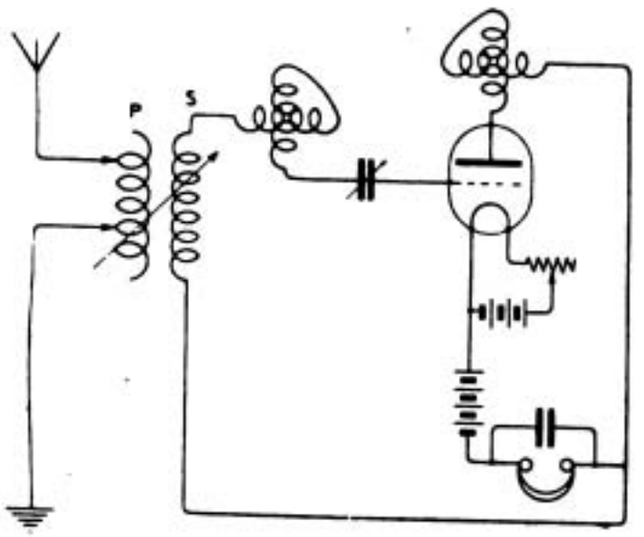


Fig. 1.

there is a condenser shunted across the telephones to intensify the audibility of the incoming signals. This circuit has unlimited

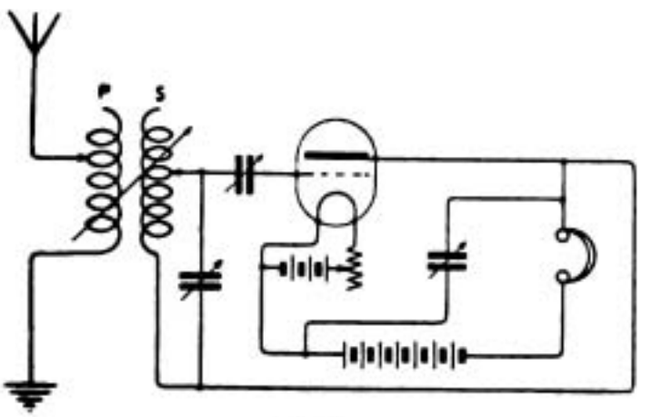


Fig. 2.

possibilities of amplification. There is no necessity of tapping, as all tuning is done through the variable condenser and the variometers.

Fig. 2 is the well-known ultra-audion circuit, and is the simplest form of reaction circuit. This circuit is employed on the De Forest receivers, and is popular with many amateurs for the reception of continuous waves. This reaction circuit is not easily controlled, and its amplifying powers are nil. As will also be seen, there is a variable condenser shunted between the telephones and H.T. batteries for the passage of high-frequency currents. There is no necessity of tapping in this circuit also as all tuning is done by means of the variable condenser and the coupler.

Fig. 3 is another good circuit where variometers are used to tune the grid and the plate, variometer 1 is used solely for the control of the inductance and the different wavelengths for the secondary circuit, while

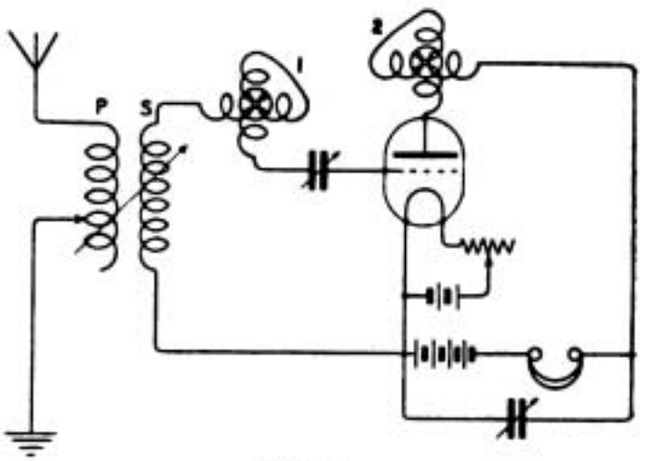


Fig. 3.

variometer 2 is used solely for amplifying and has nothing to do with the different wavelengths of the circuit. As will be noted, both telephones and H.T. batteries are included in the oscillating circuit, thereby offering a large impedance for the passage of high-frequency current. With the omission of the variable condenser, which is shunted

across the H.T. batteries and the telephones, the amount of impedance would be so high in this circuit that it would fail to react or oscillate, and it is therefore necessary to use

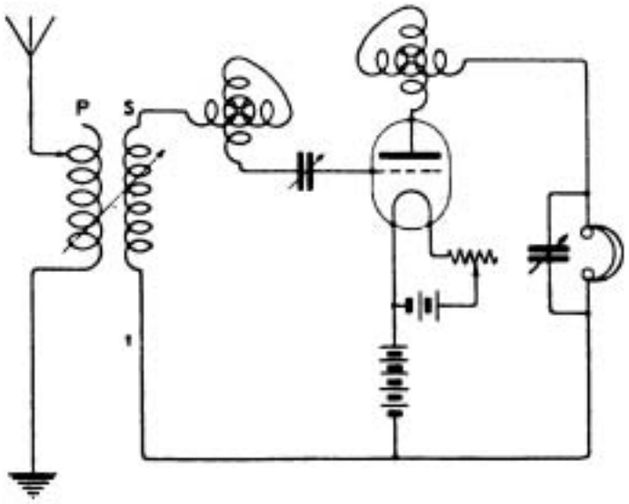


Fig. 4.

this variable condenser for the passing of these high-frequency currents. As stated before the tuning is done through the condensers and variometers.

Fig. 4 is the same as Fig. 3, with the exception that the H.T. batteries are removed from the oscillating circuit. This one is also tuned through the variable condensers and the variometers. There is also a variable condenser shunted across the telephones.

Fig. 5 is the usual circuit with one stage of amplification. With this circuit the audibility of signals can be increased to a great degree. It would be a good idea to make arrangements for the addition of a loud speaking horn to allow for any number of persons to listen in. If desired, many stages of amplification can be added.

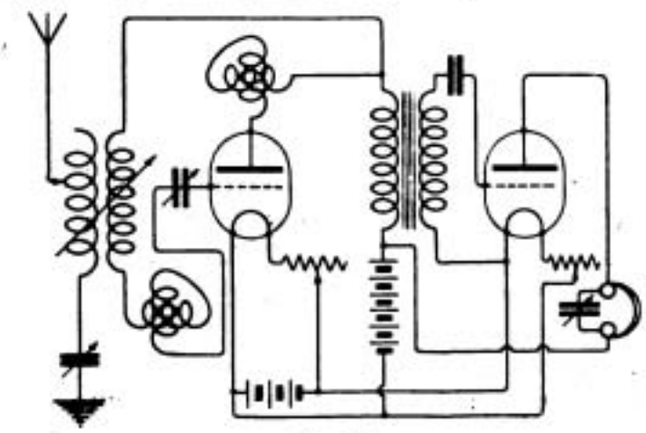


Fig. 5.

Fig. 6 is the simple Paragon reaction circuit.

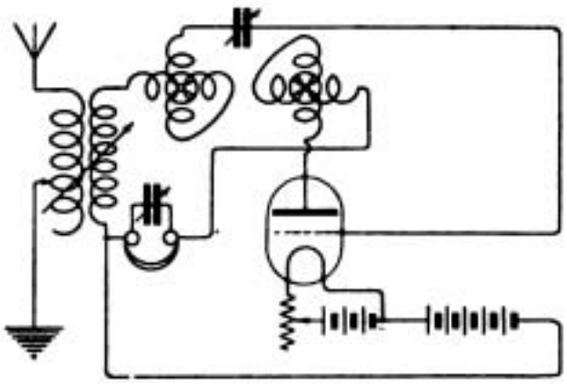


Fig. 6.

In these circuits minor details have been left out, but the writer feels sure that if the instructions are carried out faithfully the experimenter will be more than satisfied with the results.

Editor's Note.—The Author has followed American practice in drawing the batteries with short thick strokes to represent the positive poles. This should be noted when wiring the circuits.

NOTES

The "Turner" Valve Relay.

Mr. J. E. Harrison, the author of an article on the "Turner" Valve Relay, which appeared on page 735 of the January 22nd issue of *The Wireless World*, has prepared detailed working drawings of the home-made instrument he described. Mr. Harrison advises us that these drawings can be had from him, together with full instructions. His address is 34, Pennard Road, London, W.12. We understand that the price will depend upon the demand for the drawings.

Call Letters of Amateur Stations.

The Hon. Secretary of the Wireless Society of London, Mr. L. McMichael, 32, Quex Road, N.W.6, has circulated a letter to members of the Society with a request for particulars of their transmitting licenses, giving call letters, power, system and times of working. The intention is that these particulars shall be published subsequently. Will all readers kindly co-operate in the endeavour to make this list as complete as possible.

SOME ACOUSTICAL EFFECTS IN WIRELESS*

By J. Robinson, M.Sc., Ph.D.

ACOUSTICAL effects are of the utmost importance in wireless, as the universal method of receiving signals makes use of telephones. The object of the present discussion is to consider certain methods of note production by thermionic valve circuits. These are of interest in various ways, because of their bearing on the production of oscillations of wireless frequencies, of their application to the study of acoustics, and because they indicate other lines of development in wireless. Three different methods of note production will be described, and certain applications will be indicated.

I.—The Heterodyne Effect.

The method of receiving continuous waves by the heterodyne effect is so well known as to need no description. The principle employed is to utilise a local source for the production of oscillations, and to adjust the frequency until a beat tone is heard in the telephones. By adjusting the frequency of the local oscillator any desired pitch of note can be obtained from the lowest to the highest. The quality of the note obtained is fairly pure. If the two high frequency oscillations are simple harmonic oscillations, then the low frequency oscillations will also be pure, apart from any distortion due to the telephones. The freedom of adjustment of pitch of note allows the operator at times to overcome disturbances. He can adjust his note to be conveniently high so that his ear appreciates it through disturbances of low notes such as the noise on aircraft, atmospherics and spark stations.

Lag of the Ear.

Telephones often have a most sensitive pitch, and the operator can adjust his note to this pitch in order to increase the audibility. The most experienced operators have noticed that they cannot always efficiently use a pitch which is too high. This is particularly the case when the transmission is rapid. They find that dots are often missed when the pitch of note is too high and the transmission is quick. The reason for this, apparently, is that the lag of the ear depends on pitch. A simple experiment can be made to show this. Arrange an automatic transmitter at the sending station. This can conveniently be in the form of a commutator with the lengths of make and break adjusted, and with the speed of the commutator under control. A speed can soon be found where, for low notes, the separate signals can be distinguished, whilst for high notes the signals are indistinguishable. This shows that as the pitch increases the persistence of sound is lengthened. This is most probably due to the lag of the ear, although it should be remembered that these notes are made audible by a telephone diaphragm which may have some influence. The effect is of such interest in physiology that experiments should be made with other means than telephone diaphragms, *e.g.*, with a Galton's whistle. If, as is anticipated, the effect is really an attribute of the ear, the heterodyne effect gives a very convenient means for investigations in the realms of physiological acoustics.

Upper Limit of Audition.

Another use that can be made of the heterodyne is to determine the upper limit of audition. Wavelengths and wireless frequencies can be measured with such accuracy that the frequency of the highest note audible to various ears can be readily calculated. A simple means of doing this is to read the capacity of the receiving circuit for the highest audible note on both sides of the zero. From these measurements it is quite easy to calculate the upper limit of audition for any individual. Here, again, in the formal methods of reception, one must depend on the telephone diaphragm which may have some influence. Calculations by this method have given for a number of individuals upper limits of audition from 15,000 to 20,000, which is of the same

* *A Paper read before the Wireless Society of London, on Monday, April 4th, 1921.*

order as is usually obtained by other methods for notes of medium intensity.

II.—Low Frequency Oscillating Circuit.

A typical circuit for the production of continuous oscillations is shown in Fig. 1, with the anode inductance L_1 coupled to the grid inductance L_2. The frequency of the oscillations depends on the values of the inductance and capacity of the grid circuit.

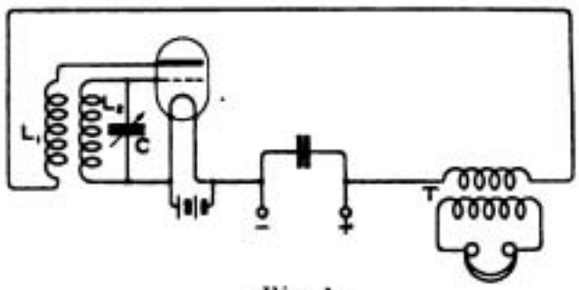


Fig. 1.

By increasing these the frequency diminishes, and it is possible to get the frequency so low that it is within the limit of audibility. For instance, when the inductance L_2 is 10 henries, and the capacity C is 25 milli-microfarads, an oscillation of frequency approximately 300 is produced. Suppose that the primary of a telephone transformer T is inserted in the anode circuit, and that the frequency is varied from wireless frequencies downwards. A frequency is reached where a very high note is heard in the telephones, and as L_2 and C are increased the pitch of this note diminishes.

The capacity and inductance are not the only controlling factors of the frequency. The anode voltage and the filament temperature also have some influence. A number of investigators have shown that for wireless frequencies, a small change of frequency is obtained by altering the anode voltage or the filament temperature. Van der Pol* and Miss Leyshon† have investigated this matter, and both have remarked on the minute magnitude of the change thus produced for wireless frequencies. At acoustic frequencies the variation of frequency is by no means minute, variations of from 2,000 to 500 frequency having already been measured. Such large variations, when first observed,

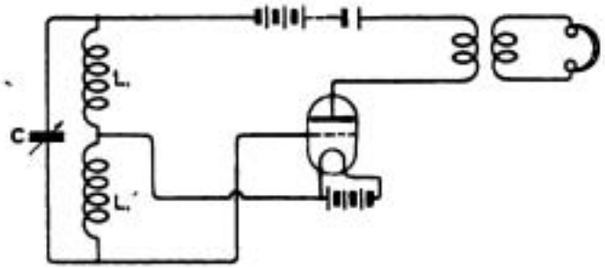


Fig. 2.

were so unexpected that attempts were made to find whether they were spurious. Another type of oscillating circuit (Fig. 2) was fixed up with the inductance L_1L_1' joined across anode and grid, the filament being joined to a point near the centre of the inductance, similar results being obtained.

Some of the results are shown in Fig. 3, for variations of anode voltage. As the anode volts increase it is noticed that the frequency

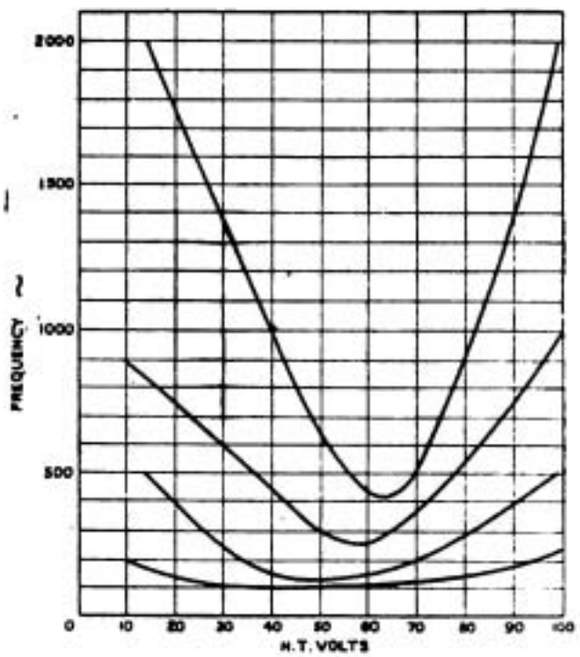


Fig. 3.

falls to a minimum and then increases. Similar effects can be observed by varying the filament temperature.

Such effects as these show that the theory of the thermionic valve oscillating circuit

* *Radio Review*, 1, page 701, November and December, 1920.

† *Radio Review*, 1, page 481, July, 1920.

needs considerable development. Miss Leyshon, for instance, attempts to explain small variations of frequency for wireless frequencies on the generally accepted treatment of valves where the effects are supposed to take place on a linear part of the characteristic. She gives a formula for the frequency, $\frac{1}{\omega^2} = LC + \frac{SL'C}{S' + 1/a}$ where ω is 2π times the frequency, L and C the inductance and capacity of the oscillating circuit, S and S' the resistance of the grid and anode circuits (external to the valve), L' the inductance in the anode circuit, and a the gradient of the anode current anode volt characteristic. Applying this formula to the case of acoustic frequencies where the resistances S and S' may be high, it is quite possible to account for a large variation of frequency. Also if S' is small in comparison with $1/a$, it is quite easy to see how $1/a$, which is really the resistance of the valve, may vary in such a way, when the anode voltage is varied, as to explain the minimum frequency for a definite anode voltage.

It is considered, however, that it will be wiser to follow the treatment of Van der Pol who takes into account the fact that the oscillating effects may take place on a part of the characteristic which is not linear.

One interesting feature of the effect is that the magnitude of the variation with anode voltage depends on the amplitude of the oscillations. The amplitude can be varied by varying the filament temperature,

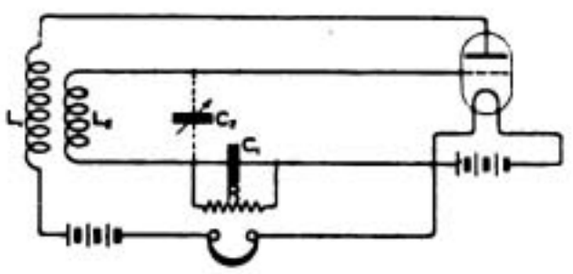


Fig. 4.

and a point can be obtained which gives comparatively small variations with anode voltage.

These circuits are very useful for some purposes where a buzzer has hitherto been used for giving intermittent currents. For electrical measurements such as the measurement of inductances, and the capacity of condensers, they are particularly useful. They will also be useful for measuring the resistance of electrolytes where it is necessary to have an alternating supply so that the effects of polarisation may not appear

III.—Production of Notes by an Oscillating Valve making use of a Grid Leak and Condenser.

A convenient method for producing audible notes is shown diagrammatically in Fig. 4. The ordinary high frequency oscillation circuit with anode and grid inductances L_1 and L_2 coupled together is used, with the addition of a grid condenser C_1 with a high resistance R, usually called the grid leak, shunted across it. A tuning condenser C_2 may be used. This grid leak is of high resistance of the order of one megohm and over.

The grid leak is often used in valve circuits to give a required potential difference between the grid and filament. The grid tends to charge negatively by the passage of electrons from the filament, and the grid leak tends to bring the grid to the potential of the end of the filament to which it is connected. As the resistance of the grid leak is usually high, it does not succeed in passing all the charge from the grid until the potential of the latter becomes somewhat negative with regard to the filament. This difference of potential depends on the capacity of the condenser, the resistance of the grid leak, and the grid current. Hence, for purposes of rectification and the production of continuous oscillations, the grid leak can often be used to replace the source of potential required for working conditions.

In the present case an oscillating high-frequency circuit is used, and the grid leak is chosen of such a high resistance that oscillations cannot be maintained permanently. The action of the grid leak will be discussed with regard to an anode current grid volt characteristic, Fig. 5. On such a characteristic,

oscillations will take place about some point which, for convenience, we shall assume to be that of zero grid volts. For this condition the grid volts will vary from R to B, and the anode current from B C to R D with a mean value equal to O P. If the resistance of the grid leak is comparatively low, it is possible that these conditions of anode current and grid volts will be permanently maintained.

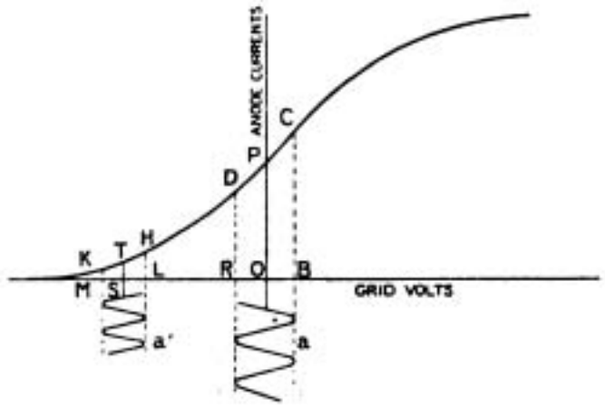


Fig. 5.

Suppose, however, that the resistance of the grid leak is very high so that the negative charge given to the condenser C_1 cannot leak away quickly enough, the mean grid volts will move towards the left and may reach a' where the anode current varies between L H and M K. For such low anode currents the amount of energy given to the grid circuit will be too low to maintain oscillations, which will therefore cease, and then the condenser C_1 will be discharged by the grid leak R. Although the time required to discharge the condenser is finite, it is, nevertheless, rapid, and is equivalent to switching on the circuits again. Hence, on reaching the potential O, or probably before, the oscillations will commence again and the same process is repeated periodically, the mean grid volts varying between two points, O and S, and the mean anode current between O P and S T.

The variations of the anode current with time are shown in Fig. 6. A complete period is composed of the decrease of the mean anode current from O X to y Y, and the increase from y Y to z Z. The number of times that this process is repeated per second is the frequency of the note heard in the telephones.

It is at once seen that the quality of the note produced is by no means pure, for the variation of anode current is not trigonometrical. By listening to the note the difference in quality from the ordinary heterdyne note is easily noticed.

It is of interest to enquire as to the quantities which control the frequency of the note produced. One complete period is made up of two portions a and b, Fig. 6. The laws governing the interval b are well known, being those concerned with the time required to discharge a condenser C from potential V_1 to V_2 through a resistance R. If v is the difference of potential the law is

$$\log v = \frac{T}{CR}$$

From this law, if either C or R is increased the time T increases, assuming that v remains constant. Thus, if we neglect the interval a for the present, the pitch of the note will fall if either the grid condenser or the grid resistance is increased. This is usually found in practice to be the case with this circuit. The interval a is controlled by various circumstances. The condenser C_1 is to be charged to a potential at which oscillations will cease. A negative charge is given to the condenser during the oscillations but part of this leaks away through the grid leak.

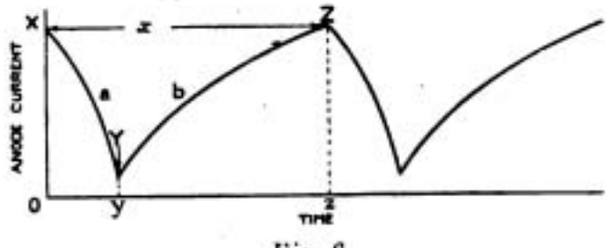


Fig. 6.

The length of time required to attain the necessary potential thus depends on the capacity of the condenser, the amount of charge given to it in each oscillation, the rate at which this charge leaks away, and the number of oscillations. The larger the

condenser the larger must be the interval. The larger the resistance the shorter will be the interval as much less charge leaks away. The greater the filament emission the shorter will be the interval, as more charge is contributed every oscillation. The influence of the anode voltage is also apparent as it alters the characteristic and thus alters the limits of grid volts within which the oscillations can persist. It will also usually alter the amplitude of oscillations, and thus change the grid voltage variations.

Considering both intervals a and b together, we can draw the following conclusions :—

(1) Increasing the resistance of the grid leak increases interval b and diminishes interval a. Usually, it is found that the increase of b is greater than the decrease of a, and so the note is lowered in pitch.

(2) Increasing the capacity of the condenser C_1 increases both intervals a and b, and so lowers the pitch of the note.

(3) Increasing the anode volts raises the potential to which the grid condenser may be charged, and thus increases both intervals a and b.

From these considerations it is seen that the formulation of a law governing the pitch of the note is complicated. All that can be usefully stated is that when other things are kept constant the pitch of the note rises when either the capacity or the resistance is diminished, provided the resistance is not too low. Within limits an approximate law for the frequency can be taken as

$$(T/CR) = \text{Constant}$$

when the oscillations are not too weak, and the resistance is not too low.

This circuit is capable of certain useful applications. It can be used for certain measurements, provided comparative methods are used. Major Prince who named this type of oscillating circuit the "Squegger," used it for measuring high resistances by the method of substitution. In a similar manner it can be used for the measurement of small capacities.

Method for controlling the Pitch of Note by the Intensity of Signal.

Another way in which it has recently become useful is to provide a method by which the intensity of the received wireless signal controls the pitch of the note heard in the telephones. With the circuit just described the pitch of the note depends on the capacity and resistance of the grid leak circuit. If wireless signals can be made to alter the resistance, the pitch of the note heard will vary with the strength of the signals. It is necessary to choose a suitable resistance for the grid leak. Resistance is usually a function of the temperature, and thus, if the received signal can be made to alter the temperature of a suitable grid leak, the problem will be solved. Such a procedure is not very practicable, and, besides, introduces a "lag." It is much better to use the resistance between two electrodes of a three-electrode thermionic valve. Besides, it is very easy to make incoming signals vary such a resistance. In Fig. 7 a convenient method of doing this is shown. The anode

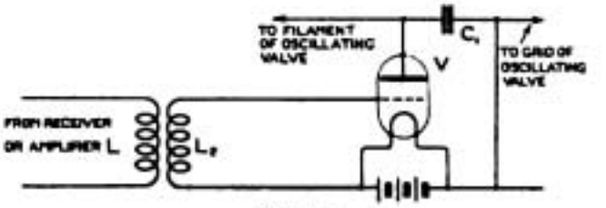


Fig. 7.

filament path of a valve V is used as the grid leak of the circuit in Fig. 4. Across the grid and filament a coil, L_2, is joined, in which the oscillations from the receiver or amplifier are induced. The signals thus vary the grid potential of the valve V, and hence the resistance between the anode and filament is varied. Thus the pitch of the note is altered.

For wireless purposes, a receiver of this type will be useful in various ways. In directional wireless the pitch of the note received will alter with the orientation of the loop or search coil. For those directional systems which depend on the comparison of signal strengths, a greater accuracy will be

obtained as the ear is more sensitive to change of pitch than it is to changes of intensity.

It will also be useful in investigations of the intensity of signals at various distances from a transmitting station.

DISCUSSION.

Mr. G. G. Blake: First of all, I should like to thank the lecturer for a most interesting lecture, and some of the work he has done will lead probably to very valuable results.

With regard to the lag of the ear, or the lag in the telephones, I wonder if it would be possible to trace that out in the laboratory by using some photographic method simultaneously with some telephone method of reception, and if it would be possible to determine whether the lag is due to the ear or the telephone.

The comparison of signal strengths is another most important point.

Mr. J. Scott Taggart: There are one or two points in connection with this paper which struck me as being interesting and calling for a little discussion. It was mentioned that when receiving C.W. at very high speeds the dots are sometimes missed. May this not be due to the dots, at high speeds, producing an effect very similar to spark signals. Dashes will produce musical notes, but short dots would impulse the receiver and would produce unmusical signals

In connection with circuits for producing low frequency notes probably the one which is commonly known as the "Hammond" circuit is most used. This process has had its greater application in the form of a wavemeter generating waves split up into groups for producing effects similar to a wavemeter using a buzzer. It is interesting to notice that Dr. de Forest, who no one can say is not a genius, has used a similar leak for the production of musical tones. He got various shapes and sizes of grid leaks, and produced all the notes on the scale by means of a key. He was so enabled to produce very fine music. (*Laughter.*) In connection with this type of circuit, probably one of the constants which effects the note produced is that of the filament current. By merely varying the filament current of such a circuit the notes may be made to go from an inaudible limit right down to a very low value indeed, and this is probably the most critical adjustment; at any rate, more critical than the variation of anode voltages. This is probably due to alteration of the slope or alteration of the grid current, or more probably due to the difference in the magnitude of the oscillations produced, so that for a wavemeter of this type the most efficient method of varying the note produced is by a rheostat connected in the filament circuit.

The most valuable feature of this paper was the circuit of Fig. 7. The device called the "Squegger" was used as a means of producing variations of the pitch, founded upon the magnitude of the input signals. The author of this paper has done good work in this connection, although he has not given all his results, and perhaps further details might have been very welcome. In connection with Fig. 7, unfortunately it will not produce the results he desires; but this is, I think, merely due to an error in the drawing. It shows the control valve with the anode connected to the grid of the oscillating valve. Secondly, the valve will not act as a conductor, and any charge on the grid of the valve will not leak away to the filament. The figure, I believe, should show the filament of the "Squegger" valve connected to the grid of the main valve. I think that is all I wish to comment on.

Mr. C. F. Phillips: With regard to the last figure shown by Captain Robinson, I should like to ask you if one use of the "Squegger" circuit would not be to assist in getting rid of wipe-outs. I remember at the Presidential Address, which took place about a month ago, this matter was raised. The question of wipe-outs is a most important one. It seems to me that, if the valve as shown in Fig. 7 can act as a variable grid leak to produce change of pitch in note, it could also be so arranged as to lower the resistance of the leak across the grid condenser at the moment that the wipe-out is taking place, and therefore this condenser would discharge more rapidly when the potential on the grid had become too great or too small as the case may be and the wipe-out would momentarily cease. If that is so, it would be a most valuable use of that circuit.

Mr. M. Child: It has occurred to me that in the last diagram, Fig. 7, it might not be clear to everybody here exactly what that left-hand inductance in the figure was joined to. I am not absolutely sure myself. I think I know where it might go, but perhaps Captain Robinson would make it quite clear to everybody where the left-hand inductance coil, which is coupled to the valve grid, is actually joined in practice. With regard to the question of music, that Mr. Scott-Taggart mentioned, I take it that Dr. de Forest only produced one note at a time, and that he did not get to the stage where definite harmony could be produced.

Major B. Binyon: There is just one point I would like to mention, and that is, that the "Squegger" was produced, if I remember rightly, during the war, at the time when everything, including the supply of meggers in this country, was quite insufficient to meet the demand. It was then that Major Prince hit upon his ingenious method of producing some sort of special apparatus to act as the megger. This is of special interest to amateurs, but there is just one word of warning I would mention, and that is, that when using the "Squegger" as a megger, it is not a very sure guide of insulation tests, although it does measure the resistance. It does not really apply in any test requiring 1,000 or 500 volts. In that respect it is perhaps rather liable to be a misleading instrument, although it has the great advantage of being exceedingly cheap to construct. I think that a paper on this subject would be extremely interesting. Perhaps Captain Robinson could supply amateurs with a few more details on the construction of such a circuit, as I am sure it would be very valuable to many of us.

There is one other point I would like to mention: Captain Robinson refers to the use of an appropriate heterodyne note for overcoming interference. It struck me that this is not always a successful method, because unfortunately it very often happens that atmospherics cause some sort of a shock excitation of your aerial circuit, which causes it to oscillate at the periodicity at which it is tuned, and may thus produce a heterodyne effect which may be confused to some extent with the heterodyne note that you are receiving. Then, as regards the upper limit of pitch, I always thought that the principle in working with the best pitch was one of the factors which was determined by the upper limit which you could hear. I do not know whether it is the case, but some time ago I was at a lecture in which most of the audience could hear quite a feeble sound of 28,000 frequency having a pure sine wave. Possibly, if the sound has not so pure a sine wave-form, the upper limit of pitch may be lowered very much.

The President: There is one little contribution which I want to make to this discussion, and it may probably help Captain Robinson towards his explanation, but it is not in any way complete.

Referring to Fig. 3 of the paper, the frequency apparently varies between about 2,000 and 500 periods for a variation of H.T. voltage between 0 and 60. May not this be due to the variation of the internal resistance of the valve with the change in H.T. voltage?

In a textbook by Dr. Alexander Russell, formulæ are given for the oscillations in a circuit consisting of a capacity and an inductance in parallel, and shunted by a resistance (Fig. *A*.) When the resistance *X* is low no oscillations are possible, nor are they when it is high. Between these two extremes oscillations are possible, and their frequency depends upon the value of *X*.

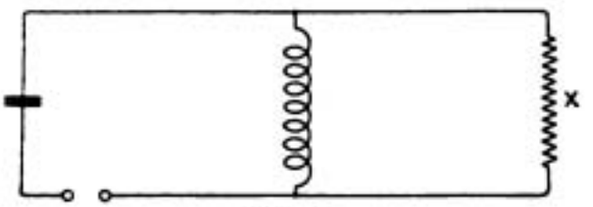


Fig. A

Mr. J. Scott-Taggart: Might I ask the value of the resistance *X*. Surely the higher the value of *X* the less it will interfere with the production of the oscillations in that circuit. If you make it infinite you get the ordinary oscillatory circuit in which the oscillations do not cease.

The President: Well, you may be right, Mr. Scott-Taggart, but in that case I have misunderstood Dr. Russell. I have only made a mental note of it, but he certainly gives it between two limits.

Captain Robinson: There have been some interesting questions asked and some remarks made, but I do not propose to attempt to answer all of them. One or two I will do my best to reply to.

A question was asked about the method of determining the lag of the ear, or the lag of the telephone. The suggested photographic method would doubtless make use of an oscillograph. Then you immediately eliminate the value of the ear. There are various methods available, and, personally, I should like to have the time to go into the question, as it interests me very much.

Now, Mr. Scott-Taggart suggests a most interesting explanation of why dots are eliminated for very high frequencies. The facts, if I understand him correctly, amount to some sort of effect like a spark effect, such as indicated in Fig. B. Is that what you mean?

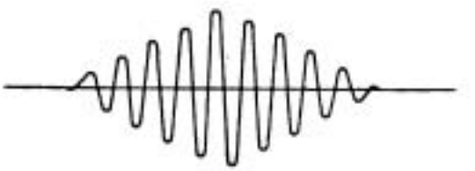


Fig. B.

Mr. Scott-Taggart: Probably worse than that in actual practice.

Captain Robinson: Supposing we take a frequency of 100,000, that is a wavelength of 3,000 metres. Now we will assume the extreme case of a dot lasting 50-thousandths of a second: you get a very large number of oscillations in that time.

Mr. Scott-Taggart: I think you mentioned that it was specially prominent in high-speed signalling, and it was in connection with high-speed signalling that I made my remarks.

Captain Robinson: The high-speed signalling I meant was where you listened by ear. I was not referring to automatic reception. I was talking about 35 to 40 words a minute, so that, under these circumstances, I do not think that that explanation would be quite sound. In automatic transmission it is beyond a doubt that this would happen.

Then there is the question of the variation of filament current varying the note. As a matter of fact, I intended to introduce that. I did not mention that you could produce this effect by variation of the filament current as well as by anode voltage. As a matter of fact, I intended to bring forward one other point in that connection. If you want to investigate the variation of pitch with voltage or with filament temperature it is possible to cut down the variation of pitch to a practically negligible amount by small adjustment. It is well known that the method, as Mr. Scott-Taggart pointed out of using a rheostat, is very sound.

Mr. Phillips's question regarding wipe-outs is a bit too hard to answer offhand, if he will excuse me. I do not know if anyone else would like to speak about that.

Referring to the question asked by Mr. Child the inductance L_1, in Fig. 7, takes the position of the telephones in the ordinary wireless receiver.

Replying to Major Binyon, at a later date I shall be able to give some more details of the "Squegger" circuit to enable amateurs to fix it up.

I think Major Binyon may have misunderstood me with regard to overcoming interference with the heterodyne effect. I did not mean to say that it was an infallible method, but that it can be used at times. The point referred to about the upper limit of audition are interesting. There are many factors which affect the upper limit, among them the purity of note, intensity of the sound and the individuality of the ear.

Communicated.

Mr. Scott-Taggart stated that Fig. 7 was incorrect and that the anode of the grid leak valve should have been shown joined to the filament of the "Squegger" valve. As a matter of fact, my diagram was shown in this way, and I had labelled the slide purposely to make this apparent. However, in view of a request by some speakers I consider it advisable to show the complete diagram for Fig. 7, and this is shown in Fig C.

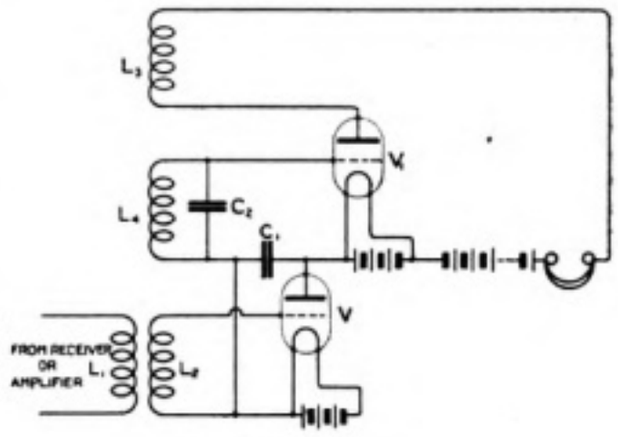


Fig. C.

THE WORLD'S CHAMPION WIRELESS OPERATOR

Photopress.

Mr. B. G. Seutter and the Cup awarded for his achievement.

The above photograph shows Mr. B. G. Seutter, who finished first in a receiving test conducted in America by the Second District Amateur Radio Convention. He established a new world's record of 48⅗ words a minute, with only two typographical errors, receiving the very fine cup, seen in the centre of the picture, as a memento of his remarkable achievement. Mr. Seutter's wireless experience dates from 1913. He was formerly in the U.S. Navy. Many other wireless records are held by Mr. Seutter.

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 of unusual or special interest read before Societies.

The Wireless Society of London.

Proceedings of a meeting of the Wireless Society of London, held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2., on Monday, April 4th, 1921.

Major J. Erskine-Murray, D.Sc., President, took the chair at 8 p.m. The Hon. Secretary, Mr. H. Leslie McMichael, read the minutes of the last meeting, and these were confirmed and signed.

A paper by Dr. J. Robinson, M.Sc., entitled "Some Acoustical Effects in Wireless," was then read and discussed. (*For a full report of the paper and discussion see pages* 71 *to* 78 *of this issue.*)

After proposing a vote of thanks to Dr. Robinson, heartily responded to by the meeting, the President said :—

There is one point I should like to draw your attention to and that is the rather curious one which crops up pretty frequently now-a-days. It is the use of the variable grid leak for the production of an efficient note through variation of grid resistance or voltage. I forget exactly the details, but this was simultaneously invented in three Government Departments. It was a task to find out who was actually the first, but finally it was patched up by the appearance of a patent with six or eight different names on it.

There is another point I would mention, and that is that the Air Ministry GFA is now sending out calibrated waves daily. Some of you may care to make a note of them.

British Summer Time 0945	Wavelength	1680	metres.
1000	,,	1400	,,
1005	,,	900	,,
1010	,,	1300	,,

I think we can guarantee their accuracy within a small percentage.

The President then announced that the following had been duly elected to membership of the Society :—Arthur Hope Kidd, Frederick Henry Berryman, William Scott Clemmey, members, and Charles Howlett, associate member.

The meeting adjourned at 9.20 p.m.

Leicestershire Radio Society.

(*Affiliated with the Wireless Society of London.*)

A meeting of the above Society was held at the Vaughan Working Men's College, on March 14th.

The President gave the meeting an idea of what had been done towards making the exhibition at the above College on Saturday, April 2nd, a success, and distributed the window bills and tickets for same to those who would have an opportunity of disposing of them.

Mr. C. T. Atkinson then called on Mr. S. Skeet to deliver his paper on "Radio Theory and Amateur Application."

The subject had so much interesting matter to be brought forward, that it could not be disposed of in a single lecture, and the meeting unanimously decided to relegate this subject for discussion on August 15th. The members present were delighted with the simple explanations of difficult points that so often puzzle amateur workers, and the facile way in which the lecturer delivered his subject. The meeting broke up at a late hour, with a hearty vote of thanks to Mr. Skeet.

A meeting of the above Society was held on April 11th, at the Vaughan Working Men's College, Mr. C. T. Atkinson being in the chair.

It is gratifying to note that eight new members were proposed, seconded and accepted, bringing the total well over the fifty line. After the minutes of two previous meetings were read, the President called on Mr. H. E. Dyson to give his lantern lecture on "Wireless Direction Finding."

A hearty discussion closed a very enjoyable and interesting lecture, and a sincere vote of thanks was passed to Mr. H. E. Dyson for his patience and splendid delivery.

Mr. Jas. W. Pallet is down for our next meeting on May 9th, and is giving "Marconi Spark Transmitters, Theory and Practice."

This subject, in the hands of so able an exponent of the theoretical side of transmitters should be both interesting and highly instructive.

Applications *re* membership should be made in the first place to Mr. W. E. Dunt, 45, Baden Road, Leicester.

The North London Wireless Association.

(*Affiliated with the Wireless Society of London.*)

The sixteenth meeting was held on March 11th. At this meeting Mr. Gartland, who has been experimenting with telephony, gave a short description of his experiences, and the amount of success he had had. He also gave a diagram of the circuit used and many useful hints, both for transmission and reception. A useful high note buzzer set was presented to the Association by Mr. Z. F. Auckland.

The Association's Committee has been active lately, and as a result of a recent Committee meeting a Club Library has been formed, a question box organised, and a field day arranged, which will be held at Cuffley on Saturday next, April 23rd, weather, etc., permitting, of course.

The eighteenth meeting held Friday, April 1st, was devoted chiefly to a discussion of the programme to be carried out on the Association's first field day, and many suggestions and offers of help were put forward. The programme finally decided upon was "Experiments with Ground Aerials," "Direction Finding," and instruction in erecting and dismantling aerial masts. It was also discussed as to whether members could bring friends and decided that for this first occasion it would be better for members only to take part. If this outing was successful, members will be asked to bring friends upon subsequent occasions.

Three new members have been elected, and Captain W. R. H. Tingey has kindly undertaken the duties of a Vice-President of the Association.

Enquiries for particulars of membership, etc., to be addressed to the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting on March 30th, Mr. Knight described a method of making "pot pourri" crystals for receiving, using Wood's metal and a special mixture of crystals.

Mr. Nicholson reported hearing Mr. L. Claude Wilcox, of Warminster, who was transmitting on 12½ watts, and to bridge a distance of 100 miles with that power speaks volumes for both transmitter and receiver. We should like to have the other gentleman as a member so as to keep the talent in the family, so to speak.

Mr. Sutton, A.M.I.E.E., described the use of thermionic valves in long distance telephony, showing their adaptability to this use in addition to those to which we are more accustomed.

At a meeting of the above Association, on Wednesday, April 6th, the Chairman, Mr. A. W. Knight, exhibited a rotary converter, which had been constructed by Messrs. Mitchells, Ltd., of Rye Lane, to Mr. Kloot's (a member of the Association) design. Working off the 6-volt filament battery it provided the 45 volts necessary for the plate circuit and was remarkably steady and quiet in its running. When sundry little improvements suggested to the present design have been effected we shall bid an unregretful goodbye to pocket lamp plate batteries.

The Gloucester Wireless and Scientific Society.

(Affiliated with the Wireless Society of London.)

The annual general meeting of the above Club was held on March 17th last, and it was proposed and unanimously carried that the present officers be re-elected for another twelve months. Auditors were also appointed to audit the Club's accounts.

The Secretary gave another lecture of a series on wireless theory, this one being on the principles of induction coils and dynamos.

Mr. C. H. Scott showed some very interesting lantern slides at this meeting, and these were much admired, particularly a set of three for which he is a medalist. Another of our members, Mr. Witchard, was good enough to bring a collection of coloured slides at the last meeting, and these were shown and the different processes employed to produce them explained.

The Club arranged a demonstration on wireless with the Upton branch of the Workers' Educational Association, to be given on the 6th instant. The Secretary would like to acknowledge his great indebtedness to The Marconi Company in connection with this lecture, for the very courteous treatment he received at their hands when asking for some lantern slides to illustrate it.

Burton-on-Trent Wireless Club.

(Affiliated with the Wireless Society of London.)

There was an excellent attendance at the fortnightly meeting of the Burton Wireless Club, which was held in the *Burton Daily Mail* office, March 11th. Mr. F. V. A. Smith presided.

Mr. T. W. Parkin, B.Sc., gave a most interesting lecture on "The Valve and its Application."

A well-attended meeting of the Burton Wireless Club was held on March 30th at the *Burton Daily Mail* Offices, Mr. A. Chapman presiding.

The Secretary (Mr. R. Rose) intimated that progress was being made in the application for a transmitting license, and details were being asked for by the authorities. The decision of the club to vary wireless lectures with other sciences has proved most successful, and a most interesting lecture was given by Mr. J. L. Berry, F.R.M.S., on "The Microscope and its Applications."

Derby Wireless Club.

(Affiliated with the Wireless Society of London.)

On March 12th Capt. Bemrose read a short paper on signalling by means of ultra violet light, etc., describing various forms of signalling by visible and invisible rays, by the use of polarised light for secret communication.

On April 9th, Mr. S. G. Taylor read a paper on W.T. calculations, which was followed by a discussion.

During May and June, meetings will be held at 7.30 p.m. at the Court, Alvaston, Derby, on the first and third Saturdays.

Edinburgh Wireless Club.

(Affiliated with the Wireless Society of London.)

Report of first annual general meeting, held on April 6th, 1921. The minutes of the previous meeting having been adopted, a vote of thanks was proposed and very heartily accorded to Messrs. Clark and Thomson for their lectures delivered during last month.

The following announcements were then made :—

That the club room would not be open on Sunday April 17th (Edinburgh Spring Holiday week-end).

That a special subscription rate had been allowed for students at the N.B.W.S. while under instruction and while acting as Marconi operators, *i.e.*, 5s. entrance fee and 5s. per annum (as for county members).

That a sale of second-hand wireless apparatus would take place in the club room on Wednesday, April 13th.

The amendment to club rules, carried on December 1st, 19120, was read, viz., "Subscriptions are payable on election and thereafter on or before the last day of April of succeeding years. Members failing to pay on this date will be notified by the Hon. Secretary. Failure to pay within seven days of this notice will signify that the member does not wish to continue membership."

A report on the balance sheet was then given, the sheet being afterwards posted on the notice board.

The Hon. Secretary then announced that notice

had been received from the landlord to vacate the club premises at the end of April. On account of this the Hon. Secretary pointed out that considering the very meagre attendance at Club meetings during July, August and September of last year, it would be advisable not to rent a new club room until October 1st. In the meantime one or two monthly meetings could be arranged and held wherever and whenever suitable, times and places to be announced in the *Evening News* and *Evening Dispatch*. This motion was seconded by Mr. Clark and carried *nem. con.*

Other motions were made as follows:—Proposed by Hon. Secretary, seconded by Mr. Melville: That one member of committee be appointed as Club Librarian, and carried *nem. con.* Proposed by Mr. Crichton, seconded by Miss Brand: That the election of a President be left over until October. Mr. Crichton pointed out that whilst there were many members of the Club who were in every way suitable to fill this post, that it would probably be better to get someone who was well known in the town, for many reasons which were too obvious to require enumeration, and carried *nem. con.* Proposed by Mr. Scott, seconded by Mr. Nesbitt: That a Vice-President should be appointed from among the members of the Club, and carried *nem. con.* Proposed by Mr. Melville, seconded by Mr. Crichton: That reports of club meetings be sent to the *Electrical Review* and *English Mechanic*, for publication, and carried *nem. con.* Proposed by Mr. Clark, seconded by Hon. Secretary: That in future the committee consist of nine members in place of seven as previously, and that the number required to form a quorum at committee meetings be accordingly raised from three to five, and carried *nem con.*

The new Committee was then appointed as follows:—Mr. Crichton (Vice-President), Mr. H. W. Clark, Mr. P. Melville, Mr. R. O. Crombie, Mr. W. Anderson, Mr. J. G. W. Thomson, Mr. W. A. Scott, Mr. S. G. Watson, and Mr. W. Winkler (Hon. Secretary).

Suggestions relative to Club furniture, workshop, etc., were brought up, but were left for decision in October.

Mr. Clark then moved a vote of thanks to the Hon. Secretary for the work he had done during last year, which was very heartily accorded.

There being no further business the meeting was adjourned.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the North Middlesex Wireless Club was held on Wednesday, April 6th, at Shaftesbury Hall, Bowes Park, with Mr. C. W. Beckman in the chair. The arrangements for the evening had included a paper on Valve Amplifiers by Mr. A. J. Dixon, but this gentleman having been called out of town on business, the Chairman called upon Mr. Symons, who had recently returned from a two months' visit to Spain, to relate some of his experiences there.

Mr. Symons then gave a very interesting talk touching on a number of points of great interest. As an instance of the way some things were done in the smaller villages, the electric light was left burning day and night. The power being obtained from waterfalls, it was less trouble to leave it on than to make someone responsible for turning it off. "This," said Mr. Symons, "was only the case in the smaller villages; in the larger towns the light went out every half hour or so." Mr. Symons passed round a number of excellent photographs, including those of a Bull Fight, taken at close quarters. He was able to confirm the prevailing impression that, to an Englishman, a Bull Fight was a revolting spectacle.

A vote of thanks was accorded to Mr. Symons at the close of the evening.

Particulars of the Club may be had on application to the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, N.21.

Sussex Wireless Research Society.

(Affiliated with the Wireless Society of London.)

This Society still continues to enjoy a very successful career. Meetings have been held at Cottesmore School, Brighton, at which the President, Capt. E. A. Hoghton, F.P.S.L., M.Inst.P., continued his series of lectures and demonstrations. These lectures have been much appreciated by the members of the Society, covering as they do, almost every branch of the scientific side of the subject.

At a meeting held on March 16th it was decided to hold the meetings fortnightly in future, meetings being given alternately with lectures by the President and demonstrations of member's apparatus and their experiences. Capt. Hoghton informed the meeting that he would deal with the theory of transmission in all its phases in his next series of lectures.

At the same meeting the Hon. Secretary, Mr. J. E. Sheldrick, B.Sc. (Eng.) Lond., announced the fact that he would have to resign the Secretaryship of the Society as he had been appointed to the Wireless Experimental Dept. of H.M. Signal School, Portsmouth. A vote of congratulations to Mr. Sheldrick on his appointment and thanks for his services as Hon. Secretary was then proposed by the President and carried.

Later Mr. E. Hughes, B.Sc. (Eng.), Lond., A.M.I.E.E., Head of the Electrical Engineering Dept., Brighton Technical College, was elected Hon. Secretary. The President then gave a short lecture on the Heaviside Layer.

Another meeting was held on March 23rd, when Mr. Sheldrick exhibited and described in detail a two-valve long valve tuner having a range from 2,000 to 20,000 metres, and also a two-valve L.F. amplifier. Both these sets are home-made, and the workmanship was much admired by the members.

The Hon. Secretary, Mr. E. Hughes, B.Sc. (Eng.), Lond., A.M.I.E.E., Technical College, Brighton, will be pleased to give full particulars of qualifications, etc., for membership to any gentleman in Sussex desirous of joining the Society.

Newcastle and District Amateur Wireless Association.

On March 24th we were entertained and deeply interested by a practical lecture and demonstration given by Mr. Nichols of Birtley, a Club member,

on High and Low Frequency Amplifiers. Our aether, however, ever restless, gave us some surprises, as when our six-volt low tension supply was tested on a single valve set the filament temperature was disclaimed as tepid and a search party was organised for further supplies of "juice," but after a period returned to report none available within a wavelength of the meeting; a further critical examination of the L.T. unit, however, revealed a blob of aether and sulphate under one of the terminals, and the meeting settled down to business. Later on, however, we had another stir when our lecturer by dint of careful manipulation of a tuned plate circuit single valve set managed with the aid of two stages of low frequency to make the Concert from PCGG audible through four pairs of telephones. We are very much indebted to Mr. Nicholls for bringing out many practical points on home-made outfits, a loose coupler on the honeycomb coil principle in particular. One question unsolved is: Why does a capacity-reaction condenser increase the W/L of a set?

On April 4th we tried out a B.T.H. Portable Receiver, and were struck with the directional properties and signal strength obtainable with this remarkably compact set. Most stations were in their usual places, but Paris' evening weather report strangely came in from true West, but as most of our members were in the line of propagation this was no doubt a case of low frequency resonance causing absorption.

We welcomed a visit from Mr. Beveridge, of the Edinburgh Wireless Club, and we trust that any other members of Clubs who are in our neighbourhood will give us a call on Monday evenings at 7.15 B.S.T.

Enquiries to Mr. Colin Bain, Grainger Street, Newcastle.

Barrow and District Amateur Wireless Association.

On Wednesday evening, March 23rd, the above-mentioned Association held an informal Exhibition of Wireless Apparatus.

Mr. J. W. Osborne, the President of the Association, in extending a welcome to the numerous visitors, remarked that at the present time the development of wireless telegraphy was so rapid that it was difficult to keep fully informed as to its progress. Wireless stations had multiplied to such an extent that during every moment of the day and night hundreds of messages were flashing round the earth.

He explained that the Barrow Club was formed in 1912, and the apparatus displayed in the room, the efficiency of which would be demonstrated, had been designed and constructed by the members.

Mr. E. Redpath, the Club Secretary, delivered an address on the history and development of radio-telegraphy, illustrating various points by means of mechanical analogies.

Mr. J. P. Atkinson described the systems of transmitting time signals adopted by the Eiffel Tower Station, including the "Scientific Time Signals," which, by means of Mr. Wood's low-frequency amplifier set and a Brown's loud-speaking telephone were made plainly audible to all present. (The particular signals received being the "clock-ticks" at 9.10 p.m.)

Mr. A. R. Pennington gave a practical demonstration upon the Club's single-valve, long-wave receiving set, and visitors were afforded the pleasure of "listening-in" by means of the Club's "exchange table" fitted with telephone jacks to take nine sets of telephones.

Mr. E. Redpath manipulated and explained the working principle of the Club frame aerial which, in conjunction with his five-valve amplifier, gave very good results, the loud-speaker being again requisitioned to render the signals audible to all present in the room.

A brief description of the principles of "Direction Finding" accompanied this last demonstration.

This concluded the set programme of the evening, after which the visitors closely inspected the excellent sets of apparatus on view and listened to the various stations working.

What the Association lacks in numbers it appears to make up in the enthusiasm and efficiency of its members, and the excellence of their apparatus was well demonstrated.

The exhibition certainly afforded a very pleasant and instructive evening to all concerned, and may be the means of attracting other interested gentlemen with a view to their becoming members, and if so, will they kindly communicate with the Secretary, Mr. E. Redpath, 19, Niger Street, Barrow-in-Furness.

Grimsby and District Radio Society.

An amateur wireless Club has been formed in Grimsby under the name of the "Grimsby and District Radio Society."

The President is Mr. M. Jennison, M.I.E.E.; Vice-President, Mr. Charles Green; Secretary, Mr. E. D. Burnett; Treasurer, Mr. C. Hewins; together with a Committee of five members.

The annual subscription is 5s. (including the entrance fee of 2s. 6d.).

Through the kindness of the Vice-President, a Club-room has been secured in Humber Street, and meetings will be held there every alternate Monday evening from 7 to 9 p.m.

All persons interested should communicate with the Hon. Secretary, Mr. E. D. Burnett, 256, Welholme Road, Grimsby, who will be pleased to furnish all particulars.

Application is being made for the Club's licence and we are looking forward to having some very interesting evenings.

Leeds and District Amateur Wireless Society.

A meeting was held at 23, Great George Street, Leeds, at 7.30 p.m. on Friday, April 8th, Mr. G. P. Kendall (Vice-President) being in the chair.

A lecture was delivered by Mr. A. M. Bage (who is one of Leeds' oldest amateurs, having carried out wireless research work for about 15 years).

Mr. Bage's lecture was on the construction of a single valve receiving set, and by means of sketches on the blackboard he explained every detail in the construction of the various parts.

He took each part separately and passed it round the audience for examination, and after dealing with each part of the set he invited questions

before passing on to the next. His audience gained some very useful information and hints on constructional work.

At the end of the lecture a very hearty vote of thanks was given.

The Society have decided to hold an exhibition of wireless apparatus on April 22nd at 23, Great George Street, at 7 p.m.

Cambridge and County.

Those living in this district, and interested in Wireless Telegraphy, willing to form a Club, are invited to communicate with Mr. H. W. Taylor, Camden House, Park Terrace, Cambridge.

Proposed Wireless Society for Kensington and District.—A few residents in and near to Kensington, having a wish to see a local Wireless Society, desire to find out if sufficient support is likely to be forthcoming to warrant the formation of one.

Such a Society would start with the offer of the free use of a room suitable for its meetings, with a good P.M.G. aerial already installed, in the close neighbourhood of Earl's Court Station.

Will all interested kindly write to Dr. Gordon Wilson, 1, Philbeach Gardens, S.W.5. If sufficient replies are received invitations will be issued for an inaugural meeting to be held in the above-mentioned room.

GLASGOW AND DISTRICT RADIO CLUB

THE accompanying photograph illustrates the apparatus used by the Glasgow and District Radio Club in the recent Transatlantic Tests. After the matter had been well discussed by the committee, the type of set decided upon was as follows :—Aerial circuit, tuned to 200 metres ; separate heterodyne, tuned to 214 metres in order to set up a beat frequency equal to a wavelength of 3,056 metres approximately ; closed circuit, tuned to 200 metres ; plate circuit, tuned to 3,000 metres, final adjustment being made by variable condensers ; the beat frequency was then passed through a 4-valve H.F. resistance amplifier, with a capacity reactance taken from the plate of the third valve to the grid of the first valve ; the H.F. amplifier was coupled by means of a trans-

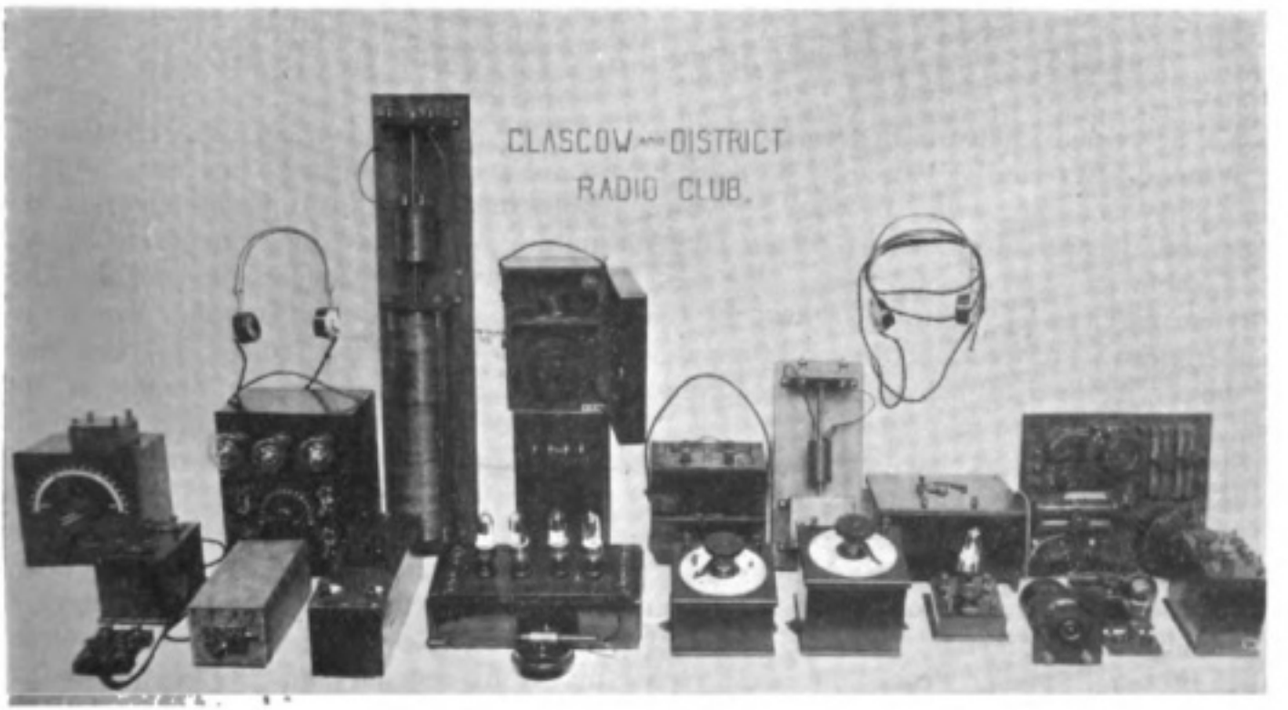
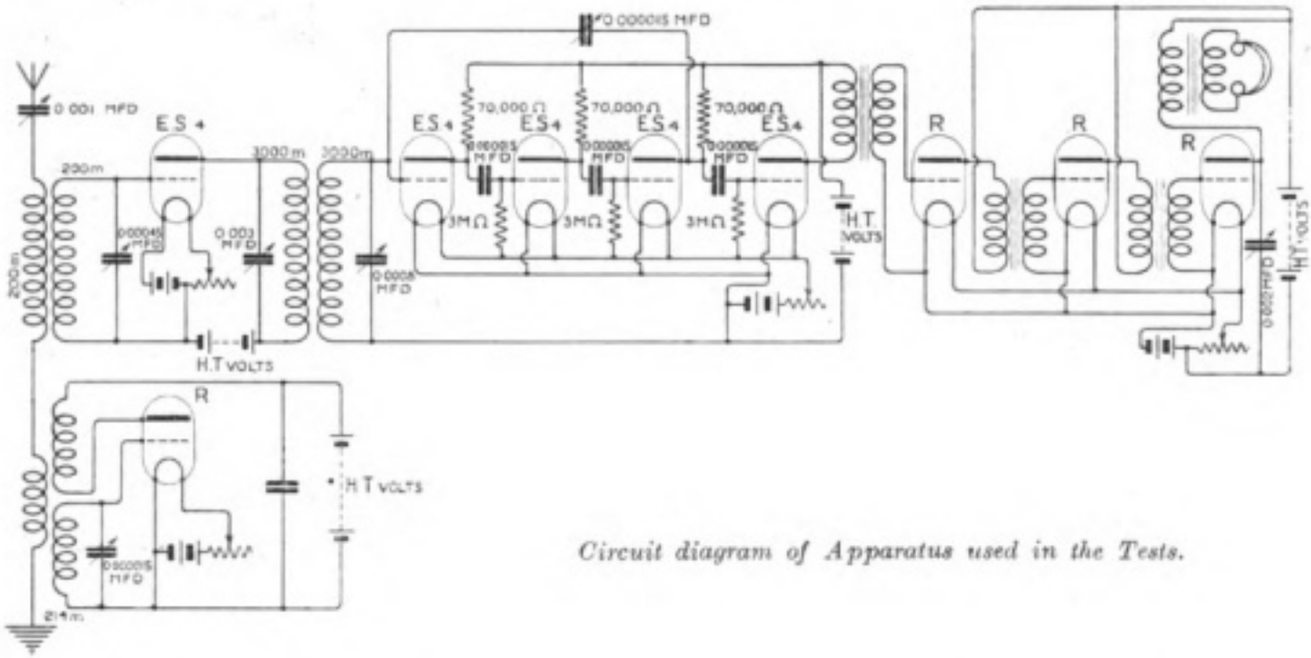


Photo by Mr. Nicol Smith.

Apparatus belonging to the Club.



Circuit diagram of Apparatus used in the Tests.

former to a 3-valve L.F. amplifier; the telephones used were Brown's 120 ohm. pair, with a telephone transformer which was home-made.

The valves used were four "Osram" R. type, and five "Ediswan" E.S. 4 type; the H.T. batteries were Siemens.

The arrangement of the circuits is shown in the diagram.

PERUVIAN POSTS AND TELEGRAPHS

BY agreement with the Peruvian Government, Marconi's Wireless Telegraph Company, Limited, will, on May 1st, take over and operate for a period of 25 years, the whole of the postal, telegraphic and wireless services of Peru, receiving as remuneration 5 per cent. of the gross receipts of the services and 50 per cent. of the annual profits.

Sir William Slingo, late engineer-in-chief of the British Post Office, who, in the light of his unrivalled experience, was commissioned by the Marconi Company to examine the Peruvian postal and telegraph situation, has accepted the position of chief of the Peruvian Postal and Telegraph Department, and will act in this position on behalf of Marconi's Wireless Telegraph Company, Ltd.

The postal and telegraphic conditions in Peru are of unusual interest. Of the approximately 9,000 miles of telegraph communications, some exist at a height of 16,000ft. notably where crossings are made of the Andes.

Of the 42,000,000 odd words telegraphed annually quite a considerable percentage has consisted in the past of traffic for Government Departments which has been handled without payment.

The concession includes the sole and exclusive operation of all international wireless telegraph stations within the Peruvian Republic, the exclusive right to erect any further wireless station that the Company may think necessary, and the sole and exclusive usufruct in the case of all Peruvian telephone services, except the few local ones already existing.

REGULAR TRANSMISSIONS *of* WIRELESS STATIONS

We have compiled, for the benefit of our readers, a list of most of the regular transmissions which can be heard in Europe. It is hoped that readers will check this list as far as possible and communicate any inaccuracies or omissions to the Editor.

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
Midnight	Paris	FL	8,000	C.W.	Working with **FF** and **WAR.**
Midnight	Lyons	YN	15,100	C.W.	
Midnight	Horsea	BYC	6,000	C.W.	Press in English.
Midnight	New Brunswick	WII	13,400	C.W.	
0030	Azores	BWP	4,000	C.W.	
0100 to 0300	Lyons	YN	15,000	C.W.	Working to **WII** (intermittently).
0100	Paris	FL	8,000	C.W.	Working with **HFB.**
	Poldhu	MPD	2,800	Spark	Press in English.
0100 to 0130	Devizes	GKU	2,100	C.W.	Marine traffic.
0130	Azores	BWP	4,000	C.W.	
0200	Lyons	YN	15,000	C.W.	Working with **WII.**
0205	Air Ministry	GFA	1,400	C.W.	Meteorological message.
0230	Bucharest	BNS	4,000	Spark	Meteorological message.
0230	Azores	BWP	4,000	C.W.	
0230	Nantes	UA	9,000	C.W.	Calls **FRI** (general call to French war vessels).
0230	Aberdeen	BYD	3,300	C.W.	Meteorological message.
0245	Paris	FL	2,600	Spark	Meteorological message.
0255	Annapolis	NSS	17,000	C.W.	Time Signals.
0300	Paris	FL	6,500	C.W.	
0300	Lyons	YN	15,000	C.W.	
0330	Azores	BWP	4,000	C.W.	
0400	New Brunswick	WII	13,400	C.W.	Working to **YN** and **LY.**
0400	Annapolis	NSS	16,500	C.W.	
0400	Nantes	UA	6,500	C.W.	Working with **BUC.**
0430	Paris	FL	8,000	C.W.	Press in French, and works to **MSK**
0430	Azores	BWP	4,000	C.W.	
0500	Nauen	POZ	12,600	C.W.	Calls Annapolis **NSS.**
0500	Rome	IDO	11,000	C.W.	Working with **BUC.**
0500	Lyons	YN	15,000	C.W.	Working with **WII.**
0500 to 0530	Devizes	GKU	2,100	C.W.	Marine traffic.
0530	Sofia	FF	3,800	Spark	Meteorological message.
0530	Azores	BWP	4,000	C.W.	
0605	Paris	FL	8,000	C.W.	Working with **WAR.**
0630	Azores	BWP	4,000	C.W.	
0700	Bucharest	BNS	4,000	Spark	Meteorological message.
0700	Bordeaux	LY	23,450	C.W.	Working with **HZH** (Brazzaville.)
0700	Nauen	POZ	12,600	C.W.	Calls **FL.**
0700	Annapolis	NSS	16,500	C.W.	
0715	Brussels	HS	1,400	C.W.	Meteorological message.
0725	Brussels	BAV	1,680	C.W.	Meteorological message (occasionally sent from **HS**).
0730	Paris	FL	8,000	C.W.	Reply to **POZ.**
0730	Azores	BWP	4,000	C.W.	
0730	Paris	FL	6,500	C.W.	Working to **AFB.**
0730	Nantes	UA	9,000	C.W.	Calls **FRI** (general call to French war vessels).
0730	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message (aviation.)
0735	Air Ministry	GFA	16,800	C.W.	Meteorological message.
0740	Strasbourg	C3	1,480	C.W.	Meteorological message.
0750	Lengby	OXE	5,000	C.W.	Danish meteorological message.
0800	New Brunswick	WII	13,400	C.W.	Working to **YN** and **LY.**

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
0800	Cherbourg	FUC	2,800	C.W.	Meteorological message.
0800	Eilvese	OUI	9,600	C.W.	
0800	Nantes	UA	2,800	Spark	Navigation warnings.
0805	Air Ministry	GFA	1,400	C.W.	Meteorological message.
0810	Brest	FUE	2,800	C.W.	Meteorological message (occasionally sent from HS).
0815	Paris	FL	2,600	Spark	Meteorological message.
0820	Amsterdam	STB	1,400	C.W.	Meteorological message (occasionnl only).
0830	Azores	BWP	4,000	C.W.	
0830	Aberdeen	BYD	3,300	C.W.	Meteorological message.
0830	Lyons	YN	15,100	C.W.	Service to Central Africa.
0840	Warsaw	WAR	2,100	Spark	Meteorological message.
0845	Air Ministry	GFA	1,680	C.W.	Calibration waves.
0845	Paris (Le Bourget)	ZM	1,400	C W.	Meteorological message.
0845	Christiania	LCH	8,000	C.W.	Meteorological message.
0850	Christiania	ZM	1,680	C.W.	Meteorological message.
0858	Lyons	YN	15,100	C.W.	Time signals.
0900	Bordeaux	LY	23,450	C.W.	Working to WII.
0900	Sofia	FF	3,800	Spark	Meteorological message.
0900	Malta	BYZ	4,200	C.W.	Meteorological message.
0900 to 0930	Devizes	GKU	2,100	C.W.	Marine traffic.
0900	Nauen	POZ	3,900	Spark	Meteorological message.
0900	Air Ministry	GFA	1,400	C.W.	Calibration waves.
0904	Lyons	YN	15,100	C.W.	Service with FRU.
0905	Air Ministry	GFA	900	C.W.	Calibration waves
0905	Paris	FL	6,500	C.W.	Press in German for OHD.
0910	Air Ministry	GFA	1,300	C.W.	Calibration waves.
0915	Air Ministry	GFA	1,400	C.W.	Meteorological message (general report in plain language).
0920	Amsterdam	STB	1,680	C.W.	
0920	Barcelona	EGE	1,600	Spark	Meteorological message to EGC.
0920	Lisbon	CTV	1,100	Spark	C.Q. calls.
0920	Prague	PRG	4,100	C.W.	Meteorological message.
0925	Brussels	BAV	1,680	C.W.	Meteorological message.
0930	Azores	BWP	4,000	C.W.	
0930	Poldhu	MPD	2,800	Spark	Admiralty meteorological.
0930	Rome	IDO	1,100	C.W.	Meteorological message.
0930	Rome	ICD	2,200	Spark	
0930	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message.
0935	Air Ministry	GFA	1,680	C.W.	Meteorological message.
0953	Paris	FL	2,600	Spark	International time signals.
1000	Vienna	OHD	5,600	C.W	Meteorological message.
1000	Madrid	EGC	1,600	C.W.	Spanish meteorological bulletin.
1000	Nantes	UA	6,700	C.W.	Working with BUC.
1003	Paris	FL	6,500	C.W.	Working with PRG.
1020	Amsterdam	STB	1,680	C.W.	Working is irregular.
1025	Brussels	BAV	1,680	C.W.	Meteorological message (aviation).
1030	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message (aviation).
1030	Azores	BWP	4,000	C.W.	
1035	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1030	Budapest	HB	3,100		
1030	Paris	FL	2,600	Spark	Astronomical time signals.
1044	Paris	FL	2,600	Spark	Time signals (old system).
1050	Paris	FL	2,600	Spark	Times for 1030 signals.
1100	Paris	FL	3,200	Spark	French press.
1100	Prague	PRG	4,100	C.W.	Calls, Annapolis NSS.
1115	Scheveningen Haven	PCH	1,800	spark	Dutch meteorological message.
1125	Brussels	BAV	1,680	C.W.	Meteorological message (aviation).
1130	Azores	BWP	4,000	C.W.	
1130	Paris	FL	2,600	Spark	French meteorological message.
1130	Paris (Le Bourget)	ZM	1,680	C.W.	,, ,, (occasional only)

REGULAR TRANSMISSIONS OF WIRELESS STATIONS

Time G.M.T.	Station.	Call Sign.	Wave length.	System.	Remarks.
1135	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1145	Paris	FL	8,000	C.W.	
1150	Paris (Le Bourget)	ZM	1,400	C.W.	Meteorological message.
1155	Nauen	POZ	3,900	Spark	Time signals and telegram "Karl, Fritz, etc.
1200	Norddeich	KAV	600	Spark	Meteorological message (or at 1700 if not sent at 1200).
1200	Paris	YA	1,950	C.W.	
1200	Horsea	BYC	6,000	C.W.	Press in English.
1200	Prague	PRG	4,100	C.W.	Press in French.
1200	New Brunswick	WII	13,400	C.W.	Working to YN and LY.
1205	Paris	FL	6,500	C.W.	Working with HB.
1220	Nauen	POZ	9,400	C.W.	Press in German repeated on 4,700 metres (chopped C W)
1230 to 1300	Königswusterhausen	LP	4,000	C.W.	Telephony.
1230	Paris (Le Bourget)	ZM	1,680	C.W.	
1230	Lyons	YN	15,100	C.W.	Press in English for NSS.
1230	Azores	BWP	4,000	C.W.	
1235	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation)
1300 to 1330	Devizes	GKU	2,100	C.W.	Marine traffic.
1300	Moscow	MSK	7,600	C.W.	Working with PSO and HB.
1315	Brussels	HS	1,400	C.W.	Meteorological message.
1325	Brussels	BAV	1,680	C.W.	Meteorological message (occasionally sent by HS).
1330	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message.
1330	Azores	BWP	4,000	C.W.	
1335	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1340	Strassbourg	C3	1,480	C.W.	Meteorological message.
1350	Lingby	OXE	5,000	C.W.	Meteorological message.
1400	Gibraltar	BWW	2,700	Spark	Meteorological message.
1400	Bucharest	BNS	4,000	Spark	Meteorological message.
1400	Cherbourg	FUC	2,800	C.W.	Meteorological message.
1400	Algiers	FUO	1,350	C.W.	Meteorological message.
1400 to 1700	The Hague	PCGG	1,150	C.W.	Telephony (Sundays).
1405	Air Ministry	GFA	1,400	C.W.	Meteorological message (aviation).
1410	Brest	FUE	2,800	C.W.	Meteorological message (aviation).
1415	Paris	FL	2,600	C.W.	French meteorological message.
1420	Amsterdam	STB	1,400	C.W.	Meteorological message (occasional only).
1430	Paris	FL	6,500	C.W.	Working with HFB.
1430	Nantes	UA	9,000	C.W.	Calls FRI (general call for French war vessels).
1430	Eilvese	OUI	9,600	C.W.	
1430	Aberdeen	BYD	3,300	C.W.	Meteorological message.
1430	Azores	BWP	4,000	C.W.	
1435	Air Ministry	GFA	1,680	C.W.	Meteorological message.
1445	Rome	IDO	11,000	C.W.	Meteorological message (occasional only)
1500	Paris	YA	1,950	C.W.	Calls.
1500	Nantes	UA	9,000	C.W.	Working with OSM.
1525	Brussels	BAV	1,680	C.W.	Meteorological (aviation).
1530	Paris	FL	6,500	C.W.	Working with WAR and HB.
1530	Madrid	EGC	1,600	Spark	Spanish meteorological message.
1530	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message (aviation).
1530	Azores	BWP	4,000	C.W.	
1530	Warsaw	WAR	2,100	Spark	Meteorological message.
1535	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1540	Vienna	OHD	5,600	C.W.	Meteorological message.

Time G.M.T.	Station.	Call Sign.	Wave-length.	System.	Remarks.
1545	Prague	PRG	4,100	C.W.	Meteorological message.
1545	Sofia	FF	3,800	Spark	Meteorological message.
1550	Christiania	LCH	8,000	C.W.	Meteorological.
1600	New Brunswick	WII	13,400	C.W.	Working to YN and LY.
1615	Paris	FL	8,000	C.W.	
1630	Azores	BWP	4,000	C.W.	
1630	Paris	FL	6,500	C.W.	Press in German for OHD.
1635	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1655	Annapolis	NSS	17,000	C.W.	Time signals.
1700 to 1730	Devizes	GKU	2,100	C.W.	Marine Traffic.
1705	Paris	FL	3,200	C.W.	Calls FUT and FUA.
1730	Azores	BWP	4,000	C.W.	
1735	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1800	Paris	FL	8,000	C.W.	Working to FF.
1800	Nauen	POZ	12,600	C.W.	Calls NSS.
1800	Prague	PRG	4,100	C.W.	Calls NSS.
1800	Paris	FL	5,000	C.W.	Calibration waves, 3-minute dash 1st and 15th of each month.
1810	Paris	FL	7,000	C.W.	Calibration waves, 3-minute dash 1st and 15th of each month.
1815	Brussels	HS	1,400	C.W.	Meteorological message.
1820	Lyons	YN	10,000	C.W.	Calibration waves, 3-minute dash 1st and 15th of each month.
1825	Brussels	BAV	1,680	C.W.	Meteorological message (aviation) (occasional only).
1830	Lyons	YN	15,000	C.W.	Calibration waves, 3-minute dash 1st and 15th of each month.
1830	Paris (Le Bourget)	ZM	1,680	C.W.	Meteorological message (aviation).
1830	Cherbourg	FUC	2,800	C.W.	Meteorological message (aviation).
1830	Azores	BWP	4,000	C.W.	
1835	Air Ministry	GFA	1,680	C.W.	Meteorological message (aviation).
1840	Brest	FUE	2,800	C.W.	Meteorological message.
1840	Strassbourg	C3	1,480	C.W.	Meteorological message.
1845 to 1900	Lyons	YN	15,000	C.W.	(Exact values of calibration waves sent out.)
1850	Lingby	OXE	5,000	C.W.	Meteorological message.
1900	Toulon	FUT	1,350	Spark	Meteorological message.
1900	Paris	FL	8,000	C.W.	French Press.
1900	Eilvese	OUI	9,600	C.W.	Working with EAM.
1900	Rome	IDO	11,000	C.W.	C.Q's., then works with IHM, ICW, IRB, etc.
1905	Air Ministry	GFA	1,400	C.W.	Meteorological message.
1930	Azores	BWP	4,000	C.W.	
1930	Paris	FL	2,600	Spark	French meteorological message.
1930	Aberdeen	BYD	3,300	C.W.	Meteorological message.
1930	Karlsborg	SAJ	4,100	C.W.	Swedish meteorological message.
1940	Nauen	POZ	3,900	C.W.	German meteorological message.
2000	Paris	FL	6,500	C.W.	Working with HB and VSL.
2000	Horsea	BYC	6,000	C.W.	Press in English.
2000	Karlsborg	SAJ	2,500	Spark	Swedish Press.
2000	Coltano	ICI	4,100	Spark	Working with MSK.
2000	New Brunswick	WII	13,400	C.W.	Working to YN and LY.
2000	Madrid	EGC	1,600	Spark	Inland working.
2000	Air Ministry	GFA	1,400	C.W.	General meteorological information.
2000	North Foreland	GNF	600	Spark	Navigation warnings, in plain language.
2010	Christiania	LCH	8,000	C.W.	Meteorological message.
2010 to 2300	The Hague	PCGG	1,150	C.W.	Telephony (Thursdays).
2020	Warsaw	WAR	2,100	Spark	Meteorological message.
2030	Azores	BWP	4,000	C.W.	
2030	Nauen	POZ	9,400	C.W.	German Press, repeated on chopped C.W. 4,700 metres.

REGULAR TRANSMISSIONS OF WIRELESS STATIONS

Time G.M.T.	Station.	Call Sign.	Wave length.	System.	Remarks.
2030	Prague	**PRG**	4,100	C.W.	Meteorological message.
2030	Madrid	**EGC**	1,600	Spark	Spanish meteorological message.
2045	Rome	**IDO**	1,100	C.W.	Italian meteorological message.
2100 to 2130	Devizes	**GKU**	2,100	C.W.	Marine traffic.
2100	Malta	**BYZ**	4,200	C.W.	Meteorological message.
2100	Paris	**YA**	1,950	C.W.	
2100	Nantes	**UA**	2,800	C.W.	Navigation warnings.
2130	Nantes	**UA**	4,000	C.W.	Repetition of navigation warnings sent at 2100.
2130	Azores	**BWP**	4,000	C.W.	
2130	Poldhu	**MPD**	2,800	Spark	Admiralty meteorological message.
2200	Gibraltar	**BWW**	2,700	Spark	Meteorological message.
2200	Paris	**FL**	6,500	C.W.	Working with **ICD.**
2200	Reval	**ELN**	1,900	C.W.	Meteorological message.
2210	Moscow	**MSK**	5,000	Spark	Russian message.
2200 to 2210	Moscow	**MSK**	5,000	Spark	Time Signals (Series of "Beats.")
2230	Azores	**BWP**	4,000	C.W.	
2230	Bordeaux	**LY**	23,450	C.W.	French Press for the East.
2300	Paris	**FL**	2,600	Spark	Astronomical time signals.
2300	Rome	**IDO**	11,000	C.W.	C.Q. calls and working with **IHM, ICW, IRB,** etc.
2315	Nantes	**UA**	6,700	C.W.	Working with **BUC.**
2315	Scheveningen Haven	**PCH**	1,800	C.W.	Dutch meteorological message.
2330	Paris	**FL**	2,150	Spark	Astronomical time signals.
2330	Azores	**BWP**	4,000	C.W.	
2344	Paris	**FL**	2,600	Spark	Time signals (old system).
2350	Paris	**FL**	2,600	Spark	Times for 2330 signals.
2355	Nauen	**POZ**	3,900	Spark	Time signals.

AN AMATEUR STATION IN HEREFORD.

Mr. F. Ladmore, of Hereford, sends the accompanying photograph of his Wireless Set, which he suggests may be of interest to readers of *The Wireless World*. The set is all home-made, with the exception of a few details. An R valve is used as high frequency magnifier, followed by crystal, and this arrangement is found fairly efficient, many large stations being readable without aerial or earth. Tuning to long wavelengths is obtained by the use of condensers, and using a two valve note-magnifier, big stations are audible at a considerable distance from the phones.

WIRELESS SOCIETY OF LONDON

The next meeting of the Wireless Society of London will be held at the Royal Society of Arts, John Street, Adelphi, W.C.2, on Monday, May 2nd, at 8 p.m., when a Lecture will be delivered by Mr. Philip R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E., entitled "Experimental Wireless Telephony."

THE MAKING OF WIRELESS APPARATUS

A WAVEMETER FOR SHORT WAVES

(Concluded.)

THE next item is the condenser, which should have a capacity of 0·00014 mfd., and it should be made as accurately as possible. To do this the dimensions given must be closely worked to.

The condenser plates, of which eight will be required, should be made of thin copper foil (tin foil is not much good for small condensers as it tears so easily), approximately 0·001 inch to 0·002 inch thick. The size of the foils should be 1¼ inches long, ⅜-inch wide. For the dielectric we normally use 0·002 inch micas, but for this condenser the thickness should be 0·004 inch, otherwise the number of copper foils required to give the capacity would be four with a possibility of a larger error due to the thickness of dielectric varying. Therefore, use one mica sheet 0·004 inch thick between the foils, or two micas 0·002 inch thick. Cut them to the size, 1 inch long by ¾-inch wide.

For building up the condenser a small quantity of thin shellac varnish will be required. First of all stick each copper foil on to a mica sheet so that $\frac{3}{16}$-inch of copper is on the mica, as shown in Fig. 4. If 0·002 inch mica is used stick one mica on each side of the copper foil, but if 0·004 inch mica is used stick a mica on one side only.

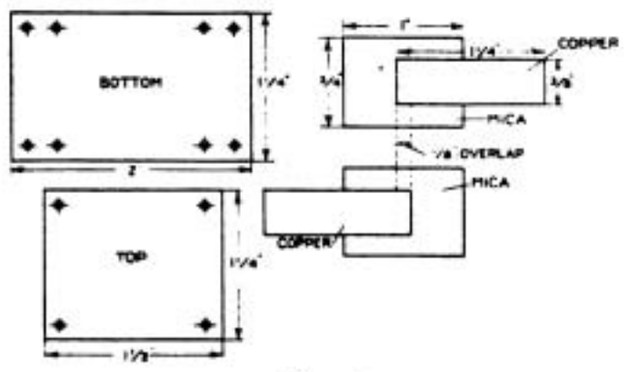


Fig. 4.

Then build up the condenser by mounting the foils one on top of the other and placing the mica sheets so that the free end of the foil is alternately one side then the other of the condenser. Then the plates of opposite polarity will overlap one another by ⅛-inch, which is the desired distance. When finished there will be four copper foils on one side and four on the other. Then place the condenser in a very tight clamp and bake it in a warm oven for several hours. Practically all of the shellac will dry out and the condenser will be like a solid block.

The clamp, also shown in Fig. 4, is made of two pieces of wood, one piece the base, 2 inches × 1¼ inches × ⅛-inch, and the other the top, 1½ inches × 1¼ inches × ⅛-inch. Four small holes are made in the corners of the top of four corresponding holes in the base by means of which the condenser may be secured in the clamp. Countersunk metal thread screws and nuts should be used for this purpose, the screws being put in from the back of the base and the holes countersunk so that the screw-heads will be flush with the base. The clamp is fixed to the under side of the variometer former (as shown in Fig. 1, last issue) by wood screws through four holes in the corners of the base of the clamp.

A small terminal board with two terminals on it, mounted on the side of the variometer former, as shown in Fig. 1, completes the parts required.

When everything is made finally mount up the set and make connections as shown in Fig. 5.

A small cardboard scale should be mounted on top of the variometer. It should have a 180° scale marked on it, either in degrees or numbered 0 to 10. The handle and pointer of the variometer rotating coil should be fixed so that maximum inductance is given when pointer indicates 10 or 180° on scale and minimum inductance at 0 or 0° on scale. This will be obtained when the position of the moving and fixed coils with

relation to one another is thus : For maximum inductance the two coils should be in the same plane and the direction of the current the same way round both coils. For minimum inductance both coils will be in the same plane, but the current will flow round the two coils in opposite directions. At 90° or 5 on the scale, the two coils will be at right angles, and there will be no mutual inductance between them.

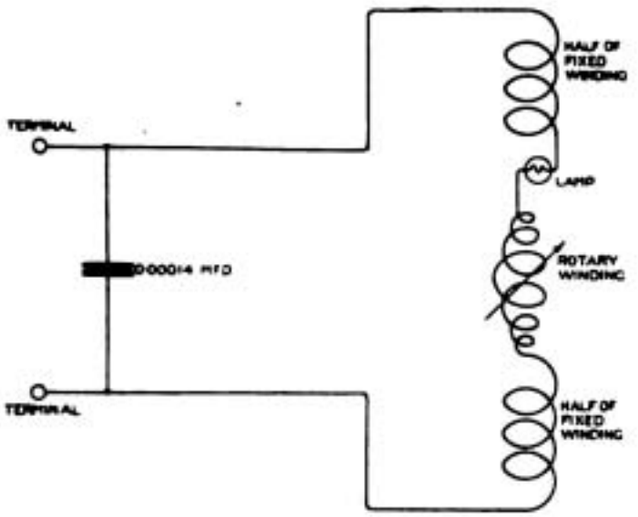


Fig. 5.

When the set is complete there remains the question of standardising.

The condenser value is 0·00014 mfd. and the inductance approximates 30 mhys. at minimum and 120 mhys. at maximum. This will give a wavelength range of, approximately, 125 to 245 metres.

If a calibrated wavemeter for such wavelengths is obtainable it may standardised against this, but if this is not possible it may be calibrated by means of a "Lecher Wire" circuit.

The principle of the "Lecher Wire" circuit is this : If two long wires, spaced a little apart, joined at one end and mounted some distance above the earth, are set into oscillation by an impulse from a tuned ignition coil circuit the fundamental wavelength of the oscillations so set up will bear a certain relation to the length of the joined wires.

In Fig. 6 A B and C B are the two parallel wires mounted, say, 2 feet above the ground and 6 inches apart. The length of the joined wires is *l*. Coupled to the wires at the joined end is an ignition coil set tuned somewhere near the wavelength it is desired to set up in the parallel wires. When the coil is sparked oscillations are set up in the parallel wires having a current loop (or maximum current at the joined end) and current nodes at the ends A and C. The oscillating potentials will be a minimum or node at the joined end and maximum or loops at the ends A and C. Thus it will be seen, as in Fig. 7, that a half wave is obtained over the whole of the two wires or a quarter wave on the one wire, so that the fundamental

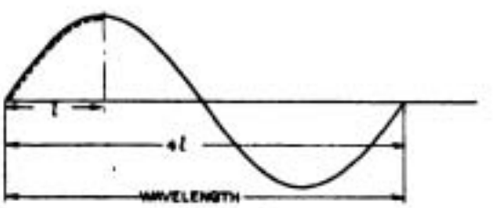


Fig. 7.

wavelength will be 4 *l* where *l* is the length of wire from one end to the join. Therefore, if the two wires are each 60 metres long the fundamental wavelength will be 240 metres.

The presence of potential loops at the ends of the wires can be detected by means of a neon tube, maximum glow being given at the points of maximum potential. Current loops

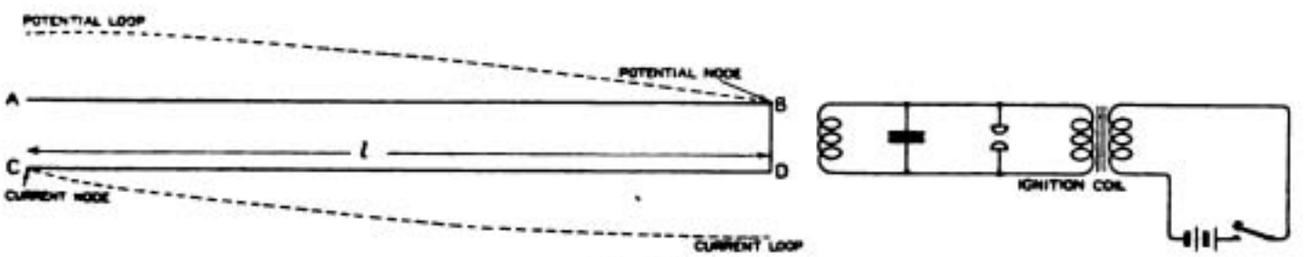
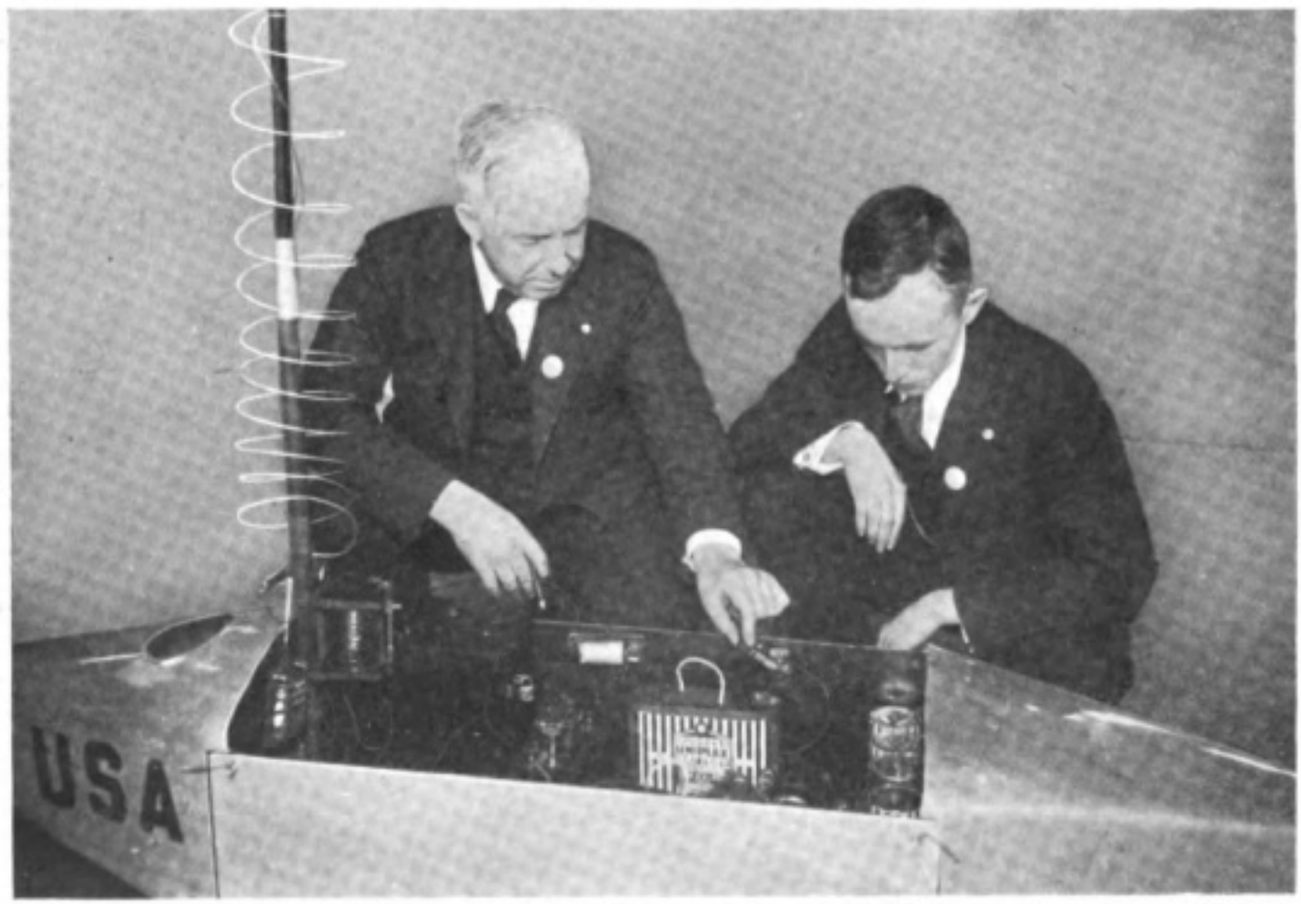


Fig. 6.

are detected by means of a wavemeter with crystal and telephones placed somewhere near the joined end of the wires.

To calibrate the wavemeter we have described having maximum wavelength 240 metres ; start off with a wire length of 60 metres. Pick this up and adjust variometer for maximum signals. Then reduce the length of wires, say, to 55 metres, *i.e.*, 220 metres wavelength, and obtain another point on variometer scale. By reducing the lengths of wire in this way about 8 points may be obtained. These can be plotted and a calibration chart made out. The wires should be kept as near parallel to the ground as possible, or, say, 6 equally spaced posts 2 feet high and with the wires 6 inches apart. The best wire to use is about No. 20 copper, either bare or cotton covered. Iron wire may be used but should be of larger gauge owing to its higher resistance. The wires should be insulated from the posts.

WIRELESS CONTROL*



The Arrangement of Apparatus inside the Car. *Photopress.*

A wireless controlled automobile was exhibited at the Convention and Exhibition of the Executive Radio Council, New York, on March 18th. The car was driven round the roof of the Pennsylvania Hotel, where the Exhibition was held, and was controlled from a distance of more than 100 feet. The controlling apparatus is said to be capable of directing the car from a distance of 800 miles. The photograph shows the inventor of the apparatus, Mr. E. F. Glavin, explaining the mechanism.

* An article on Wireless Control appeared on p. 385 of Vol. viii., No. 11 of *The Wireless World*.

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) *Questions should be numbered and written on one side of the paper only, and should not exceed four in number.* (2) *Queries should be clear and concise.* (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.**

ORPHEUS (Bangalore).—(1) The circuit in your Fig. 1 requires a grid leak, and even then is rather tricky to make oscillate. You would be safer to rectify on the bend of the characteristic—remove S 1 and use a potentiometer. The inductance L 8 is superfluous and L 6 and L 7 may give you an unduly large amount of coupling, otherwise O.K.

(2) Aerial circuit, 8,000 ms.; closed circuit, 14,000 ms. Your inductances are of good practical design.

(3) A smaller condenser is better—about ·0003 mfds. or less. But see (1) above.

(4) You should earth the negative of the filament. S = ·01 mfds., but this is too big for a parallel condenser. A good arrangement is to put an extra fixed condenser (·0003 mfds.) so as to be in series with S 1 when the latter is in parallel with the inductances. Use coil L 2 and L 3 for extra long-wave inductance. *Re* condenser and leak, see (3) above. We do not recommend a single circuit receiver for auto-heterodyne reception, owing to radiation.

EX-SANSFILIST (Wimbledon).—(1) Use the largest former wound with No. 28 (as sample) for the A.T.I., with the smallest with the same wire for the primary of the coupler. The secondary of the coupler should be the remaining coil, wound with No. 32.

(2) Total about 1,000 yds. of No. 28, and 750 yds. of No. 32.

(3) A.T.C. 0·001 mfds. (in parallel with the A.T.I.). Tuned circuit condenser 0·0008 mfds.

(4) Eccles' "Handbook of Wireless Telegraphy" has a comparative table of wire gauges with metric sizes.

A.B. (Seven Kings).—(1) Yes.

(2) A.T.C. should be about ·0008 mfds. If this is so the A.T.I. should be about 20" × 10" wound with No. 26 for really efficient working.

(3) About 8" × 6" wound with No. 28 or No. 30.

(4) K (1) = 0·00005 mfds. K (2) less than 0·001 mfds.

B.A.C. (Oxford) *refers to Mr. G. G. Blake's article on page 614 of the issue for 27/11/20, and asks the distance to place apart the end cheeks of the former also the diameter of its core.*

This type is not wound on a former with cheeks. See the article in the issue for 12/6/20, referred to by Mr. Blake. As regards the diameter of the cores, we suggest that ¾", as stated in the June article might not be far out, or you might communicate with Mr. Blake on this point through the Editor.

P.L. (Wellington College).—The set you sketch and which you say is described on page 697 is entirely different to any given on that page, and is quite unsuitable. The circuit of Fig. 4 should be quite satisfactory; if you wish to use a crystal as well, *cf.*, page 65, April 17th issue.

(1) The valve may be any hard receiving valve with suitable H.T. voltage.

(2) All right for spark, C.W. and telephony.

(3) Range impossible to state.

(4) The capacities given for variable condensers are capacities at maximum.

We regret we have not space to deal with your remaining five questions. (See rules printed at head of this section.)

W.S. (Hunslet) *asks* (1) *The power required to operate a valve transmitter set over a range of* 30 *miles under the worst conditions of weather. The aerial is indoor and* 50′ *long.* (2) *A sketch of the circuit with the simplest connections.* (3) *The probable cost of materials.*

(1) Depends on circumstances, such as efficiency of the set, freedom from jamming, etc., say, 30 watts.

(2) See Fig. 1

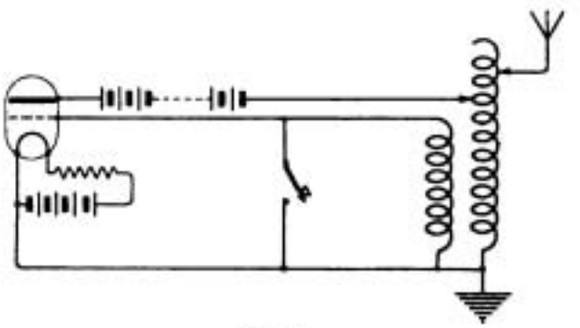


Fig. 1.

(3) Difficult to say; so much depending on the finish desired, etc. Possibly about £10 inclusive for a fairly good set.

D.N.T. (Rugby) *asks* (1) *What is the best circuit using* 4 *valves,* 3 *employed as a cascade amplifier.* (2) *What is the best way to make the high resistance required.* (3) *The formula for the making of tinfoil and paraffin waxed paper blocking condensers to a given capacity.* (4) *A circuit employing a capacity reactance.*

(1) Of many possible circuits a resistance coupled amplifier on the lines of Fig. 1, page 833, of the issue for March 5th, is one of the best except for short wavelengths, on which it is inefficient.

(2) Either by rubbing in pencil lead on the surface

of a strip of fibre or on to rods of slate (slate pencils).

(3) The capacity of a parallel plate condenser in microfarads is :

$$\frac{1}{900,000} \times \frac{K.A.n.}{4\ \pi\ d.}$$

where K = specific inductive capacity,
(*for waxed paper* $K = 2{\cdot}5$)
A = area of overlap of each pair of plates in sq. cms.,
n = number of plates of active dielectric,
d = thickness of the dielectric in cms.

(4) Couple the plate of the third valve to the grid of the first valve through a small variable condenser.

F.J.B. (Harrow) *gives a description of his single valve receiver, which is a grid-condenser detector-amplifier with reaction. He states that he can get C.W. stations well, but cannot hear speech clearly.*

Your trouble is almost certainly due to the fact that you are near the oscillating point. This must certainly be avoided, even at the expense of signal strength. A safe way of bringing up the latter is to employ more valves; one additional note magnifier might be sufficient in your case. The range at which you can receive telephony will, however, always be shorter than for C.W., owing to the fact that in the latter case you can employ more reaction.

B.G.G. (Venice) *is using a valve of audion type and gets satisfactory results, except that signals go off with a click and are recovered by switching off for a few moments. He asks* (1) *the reason for this.* (2) *Would the use of a variable condenser in place of the grid condenser be of any benefit.* (3) *Is the tuner he is using the ordinary magnetic crystal type with wavelengths from* 300 *to* 3,000 *ms.* (4) *What is the cause of a purple glow round the plate when the valve is in circuit.*

(1) This may be due to either (*a*) the fact that you have no leak across your condensers, though this is admittedly common practice with soft valves; or (*b*) that your valve is too soft, and is "flopping"; this may be improved by resting or by running the filament with the H.T. off.

(2) Probably not.

(3) We cannot say.

(4) This glow is common in valves which contain a fair amount of residual gases, which leads to unsteady working.

F.F. (Wath-on-Dearne).—(1) You give no particulars by which we can identify the valve in question, so we cannot answer your query.

(2) Yes, with suitable chokes and condensers to smooth out machine noises.

(3) You might connect your valve to the balanced crystal receiver as a note magnifier. Make an intervalve transformer (see article in the issue for March, 1920), but use ½ oz. and 1½ oz. of No. 44 S.W.G. for the windings, and substitute it for your present telephone transformer. Connect the secondary winding to the grid and filament of your valve. (See diagram on page 851 of the issue of March, 1920, for connections for note magnifier.)

(4) You will not require a grid leak if you use your valve as a note magnifier. You need not use a telephone transformer, but put your H.R. telephone direct in the plate circuit of your valve.

T.A.M. (Cowes) *asks* (1) *For suggestions for the improvement of a single valve receiver sketched.* (2) *For the probable cause of unsteady working on telephony.*

(1) Put the telephones on the negative side of the H.T. battery; you would also get better selectivity by using a two-circuit receiver loosely coupled with the closed circuit only.

(2) Setting aside the possibility of an intermittent contact somewhere on the circuit this may be due to (*a*) too tight reaction coupling; (*b*) an unsatisfactory grid condenser leak. Try without these items.

BUZZER (Bishop's Stortford) *asks* (1) *At what hours are the time signals and news and weather reports.* (2) *Must the earth lead connected to a water pipe be an insulated wire.* (3) *For information regarding a station which transmits between* 12 *and* 1 *p.m. and at* 8 *p.m. at which time two other stations appear to transmit alternately.* (4) *When is the next Chelmsford concert.*

(1) See page 85 of this issue.

(2) This is not essential.

(3) Quite impossible to say, as you give no information as to the type of set or the wavelength used.

(4) There is none in prospect as the station is at present engaged on commercial work.

GRANGE AVENUE (Reading).—(1) The secondary coil is much too high in inductance: rewind with about No. 28.

(2) Capacity about 0·0025 mfds—about five times too big. The maximum convenient wavelength for a set of this type is about 4,000 ms. You will get this all right as suggested.

(3) The reactance coil might be 5" × 3", wound with No. 30.

(4) Either type is satisfactory and 4½ volt flash lamp cells are suitable for H.T. batteries.

J.M.C. (Bothwellhaugh) *asks* (1) *What is the resistance of an enclosed sample of bare wire.* (2) *Is a sample of silk-covered wire suitable for the secondary of the loose coupler.* (3) *Could he convert or use an ignition coil as a valve (telephone) transformer.* (4) *Is an enclosed sample of mica suitable in thickness for condenser purposes.*

(1) 0·45 ohms per yard.

(2) No, it is rather too thin (No. 28).

(3) Not very well. The alterations necessary would be almost as much trouble, and as expensive, as making a new transformer.

(4) Yes.

P.J.F. (Burma).—(1) When a condenser in series with an aerial is made of negligibly small capacity the aerial becomes effectively isolated from earth (in practice this limit is unattainable). Under these conditions anti-nodes of potential exist at the extremities of the wire and a node at the middle. This is not as you stated, but considerations of symmetry make it fairly obvious.

(2) The reactance of a condenser to H.F. oscillations is given by $1/2\pi fC$ where C = Capacity and f = frequency. When the capacity is large the reactance is small; thus, if $C = 1$ mfd. $(= 10^{-6}$ farad) and $f = 500{,}000$ (600 metres wavelength) the reactance

$$= \frac{1}{2\pi \times 500{,}000 \times 10^{-6}}$$
$$= 0{\cdot}32 \text{ ohms.}$$

R.G.S. (Chester) *asks* (1) *For the wiring diagram of the circuit on page 444 of the issue for September 18th.* (2) *For the sizes of the coils.* (3) *For the best type of aerial to use.*

(1) and (2) We regret we have no further information on this matter, but see remarks on the subject and diagram by G. G. Blake, page 614, November 27th issue.

(3) Any normal type, as large and as high as possible will do.

BEGINNER (Glasgow) *asks* (1) *How many semi-circular plates of 1½" radius will he require to give 0·001 mfds. capacity.* (2) *Would aluminium have any advantage over zinc for these plates.* (3) *How many of these plates would be needed for 0·0005 mfds. capacity.* (4) *What would be the best method of mounting slab inductances in order to be able to vary the coupling.*

(1) This depends on the thickness of air space between plates; if this is 2 mms., you will require about 56 plates in all. Preferably increase the size of plates and reduce their number.

(2) Preferably zinc, as this will allow you to solder the plates firmly into position.

(3) Half as many as in (1).

(4) You could mount them on ebonite or fibre plates hinged together.

H.J.V.W. (Swansea).—(1) We cannot calculate inductances without knowing the number of turns per inch or the S.W.G. No. of the wire. Further, we cannot calculate the capacity of your condenser without knowing the distance between plates. As regards increasing your wavelength we cannot make out your diagram, which appears to show no earth connection. We do not, however, advise you to attempt more than 5,000 metres with a crystal set.

(2) Your diagram appears to show no telephone transformer and we should, consequently, think that H.R. telephones would give better results. Wavelength does not enter into the question.

(3) No: frame aerials are quite unsuited for use with crystal sets.

(4) Your aerial wire appears to be suitable, but an empty firegrate is a very indifferent earth. You should certainly get FL with a good earth, if you are tuned in to it, but we doubt if you would get Arlington. We cannot say what causes the "clicks" when you turn the condenser, possibly a short circuit.

F.A. (Portsmouth).—(1) Circuit is quite good; wavelength will be above 3,500 ms. The primary of the coupler is too big. It should be rewound with No. 22; even then the coupling will be quite tight.

(2) The single wire aerial will probably give the better results. Try and increase the height at the free end so as to avoid the sharp bend at the down lead.

(3) The wavelength of the aerial circuit (with primary wound as above) will be approximately 4,200 ms. Wavelength of secondary is 6,000 ms. Make a tapping on the secondary at 2" and 5" to get shorter wavelengths.

GUNNER (Guthrie).—(1) Your grid condenser appears abnormally large (0·001 mfds.). You might advantageously try reducing its value to about 0·0001 mfds. Otherwise O.K.

(2) You may get improved results in reducing the condenser. The cracklings you describe may be due to your big condenser being unable to discharge sufficiently quickly through 2 megohms.

(3) You should be able to shorten your wavelength satisfactorily by inserting a 0·005 mfd. condenser in the aerial down lead, and omitting the 0·0003 condenser in parallel with your A.T.I. A condenser of small value in the earth lead may give rise to howls owing to the filament batteries not being at earth potential.

J.L. (Harrogate).—(1) You answer your own question. It should be wound with No. 22 double wound silk, as you say.

(2) The maximum wavelength would be about 28,000 ms. The thickness of the mica sheets and copper foils should be about 0·001" and not 0·01", as stated in the article.

VALVE (Cambridge).—(1) Quite O.K., but put the telephones on the negative side of the H.T. battery.

(2) 5" × 3" of No. 28.

(3) 0·00005 mfds., grid leak about 5 megohms.

(4) Maximum about 3,500 ms., minimum difficult to state, probably about 400 ms.

J.E.B. (Coventry).—(1) The circuit is quite good. The wavelength range is not very satisfactory. The aerial will tune to 2,400 ms., but the secondary to only 1,700 ms.

(2) Inductance of coil A = 16,000 mhys.
" " B = 3,000 mhys.
" " C = 1,400 mhys.

(3) Make a new former for coil B, 4" in diameter and wound with 7½" of No. 28 D.S.C.

(4) The circuit will receive spark and telephone signals, but will not receive C.W. unless a reaction coil is used to generate local C.W. oscillations. For a reaction coil connect a 3" former wound with 3" of No. 28 D.S.C. between the positive H.T. and the anode of the valve. A 0·002 condenser should be connected across the H.T. and telephones as a low impedance path for high frequency.

Q.T.C. (Swindon) *wishes to make a crystal set to tune from 600 to 4,000 ms., and asks* (1) *If the arrangement sketched is O.K.* (2) *The values for the condensers.* (3) *The size of formers and gauge of wire for the inductances.* (4) *If a small inductance of 90 turns as per enclosed sample on a former 4" in diameter winding taking about 4" in length would do for the aerial circuit coupling.*

(1) Yes, but preferably put the A.T.C. on the earth side of the coupling coil.

(2) A.T.C. not less than 0·005 mfds., closed circuit condenser = 0 00005 mfds.

(3) A.T.I. 12" × 7" wound with No. 24. The

coupling coil as you suggest, or wound with No. 24. The tuned circuit inductance 6" × 5", wound with No. 28.

(4) See above (3).

OOJAH (Durham) *asks* (1) *How many honeycomb coils he wants to tune to* 25—30,000 *ms. with a* 0·006 *mfd. condenser.* (2) *If honeycomb coils are better than slabs, pancakes or lattice coils.* (3) *How to make an intervalve transformer.* (4) *If a diagram which he submits is efficient for C.W. reception.*

(1) Calculations of this kind are somewhat uncertain, but you might try 4 coils 1" wide on 1" formers, having 30 layers each of 26 S.W.G. The required inductance is 42,000 mhys.

(2) See Mr. P. R. Coursey's articles in recent issues (*e.g.*, October 2nd, October 16th and December 11th) for a general discussion of the relative merits of different coils. There is not very much to choose, but in general the more compact the coil the worse its electrical properties.

(3) The construction of such a transformer varies for different wavelengths. A description of one type is given on pp. 588—590 of the issue for November 30th.

(4) Put the A.T.C. in the aerial downlead, not on the earth side of the A.T.I. Otherwise O.K. (We presume your reactance is located close to the A.T.I. and not as shown in your diagram.)

BIMBO (Reading).—(1) The set is not as good as it might be. Without a parallel condenser the primary is not tuned to more than 2,000 ms. The secondary is only approximately tuned to the primary by the tight coupling.

(2) Increase the primary inductance up to 10,000 mhys., or use a 0·0005 mfd. condenser in parallel with the existing coil. Rewind the secondary with No. 24, and use a 0·0005 mfd. variable condenser; this will increase the range to 4,000 ms.

(3) Impossible to say.

(4) Yes, but we cannot give the definite times. Aerodrome stations work at irregular hours on 900 ms.

AMATEUR (Shelton) *asks* (1) *The relation between the terms "Jar" and "Microfarad."* (2) *If it is wrong to run the aerial and earth leads close together into the receiving room.*

(1) A Jar is a unit of capacity much beloved by the Navy; it is equivalent to 1,000 cms., or 0·0011 mfds.

(2) These leads should not run very close together, as this weakens signals owing to capacity between them.

J.H. (Stacksteads).—(1) Your query is vague. To reach Hornsea the set must have a range up to 6,000 ms. We presume you have a standard P.O. aerial and propose to use a valve. The A.T.I. should be 6" × 9", wound with No. 28, with several tappings. Use a parallel condenser of 0·0005 mfds. across it. The reaction coil should be 5" in diameter and 5" long, wound with No. 28 D.W.S.

(2) No.

(3) Answered in (1).

(4) Copper pyrites.

A.M. (Hunts).—(1) A valve receiver which gives spark signals should almost invariably give telephony. You probably do not listen on a wavelength and times when there is any to get. Listen on 900 ms. for aerodrome telephony at various hours of the day.

The wire on your A.T.I. (No. 34 enamelled) is too small a gauge for aerial circuits; it introduces too much resistance. As a general rule it should not be finer than No. 26 or 28; No. 34 is quite right for the reaction coil. You will find a 0·0015 to 0·002 mfd. condenser across the H.T. battery an improvement for the reception of C.W. signals.

H.W.D. (Bath) *asks* (1) *What number of turns must he use for an intervalve transformer of the wire enclosed as sample.* (2) *Can he use the* 3 *valve receiving set for sending up to the range allowed (ten miles). If so, what alterations must he make in the set. Are there any additions required, or is it only a matter of inserting a key in the circuit.* (3) *Does a resistance between the valves act as well as a transformer, and if so, how is one made.*

(1) Intervalve transformers wound with copper wire are "tuned" transformers having a certain definite wavelength, depending on the arrangement and number of turns. They are most efficient for this definite wavelength and the efficiency falls off rapidly for wavelengths on either side of this value. For example, a 600 metre transformer is suitable for 450 to about 900 ms. or a 3,000 ms. transformer for 2,000 to 5,000 ms. We cannot give you a winding unless you say for what wavelength you require it.

(2) You do not give a diagram of your receiver, so that we cannot give an opinion. It is very unlikely that you could use your 3-valve receiver for transmission without radical changes in its construction, after which it would not be so suitable as a receiver.

(3) Yes. Resistances in the anode circuits of valves are usually of the order 50,000 to 100,000 ohms., and are non-inductive. They are not easily made and maintained constant. It is usual to buy carbon rods of the required resistance. Fairly satisfactory substitutes can be made by rubbing pencil lead into a piece of slate rod.

E.B. (Ross-on-Wye).—(1) There should be no harmful inductive effect if the coils are spaced a little apart. Your sketch shows both ends of the unused coils disconnected, so there can be no free-end effect.

(2) It is usual to do so, but not absolutely essential.

(3) You do not understand H.F. intervalve transformers. For a wave range of 300 to 3,000 ms. (with copper wire) you would require about half a dozen interchangeable transformers. The 0·001 condenser in the aerial circuit will have no tuning effect on the intervalve transformer. (A constructional article will deal with this subject in the near future.)

(4) The general arrangement of the circuit is not quite correct. Why put two variable condensers in series in the aerial circuit? You show the anode of the 2nd and 3rd valves connected to the negative side of the filament instead of to the positive H.T. terminal. There should be a H.F. transformer between the 2nd and 3rd valves.

H.X.Z. (London).—(1) Certainly. Short wave should go up to 2,500 ms.

(2) We know of no information dealing with exactly the points you mention, except, perhaps, the article on page 699 of the March, 1920, issue. A similar construction, substituting ½ oz. and 1½ oz. of No. 44 for the windings given in the article would do for an intervalve transformer. With regard to other points, C = 0·01 mfds., and 3 = 0·003 mfds. for all waves. B = 8,000 mhys. for the short waves. For long waves, B = 250,000 mhys., for a maximum of 14,000 ms. For such wavelengths a small condenser, 0·0003 mfds. should be used in parallel with the A.T.I., instead of a series condenser. A must, in all cases, be found by experiment.

(3) Formula is correct, but gives the result in centimetres.

(1,000 cms. = 1 mhy.)

AMATEUR (Herne Hill).—(1) The circuit will be fairly satisfactory if you put the A.T.C. on the aerial side of the A.T.I.—between the grid lead and the aerial. Also put a condenser across the telephones.

(2) You do not give enough particulars of your aerial for us to say exactly, but you will probably be able to get to 8,000 ms. with a coil of the size you give.

(3) The aerial system should be fairly satisfactory if of sufficient height, but keep as far from the metal as possible.

MICROHENRY (Barnet).—(1) The circuit will be satisfactory if you place the H.T. battery on the plate side of the tuned circuit instead of on the earth side. The set will receive spark and telephony and C.W. if you provide suitable inductive coupling between the plate and grid circuits.

(2) An R valve will be quite suitable.

(3) Yes, with the alternations given in (1) above. Of Fig. 2, page 662, December 11th issue.

(4) Not satisfactorily with only one valve.

B.R. (Oxford) *asks* (1) *The difference between telephones with an adjustable iron reed and telephones with a diaphragm.* (2) *If a variometer will give as fine tuning as a variable condenser.* (3) *If the diaphragm of a telephone touches the poles when a signal is received.* (4) *If the annual wireless licence counts from January 1st each year.* (5) *If No. 18 rubber-covered cable would do for a lead in.*

(1) You have stated the chief difference. The principle of action is the same, and there is little to choose between good specimens of either type in performance.

(2) Quite.

(3) Not as a rule, though it can sometimes be made to with very strong signals and adjustable te'ephones.

(4) See references made in the proceedings of the Second Annual Conference of Wireless Societies, page 42 of the April 16th issue.

(5) Yes.

RADIO (Blackburn).—The sketch you sent is incorrect; see Fig. 1, page 497, October 2nd issue for correct crystal and potentiometer connections.

(1) 0·00033 mfds.

(2) About 1,000 ms.; but you are not likely to get good results with a kite aerial, owing to variation of tuning with variation of the height of the kite.

(3) Yes; see Nos. 16 to 21 of Vol. VIII., obtainable from the Wireless Press, price 6d. each.

(4) For general purposes we prefer the carborundum.

R.A.F. (Cape Town).—(1) Natural wavelength 140 ms., inductance = 32 mhys., capacity = 0·00027 mfds.

(2) Wind the intervalve transformers with the finest gauge resistance wire obtainable, say, No. 48 Eureka. Wind in short sections, sections of each winding alternately. We are afraid we are unable to give the exact amounts necessary for various wavelengths; try by experiment.

(3) 14,000 mhys. and 45,000 mhys.

C.D.F. (West Ealing) *asks* (1) *For an alternative H.R. winding for the telephone transformer given in the recent articles on the construction of a frame aerial set, as he finds No. 44 wire hard to get.* (2) *What resistance telephones to use.*

(1) Use the windings given if at all possible. If not, either fill up all the available space with No. 42, increasing the size of the cheeks a little if possible, or fill about 2/3rds of the available space on the original bobbin with No. 46.

(2) About 100 ohms.; the exact value is not important.

J.A.S.W. (Rugby).—(1) You will not get good results with a frame aerial and only one valve. You will find instructions for the construction of a suitable set of this type with several valves in Nos. 16 to 21 of Vol. VIII. There have also been several diagrams of sets of this type in these columns recently.

(2) A convenient way of making a resistance of 80,000 ohms. is to bind wires tightly round a piece of slate pencil at points about an inch apart, and rub pencil lead on to the slate between these points until a suitable resistance is obtained. You can tell when you have rubbed in enough either by a sensitive galvanometer or by the results that you get with the resistance when used in a set.

RADIO (Malvern College) *asks* (1) *If two gramaphone records glued together would be a suitable substitute for an ebonite panel for a valve unit.* (2) *For the address of a club in the Birmingham district other than the Birmingham Wireless Association.* (3) *If 120 ohm. telephones, with a telephone transformer will be suitable for a crystal set.*

(1) We distrust the glue. We should prefer shellac, or other good insulating substance. Except for this the material will very likely be quite satisfactory.

(2) Birmingham Experimental Wireless Club, Hon. Secretary, Mr. F. S. Adams, 110, Ivor Road, Sparkhill, Birmingham.

(3) Certainly.

W.B. (Holt).—(1) No. The inductance will only tune a P.O. aerial to 900 ms. Wavelength of FL is about 2,800 ms.

(2) Increase the A.T.I. to 12,500 mhys. Apply a potentiometer and battery to the crystal. Increase the condenser across the telephones to about 0·001 mfds.

(3) See constructional article in Nos. 2, 3 and 4 of Vol. 8, where a suitable set is described.

(4) French R type valve (50 volts H.T.) or a Marconi V.24 (24 v. H.T.).

W.P.P.(Monkseaton).—(1) and (4). Your set is not quite correct. The aerial circuit may be

all right. A series condenser would improve the tuning, but the secondary circuit is not properly tuned. To receive FL and MPD your secondary should be tuned to 2,800 ms., which it is not at present, unless your secondary winding has a natural period corresponding to that wavelength, in which case it would be useless for ships on 600 ms. Connect a variable condenser (0·0003 to 0·0005 mfds.) across the secondary. The crystal potential should be applied by means of a potentiometer and not direct by 2 cells as you show. Three volts is probably too much for the crystal.

(2) Ships and GCC work on 600 ms.

(3) No detrimental effect at all. It would be the best way of leading in.

GALENA (Edinburgh).—(1) Probably at G.P.O. headquarters, Glasgow or Edinburgh.

(2) From any firm advertising valves in the advertisement columns of this magazine.

(3) Not as a rule. You may possibly obtain an old set from the Marconi Scientific Instrument Co.

(4) The maximum length of wire allowed is 100′ single or 140′ in twin wire aerials (including down lead). Use a single wire aerial, making the horizontal portion as high as possible, and make it directional for south, *i.e.*, the open end pointing north. Your signals will be fairly weak.

C.W.W. (Stamford Hill).—(1) Yes.

(2) Much better to use a separate heterodyne. It might be possible to use capacity reaction. Magnetic reaction would not be easy to obtain, owing to the arrangement of the circuit, and the large amount of wavelength range to be covered.

(3) The thickness of the mica should be 0·001 for block and intervalve condensers.

(4) August 21st, 1920.

J.H.W. (Henley-in-Arden) *is using a set of "Polaris" instruments made by Gamages, and has difficulty in receiving telephony owing to a singing noise, caused presumably by the transmitting valves. He asks how he can get rid of this noise. (2) Cannot get sufficient magnification with a "Multifier" made by Gamages, and asks if he could use any other three-valve amplifier in conjunction with this. (3) asks if Chelmsford has any definite times for sending, and if so, on what wavelength.*

(1) The singing is probably caused by too tight a reaction coupling, causing your set to generate C.W., and give a beat with the C.W. carrying the speech frequency. If so, your singing note will vary as you alter the adjustment of your tuning condenser. If it is this, weaken your reaction coupling or reduce the anode voltage. The note given by the transmitter when an A.C. voltage is rectified for the oscillator anode voltage is usually of small amplitude, and does not interfere with the reception of speech.

(2) A "Polaris" and "Multifier" should give strong signals. Possibly there is a disconnection in the "Multifier." Check the circuits with a pair of telephones and a dry cell—clicks when the battery circuit is made and broken showing complete circuits. It is no use putting another three-valve amplifier in conjunction with the first one. See if there is anything wrong, and then try another in its place.

(3) There is no telephone transmission from Chelmsford at present, and we do not know when there will be any.

J.G.D. (North Shields).—A good deal of information on loud-speaking telephones is given in the issue for February 19th, which you have probably already seen.

G.H.D. (Leigh-on-Sea.) (1) See Fig. 2.

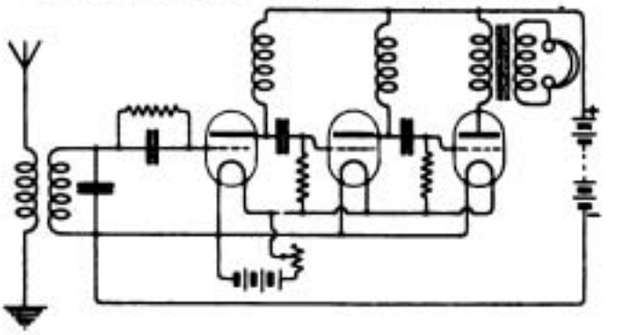


Fig. 2.

Grid condensers about 0·0005 mfds.
Grid leaks 5 megohms.

(2) and (3) 0·0046 mfds. will do for a series A T.C., though rather small; it is too large for a parallel A.T.C. Reaction can be adjusted as you suggest.

(4) A copy of "Bucher's Vacuum Tubes" would give you a large number of circuits, some of them good, but others rather doubtful.

L.B. (Marseilles) *asks for a formula for finding the maximum range one can transmit, knowing the power and efficiency of the generator and the length and height of the aerial.*

There is no formula at all suitable for the practical prediction of the range of a small set. Various formulæ will be found in most advanced text-books which give fair results with large sets over long ranges. The Austin-Cohen formula is one of the best, but even this is of very little use to an amateur.

SHARE MARKET REPORT.

There has been considerable activities in Marconi Shares and a marked improvement is shown. Prices as we go to press, April 22nd, are :—

Marconi Ordinary	£2 - 8 - 9
,, Preference	£2 - 7 - 6
,, Inter. Marine	£1 - 8 - 9
,, Canadian	8 - 3

Radio Corporation of America :—

Ordinary	9 - 0
Preference	10 - 9