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# THE WIRELESS WORLD AND RADIO REVIEW

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THE
# WIRELESS WORLD
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THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

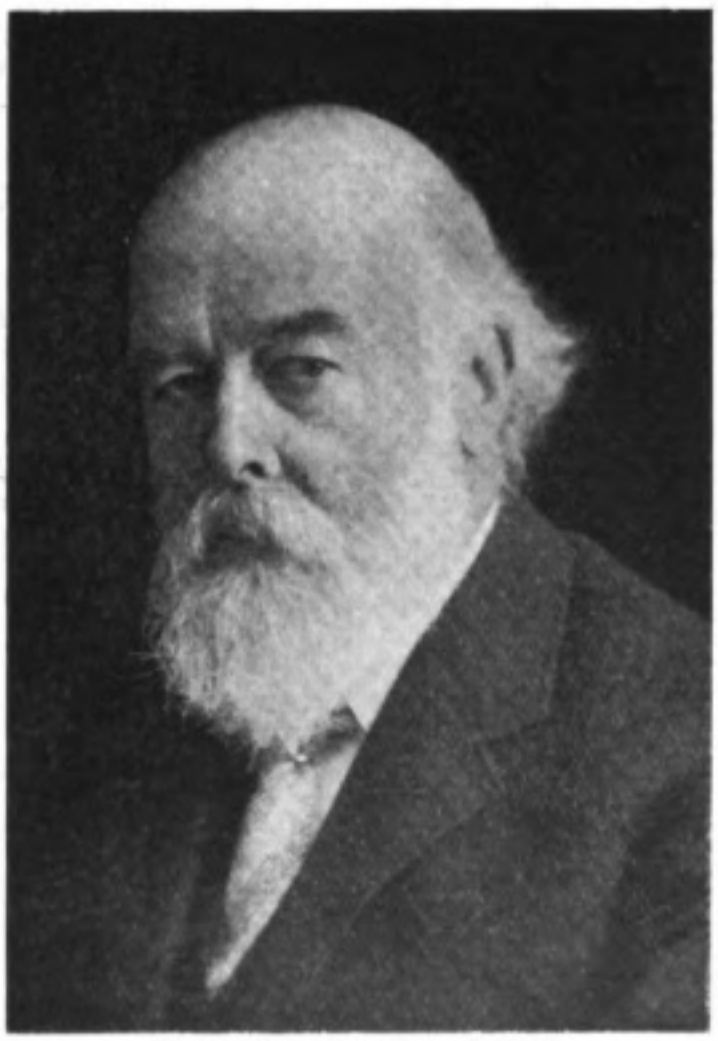
VOL. X. No. 14. JULY 1ST, 1922. WEEKLY

## Address to the Wireless Society of London*

By SIR OLIVER J. LODGE, F.R.S.

MR. PRESIDENT and Members of the Wireless Society—It is a pleasure to speak under the Presidency of Sir Henry Jackson, one of the very early pioneers in the application of Hertzian waves to actual telegraphy between ships, and one who has continued his interest in the subject to the present day. His naval position doubtless prevented full publication of the experiments made in 1895. Consequently, that early work is probably less well known than it ought to be, even by myself.

To a great application of this sort many have contributed; but nothing could have been done had it not been for the magnificent researches in pure science of the great physicists, James Clerk Maxwell and Heinrich Hertz. The present generation can hardly realise, I expect, the sensation caused by Clerk Maxwell's mathematical prediction of electric waves. He showed so far back as 1865 that electromagnetic waves were possible. No, I hardly think he showed that they were actually possible, he certainly did not show that we could generate them, but he showed that they existed and that they would have certain properties and gave their theory, the beginnings of their theory, and ultimately their more complete theory was dissected out from his work by Hertz. I do not think that in this country, at any rate, the name of Hertz is sufficiently well known, that is popularly known. He died very young in the thirties (of his age I mean), but not before he had done some very remarkable things. His chief discovery was the actual production of the electromagnetic waves in space, which was unknown in this country in 1888, and he not only displayed them experimentally, with the very inferior tools which were possible at that time, but he gave their theory in some considerable detail, after a study of Clerk Maxwell's work, and worked out those wave diagrams which you find depicted in wireless books, those waves that curl over the face of the country emitted by an oscillator at the centre or origin. The complete waves are more like those shown in Fig. 1, and all that is due to Hertz. That is how Hertz depicted them, but if you use an earth connection, instead of a complete vibrator at the origin, then you bisect the figure as indicated by the dotted line, the lower half being the image of the upper.



*Sir Oliver J. Lodge, F.R.S.*

All that is in Hertz's papers, and it holds good to-day. He dissected it out of Maxwell's equations. Maxwell showed us all these details. He did not know all that was in his equations, but he showed

*At a meeting of the Wireless Society of London, on the 14th June, 1922.

that the rate of propagation of waves would be the reciprocal of the geometric mean of the two ethereal constants, the magnetic permeability and the dielectric coefficient of the ether of space.

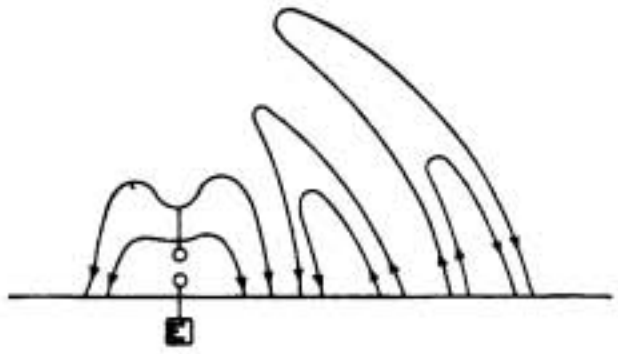


*Fig.* 1. *Electric Waves, showing effect of the Earth.*

I apologise to some of my audience for touching on very elementary things just now, but these two constants of the ether I must not lose an opportunity of emphasising in the presence of those who are working with the ether and to whom we look for the discoveries of the future. It is fashionable sometimes to disbelieve in the ether. Some of the newspapers think that Einstein abolished ether and that Eddington agrees with him. Eddington does agree with Einstein but Einstein does not think that he has abolished the ether. Einstein's theory does not say anything about the ether, but he has no thought or notion that the ether does not therefore exist. A thing does not cease to exist because you refrain from attending to it. Those who daily use the ether for signalling purposes can hardly disbelieve in its existence. I advise you to try and investigate its properties by all means. We actually use the ether a great deal more than simply for wireless signalling. We use it really in ordinary telegraphy and in telephony; you use it really when you are driving electric tramcars; you use it in every electric and magnetic experiment. Moreover you use it every time you look at anything, for it is through the ether that light comes and the eye is our one ethereal sense, only it is a sense organ which does not tell us anything about the ether but it tells us of all the things which agitate the ether and emit or modify the light which enters the eye. We learn about the things in the ether, not about the ether itself, but by means of the ether. That is an inference which is not at all obvious and the human race existed for I don't know how many thousand years without knowing anything about it.

Now, I say, the ether has two great constants which are defined electrically and magnetically. Thus, if you take two electric charges $e$ and $e'$ at a distance $r$ apart, the force of attraction or repulsion between them is the ordinary law $F = \frac{ee'}{r^2}$, but the dimensions of that equation, if I leave it like that, are all wrong. You have two electric charges multiplied together, and you don't know what they are, you divide by the square of the distance and get a force. There must be some constant whose dimensions will put the matter right. That is the constant which Faraday called $k$, and it is called $k$ to-day—Faraday's dielectric coefficient. We then get

$$F = \frac{ee'}{kr^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Faraday did not treat it as a property of the ether but treated it as the property of the substance, and measured the value of $k$ for different substances in consequence. In a vacuum it has some value, though we have no idea at present what that value is. The constant $k$ is unknown; all that we know are the relative values of $k$. Comparing the $k$ of different materials with the $k$ of vacuum we can say that in one substance the inductive capacity is measured by 3 or 6 or what not, but the true $k$ is unknown—it is the property of the ether.

Take then the similar magnetic equation. Take two magnetic poles ($m$, $m'$) and put them at distance $r$ apart. There will be an attractive or repulsive force according to the law, $F = \frac{mm'}{r^2}$, and again as you do not know the dimensions of magnetic poles you must introduce the constant that will put the dimensions right, *i.e.*,

$$F = \frac{mm'}{\mu r^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

That constant was named by Lord Kelvin the magnetic permeability, but again he treated it as relative to different substances—the magnetic permeability of iron having a high value and it may be a thousand times bigger than in an absolute vacuum. It is important to remember these magnetic quantities do not belong to matter, they belong to ether.

Matter interferes with light. Light comes through the ether not through matter. If there is matter in its path it is interfered with. It may be reflected, it may be absorbed, but it is never assisted. Light is transmitted by the ether, sound is not. Sound won't go through a vacuum, light will. That magnetic permeability constant then is the permeability of the ether of space, and is another constant of the ether. These two are the only two constants which we know the ether possesses, and we have not the remotest knowledge of the value of either, but Clerk Maxwell showed that if there are waves in space they will travel with a velocity $v$ equal to the reciprocal of the geometrical mean of these two constants, *i.e.*,

$$v = \frac{1}{\sqrt{k\mu}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

He made experiments to determine that velocity not by exciting waves, for he could not have done that, but by balancing the repulsion of two flat coils placed on the same axis, each being wound on a flat plate, Fig. 2. He balanced the repulsion of the coils by the attraction of the plates, the plates being electrified by connection to the terminals of the coils and the current being maintained through the coils. He took a measured current and measured the electric repulsion between the two coils, and balanced that against the electric attraction of the plates. The experiment is not by any means an easy one to carry out, but it is rather an elaborate one, and the above is merely the barest outline of it. It gave not the values of $k$ or of $\mu$, but the product $k\mu$, since $k$ came into the electric attraction of the plates, and $\mu$ came into the magnetic repulsion of the coils. When he had balanced the two, from the dimensions he

determined $k\mu$ and found it to be the reciprocal of the square of the velocity of light. The results came out within the limits of experimental error; and the electromagnetic theory of light was born.

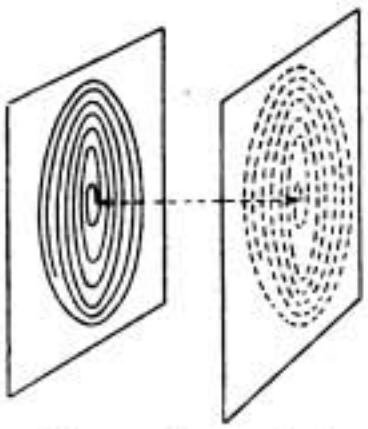


*Fig. 2. Maxwell's experiment for the determination of the product $k\mu$.*

You see the point: If they were electromagnetic waves they would travel at that speed, and so indirectly by measuring this product $k\mu$ in that experiment in which no light was used (except to see the instruments) and obtaining the velocity of light, showed that light was composed of exactly those particular waves, and that light was an electromagnetic phenomenon. The nature of light up to that time had not been known and I must say that his theory was not accepted straight away, and other theories continued for many years. Lord Kelvin, for instance, as one of the great leaders of science, did not accept Maxwell's theory until the year 1888. Maxwell's theory was born in 1865. It was well known to me in 1875, but there was a good deal of conservative feeling about the elastic theory of light—the ether being the light. Many ingenious mechanical theories were developed in the early part of the last century by Faraday and other great men, but they would not work, the more you went into them the more they would not work. The only theory that worked is Maxwell's, since light is not a mechanical thing at all.

So I say the electromagnetic theory of light was born then. No one knew how to produce waves except by the ordinary methods of producing light. But echoes of Maxwell's discovery ran about among the young students of these days. Fleming and I, in the Chemical Laboratories at South Kensington, had many talks on the subject in the 70's of last century. We both of us made a serious study of Maxwell, I partly during a stay at Heidelberg and he more personally at Cambridge. I constructed models illustrative of Maxwell's theory, and I for one determined to devote myself to the experimental production of such waves, if any method could be devised. Later in the '80's, I discussed various methods with my great friend G. F. Fitzgerald of Dublin, whose acquaintance I had made during a visit of the British Association to that City. And in due time—though at first he was sceptical about the possibility of producing them, (he read a paper on the "Impossibility" of producing them, but struck out the "im" afterwards)—Mr. Fitzgerald made the suggestion which ultimately in other hands proved successful.

I would like to call your attention to that, because I feel that the present generation which is very active in the practical application of these things and in the details which have grown up in recent years is naturally not so well acquainted with the ancient history of the subject as those who have lived through it, and so it is apt to be forgotten what a lot was done in those early days. Fitzgerald, in 1883, gave the amount of energy that could be radiated by an alternating current. You see all radio generators are really alternators, or oscillators, and because they emit waves it follows that continuous oscillators emit waves. This title of Fitzgerald's paper is: "On the energy losses by radiation from alternating currents."

Take an alternating current represented by $I = I_0 \cos \frac{pt}{T}$. You recognise that as an alternating current with a period $T$ and amplitude $I_0$. Now if you have an alternator producing that current it must radiate some energy. Fitzgerald calculates how much energy it radiates per second. He takes the case of a circular coil like a frame aerial connected with an alternating current, then the energy radiated per second $= (\pi a^2 I_0)^2 \frac{8\pi^4\mu}{3T^4v^3}$. That is simply the area of the coil multiplied by the current amplitude and the whole squared and multiplied by $\frac{8\pi^4\mu}{3T^4v^3}$ where $v$ = velocity of light and $T$ = the period of the oscillations, $a$ = the radius of the coil and $\mu$ = the permeability.

Since you do not know what $\mu$ is, you call it unity, and so you are expressing it magnetically. while if you are working in electrostatic units you call $k$ unity. It is the best we can do for the present, and I hope that some of you will find out what these values really are.

Returning to the expression for the energy radiated per second, the important part lies in the denominator in which the frequency is raised to the fourth power, *i.e.*, the radiated energy will be inversely as the fourth power of the wavelength. I might write that expression thus:

$$\text{Energy radiated} = (\pi a^2 I_0)^2 \cdot \frac{8\pi^4\mu v}{3\lambda^4} \quad . \quad . \quad (4)$$

That is to say, the radiated energy is inversely as the fourth power wavelength, *i.e.*, the longer the wave the less is the radiating power of an alternator, or the slower the frequency the less the radiation. All that was developed in 1883, and it applies to this day both to the alternator and to the Hertz vibrator, and it is encouraging to amateurs who are limited to short waves that the radiation from a short wave radiator is really more powerful than from a bigger one. The reason for that comes out very well from Hertz's method of dealing with the matter, because he showed in these wave diagram, which I have given above (Fig. 1) that the wave does not start actually from the oscillator, but a quarter of a wavelength away. Now consider the case of an ordinary commercial alternator or even an alternator with a frequency of a thousand per second, the wavelength is nearly 200 miles, a quarter of that is 50 miles, so if I had an alternator in this room with a frequency of a thousand per second what loss of energy will there be? Not much, because the radiation does not really start

until 50 miles away, and 50 miles away the magnetic effect of that alternator is not noticeable. Hence for practical purposes there is no radiation from an oscillator of ordinary frequency.

This is rather analogous to Stokes' theory about a vibrating fan. Everyone knows that a tuning fork emits a musical note or a reed does if it is vibrating fast enough. Everyone also knows that a lady's fan does not, even if it is very hot. That is because it is not moving fast enough to create waves. There is a critical speed, which Sir George Stokes worked out, which is necessary before the air is condensed or rarefied. If you work it at any low speed the air curls round the blade, and is not rarefied to any appreciable extent. Now it is something the same with an ordinary alternator. Your present commercial alternator does not emit waves because its frequency is too low. If you raise it from a thousand per second to a million per second then you get some radiation and all the vibrations that we use in wireless are of the order of millions per second, as you know. But, if instead of millions a second you use a thousand millions a second the waves will be stronger still; the higher the frequency the better

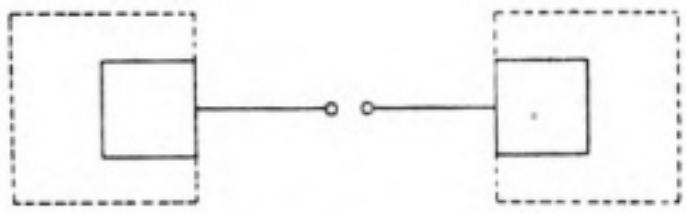


*Fig. 3. Inside square; ordinary Hertz Oscillator. Dotted square; enlarged Hertz Oscillator.*

the radiation, the radiation being proportional to the fourth power of the frequency. The radiation intensity of an ordinary Hertz vibrator such as we used to work with, excited by a coil (Fig. 3) is of extraordinary intensity, and when we used to work it out in the old days it came to about 100 H.P., from an ordinary radiator. If you make the radiator bigger the radiation is no stronger. If you make it bigger as shown dotted in the Fig., you get more energy to radiate, but you also give it a greater capacity. Of course, there is more electricity accumulated, and so you might expect to get more radiation, and you get more energy in the spark, but you get no more radiation because the wavelength is increased and so the radiation intensity is kept down.

It is rather like the radiation which you get from a hot body; the same law holds in that instance and, indeed, for a very good reason, for the radiation from a hot body is the excitation of waves in the ether, and the same theory holds. Contemplate the effect of frequency in this case—*i.e.*, the temperature as it is called in the world of heat. If you double the absolute temperature you more than double the radiation. You make it 16 times, *i.e.*, $2^4$. The radiating power of the hot body depends on the fourth power of the temperature; that is why the sun is such a prodigious radiator, although it is about 90,000,000 miles away. A few days ago it was exceedingly hot because of this terrific temperature. Every square inch of the surface the sun radiates 16 times as much power as the electric arc, and it is therefore adapted to distributing energy into space in the most efficient manner. But, you may say, why then do we use long waves for getting great distances in radio signalling? Well, these short waves, although they start with great energy, are easily mopped up if there is any obstruction in the way. A short wave gives hundreds of opportunities for being mopped up. That is why light is so easily stopped. The waves are so short and the frequency so high that in an $\frac{1}{4}$th of an inch of space there are thousands of oscillations which have no chance of getting through if each oscillation is wiped out to the smallest degree. Hence, a very thin obstacle will stop light and a much thinner obstacle will stop ultra-violet light, but when you come to the long waves of what we call heat they get through much more readily, and when you come to the longest waves of wireless telegraphy they can go through all sorts of things, and the longer they are the more they can get through. Hence, long waves are useful and necessary for travelling great distances across obstacles and through the atmosphere and round the earth where they may be reflected by the upper Heaviside layer.

At that time, however, the whole subject of electrical oscillations was unexplored, and by many prominent men it was disbelieved. It is true that Kelvin had given the theory of electrical oscillations, quite apart from any idea of waves, as early as 1853, in a very remarkable and still interesting paper on "Transient Currents," to which I would like to call your attention. It is quite a readable paper, as you can see for yourself unless you are bothered with the antique terms, but the whole idea of electric inertia or what Maxwell calls self-induction, but which Kelvin called "Electrodynamic-Capacity," was new and confused, and a great deal of experimental work had to be done to bring home the fact of electrical oscillations in a circuit containing capacity and self-induction. One of the methods for displaying the oscillatory character of a discharge was to take photographs of a spark on a revolving plate. This was done by C. V. Boys and several others (see, for example, Fig. 4).

By this method I determined to make a metrical determination of oscillation frequency, using

*Fig. 4. Photograph of oscillatory spark taken on a revolving plate.*

absolute measure, and so determining afresh the product of the two ethereal constants or the velocity $v$, but I have not time to describe that in detail now I entered into collaboration with Sir Richard

Glazebrook, who at that time was Custodian of the British Association Electrical Standards in the Cavendish Laboratory at Cambridge, and with my assistant, Mr. E. E. Robinson, we took up our abode in Cambridge and worked in the Cavendish Laboratory for many weeks, and ultimately made a determination of velocity by means of an oscillatory discharge by a condenser through a known accurately determined self-induction.

The condenser was a large air condenser with multiple plates of known area and known distance apart, and the coil was a special coil of about 4 henries—or "secohms" as they were then called—the self-induction of which was determined by Glazebrook in absolute measure with extreme accuracy.

Laying off a length to represent the magnetic measure of self-induction, and another length in the opposite direction to represent the measure of electrical capacity, constructing a semicircle on these two lengths, and erecting a perpendicular to meet it, you obtain a radius which, employed as the spoke of a wheel revolving at the determined frequency, would roll along with a velocity "$v$," that is to say, with the velocity of Light. The frequency was determined by discharging the condenser through the coil, and photographing the spark on a plate which was kept revolving at a steady and known speed by a small turbine, controlled by observation of a stroboscopic disc through the jaws of a vibrating fork, which was carefully timed in absolute measure by a chronometer.

The whole investigation was published in the Stokes Memorial Volume, in 1899, published by the Cambridge University Philosophical Society, but that volume is rather buried, and I do not think it is well known.

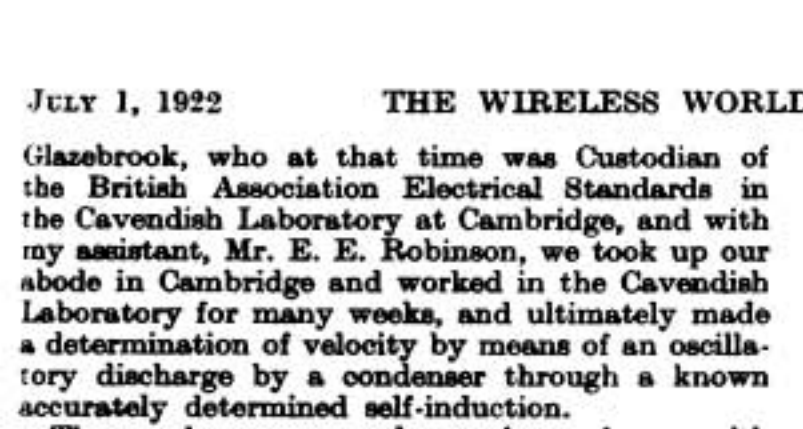



*Fig. 5. Lodge's experiment on the production of waves on parallel wires.*

The problem now was to convert these oscillations into waves or to demonstrate what Fitzgerald had insisted on, that they produced waves all the time. I succeeded in displaying these waves running along wires, by taking a Leyden jar and discharging it in the manner indicated in Fig. 5, with a couple of wires, one from each coating, running for some distance. I knew that the waves would run along the wires, at any rate along thin copper wires, at the same rate as they travelled through space. Consequently, by attaching long wires to an ordinary Leyden jar circuit of known dimensions I knew what the length of these waves ought to be. By that means I was able to demonstrate the waves, and in the dark the wire glowed at intervals. When the spark was produced the oscillations were set up and they splashed along these wires giving short glows interrupted by dark spaces. That was not the only method of displaying the effects, but it was one convenient method. By a reflection at the far end the waves on the wires were converted into stationary waves and the distance between the glows was half a wavelength, and so the wavelengths could be measured and compared with theory. They came out correctly. That was what I showed at the Physical Society of London, but it was not properly published.

The arrangement of the jars and wires became well known afterwards under the name of Lecher, who, in Germany, made a large number of excellent experiments in this direction, using vacuum tubes as his detector, as, indeed, had also been done by Dr. Drakoulis in my laboratory at Liverpool.

That arrangement was described at Bath with experiments of that kind, in the year 1888. But Fitzgerald who was President of Section A of the British Association that year, called attention to the publication that had just been made the month before by Hertz. He had got waves in the same way with nodes and loops, but in space, not running along wires at all, by opening out the coatings of the Leyden jar into two capacity areas, so that the electrostatic field extended into space as well as the magnetic field, thus giving the necessary conditions for generating electro-magnetic waves of considerable intensity—in fact of very remarkable intensity, so strong that they could excite little sparks in conductors in the neighbourhood. This fact that they were strong enough to produce sparks was surprising, but it was the fact which enabled the waves to be discovered at that time; a brilliant series of experiments were made upon them by Hertz in spite of the troublesome and capricious nature of his means of detection.

The paper in which I first published the account of the experiments on these waves, and with that diagram (Fig. 5), was published in the *Philosophical Magazine* for August, 1888, but it is buried under the title of the "Theory of the Lightning Conductor." I would like to draw your attention to it because it is buried, and it shows the historical kind of feeling about these waves that was going on at that time.

It is interesting to see how short it is practically possible to make waves of this kind. The wavelength was written down as:—

$$\lambda = 2\pi \sqrt{\frac{S}{k} \cdot \frac{L}{\mu}} \quad . \quad . \quad . \quad . \quad (6)$$

where $\lambda$ = wavelength
$S$ = capacity of the Leyden jar
and $L$ = inductance of the discharge loop.

That formula which holds to this day and was the best expression for wavelength known in 1888, shows how short it is possible to make waves of this kind. I reckoned that I might be able to get them 20 or 30 centimetres long, corresponding to a thousand million alternations per second, but the difficulty was to detect them. It might be possible to get them shorter, which Hertz did, but how could they be detected. No doubt they could be detected with the greatest ease by using the wave-

lengths of light, and I consider that glow-worms and phosphorescent creatures have learnt how to accomplish this direct production of very short waves.

Since writing the above I have seen in *Wiedemann's Annalen* an article by Dr. Hertz where he establishes the existence of ether waves in the same way but in free space. The whole subject of electric radiation seems to be working itself out splendidly. I should like to say more about that luminosity and vision, but there is hardly time for that in this lecture.

At any rate the early researches of Branly and the discovery of the coherer followed; but the surprising thing that Hertz found was that these waves had energy enough to produce sparks. Imagine *light* so intense that when it fell upon anything it produced sparks, that was the equivalent of what he got. The radiation was at the rate of 100 H.P. while it lasted.

The discovery of the coherer followed, and then things were much better, and by means of the coherer I continued spasmodic experimenting in the intervals of teaching, and at the lamented too early death of Hertz I described my experiments at the Royal Institution in 1894 as a sort of memorial to Hertz, calling the lecture "The Work of Hertz," though I ought to have called it "The Work of Hertz and His Successors," for a number of new results were shown in that lecture. Later, in the same year, 1894, at the British Association meeting at Oxford, I demonstrated that signals could be sent by this means, using a Thomson marine galvanometer for short and long signals; as has been recorded by Silvanus-Thompson, and as known to many others who were present. Alexander Muirhead then began to work at what subsequently became known as wireless telegraphy. Professor Righi at Bologna also devoted himself to the extension of Hertzian experiments, and your President, Sir Henry Jackson, began an attempt to apply the method in some form to ships at sea. Then in 1896 came Mr. Marconi to England, full of energy and enthusiasm and possessing the ability to interest officials and financial magnates, and wireless telegraphy proper entered on its tumultuous career.

Tuning and selectivity, so that stations could be discriminated from each other, and one tuned in while others were tuned out was secured by my patent of 1897. Crystal detectors gradually became employed instead of the more troublesome coherer, and then came the era of the valve wherein electrons were first harnessed to the service of man. And after that most of you know more about the subject than I do, and certainly your past President, Mr. Campbell Swinton, knows a great deal more.

I have gone over the early past history chiefly in order to recall to your attention the extraordinarily brilliant work of Clerk Maxwell. It was not of a kind to get into the newspapers or to be understandable by the people. But in the students of those days—I mean the students of mathematical physics—it aroused the utmost enthusiasm; and it is well that this mighty work in pure science should not be forgotten and overwhelmed in the mass of practical detail and exuberant invention, which is a characteristic of the additional developments in our own day. "All can raise the flower now, for all have got the seed." But it is well occasionally to think of what we owe to the sowing of that seed, as sprinkled in algebraical symbols on the pages of Clerk Maxwell's papers and incorporated, some of them, in his great book.

Since that time Sir Joseph Larmor has shown that Clerk Maxwell's equations contain the whole theory of radiation, and the relation between electric charge and the ether of space. He has also shown that radiation is always excited to a known extent whenever an electron is accelerated, and that without electric acceleration there is no radiation. I must just give Larmor's expression for the radiation of energy because it is very fundamental. It is:—

$$W = \frac{2}{3} \cdot \frac{e^2}{c} \dot{u}^2 \quad . \quad . \quad . \quad . \quad . \quad (7)$$

This gives the energy radiated per second from an accelerated electron where $e$ is the charge of the electron; $c$ is the velocity of light; $\dot{u}$ is the acceleration.

Why is that expression so important. It is because it is exceedingly general and comprehensive. Radiation of so many kinds is known—X-rays, wireless telegraphy, light, radiant heat—all these obey that law—there is no radiation if an electron is not accelerated. There are three possible states: an electric charge stationary is one of them, an electric charge in unchanging motion is another, an electric charge in changing motion, or acceleration is another. You have the three great departments of the science. Static, kinetic, oscillatory. In the first the charge is at rest, *i.e.*, ordinary static electricity. In the second the charge is in motion—steady motion—that is magnetism. Directly a charge is put in motion you get magnetic lines surrounding the path of the charge. That is all that magnetism is. You don't get any magnetism unless there is a moving charge. In the third, the charge is accelerated, and that is light, because you see in any oscillation there is acceleration. The connections between these three groups are indicated in the table:—

| Charge at Rest | Charge in Motion | Charge in Accelerated Motion |
|---|---|---|
| Static | Kinetic | Oscillatory |
| Electricity | Magnetism | Optics |

Wherever you have acceleration, and therefore whenever you have oscillation, you must get radiation to an amount which depends upon the frequency in the way I have been explaining, and the amount of energy radiated depends upon the square of the acceleration—*i.e.*, upon $\dot{u}^2$ ($\dot{u}$ being the first time differential of the velocity $u$). If an electron is moving steadily it does not radiate at all, it does not lose any energy—a magnet loses no energy. When its velocity changes, it radiates energy depending on the square of the acceleration.

The only step beyond that is the detection by Prof. Planck, of Berlin, of the quantum. We all hear about the quantum, we do not hear so much about the quantum as we do of Einstein, but it is, nevertheless, a very important thing in physics. It is that curious and unexpected phenomenon

which prevents radiation of energy below a certain amount and causes it to be emitted in packets or bundles in a numerable manner—by which I mean that the packets can be counted—but that no fraction of a packet can be got. It is rather like buying postage stamps. You may buy any number but not half a stamp, or it is like coins of the lowest denomination, you can pay with any number of them but you cannot have fractions, so that it seems that energy was given to us in quantum units or packets, but no fractions, and if you could not have a whole quantum you could not have anything. If an object cannot emit a whole quantum of energy it does not lose any energy at all.

The quantum thus brilliantly discovered in physics is a fundamental constant of Nature, and we now see that it must depend somehow on the properties of the atom. Although a great deal was said in the other direction I admit there is no discontinuity in the ether or in energy or in time, but there is discontinuity in a group of electrons, and in the atoms which are built of electrons, and, accordingly, in atomic theory the quantum is of fundamental importance, and in the hands of Prof. Böhr, of Copenhagen, has begun to solve the secret of atomic constitution. Prof. Böhr's work is well known to those who know it—(*laughter*)—and too elaborate for anyone else. But it is the needed supplement to Larmor's theory, and the quantum may be said to be the first vital and fundamental discovery in the region of electro-magnetism since Clerk Maxwell, for all the rest of the theory of electricity, magnificent and extensive as it is, may be regarded as a legitimate development of those astonishing equations which contain within themselves a great part of the secret of the ether, except in so far as it is modified and sophisticated by the presence of the discontinuities of matter.

And yet there are signs that even the quantum can be got out of these old equations too. Attempts in that direction are very recent—too recent to be properly referred to. But I must just refer to a paper by Prof. Whittaker, of Edinburgh, read before the Edinburgh Royal Society last month (May, 1922), together with an introduction and a sequel to it by Sir Alfred Ewing.

The fact that required explanation was that an electron impinging on an atom gave it no energy unless it attained a certain critical velocity, that if it had this critical velocity it delivered up to the atom a certain packet of energy—a quantum, or it might be two or three quanta but no fractions—and that if it had a velocity greater than that critical velocity it delivered up no more but retained the residue.

Furthermore, that an atom so struck emitted this quantum of radiation at a definite frequency, determined by the energy on the impinging electron, and then settled down again into its own steady condition.

Moreover, that if radiation of this frequency fell upon an atom an electron was expelled with an energy precisely corresponding to that frequency; the relation between the energy and the frequency being always definitely determined by the quantum.

It is rather ambitious to refer to this thing now, but you will, I expect, hear more about it because it is an important thing, and I think it will help you if I indicate something of what it is. I was going to trouble you with the equation, but I won't do that, I will just illustrate how an electron striking an atom might refrain from giving it any energy at all unless it gave it a whole quantum and that it will not give it more than a quantum, but will retain the rest. I am going to take a ring of perfectly conducting material, (Fig. 6). The little difficulty—if it can be called a difficulty—of following this experiment is because we are not accustomed to dealing with perfectly conducting materials, but some of you may know that Kammerlingh Onnes in Leyden cooled a lead ring down to nearly absolute zero by means of liquid helium—he cooled it down to within two or three degrees of zero—and the lead became perfectly conducting, so that if you excited a current in that ring, such as you might do by snatching a magnet out of it, that current would continue ordinarily for a fraction

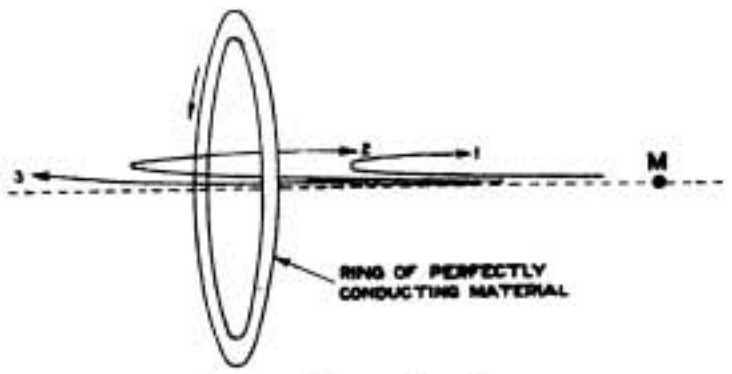



*Fig. 6. Diagram illustrative of energy quantum being given to perfectly conducting ring by a moving magnetic pole.*

of a second only, but with the conductivity so perfect there is nothing to stop the current, there was no resistance, so the current simply went on, it was like a flywheel. In Onne's experiments it died out ultimately—it is not going now—but it did not die out in a fraction of a second, and some trace of it lasted a fortnight afterwards, while it only died down to half its value in four days. Theoretically, if there was no resistance at all it would never stop. As Lord Rayleigh said four days was a very good approach to infinity. (*Laughter.*) It was a very interesting experiment. You could see the current was in the ring as it deflected a magnetic needle like a galvanometer.

As a matter of fact we are quite used to these currents, but they are generally of molecular nature, as in a magnet where they flow in the interstices of the atom since there is nothing to stop them.

It is like a planet and the sun. What makes the earth go round the sun? Nothing—there is nothing to stop it. Things in Nature do not want propulsion, they want guidance, deflection, they look after the rest. We are all travelling round the sun at the rate of about 19 miles a second. What is driving us? People think it is because they are attached to the earth, but they are not. I am quite loose, I am going round the sun on my own, there is nothing to stop me, and that is what we commonly find in nature—things just going on. We are each of us like little planets circulating once a year round the sun and turning on our axis in 24 hours. Your head is up now, in 12 hours it will

be down. We are all doing the proper things on our own—a planet need not be a big thing—and so these electrons are just carrying on and in those experiments they were travelling round and round the ring. Now if you take a magnetic pole (the difficulty of this experiment is that you cannot get one magnetic pole without the other, that is a weak point, but you can imagine a magnetic pole) there is the ring with no current in it, and take the magnetic pole from any distance and bring it up to the ring. As it comes nearer to the ring it induces a current in the ring; that current induced by the approaching magnetic pole repels the pole. It is like propelling the pole as it were against an elastic coil. If you let it go it would drive it back again. If then you shoot at that ring a magnetic pole M (Fig. 6) from a long way off, it will follow a path shown by the arrow (1). It would put some energy into the ring as it approaches, but that energy will be transferred back to the pole as it recedes, and it will go back with the velocity with which it came, retaining its energy and leaving none in the ring. It put energy into the ring, but took it back as it receded. If it is fired at the ring with more energy, and it gets as far as (2), it will still go back. Just for a moment you may think it should be propelled the other way, but that is not so, since the repulsive force is in the same direction. In order to retain any of its original motion it must travel with sufficient speed to get right away out of the range of the ring altogether (3), if it does that it will not wipe out the current generated. If it does that it will have some energy left to go on, and it will have left a quantum of energy in that ring. It will retain the rest. The energy delivered to the ring is

$$\tfrac{1}{2} m (u^2 - v^2) = h\nu \quad - \quad - \quad - \quad - \quad - \quad (8)$$

where $m$ = the mass, $u$ = the initial velocity and $v$ = the final velocity after passing the ring.

If it starts with the velocity $u$ and leaves with the velocity $v$, it retains the rest of the energy, and only delivers up that to the ring the amount given by the above expression which is commonly written as $h\nu$. Beyond this rough outline, the matter becomes rather too difficult at any rate to explain in less than a separate lecture. But on somewhat those lines the quantum can be explained in terms of Maxwell's equations, and it is interesting to me that it can be explained on proper dynamical principles for at first it seemed to be a fresh thing not explicable in the old theories.

These problems which relate to the spectrum of radiation, the spectrum of the atom, the connection between the atoms and the ether all involve gyrostatic properties—the relation between "translation" and "spin." Wherever you have electro-magnetism you have what in mathematics is called "curl." If we had mathematical physics here I would urge you to pay great attention to "curl" because I feel that in it is a theory of the ether, *i.e.*, in the relation between translation and spin. There is in the ether itself, I believe, a tremendous spin always going on, and if we could get at that we should begin to understand the inter-relations between ether, matter and the electron in a way which at present we do not. (*Loud and continued applause.*)

**Mr. A. A. Campbell Swinton.**

It is my pleasing duty to ask you to give a very hearty vote of thanks to Dr. Sir Oliver Lodge for the very interesting and I may say wonderful address that he has given us this afternoon. He has touched upon the most difficult subjects and made us all think that we understand them, at any rate for the moment—whether we shall think it in a day or two's time I am not so sure—but in a way he has made everything extraordinarily plain, and done it in a style which I do not think has been imitated by any other living man.

I am personally too young to remember the announcement of Maxwell's discoveries, and I am afraid I should not have understood them had I been old enough to read them, but I do remember some of the very early things which brought about this great science of Wireless Telegraphy.

I was present at the lecture at the Royal Institution given by Sir Oliver Lodge, I think, in 1894, when he gave a wonderful experimental lecture on the work of Hertz and showed us for the first time the sending of wireless signals over considerable distances of space. Even before that, I think about two years before that, at the British Association meeting in Edinburgh—there was, I think, the first public exhibition in this country of a coherer, and it was shown by Dawson Turner, and it was not what most of you would expect. It was in the form of a coherer such as we are accustomed to use, but it consisted of a stick of sulphur in which metal filings had been melted. It was a solid stick of sulphur and connected in the circuit with two clips. When a spark was made in the neighbourhood, it cohered just like ordinary coherers with loose filings do. It is to be remembered that even before the coherer, Professor Hughes, who was President of the Institution of Electrical Engineers, in whose hall we are sitting, had made experiments on the subject of transmitting signals through space, which he had never published, although he showed them to some of his scientific acquaintances. These experiments have now become known to us by the fact that his note-books, in which he wrote accounts of everything that was done, have been bequeathed to the British Museum by the late Mrs. Hughes. More than that, owing to evidences in these note-books, at some period or other he must have had a great deal of apparatus made with his own hands. That apparatus has now been found in a warehouse off the Tottenham Court Road together with a whole lot of Hughes' effects, including umbrellas and books, etc., and now is in the South Kensington Museum. Hughes had no idea of electric waves—at least that is the impression I have got from his note-books—but still he arrived at some very wonderful results, for he produced signals over hundreds of yards.

This has now all been published. There is an account of it in the just issued number of the *Journal of the Institution of Electrical Engineers*. I thought I would just refer to it, as it goes back a little on similar lines to what Sir Oliver Lodge has been saying, so I will ask you to accord Sir Oliver Lodge a hearty vote of thanks for the wonderful lecture address which he has delivered to-night. (*Applause.*)

**Professor G. W. O. Howe.**

I have been asked to second this vote of thanks,

and I rise to do so with very great pleasure. I am sure we all feel that it is a great honour for the Wireless Society of London to have had Sir Oliver Lodge here this evening to give us this very inspiring lecture. Not only have we learnt much about the early history of wireless telegraphy, but I am sure we will all leave this building with our heads thrown back and our chests thrown out, as we realise we are all "going round the sun on our own." I attended a lecture by Sir Oliver Lodge about two years ago at the Royal Society of Arts. I hope he will not feel hurt if I say I have forgotten what it was about, but I remember the closing expression which was the advice not to throw the ether overboard as there was such a lot of it. Another remark that sticks in my mind was not made by Sir Oliver but by my neighbour at that meeting—a well-known electrical engineer—who said what a wonderful man Sir Oliver was to bring all this abstruse scientific matter down to the level of the intelligence of a Member of Parliament. (I do not want to insult the audience by suggesting any close analogy.)

One thing which has been forced upon me in listening to this wonderful address this evening has been the importance of pure scientific research which at the time had no apparent application. The workers in the early days to whom Sir Oliver has referred—Clerk Maxwell, Hertz and all those others—had no idea that what they were doing had any practical application whatever; it was merely pure love of search for all scientific things, and I think when we realise now the enormous benefit that their work has been to mankind, it should prevent us from referring scornfully at the present day to the vast amount of the pure scientific work that is being done without any immediate prospect of application.

I therefore feel sure that I am voicing the opinion of everyone here when I say that we all feel very grateful to Sir Oliver for coming here this evening and giving us such a lecture with so many beautiful reminiscences of the past, and so many thoughts with which he has enlivened his discourse and given us new ideas. I could not help thinking, towards the close of his lecture, what a good thing it would be if Sir Oliver were forced to read all the modern papers on advanced physics and then forced to serve it up to audiences such as this, so that we could understand what it was about. I have much pleasure in seconding the vote of thanks. (*Loud and continued applause.*)

### Admiral of the Fleet, Sir Henry Jackson.

I take it your applause passes that resolution. I think it is difficult to say which part of Sir Oliver Lodge's lecture was the most instructive, the historical, or the descriptive, or the very latest modern particulars about the Quantum Theory. It ought to be borne in mind that we owe him a great vote of thanks for bringing to our notice the work done by Prof. Hertz, and by those who are now dead and gone, but never thought that their wonderful work would be of any practical use. We must remember that we are all interested in the modern side of this work, and let us, as we do our daily work on wireless, not forget what these men did for us. For it is due to them that you have now got this occupation. Clerk Maxwell certainly stands out first, Hertz comes second I suppose, besides the others which have been mentioned, and I think we must not go away with our chests thrown out and too proud because we think we know all about it, because I think there is a great deal more yet to be learnt about wireless telegraphy, and as Sir Oliver pointed out to-night, we are only on the stepping-stone to the quantum theory.

I will not occupy your time further. Sir Oliver, I will ask you to accept the thanks of the Members of the Society and the audience here for your very instructive lecture. (*Loud and continued applause.*)

### Sir Oliver Lodge.

I am obliged to Mr. Campbell Swinton and Professor Howe for what they have said. I will not follow Professor Howe into politics, but I do heartily agree with what he says, as I suppose we are all agreed, as to the importance of pure science. That is sowing the seed, and we are reaping the crop. I have not dealt with the recent advances of wireless because, as I said, I expect most of you in this room know more about it than I do, but I may incidentally mention that my friend and assistant, Mr. Robinson, and I have a little scheme on hand, but I refrained from saying anything about it because I have sometimes talked too soon about something which ultimately became of some use, and so I thought I would not err in this direction this time.

I therefore kept off that subject, but there are many phases of possible discovery before us. There is the whole idea of atomic energy and the means of getting at it. You are harnessing the electrons now, directing them, making them do what you want, in the wonderful instrument with which no doubt you are most enthusiastically working, but you have to supply the energy. You are not at present tapping the energy of the earth. That has got to be done some day, and I hope some of you will do it.

We are living in an astonishing epoch in physical science. I felt that towards the end of the last century, and I suppose you feel it now in the early part of the twentieth century. There are a number of discoveries waiting to be made. The electron itself was only discovered in 1889, it is only just as old as this century—and think of all that it means now.

I concluded in one of my lectures at the Royal Institution by likening the scientific worker to a boy sitting at the silent keyboard of a deserted organ and playing on its keys; an organ into which an unseen power began to blow a vivifying breath. Astonished he finds that the touch of his fingers now elicits a responsive note and he hesitates, half delighted, half affrighted, lest he be deafened by the chords which he could seem to summon almost at will. That is our position in science to-day. (*Loud and continued applause.*)

**The List of Regular Transmissions which is published from time to time is now undergoing careful revision, and it is hoped that the revised list will be completed for inclusion in an early issue in August.**

# Screening Valve Oscillators

## THE ELIMINATION OF HIGH FREQUENCY RADIATION

IN a recent paper read before the Physical Society of London, by R. L. Smith-Rose, some experiments that have been carried out at the National Physical Laboratory on the screening of a valve oscillator, such as a heterodyne, were described in detail. The problem of screening a piece of apparatus from the effects of a high-frequency electromagnetic field is known to be very much more difficult than screening it from steady electric or magnetic fields. Electrostatic screening may be accomplished by surrounding the apparatus by a metal covering, which need not be completely continuous—such, for example, as metal gauze—and magnetic screening from a steady field can be accomplished by surrounding the apparatus by a heavy iron screen. Experiments with high-frequency fields, however, give the impression that the difficulty of such screening is much greater, but this is largely a false idea due to the fact that the induced E.M.F. in any circuit placed in an alternating magnetic field is directly proportional to the frequency, and therefore becomes very large at the frequencies used in radio work. It is essentially this fact, coupled with the high amplifications possible with multi-stage valve receivers, that lead to unexpected results when endeavouring to shield instruments from radio frequency fields.

The experiments that were carried out, arose from the need for developing a local heterodyne oscillation generator for use in connection with directional reception. The heterodyne oscillator can be operated entirely from a 6-volt battery and the problem is to screen the receiving apparatus from the effects induced directly by the oscillator, which would tend to distort the directional readings obtained with the receiver. The transfer of electrical energy from one oscillating circuit to another may take place either by mutual induction or by radiation, or by both of these methods. In the case under consideration—viz., that of a heterodyne oscillator near to a receiving apparatus—the transfer is almost entirely by mutual induction, and the problem may therefore be considered correctly as the limiting of the high frequency magnetic field around the oscillator by induced eddy currents in the screening body.

The first experiments made in this direction were carried out with an "R" valve, operating from a 6-volt battery, and having a wavelength adjustable between 1,000 and 10,000 metres. With this instrument used in conjunction with a large frame aerial and a seven-valve amplifier, signals from the more powerful C.W. stations could be perceived even when the local oscillator was quite 100 feet away from the amplifier. This indicated how very small is the oscillating current required to give a beat note with the incoming signals. When the oscillator and its battery were placed inside a thin copper box, with a loose-fitting copper lid, the induced oscillations in the receiving coil were considerably reduced in strength and were only effective in producing beats when the oscillator was within 20 feet of the coil. The use of a galvanised iron box gave similar results. In both these cases it was noticed that the placing in position of the lid of the screening box had a considerable effect on the reduction of the induced field, but that the position of the open end of the box relative to the receiving frame aerial appeared to be immaterial to the strength of the induced currents.

The oscillator and its battery were next placed inside the copper box as above, and this was in turn supported on blocks of paraffin wax inside an iron box, the respective lids of the boxes being in position. In this condition the beat note was only appreciable when the boxes were placed within about 12 feet of the frame aerial. By the use of a small search coil attached to the amplifier, it was proved that a considerable proportion of the escaping energy came out through the space between the lid and the sides of the box, the lid having an overlap of about $\frac{1}{4}''$ only. By fitting another lid having an overlap of 3" all round, the effectiveness of the screening was further increased. Experiments were also made with screening consisting of two metallic boxes of various sizes, one being inside the other, and with various arrangements of lids, giving results similar to those obtained with the above-described arrangement.

Tests were also conducted on the effect of bringing connecting leads outside the screening boxes in order to provide a means of definitely coupling the heterodyne to the receiver itself, but as usually experienced in such cases, it was found that as soon as any part of the wire was exposed outside the metal screening, powerful beat-note signals were heard in the receiving amplifier.

As a result of the tests a design for a screened oscillator was prepared, using a wooden box, double-lined with sheet copper, 1/64" thick, fitted with an inner copper lid, and with a second enveloping lid constructed of wood and double-lined with sheet copper. Ebonite connecting pins were used between the control handles on top of the lid and the corresponding condenser knobs, switches, etc., within the box. The metal parts of the control handles were in metallic contact with the outer coating of copper. A separate coil within the box was used to couple to the inductance of the oscillator circuit, and leads from this coil were led out of the box through metallic sheathed wires to a double D-shaped coil to which was coupled a second pair of D-shaped coils, the terminals of which form the outer terminals of the instrument.

The following are the chief features of the instrument:—

1. The entire control of the oscillator is obtained from outside, and it need never be opened except for inspection or for recharging of the accumulator, the complete oscillator with its batteries, etc., being within the sheathing.

2. The opening of the box is a simple operation and does not necessitate the breaking of soldered joints, etc., although when in normal working condition close metallic contact is secured at all joints

3. No part of the oscillator circuit itself is

outside the inner metallic casing, and the external coupling is made through an astatic coupling arrangement (the double D coils).

4. Variations of the coupling of the D-shaped coils forms a convenient means of varying the effective strength of the heterodyne.

When using this oscillator in conjunction with a rotatable frame aerial and amplifier for D.F. work, it was found that it caused no appreciable errors in the observed bearings, thus proving the effectiveness of the screening, provided that the oscillator was kept outside the frame itself. If mounted at the centre of the frame, it caused variable errors up to a maximum of 2°.

Soldering up the joints of a simple *copper* box surrounding an oscillator was found to reduce considerably the energy radiated from the box, but some still passed apparently through the metal itself, but a similar experiment made with a tinned iron box proved that the iron was much more opaque to the radiation than the copper, as soldering up all the cracks cut off the radiation completely. The theory of the penetration of high frequency currents into metal indicates that such a difference is to be expected and that in fact, iron should be equivalent to between four and six times the thickness of copper. Hence it is only possible to screen a valve oscillator completely (*i.e.*, completely as far as an ordinary H.F. amplifier is concerned) by enclosing it inside a hermetically sealed box of tinned iron of sufficient thickness to prevent the direct penetration of the H.F. magnetic field through it. A mercury seal for the lid of the tinned iron box proved equally effective to the solder, but the slightest crack not closed allowed a relatively large escape of radiation. For complete screening in this manner no controls can be carried outside the box, unless with careful design it should prove possible to seal with mercury these moving parts as well. If controls cannot be carried outside the screening a large part of the value of the heterodyne is lost, especially since the frequency of the oscillator is changed by a considerable amount when the lid is put on the box, owing to its effect upon the inductance of the coil in the oscillation circuit.

The efficiency of these screening methods depends upon the frequency of the oscillations, and decreases with increase of wavelengths—the longer wavelengths proving more difficult to screen. Since, however, the amplifier and its associated circuits are much less affected by the stray fields of longer wavelength, the difference is not so serious as the mathematical theory would at first lead one to expect. The difficulty of screening amplifiers, etc., from disturbing low-frequency fields, however, rather tends to emphasise this fact, and to confirm the general results given by the theory.

The difficulties of high frequency screening arise mainly, therefore, from the extreme sensitiveness of modern amplifiers, as compared with galvanometers and instruments of a similar class for which magnetic screening (low frequency) is more usually called for. Given the same sensitivity of detecting instrument, however, the theory indicates that to obtain the same effectiveness for the screening, the metal would need to be about 80 times thicker for a 100 ~ magnetic field than for an oscillation with a 300-metre wavelength.

To effectively screen a low-frequency amplifier, or note magnifier from disturbances would, therefore, seem to require much more massive screening than is ordinarily employed for this purpose.

P.R.C.

# Questions and Answers

## INTRODUCTION OF SYSTEM OF REPLY BY POST

In the issue of *The Wireless World* for December 10th, 1921, a note appeared regarding the "Questions and Answers" columns of the magazine pointing out the necessity for certain changes on account of the growth of this section of the magazine. At the time this note appeared four or five pages were being devoted to this section in each issue, the Journal then being published fortnightly. Although *The Wireless World and Radio Review* now appears twice as often and we have recently been devoting eight pages an issue to this section it has, in spite of this, been found impossible to keep pace with the demand for information through this Journal in such a way as to give prompt replies to queries.

During the last few weeks the increase in the number of questions received has been enormous, and it is no doubt the result of the big increase in the circulation of the Journal, brought about in part by the ever-growing popularity of wireless. As might be expected, quite a large proportion of the questions now being received are from beginners in wireless who have not back numbers of the Journal to refer to. Taking these circumstances into consideration, it has been decided to form a special department of the Editorial Staff of the Journal to deal exclusively with this section, and our proposal is to introduce a postal reply service (when a nominal charge will be made) in addition to maintaining our present free service. The advantages which the reader will gain from the introduction of a postal reply service will be found principally in a very great saving of time in receiving replies, whilst those who do not wish to avail themselves of the postal service will not suffer in any way as their questions will be included in due course in the Journal as hitherto, but a delay of two or three issues before answers can be published must be expected.

In order to cover certain clerical expenses which must necessarily be involved, it is necessary to make a nominal charge for replies to questions through the post, and the rules under which the "Questions and Answers" Section will be run from the date of publication of this issue will be found on page 334.

# List of Experimental Transmitting Stations Licensed in the United Kingdom

In our issue of June 3rd we published a letter from the Postmaster-General to the effect that the hours of transmission are no longer restricted. Transmission is permitted for an aggregate maximum of two hours in each twenty-four, provided listening-in on the wavelength used is practised. Any single transmission must be no longer than ten consecutive minutes, and be followed by three minutes of listening-in on the wavelength used for transmission.

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 AA | — | — | Radio Communication Company (Slough Experimental Station). |
| 2 AB | — | Spark, C.W. and Telephony | Capt. H. de A. Donisthorpe, London. |
| 2 AF | — | C.W. | A. Rickard Taylor, 49, Idmiston Road, W. Norwood. |
| 2 AG | — | C.W. | A. Rickard Taylor, 49, Idmiston Road, W. Norwood. |
| 2 AH | — | C.W. | Oxford. |
| 2 AK | — | Spark, C.W. and Telephony | R. M. Radio Ltd., Townsend Mills, Worcester. |
| 2 AL | — | C.W. and Telephony | W. Halstead, Briar Road, Briar Lane, Thornton-le-Fylde. |
| 2 AN | — | C.W. and Telephony | A. W. Sharman, Kelvin Lodge, 1, Morella Road, S.W. |
| 2 AQ | — | Spark, C.W. and Telephony | Davis, Thornton Heath, London, S.W. |
| 2 AR | — | — | E. Gaze, 3, Archibald Street, Gloucester. |
| 2 AU | — | — | A. C. Bull, 25, Fairland Road, West Ham, E.15. |
| 2 AW | 100 | C.W. and Telephony | H. H. Burbury, Crigglestone, Wakefield. |
| 2 AX | 10 | — | Geo. Sutton, 18, Melford Road, S.E.22. |
| 2 AZ | — | Spark, C.W. and Telephony | William Le Queux. |
| 2 BM | — | C.W. and Telephony | J. H. A. Whitehouse, 25, Ennersdale Road, New Brighton, Cheshire. |
| BXH | — | — | Capt. C. H. Bailey, Cliffaes, Crickhowell, Abergavenny. |
| 2 BZ | 10 | — | Basil Davis, Electric Pavilion, Marble Arch, W.1. |
| 2 CH | 10 | — | Science Society, The School, Oundle, Northants. |
| 2 CI | 10 | Spark | R. Brooks King, Widcombe, Taunton. |
| 2 CZ | 10 | Spark, C.W., Tonic-Train and Telephony. | C. Atkinson, 17, Beaumont Road, Leicester. |
| 2 DC | 10 | — | M. Child, 60, Ashworth Mansions, Maida Vale. |
| 2 DD | 10 | — | A. C. Davis, 105, Brynland Avenue, Bristol. |
| 2 DF | — | — | Mitchell's Electric and Wireless, Ltd., Peckham. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 DG | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. |
| 2 DH | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. Portable set. |
| 2 DI | 10 | — | W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. |
| 2 DJ | 10 | — | A. T. Lee, The Court, Alvaston, Derby. |
| 2 DT | — | — | Barrow and District Wireless Association. |
| 2 DX | 10&50 | C.W. and Telephony | W. K. Alford, "Rosedene," Camberley, Surrey. |
| 2 DY | — | — | F. Haynes, 157, Phillip Lane, S. Tottenham, N.15. |
| 2 DZ | — | — | F. Haynes, 26, Avenue Road, S. Tottenham, N.15. |
| 2 FA | — | — | F. G. Bennett, 16, Tivoli Road, Crouch End, N.8. |
| 2 FB | 10 | Spark, C.W. and Telephony | W. Ison, 80, Harnham Road, Salisbury. |
| 2 FC | — | — | London, S.E. |
| 2 FG | — | Spark, C.W. and Telephony | L. McMichael, 32, Quex Road, W. Hampstead. |
| 2 FH | 10 | C.W. and Telephony | T. S. Rogers, 2, Park Hill, Moseley, Birmingham. |
| 2 FL | 100, 50 | Spark and C.W. | C. Wilcox, 21, George Street, Warminster, Wilts. |
| 2 FN | 10 | — | L. Baker, Ruddington, Notts. |
| 2 FP | 10 | Spark, Telephony, C.W. and T.T. | F. Foulger, 118, Pepys Road, S.E.14. |
| 2 FQ | — | Spark, C.W. and Telephony | Burndept Ltd. Experimental Station, Blackheath. |
| 2 FR | — | Spark | S. Rudeforth, 54, Worthing Street, Hull. |
| 2 FU | 10 | Spark, C.W. and Telephony | E. T. Manley, Jr., 27, Home Park Road, Wimbledon Park, S.W.19. |
| 2 FW | — | Spark | Rev. D. Thomas, St. Paul's B.P. Scouts, Bournemouth. Also Portable Set. |
| 2 FX | — | Spark, C.W., T.T. and Telephony. | H. C. Binden, Bournemouth. |
| 2 FZ | 10 | Spark, C.W. and Telephony | Manchester Wireless Society, Headquarters, Albion Hotel, Piccadilly, Manchester. Also Portable Set same details and call sign. |
| 2 GD | 10 | For Indoor Transmissions only | Birmingham Wireless Experimental Club, Digbeth Institute, Birmingham. |
| 2 GG | — | — | A. H. Kidd. |
| 2 GL | 10 | C.W. and Telephony | W. J. Henderson, 2, Hollywood Road, S.W.10. |
| 2 GP | — | C.W., T.T., Spark and Telephony. | W. Gaitland, Highbury, N. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| **2 GQ** | 10 | Spark $\frac{?}{\lambda}$ | 1st Taunton Scouts, Parish Buildings, Wilton. |
| **2 GR** | — | — | T. Forsyth, Ashington. |
| **2 GS** | — | — | T. Forsyth, Ashington. Portable Set. |
| **2 GU** | 10 | — | Halifax Wireless Club. |
| **2 GV** | 10 | — | Rev. J. Rigby, St. Lawrence Vicarage, Bristol. |
| **2 GW** | 10 | Spark, C.W. and Telephony | Allan Cash, Foxley Mount, Lymn, Cheshire. |
| **2 GZ** | — | C.W. and Spark | A. L. Megson, Bowdon. |
| **2 HA** | — | C.W. and Spark | A. L. Megson, Bowdon. Portable Set. |
| **2 HB** | 10 | C.W. and Spark | L. H. Lomas, Macclesfield. |
| **2 HC** | 10 | C.W. and Spark | J. W. White, Windcombe Lodge, Bucklebury, near Reading. |
| **2 HG** | — | — | T. Boutland, Senr., Ashington. |
| **2 HH** | — | — | T. Boutland, Jr., Ashington. |
| **2 HK** | — | — | A. A. Campbell Swinton, Chester Square, W. |
| **2 HP** | 10 | C.W. and Telephony | H. C. Woodhall, 10, Holborn House, E.C.1. |
| **2 HQ** | 10 | C.W. and Spark | A. W. Faucett, 11, Leigh Road, Clifton, Bristol. |
| **2 HS** | 10 | C.W. Telephony and T.T. | G. W. Hale, 51, Grafton Road, New Malden, Surrey. |
| **2 HT** | — | Spark, C.W. and Telephony | R. H. Klein, 18, Crediton Hill, W. Hampstead. N.W.6. |
| **2 HX** | — | Spark, C.W. and Telephony | F. A. Love, Ivydene, Guildford Park Road, Guildford. |
| **2 IB** | 10 | C.W. and Telephony | W. Bemrose, Littleover Hill, Derby. |
| **2 ID** | 10 | C.W. and Spark | E. S. Firth, Thames Ditton. |
| **2 IF** | 10 | C.W. and Telephony | S. W. Bligh, 2, North Lane, Canterbury. |
| **2 IH** | — | — | Technical College, Cardiff. |
| **2 II** | 10 | Spark | Southport Wireless Society, 74a, Kensington Road, Southport. |
| **2 IJ** | — | — | Southport Wireless Society, 74a, Kensington Road, Southport. Portable Set. |
| **2 IK** | 10 | C.W. and Telephony | County High School for Boys, Altrincham, Cheshire. |
| **2 IL** | 10 | Telephony | H. R. Goodall, "Fernlea," Winchester Road, Bassett, Southampton. |
| **2 IN** | 10 | C.W., Spark and Telephony | J. E. Fish, "Thornleigh," Thornton-le-Fylde, Near Blackpool. |
| **2 IQ** | — | C.W. and Telephony | W. A. Ward, 26, Marlborough Road, Sheffield. |
| **2 IS** | — | — | Rev. H. W. Doudney, St. Luke's Vicarage, Bath. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
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| 2 IT | — | — | Rev. H. W. Doudney, St. Luke's Vicarage, Bath. Portable Set. |
| 2 IU | 10 | — | G. A. E. Roberts, Twyford, Winchester. |
| 2 IV | 10 | Spark, C.W. and Telephony - | L. F. White, Priory Road, Knowle, Bristol. |
| 2 IW | 10 | — | G. R. March, Twyford, Winchester. |
| 2 IX | 10 | C.W. and Telephony - - | S. G. Taylor, Littleover, Derby. |
| 2 IY | 10 | C.W. and Telephony - - | J. Briggs, City School of Wireless Telegraphy, 66½, Corporation Street, Birmingham. |
| 2 JF | 10 | Spark, C.W. and Telephony - | C. G. Williams, 22, Scholar Street, Sefton Park, Liverpool. |
| 2 JG | — | — | W. A. Seed, Crigglestone, Near Wakefield. |
| 2 JJ | 10 | Spark, C.W. and Telephony - | C. Worthy, 4, Riversdale Road, Egremont, Wallasey. |
| 2 JK | 10 | Spark, C.W., T.T. and Telephony. | Philip R. Coursey, 138, Muswell Hill Road, N.10. |
| 2 JL | 10 | Spark, C.W. and Telephony - | G. G. Bailey, The Beeches, Cowley, Middlesex. |
| 2 JM | 10 | Spark, C.W. and Telephony - | G. G. Blake, 10, Onslow Road, Richmond, Surrey. |
| 2 JO | 10 | Spark, C.W. and Telephony - | J. W. Whiteside, 30, Castle Street, Clitheroe, Lancs. |
| 2 JP | — | Spark, C.W. and Telephony - | M. C. Ellison, Hutton's Ambo Hall, York. |
| 2 JU | 10 | Spark, C.W. and Telephony - | E. J. Pearcey, 610, Fulham Road, S.W. |
| 2 JV | 10 | Spark, C.W. and Telephony - | A. G. Robbins, Station Road, Epping. |
| 2 JW | 10 | C.W. and Telephony - - | J. R. Barrast, Westgate Court, Canterbury. |
| 2 JX | 10 | C.W. and Telephony - - | L. Vizard, 12, Seymour Gardens, Ilford. |
| 2 JZ | 10 | C.W. and Telephony - - | R. D. Spence, Craighead House, Huntly, Aberdeenshire. |
| 2 KA | 10 | — | N. Curtis, Belvedere West, Taunton. |
| 2 KB | 10 | C.W., Telephony and T.T. - | W. E. Earp, 675, Moore Road, Mapperley, Nottingham. |
| KCLX | — | Spark - - - - - - | Professor Wilson, University of London, King's College. |
| 2 KD | 10 | C.W., T.T. and Telephony - | P. Denison, Rostellan, Saville Park, Halifax, York. |
| 2 KF | 10 | C.W. and Telephony - - | J. Partridge, Park Road, Merton, S.W.19. |
| 2 KG | 10 | Spark, C.W. and Telephony - | A. E. Hay, "Glendale," Abernant, Aberdare. |
| 2 KK | 10 | — | Hutchinson & Co. (F. Pinkerton), 101, Dartmouth Road, Forest Hill, S.E.23. |
| 2 KL | 10 | Spark - - - - - - | F. Pemberton, 50, Peak Hill, Sydenham. |
| 2 KM | — | Spark - - - - - - | C. Stainton, 44, Kimberley Street, Hull. |
| 2 KN | — | C.W. and Telephony - - | A. B. Day, Finchley. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 KO | 10 | C.W. and Telephony | C. S. Baynton, 48, Russell Road, Moseley, Birmingham. |
| 2 KQ | 10 | — | Wolverhampton (Communication to Taylor Relief Motor Co., Ltd., Cleveland Street, Wolverhampton). |
| 2 KR | 10 | C.W. and Telephony | E. Edmonds, 2 Yew Tree Road, Edgbaston, Birmingham. |
| 2 KS | 10 | Spark, C.W., T.T. and Telephony. | C. Clayton-Breakell, Mill Bank, Church Street, Preston. |
| 2 KT | — | Spark, C.W. and T.T. | J. E. Nickless, 83, Wellington Road, Snaresbrook, E.11. |
| 2 KU | 10 | Spark, Telephony and T.T. | A. J. Selby, 66, Edward Street, Burton-on-Trent. |
| 2 KV | — | C.W. and Telephony | W. J. Crampton, Weybridge. |
| 2 KW | — | C.W. and Telephony | W. R. Burne, Springfield, Thorold Grove, Sale, Cheshire. |
| 2 KY | 10 | C.W. and Telephony | L. Pollard, 209, Cunliffe Road, Blackpool. |
| 2 KZ | 10 | Spark, C.W. and Telephony | B. Clapp, Meadmoor, Brighton Road, Purley. |
| 2 LA | — | C.W. and Telephony | H. F. Yardley, 121, Victoria Road, Headingley, Leeds. |
| 2 LB | — | C.W. and Telephony | H. F. Yardley, 6, Blenheim Terrace, Leeds. |
| 2 LF | — | Spark and C.W. | P. Harris, Chilvester Lodge, Calne, Wilts. |
| 2 LG | 10 | C.W. | H. Whitfield, The Glen, Primrose Lane, Hall Green, Birmingham. |
| 2 LI | — | Spark, C.W. and Telephony | H. E. Wilkinson, Lonsdale Road, N.W.6. |
| 2 LK | 10 | Tonic Train and C.W. | S. Kniveton, Brooklands, Normanton, Yorks. |
| 2 LL | 10 | Tonic Train and C.W. | S. Kniveton, Brooklands, Normanton, Yorks. |
| 2 LO | — | — | Marconi House, Strand, W.C. 2. |
| 2 LP | 10 | Spark, C.W. and Telephony | A. W. Knight, 26, Stanbury Road, S.E. |
| 2 LR | 10 | C.W. and Telephony | John Scott Taggart, 6, Beattyville Gardens, Ilford. |
| 2 LU | 10 | C.W. and Telephony | W. A. Appleton, Wembley Park. |
| 2 LV | — | Spark, C.W. and Telephony | W. R. H. Tingey, Queen Street, Hammersmith. |
| 2 LW | — | Spark, C.W. and Telephony | W. R. H. Tingey, Queen Street, Hammersmith. |
| 2 LY | 10 | Telephony | H. H. Thompson, 59, Redlands Road, Penarth, Glamorgan. |
| 2 LZ | 10 | Spark, C.W. and Telephony | F. A. Mayer, Stilemans, Wickford, Essex. |
| 2 MA | 10 | Spark | P. S. Savage, 14/16, Norwich Road, Lowestoft. |
| 2 MB | 10 | C.W. and Telephony | E. H. Jeynes, 67, St. Paul's Road, Gloucester. |
| 2 MD | 10 | Spark, C.W. and Telephony | C. Chipperfield, Victoria Road, Oulton Broad, Lowestoft. |
| 2 MF | — | C.W. and Telephony | Marconi Scientific Instrument Co., Ltd., 21/25, St. Anne's Court, Dean Street, W.1. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
|---|---|---|---|
| 2 MG | 10 | C.W. and Telephony | C. E. Millar, Arndene, Bearsden, Near Glasgow. |
| 2 MH | 10 | Telephony | A. Lawton, Brown Edge Vicarage, Stoke-on-Trent. |
| 2 MI | 10 | Spark, C.W. and Telephony | L. McMichael, Stag Works, Kilburn, N.W. |
| 2 MK | 10 | — | A. W. Hambling, 23, Winchester Avenue, Brondesbury, N.W.6. |
| 2 ML | 10 | Spark, C.W. and Telephony | R. C. Clinker, Bilton, Rugby. |
| 2 MO | — | Spark, C.W. and Telephony | Burndept, Ltd. Experimental Station, Chiswick. |
| 2 MR | 10 | Spark, C.W. and Telephony | R. H. Reece, The Corner House, 62, Addison Gardens, London, W.14. |
| 2 MS | 10 | C.W., Spark and Telephony | R. H. Reece, "Basketts," Birchington, Kent. |
| 2 MT | 1,000 | Spark, C.W. and Telephony | Marconi Scientific Instrument Co., Ltd. (Near Chelmsford. Station for specially authorised transmissions to amateurs.) |
| 2 MY | 10 | C.W. and Spark | H. M. Hodgson, Clifton House, Hartford, Cheshire. |
| 2 MZ | — | — | J. Mayall, "Burfield," St. Paul's Road, Gloucester. |
| 2 NA | 10 | C.W. and Telephony | H. Frost, Longwood, Barr Common, Walsall. |
| 2 NB | — | — | J. W. Barnaby, Sylvan House, Broad Road, Sale, Cheshire. |
| 2 NH | 10 | C.W. and Telephony | O. R. C. Sherwood, 41, Queen's Gate Gardens, S.W. |
| 2 NI | 10 | — | P. H. Lyne, Dartford and District Wireless Society. |
| 2 NJ | — | — | Lee, S.E.12. |
| 2 NL | — | — | F. J. Hughes, "Ashdene," 129, Well Road, Bath. |
| 2 NM | — | C.W. and Telephony | G. Marcuse, Coombe Dingle, Queen's Park, Caterham, Surrey. |
| 2 NN | 10 | — | Brig.-General Palmer, Epping. |
| 2 NO | 10 | C.W., T.T. and Telephony | H. R. Adams, Crescent Cabinet Works, Walsall. |
| 2 NQ | — | — | Morton, Kingston. |
| 2 NP | — | C.W. and Telephony | H. S. Treadwell, Middleton Cheney, Banbury. 'Phone: 3 Y Banbury. |
| 2 NR | — | — | J. Knowles Hassall, Mount Pleasant Works, Wooden Box, Near Burton-on-Trent. |
| 2 NY | 10 | C.W., T.T. and Telephony | J. N. C. Bradshaw, Bilsboro', Near Preston. |
| 2 NZ | 10 | C.W., T.T. and Telephony | J. N. C. Bradshaw, Bilsboro', Near Preston. |
| 2 OF | 10 | Spark, C.W. and Telephony | H. C. Trent, Secondary School, Lowestoft. |
| 2 OI | — | C.W., Telephony and T.T. | Colin Bain, Newcastle-on-Tyne. |
| 2 OM | — | C.W. and Telephony | H. S. Walker, Park Lodge, Brentford, Middlesex. |
| 2 ON | 10 | Spark, C.W. and Telephony | Major H. C. Parker, 56, Stern Hall Street, Walthamstow, E.17. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
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| 2 OY | 10 | C.W. and Telephony | Capt. E. J. Hobbs, 4th Tank Battn., Wareham. |
| 2 PA | — | Spark, C.W. and Telephony | C. Z. Auckland & Son, 395, St. John Street, E.C.1. |
| 2 PF | 10 | Spark | F. Foulger, S.E.14. |
| 2 PI | 10 | Spark, C.W. and Telephony | Loughborough College, Leicestershire. |
| 2 PJ | 10 | Spark, C.W. and Telephony | Loughborough College, Leicestershire. |
| 2 PR | 10 | C.W. and Telephony | A. E. Whitehead, "Hollingwood," King's Ride, Camberley, Surrey. |
| 2 PS | 10 | C.W. and Telephony | J. H. Gill, 18, Fourth Avenue, Sherwood Rise, Nottingham. |
| 2 PU | 10 | Spark, C.W. and Telephony | C. R. W. Chapman, "Nirvana," 44, Chaplin Road, Wembley. |
| 2 PX | 10 | C.W. and Telephony | H. H. Lassman, 4, Avenue Parade, Barking Road, East Ham. |
| 2 QH | 10 | C.W., T.T. and Telephony | A. Hewins, 42, St. Augustine Avenue, Grimsby. |
| 2 QI | — | — | Balham. |
| 2 QK | 10 | C.W. and Telephony | J. Bever, 85, Emm Lane, Bradford. |
| 2 QL | — | C.W. and Telephony | R. J. Hibberd, Grayswood School, Haslemere, Surrey |
| 2 QN | 10 | — | A. Hobday, Flint House, Northdown Road, Margate. |
| 2 QO | — | Telephony | P. Pritchard, Blenheim House, Broad Street, Hereford. |
| 2 QP | — | C.W., Telephony and Spark | L. C. Grant, 3 Langhorn Street, Newcastle-on-Tyne. |
| 2 QQ | — | — | Burnham & Co., Experimental Station, Wembley. |
| 2 QS | 10 | Spark, C.W. and Telephony | S. Ward, "Ravenswood," 339, Brixton Road, S.W.9. |
| 2 QU | — | — | Blackheath. |
| 2 QY | — | — | London, N.W.6. |
| 2 RB | 10 | Spark, C.W. and Telephony | H. B. Grylls, Trenay Fawton, Carew Road, Eastbourne. |
| 2 RD | 10 | C.W. and Telephony | G. W. Fairall, 27, Newbridge Street, Wolverhampton. |
| 2 RH | 10 | Spark | H. A. Pound, 101, High Street, Broadstairs. |
| 2 RK | — | Spark | A. E. Blackall, 7, Maple Road, Surbiton. |
| 2 RP | 10 | C.W. and Telephony | F. W. Emerson, 178, Heaton Moor Road, Heaton Moor, Near Stockport. |
| 2 RY | — | — | S. Hanley, Forbury, Kintbury, Berks. |
| 2 SD | — | — | J. Mayall, Burfield, St. Paul's Road, Gloucester. Portable Set. |
| 2 SF | — | C.W., T.T. and Telephony | C. Midworth, 4c, Vicarage Mansions, West Green, N.15. |
| 2 SH | — | C.W., T.T. and Telephony | F. L. Hogg, 37, Bishop's Road, N.6. |

| Call Letters. | Power in Watts. | System of Transmission. | Name and Address. |
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| 2 SI | — | Spark, C.W., T.T. and Telephony. | L. C. Holton, 112, Conway Road, London, N.14 |
| 2 SK | — | — | K. G. Styles, 52, Jerningham Road, S.E.14. |
| 2 SL | — | — | A. G. Styles, "Kitscot," Maidstone, Kent. |
| 2 SP | 10 | C.W. and Telephony - - | L. Mansfield "Cregneish" Ley Hey Park, Marple, Ches. |
| 2 SZ | 10 | Spark, C.W. and Telephony - | W. H. Brown, Mill Hill School, N.W.7. |
| 2 SX | 5 | C.W. and Telephony - - | F. B. Baggs, 24, Westhorpe Street, S.W.15. |
| 2 TG | 10 | C.W. and Telephony - - | Sheffield University, Dept. of Applied Science. St. George's Square, Sheffield. |
| 2 TH | 10 | C.W. - - - - - - | Sheffield University. Portable Set. |
| 2 TN | 10 | C.W. and Telephony - - | C. E. Stuart, Lyndon Lodge, Polesworth, Tamworth. |
| 2 TO | 10 | C.W. and Telephony - - | F. Townsend, 46, Grove Lane, Ipswich. |
| 2 UG | 10 | C.W. and Telephony - | W. Humphreys Burton, 103, Portland Road, Nottingham. |
| 2 UJ | — | C.W., Telephony and T.T. - | L. R. Richards, Mona, 25, Cholmeley Park, Highgate, N.6. |
| 2 UM | 10 | Spark, C.W. and Telephony - | H. Lloyd, 3, Ventnor Place, Sheffield. |
| 2 UV | 10 | T.T., C.W. and Telephony - | W. Corsham, 104, Harlesden Gardens, London, N.W.10. |
| 2 UY | 10 | C.W. and Telephony - - | W. Fenn, Holly Cottage, Polesworth, Tamworth. |
| 2 VN | 10 | C.W. and Telephony - - | H. Drury-Lavin, Old House, Sonning, Berks. *'Phone, Sonning 22.* |
| 2 VP | — | — | P. G. A. H. Voigt, Bowdon Mount, 121, Honor Oak Park, S.E.23. |
| 2 VW | — | C.W. and Telephony - - | E. H. Robinson, 125c, Adelaide Road, N.W.3. |
| 2 WB | — | Spark, T.T., C.W. and Telephony. | George W. Jones, 8, Rosebery Street, Wolverhampton. |
| 2 XZ | 10 | C.W. and Telephony - - | Lewis T. Dixon "Strathspray," 4, Heythorp Street, Southfields, S.W. 18. |

*Holders of Experimental Transmitting Licences are requested to notify the Editor of changes in the particulars given above for amendment in subsequent lists. Licensees may find it convenient to include their telephone numbers.*

**With a view to making the List of Regular Transmissions of greater value, special consideration is being given to its revision. The list which is consequently delayed, will appear in an early issue in August.**

# Time Signals and Weather Reports

BY W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

1. In this and future articles, it is proposed to deal briefly and in a simple manner with time signals, weather reports and other transmissions of special scientific interest, so that the amateur on picking up these signals may be able to decode them and turn them to some practical use. The following transmissions by W/T will therefore come within the scope of these notes :—

(*a*) Time signals—automatic and semi-automatic.

(*b*) Rhythmic time signals.

(*c*) Meteorological messages and forecasts.

(*d*) Seismological radio-telegrams.

(*e*) U.R.S.I. signals.

(*f*) Calibration waves and standard wavelengths.

Details will be given of the various codes in use for these messages, of methods and apparatus employed and times of transmission, together with a brief explanation of how meteorological forecasts are prepared.

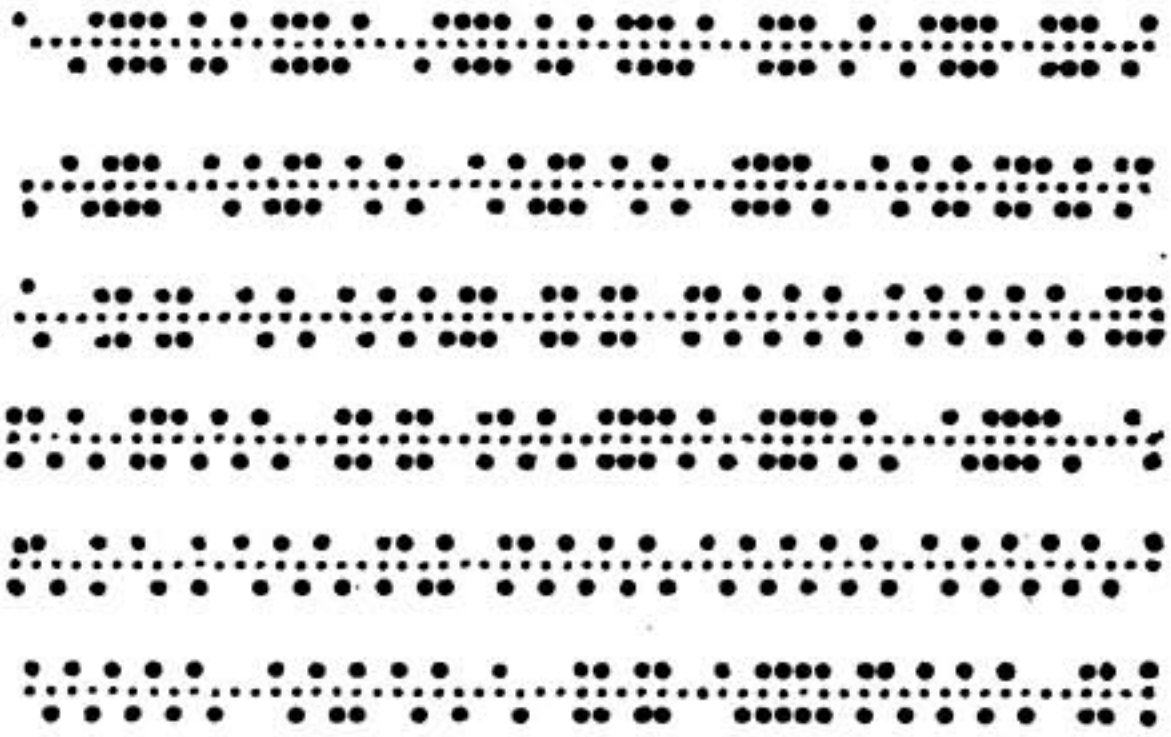


*Fig. 1. Portion of Wheatstone Tape used for transmitting 1000 G.M.T. meteor message on June 10th from G.F.A. Air Ministry 1680 Av.*

2. In the first instance, it may be pointed out that these scientific signals are of special interest to the beginner who is not likely to be expert with the Morse code, for the following reasons :—

(1) Such messages are intended for general scientific use and are therefore transmitted at a relatively slow speed, and so far as meteor messages are concerned consist chiefly of groups of figures in code. A figure code is used with the object of dealing quickly and accurately with a large number of observations of different kinds. The messages may be decoded after they are taken down, and with some practice this can be done quite expeditiously.

(2) Forecasts are perhaps of wider interest than coded meteors and are usually sent out in plain language. The Belgian Meteorological Office transmits daily at noon (G.M.T.) from Uccle, call sign **HS**, a forecast for Belgium and Western Europe in French. The report is issued specially for amateurs, and is therefore transmitted very slowly and repeated. A wavelength of 1,500 metres is used and the message usually lasts about 20 minutes. The Air Ministry also broadcasts daily at 0915 (9.15 a.m. G.M.T.) and 2000 (8 p.m. G.M.T.) on 1,400 metres C.W., a general forecast in plain language based upon observations made at 7h. and 18h. respectively. These messages are sent out from the Air Ministry (G.F.A.) through a Wheatstone tape machine and the rate of sending is about eight words per minute. (See Fig. 1.)

(3) The simplest form of crystal detector will enable the amateur to receive Eiffel Tower time signals and thus put him in possession of Greenwich time to within an error of $\frac{1}{4}$ second. Regarding meteorological information, he will be in receipt of reports usually about $1\frac{1}{2}$ hours after the time observations are made. In this connection the newspaper forecast received at the breakfast table is based on observations made at 6 p.m. the previous evening, and is therefore at least 14 hours "out-of-date," so that for this reason alone it is not to be wondered at that newspaper forecasts do not

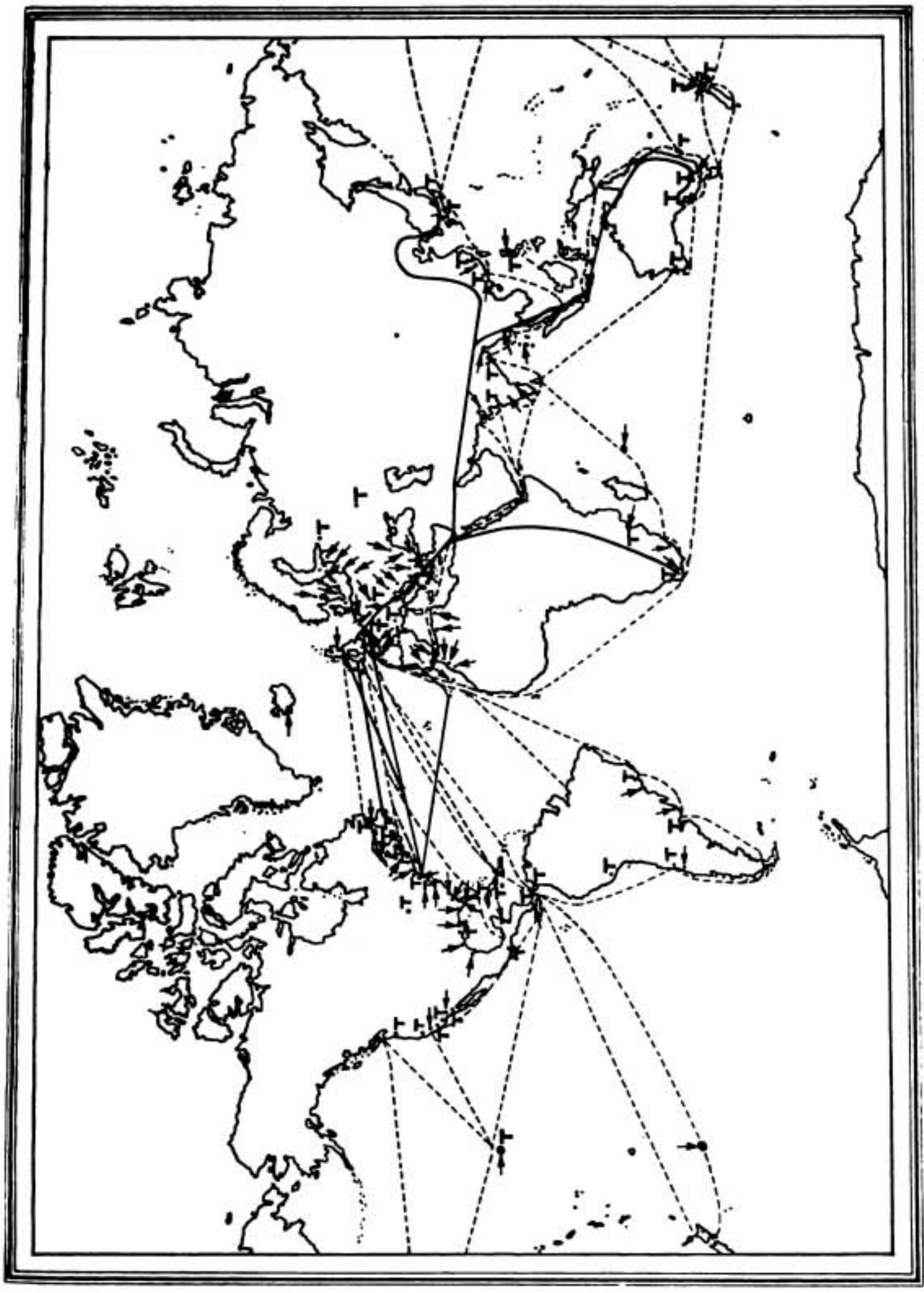


*Fig. 1. Stations supplying Time and Weather Reports.* (1) *Stations issuing Meteorological Reports marked* ➡. (2) *Stations issuing Time Signals marked* T. *Principal Steamship Routes marked* ——. *and long-distance Aeroplane Flights marked* ——·——.

always entirely agree with the actual prevailing conditions of weather.

3. In the case of some reports too long an interval of time elapses between the times of observations and that of transmission by W/T. This is especially the case with the European weather report issued daily from Paris FL at 11.30 a.m., 4½ hours after the time to which observations relate. The International Convention for Aerial Navigation envisaged a scheme in which all National reports were collected and a selection from these reports issued in collective form from a Central National Office within 1½ hours of the time of observation. Although we are far from this ideal at present, progress has been made as is evidenced in the "up-to-date" information contained in the hourly route meteors issued on the principal aviation routes. In this country the Air Ministry and the Meteorological Service are housed under the same roof at Kingsway, so that we may expect close co-operation between the two services. The importance of early meteorological information regarding the amount of cloud, wind force and visibility at different levels to airmen is fully realised. The chief airway companies operating on the Cross-Channel and London-Amsterdam routes require their pilots to sign an undertaking that they are conversant with meteorological conditions along the route before commencing a journey, and it is within the discretion of a pilot to cancel a flight if he thinks the conditions unsuitable.

4. The accompanying map of the world (Fig. 2) indicates the distribution of stations supplying time and weather information and the extent of the present services. The growing importance of the subject to the seaman, the airman and the general public has found practical expression in the formation of an international body known as The International Commission of Weather Telegraphy charged with the responsibility of devising an International Code. Before the war the recognised, and practically the only method of exchange of weather information, was by ordinary telegram and cable, for in most cases the distances involved are too long to make the telephone practicable. A certain number of reports were received from ships by W/T, although these were by no means regularly received. The Eiffel Tower station had made some headway by issuing a daily weather report from a limited number of reporting stations in Western Europe. At the present time there are many departures from the International Code in the various countries. These are unhappily too frequent, and very often lead to confusion, as for example when wind velocity is given in miles per hour instead of the code agreement of kilometres per second. Another difficulty arises from the fact that in many countries the meteorological services depend upon a single wireless station and consequently the reception of reports from other stations issued at the same hour is impossible.

The two directions then in which progress is desired are (*a*) the "speeding-up" of the issue of reports by W/T, and (*b*) a carefully conceived time-table of transmission times so that the greatest

**Paris FL (lat. 48° 52′ N., long. 2° 18′ E).**

**COMPLETE LIST OF REGULAR DAILY TRANSMISSIONS.**

| Time G.M.T. | Nature of Transmission. | Wavelength. | Power in Aerial. |
|---|---|---|---|
| 0220 | Meteor-observations at 1 hr. followed by detailed forecast for France valid until evening of same day. | 2,600 m. Spark | 60 kW. |
| 0820 | Meteor-observations at 7 hr. | 2,600 m. Spark | 60 kW. |
| 0923–0930 | Time signals (automatic) | 2,600 m. Spark | 60 kW. |
| 1000–1003 | Rhythmic signals, 300 beats | 2,600 m. Spark | 60 kW. |
| 1033–1038 | U.R.S.I. signals | 2,600 m. Spark | 60 kW. |
| 1038–1043 | Groups for correcting rhythmic signals | 2,600 m. Spark | 60 kW. |
| 1044–1049 | Time signals (semi-automatic) | 2,600 m. Spark | 60 kW. |
| 1130 | European meteor ob. at 7 hr. followed by detailed forecast for France and Western Europe until the following morning. | 2,600 m. Spark | 60 kW. |
| 1130 | (At end of meteor) Seismological telegram | 2,600 m. Spark | 60 kW. |
| 1200 | Press | 3,200 m. Spark | 60 kW. |
| 1420 | Meteor. Ob. at 13 hr. | 2,600 m. Spark | 60 kW. |
| 1700 | Telephony | 2,600 m. Spark | 1 kW. (approx.) |
| 1710 | Agricultural meteor in plain language (as from February 6th, 1922). | 2,600 m. Spark | 1 kW. (approx.) |
| 1800 | Calibration waves, 1st and 15th of month only | 5,000 m. | 60 kW. (approx.) |
| 1810 | Calibration waves, 1st and 15th of month only | 7,000 m. | 60 kW. (approx.) |
| 1920 | Meteor. Ob. at 18 hr. | 2,600 m. Spark | 60 kW. |
| 1920 | (At end of meteor) Seismological telegram | 2,600 m. Spark | 60 kW. |
| 2200 | Rhythmic signals, 300 beats | 2,600 m. Spark | 60 kW. |
| 2236–2243 | Groups for correcting rhythmic signals | 2,600 m. Spark | 60 kW. |
| 2244–2249 | Time signals (semi-automatic) | 2,600 m. Spark | 60 kW. |

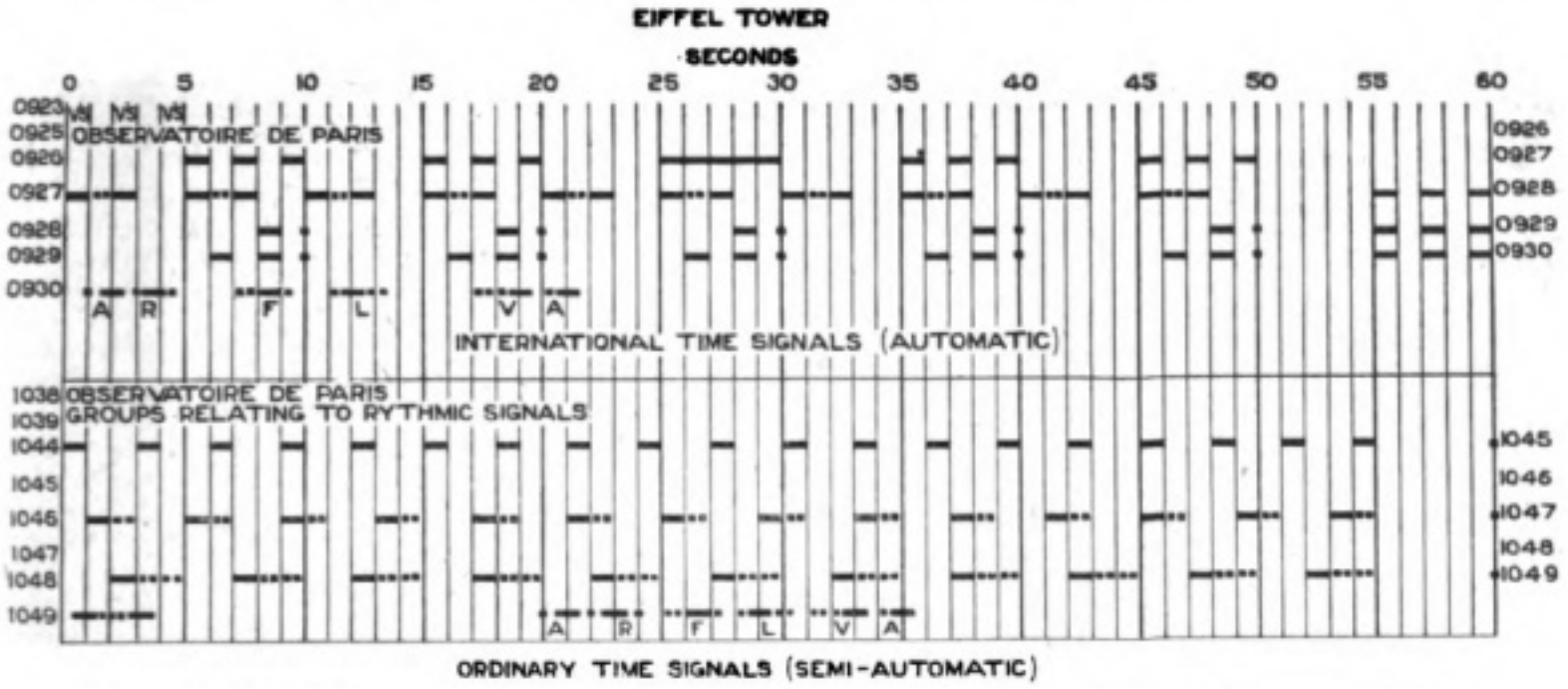



*Fig. 3. Method of transmitting Time Signals. (Ordinary time signals are also transmitted every evening from 2244-2249.)*

possible use may be made of reports issued and that they may be available for the greatest number of countries desiring to have them.

The Table on the previous page gives a complete list of the regular transmissions made every day by the Eiffel Tower **FL** from which it will be seen that the greater part of the daily programme is taken up with these scientific time and weather signals.

A diagram (Fig. 3) is also given showing the method of transmission of time signals from the same station, while a future article will explain the apparatus used in this connection.

# Notes

**Second Reading of Wireless Bill.**

Mr. Kellaway moved the second reading of the Wireless Telegraphy and Signalling Bill in the House of Commons on June 16th. The Bill, he said, did not propose in any way to withdraw from the publicthe advantages ofwireless communication. On the contrary its effect would be, by ensuring the proper use of wireless, to assist its development. Mr. Kellaway said the conditions under which the broadcasting of wireless telephony would be worked had not yet been decided. He did not think it desirable that the work should be carried on by the Government. The Bill was read a second time.

**American Broadcasting Stations No. 300.**

Twenty-six new broadcasting stations were licensed during one week in May in 18 different States. This brings the total stations broadcasting news and entertainment to 300. Five of the new stations are located in California, which leads the list with a total of 59 stations. Ohio is second with 23, Pennsylvania has 20, and New York 18. Texas is no longer the only state with one station, as Maryland, Utah, North and South Dakota each have one only.

To-day, every state except New Hampshire, South Carolina, Delaware, Mississippi, Kentucky, Wyoming and Idaho has one or more broadcasting stations.

The prospective Bill to give the Secretary of Commerce more control over radio transmission stations has not yet been introduced in Congress. Little opposition is expected. Support is guaranteed by nearly 16,000 amateurs.

**Ice Patrol Broadcasting.**

On the closing of the St John's Station reports hitherto transmitted respecting dangers to navigation in the vicinity of the Great Banks of Newfoundland, are to be broadcasted by the United States Coastguard cutters on ice patrol.

**Senatore W. Marconi Receives Medal.**

At a joint meeting of the American Institute of Electrical Engineers and the Institute of Radio Engineers, held on June 20th at the Engineering Societies Building, New York, Senatore Marconi delivered an address on "Radio Telegraphy." He was afterwards presented with The Institute Medal of Honour for 1920.

**Charity Demonstration.**

A wireless demonstration was given by Marconi's Wireless Telegraph Co. on Friday, June 16th, for the benefit of the annual fête and sale in aid of the Actor's Church Union Hostels Fund for Children of Touring Actors, at Caxton Hall, Westminster, the arrangements for which were carried out by Miss Kitty Loftus, in co-operation with the Marconi Company.

There was a demonstration of general wireless reception during the afternoon, and at 8 p.m. a message from the Archbishop of Canterbury, spoken from Marconi House, was received on a loud speaker in the main hall. The message, which contained a warm expression of goodwill and desire for the

success of the fête, had been sent by the Archbishop of Canterbury to the Bishop of Willesden for transmission by wireless.

Some gramophone music was also given and the demonstration proved of great interest to a large gathering of people.

### Transmission of Memorial Ceremony.

At Marconi House at noon, on June 21st, when the Roll of Honour was unveiled in memory of the 348 men whose names are on it, the ceremony

*Boys of the "Exmouth" sounding the Last Post.*

was broadcasted. The Last Post and Reveille sounded on bugles, and an address by Mr. Godfrey Isaacs was heard by operators in ships all round the coast of the United Kingdom.

### Report on Radio Telephony Conference.

At a conference called by the Secretary of the Department of Commerce at Washington, questions concerning the regulation of radio communication were considered. The conference was held from February 27th to March 2nd, and April 17th to 19th. The conference recommended that the Secretary of Commerce should have authority to control the establishment of all radio transmitting stations except amateur, experimental and Government stations; also the operation of non-governmental radio transmitting stations.

It was recommended that the Secretary of Commerce assign to each radio telephone broadcasting station a permissible power based on the normal range of the station, such normal ranges for the different classes of service to have stipulated average values. Government broadcasting stations were recommended 600 (land) miles; public stations 250 miles, and private and toll stations 50 miles.

An interesting clause in the recommendation was that for the purpose of self-policing among the amateurs, amateur deputy radio inspectors be created, elected from their number in each locality. The duty of the deputy inspector would be to endeavour to the best of his ability to accomplish, under the direction of the district radio inspector observance of the Radio Communication Laws.

## Book Review

**HOW TO MAKE GOOD WIRELESS APPARATUS. A Useful American Publication.**

Many experimenters who have evolved useful circuits are anxious to embody them in neat, easily handled and robust equipment. They are aware that their apparatus in its experimental form is sensitive and electrically efficient, but owing to the lack of suitable textbooks on instrument design (as distinguished from *circuit* design) they are frequently unable to produce finished apparatus of the style associated with commercial equipment. With this in mind, Mr. M. B. Sleeper (late editor of the Radio section of "Everyday Engineering," and best known to British amateurs as the originator of the first transatlantic amateur tests), has written a useful textbook entitled "How to Make Commercial Type Radio Apparatus,"* in which he deals in detail with a number of American commercial designs, giving much data and photographs of interior construction which are not otherwise available.

The book is not intended for the raw tyro. For this reason all theoretical matter is excluded, and the reader is presumed to understand the principles upon which the apparatus works. The work is divided into four parts, devoted respectively to Receiving Equipment, Transmitting Equipment, Airplane Radio Equipment and Special Notes on Miscellaneous Equipment. In the first portion, which is of particular interest to the experimenter on this side of the Atlantic, some suggestive particulars are given on several types of receiver. The first chapter deals with a combined crystal and valve receiver intended to operate on waves from 250 to 8,000 metres, designed by the Bureau of Steam Engineering of the U.S. Navy Department, and known as the "Destroyer Type." The circuits are of the usual loose-coupled form, with a six-step aerial inductance and series condenser for the primary, and a secondary coupling coil, six-step inductance and shunt tuning condenser in the secondary circuit. One-half of the condenser dials are divided into 180 degree scales, and the other halves are used for wavelength calibrations. An interesting feature is that as the inductance switches are taken from one stud to another, pointers on the calibration scales of the condensers move to corresponding arcs on the dials. The six separate arcs on each condenser dial can thus be ready without risk of confusion. Vernier adjustment of the condensers is brought about by turning small wheels which bear upon the dial edges.

Dead-end effects on the six-stud inductances are obviated by using four contact fingers which short circuit the unused parts of the coils. The filament resistances are made up of resistance wire wound zig-zag fashion between brass pins set into the peripheries of two bakelite discs. A switch arm runs over the set of pins nearest the panel, thus giving the necessary variation. The reaction coil (or "tickler" as it is called over the water) is made in rather an unusual way, being partly a fixed coil wound on the same former as the secondary in-

* How to Make Commercial Type Radio Apparatus." By M. B. Sleeper. (New York: *The Norman Henley Publishing Co.* 1922 Edition, 75 cents.)

ductance, and partly a coil on a separate movable former. The condenser shunted across the H.T. battery and telephones is variable in six steps up to 0·007 mfd.

The above points have been selected for mention from one chapter alone, with the idea of giving the reader an indication of the value of the book to the serious experimenter. Other chapters contain just as many suggestive and interesting ideas. Chapter two deals with an American receiver designed for use on French ships with the well-known French valves. The chapter concludes with the following note :—

> "The outstanding feature of French and English instruments is the amount of hand work on them—beautifully made. The trouble is, however, that there is so often the same delicacy of design. American equipment, on the other hand, gains in many cases because due allowances are made for quantity production and the ruggedness required, particularly for the Army and Navy. Although foreign apparatus often calls for commendation of workmanship, it seldom equalled our own recent developments under the severe test of war conditions. In the illustrations . . . . the standard French tube, also used by the English, can be seen. . . . This tube requires only 40 volts, though transmitting tubes of this type of construction operate at as high as 750 volts. Either sort do not come up to the VT1 or VT2 of the Signal Corps."

We rather fancy Mr. Paul Godley held views like this until he came here last winter. We hope it will not be long before Mr. Sleeper awakes.

In Chapter three the Grebe Long-Wave Receiver is described with the same thoroughness which characterises the other chapters.

Other chapters in the receiver section deal with a uni-control receiver in which continuous searching is automatically carried out by the slow rotation of the tuning handle by an electric motor, an audion control box, and a two-step amplifier (L.F.). The transmitting section contains a detailed description of a recently designed Duplex Radiotelephone set made by the Western Electric Company for the Navy and other interesting apparatus, including some notes regarding the English Marconi apparatus. The aeroplane section is equally instructive. In the miscellaneous equipment section one of the most interesting portions is the description of the Eaton Oscillator, a device which can be connected to an ordinary loose coupler, tuning condenser and valve so that it can be used for C.W. reception for any wavelength between 200 metres and 25,000 without any additional adjustments. In the same section is also included a description of the Bureau of Standards Long-Wave Wavemeter for waves from 1,500 to 22,000 metres.

Unfortunately, the book lacks an index, which, in view of the many practical and important matters discussed in it, is a drawback to the experimenter. The photographic illustrations are also badly reproduced. However, these are minor criticisms in an otherwise very valuable and well-written book, which every amateur constructor (and many a professional as well) should add to his bookshelf.

P. W. H.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with interest the recent correspondence on jamming with valve receivers.

I am afraid it is hopeless to ask all amateurs to use separate heterodyne or to make their sets as little nuisance as possible. People are not made that way ; as long as they cannot be found out they will still carry on.

But are even experienced amateurs free from blame ? A recent letter in *The Wireless World* reads :—

> "Immediately one got the set off the oscillation point and was receiving the concert nicely, in would come a terrific howl . . . . and set the whole apparatus oscillating strongly again."

Was there ever a clearer case of "giving the show away ? "

J. W. W. WHITESIDE (2 JO).

Clitheroe, Lancs.

# Calendar of Current Events

**Saturday, July 1st.**

CROYDON WIRELESS AND PHYSICAL SOCIETY.
Ordinary Meeting.

**Sunday, July 2nd.**

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

**Monday, July 3rd.**

NEWCASTLE AND DISTRICT AMATEUR WIRELESS ASSOCIATION.
7.30 *p.m.*—Annual General Meeting and election of President and officers.

**Tuesday, July 4th.**

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

**Wednesday, July 5th.**

FOLKESTONE AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At Cave's Café, Sandgate Road. Weekly Meeting.

ILKLEY AND DISTRICT WIRELESS SOCIETY.
7.30 *p.m.*—At the "Regent Café," Cowpasture Road, Ilkley. Committee Meeting.
8 *p.m.*—Lecture and demonstration on "Short Wave Telephony Reception."

**Sunday, July 9th.**

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

**Monday, July 10th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.
7.30 *p.m.*—Annual Meeting for election of officers.

**Tuesday, July 11th.**

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

**Friday, July 14th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.
8 *p.m.*—Lecture on "Maritime Radio Communication," by Mr. D. E. Pettigrew.

# Wireless Club Reports

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

WIRELESS SOCIETY OF LONDON.

The Forty-ninth Ordinary General Meeting was held on Wednesday, June 14th, at the Institution of Electrical Engineers, at 6 p.m.

After the minutes of the previous meeting had been approved and signed, the President called upon Sir Oliver Lodge to give his address.* Ballot papers, which had been circulated, were collected at the end of the meeting. The President announced that the new members had been duly elected, and that that meeting closed the session.

### The West London Wireless and Experimental Association.*

Club Rooms, Belmont Road Schools, Chiswick, W.4. Hon. Secretary, Mr. Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

Meeting held Thursday, June 8th. :—

A very interesting gathering assembled to listen to a very instructive lecture by Mr. J. F. Turner, of the M.O. Valve Co., entitled the "Theory of the Thermionic Valve." The lecturer dealt with his subject in an elementary form, and remarked that to understand the inner mysteries of the valve one had to, according to present-day theory, bring in the electron.

The electron was briefly explained and its properties were outlined and with the aid of diagrams, projected by a lantern, a good deal of the "inner mysteries" were made more comprehensive. In turn the lecturer dealt with the composition of the filament, the grid, and the anode, also the bulb, and the pumping of the bulb. Questions were invited and the lecturer replied very fully. A very hearty vote of thanks was accorded Mr. Turner on completion of his lecture and all present were invited to inspect the large number of specimens of various types of valves which were exhibited.

The Secretary desires to point out that all members will receive a copy of the Additional and Amended Rules in due course, and, further, any gentlemen who feel interested in radio telegraphy and are going in for "broadcasting" sets, should endeavour to join a society in that neighbourhood which will give them most valuable help in their launching out into the mysteries of the æther. All applications for membership and terms of subscriptions, together with objects of this Association, will be immediately replied to by the Secretary.

### Folkestone and District Wireless Society.*

Hon. Secretary, Mr. H. Alec S. Gothard, Associate I.R.E., 8, Longford Terrace, Folkestone.

Arrangements are being made to hold weekly meetings, in a private room at Cave's Café, Sandgate Road, throughout the summer months.

The first meeting will be held at 7.30 p.m., on Wednesday, July 5th. Old members are particularly requested to be present. Those seriously interested in the science of radio telegraphy and telephony are cordially invited.

Full particulars of the Society may be obtained on application to the Hon. Secretary.

### Newcastle and District Amateur Wireless Association.*

The Annual General Meeting for election of President and Officers will take place on Monday, July 3rd, at 7.30 p.m.

Country and intending new members should make an endeavour to be present.

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

### Bradford Wireless Society.*

Hon. Secretary, Mr. J. Bever, 85, Emm Lane Heaton, Bradford.

Organising Secretary, Mr. N. Whiteley, 8, Warrels Terrace, Bramley, Leeds.

A meeting was held in the club-room at 7.45 p.m., on Friday, June 16th, with Mr. W. C. Ramshaw in the Chair. The minutes of the previous meeting were read and passed, following which a few new members were elected.

The Chairman then called upon Mr. J. Bever to give his lecture on "General Wireless Matters." This consisted in the main of a description of his own four-va'ye set, and was extremely interesting. During the course of his remarks Mr. Bever made several references to the increasing number of people using valve sets, who not having the necessary knowledge to operate them cause interference by allowing their apparatus to oscillate unnecessarily. Mr. Bever's set was on view, and is a very well made piece of apparatus, fitting, as it does, in a moderate sized attaché case. The set was connected to the Society's aerial and excellent signals were obtained on short wave, including telephony from a local station. These signals were easily readable with the telephones lying on the table, at the other end of the meeting room.

At the conclusion a hearty vote of thanks was passed.

The meeting on June 30th concluded the session but the Committee have decided to continue the fortnightly meetings throughout the recess, when short elementary lectures and discussions will be given for the benefit of new members. Morse practices will also be held.

The Chairman made an announcement urging all new members desirous of purchasing apparatus to consult members of the Committee before deciding

* The address by Sir Oliver J. Lodge appears on p. 407 of this issue.

on what to buy, in view of the fact that there is a considerable amount of junk gear being placed on the market at the present time.

### Stoke-on-Trent Wireless and Experimental Society.*

On Thursday, June 15th, J. Gaskell, Esq. (Assistant Hon. Secretary), gave a lecture and demonstration on X-rays. Questions were asked and answered regarding the relation of X-ray waves to wireless waves, and remarks were made concerning the similarity between the X-ray tube and the thermionic tube used in wireless communication. A vote of thanks was heartily accorded to the lecturer, the Chairman expressing a wish that in the coming session they would have the pleasure of hearing Mr. Gaskell again.

A corresponding members section has been opened for members unable to attend the ordinary meetings, and a technical committee has been formed to deal with questions put forward by them.

Those interested should communicate with the Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley, Stoke-on-Trent.

### Wireless Society of Highgate.*

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

The second of the series of elementary lectures on wireless was given at the Highgate Literary and Scientific Institution on Friday evening, June 16th, by Mr. J. Stanley, B.Sc., A.C.G.I., to an audience which again comprised a large number of visitors, including several ladies.

Mr. Stanley went briefly over the theory of the ether, showing that it possesses the properties essential for wave motion—elasticity and inertia—and then took his hearers carefully over the important subject of wave-motion generally, showing exactly what is meant by wavelength and frequency. He illustrated his remarks by analogies derived from the action of water waves, and led up to the fundamental equation for all wave motion, *i.e.*, velocity = frequency × wavelength. He then took up the question of oscillating current, showing how these could be produced by the discharge of a condenser through a circuit containing inductance, and how trains of oscillatory discharges could be produced by the inclusion of a spark gap in such a circuit.

The lecturer followed on by showing what was meant by the "impedance" of a circuit, and gave the formula for this quality, and went on to point out how it followed from this that the wavelength of a circuit was dependent upon the inductance and capacity in that circuit.

Finally, he showed how by application of oscillating currents to open radiating circuits such as ordinary wireless aerials, electro-magnetic waves were set up in the ether and sent out into space, and he showed the different forms of aerials affected the shape of the waves produced and the directional properties of the aerials.

Mr. Stanley's remarks were illustrated throughout by excellent diagrams thrown on the screen, and this added considerably to the interest and clearness of the lecture.

At the conclusion a very hearty vote of thanks was given to Mr. Stanley, and the meeting was adjourned. Seven new members were elected, and five further applications for membership were received.

The Hon. Secretary would be pleased to hear from anyone interested, and to give further particulars of the Society. The Society has made arrangements to receive the Marconi concert at the Highgate Literary and Scientific Institution on Tuesdays, at 8 p.m., during June and July and anyone interested will be welcome on these occasions.

### The Wireless Society of Hull and District.*

On June 12th, before a large attendance of members, Mr. W. J. Featherstone, who was one of the pioneers in wireless in Hull, read a most interesting paper on miscellaneous topics dealing with wireless. For the benefit of the new members he gave an account of the various detectors (past and present) such as the coherer, magnetic, crystal and valve. He also exhibited a relay and explained by the aid of diagrams the various uses to which it could be put. The lecturer related many incidents which had happened since he first took up wireless work, and altogether a very interesting evening was spent.

Mr. G. H. Strong, President, was in the Chair, and in the course of a few remarks, in which he welcomed the new members, he sounded a note of warning and told them that they must not expect too much from the crystal detector as regards receiving telephony. He mentioned that in view of the many cheap crystal sets which are being placed on the market just now. He proposed a vote of thanks to the lecturer and this was ably seconded by Mr. C. Dyson (another pioneer of wireless in Hull).

Fourteen new members were elected. A number of books on wireless subjects have been given by different members, and the whole question of the formation of a library has been relegated to a small sub-committee, to draw up suitable rules, etc. Members who are willing to give books for this purpose should communicate with the Hon. Secretary. Members should note that "The Wireless Year Book for 1922" can be consulted at the Central Free Library (Reference Dept.).

The annual meeting for the election of officers, and other business, will be held on Monday, July 10, at 7.30 p.m. The remainder of the evening will be occupied by questions and answers, which should prove very helpful to the new members. It is hoped that there will be a large attendance on this occasion.

Meetings of the Society are held at the Signa Corps Headquarters in Park Street, on the second Monday in each month.

Intending members should apply to the Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull, who will supply full particulars.

### North Middlesex Wireless Club*.

The 93rd meeting of the Club was held on Wednesday, June 14th, at Shaftesbury Hall, Bowes Park, N. The Chair was taken by the President, Mr. A. G. Arthur, and after the minutes had been read, the Secretary, Mr. E. M. Savage, announced that it had been arranged to hold elementary classes for beginners, commencing at 7.30 on ordinary meeting nights, for one hour. Will all those interested please make a note of this for next meeting on June 28th.

The Chairman then called on Mr. L. C. Holton to read his paper on "The Townsend Wavemeter and How to Use It."

Mr. Holton commenced by explaining how waves were produced in water, and compared these with those produced in the ether in wireless work. He made clear to beginners that wavelength is independent of range of transmission. He also explained the meaning of the terms frequency and amplitude. The wavemeter was used in a number of ways, but one of its chief uses was to measure the incoming waves at a receiving station. The lecturer gave a demonstration of this, and explained how to use the charts supplied with the meter.

This wavemeter is the property of the Club, and has been calibrated by the National Physical Laboratory at considerable cost, so that its accuracy is to be depended upon. It is available for the use of members under the Club's Loan Scheme.

A vote of thanks was moved from the Chair at the close of Mr. Holton's lecture.

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

### The Wallasey Wireless and Experimental Society.*

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

The twenty-first meeting of the present session was held on Thursday, June 14th. Mr. S. J. Martin in the Chair.

The lecturer for the evening having met with an accident, Mr. Martin offered to fill the gap caused by his absence and gave a most interesting lecture on "The Construction and Theory of Valve Receivers."

On the termination of the lecture a general discussion was opened, during which the question of the reception of the telephony from the proposed Manchester broadcasting station was brought forward. The Society stated their opinion that the music should be received quite well in Liverpool on a crystal set, provided that the power of 1½ kW. is used, the Society are also of the opinion that two or three valves will receive the telephony from most of the broadcasting stations in the kingdom.

The above may be of use to the many amateurs in the district who wish to construct a set. The Society would like to ask the users of valve sets in the district to avoid, as far as possible, excessive radiation during the reception of the Bar Ship telephony, and the concerts on Sunday morning.

On Sunday last 15 radiation waves were detected by one of the members. The Society would like to advise offenders in this respect that a direction finding set is under construction; it is intended to find, as far as possible, the culprits, and to take the necessary steps to prevent the disturbances.

### Sheffield and District Wireless Society.*

On and after June 23rd the address of the Hon. Secretary of the above Society will be 18, Linden Avenue, Woodseats, Sheffield.

### The Wireless and Experimental Association.*

A very busy evening was spent on Wednesday, June 7th, deciding what arrangements were best for our forthcoming public demonstration. Many members volunteered to bring along apparatus for show and demonstration, and some well-known transmitting stations are providing a special programme. It is hoped that the President, Mr. Wm. Le Queux, will be present on that occasion, and a very varied and interesting programme has been prepared so as to give the public a true idea of the possibilities of wireless broadcasting.

Although the membership list is steadily increasing, there are a few rows of seats available for any who care to take up the study of wireless.

Final arrangements for the public demonstration on June 22nd were made. Marconi's had promised to supply a short programme, and the members looked forward to a very successful broadcast of the advantages of wireless, either as a hobby or study. The Chairman gave a very lucid description of how to determine the sensitiveness of receiver required for the reception of signals from predetermined stations, taking into account local conditions and power of transmitter. One of the members having come down from the meeting of the Wireless Society of London was able to pass on some of the information so ably put forward by Sir Oliver Lodge.

Those requiring information should communicate with the Assistant Secretary Mr. W. J. Joughin, 21, Troughton Road, Charlton, S.E.7.

### Leicestershire Radio Society.

*A Group of the Officials of the Leicestershire Radio Society.*

Standing: Mr. L. Pratt, Mr. D. Morton. Sitting: Mr. J. Rudkin (Treasurer), Mr. C. T. Atkinson (President), Mr. J. R. Crawley (Hon. Sec.)

### Radio Experimental Association (Nottingham and District).

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

A meeting of the above Association was held on May 25th at 7.30 p.m., Room 74, Mechanics' Institute. We had the pleasure of listening to an interesting talk on wireless telephony by Mr. Gosling. In view of the interest taken at the present time in the proposed broadcasting schemes, the subject chosen was very appropriate. Mr. Gosling dealt with the evolution of wireless telephony from the first experiments, and explained the various methods employed in this class of transmission. The lecturer also gave hints on the best methods for receiving telephonic communications. The usual discussion on the lecture ensued.

During the summer months meetings will be held monthly, the dates being:—June 29th, July 27th, August 31st, September 28th.

# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"CONTACT STUD" (Rotherham)** *asks with regard to the Reinartz Tuner* (1) *For a diagram of circuit adapted for three valves.* (2) *Could the Broadcast signals be heard with this circuit and the loud speaker at a distance of about 80 miles.* (3) *Is the length of a receiving aerial still restricted to 100 ft.* (4) *Will the Reinartz Tuner tune to any wavelength by means of external coils.*

(1) We have no information on a modification of this set in this way, but think the scheme outlined in the diagram should be satisfactory. (2) We doubt if sufficient strength for a loud speaker would be obtained at this distance. (3) We believe that the restrictions are still enforced, but the requirements of the P.M.G. are not finally decided as yet. (4) Yes, up to reasonably high values of wavelengths. We should not recommend this circuit for very long wavelengths above, say, 5,000 metres.

**"M.F.G." (Manchester)** *asks* (1) *Is a circuit sketched correct.* (2) *Will the two-valve resistance coupled circuit on page 12 of Mr. A.M. L. Douglas' book receive signals from America and the Dutch Concerts.* (3) *The gauge of an enclosed specimen cannot get telephony. He asks* (1) *Why.* (2) *How to remedy howling.* (3) *Should he be able to receive the Hague Concerts with a four-wire aerial, 30 ft. long and 26 ft. high.* (4) *Is the four-wire aerial connected up correctly.*

(1) Set should give 2 MT. A 43 turn coil is too small with a series tuning condenser. Use about 100 turns. (2) Howling is probably due to strong fields from your L.F. transformers. Try separating them more, or screening them from each other. Also try less reaction. Try the A.T.C. on the aerial side of the A.T.I. (3) Doubtful, without some H.F. amplification. (4) It is better not to cross-connect the wires at the free end.

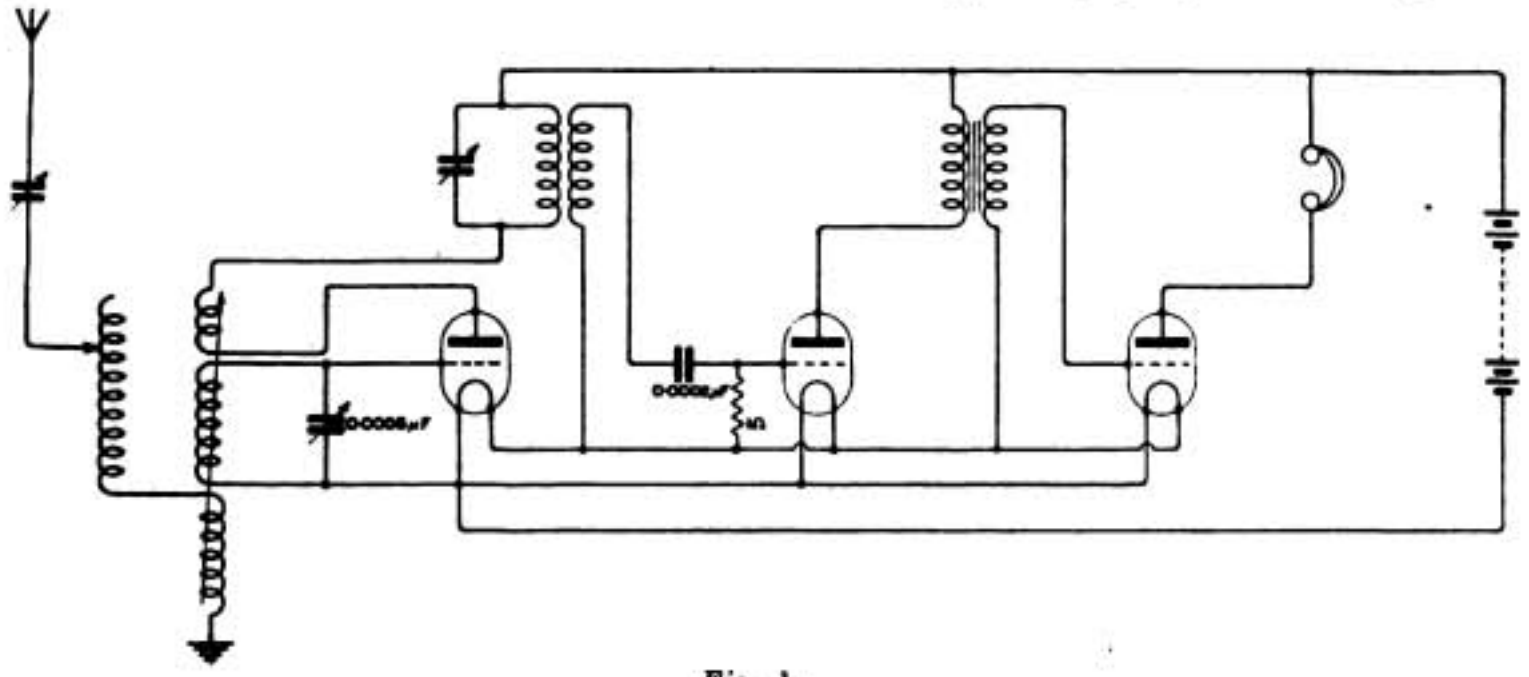


*Fig. 1.*

**"J.E.L." (Letchworth)** *asks* (1) *for a circuit for connecting up certain apparatus to form a three valve set.* (2) *The range of the set.*

(1) See diagram, Fig 1. (2) Maximum wavelength approximately 3,000 metres.

**"J.W.C." (Loughborough)** *has a three-valve receiving set on which he gets C.W. and spark, but of wire, and is it any use for construction of wireless apparatus.* (4) *Can basket coils be put in series with the solenoid inductance to increase the wavelength.*

(1) The circuit is correct, but you would get better results with more turns on the inductance and less parallel capacity. (2) It should do so,

provided that the inductances and capacities in the circuits are suitable for tuning in the stations required. (3) No. 30. It might be used for closed circuit and reaction coils, short wave L.F. transformers and similar purposes. (4) Yes.

**"G.S.F.B." (Hampstead)** *asks with reference to Reinartz Tuner described in the issue of May 13th (1) If certain modifications would make it suitable for 700 metres without additional coils. (2) What tappings would be necessary. (3) What tappings for reaction coil. (4) How to add a stage of H.F. amplification.*

(1) We cannot give exact valves without experimental work which you can equally carry out yourself, but we think your suggestion of a former 3½" diameter with 25 turns for the aerial, and 50 for the grid circuit, should be satisfactory (2) Try tapping the grid coil at 20, 30, 40 and 50. Tap the aerial coil at every two turns. (3) Reaction coil might have 35 turns, tapped at 10 and 20. (4) See diagram, Fig. 2.

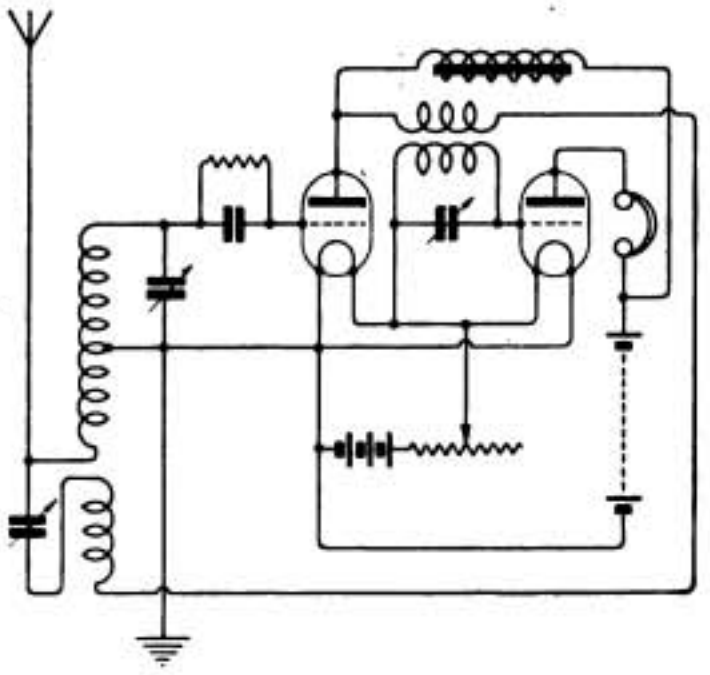


*Fig. 2.*

**"O.J.L." (Euston Road)** *asks how to add a valve to his set of which he encloses a diagram.*

It is difficult to advise you with any certainty without a knowledge of the internal connections of your set, but the addition of an L.F. valve, as in the diagram, would probably be satisfactory.

**"ANDREAE COLLEGIUM" (Bradfield)** *asks (1) How to add another valve through a resistance capacity to a circuit sketched, so that he can switch over quickly from one valve to two. (2) Whether English broadcasting stations could be heard on one valve at Rouen.*

(1) Use a spherical reaction coil. Preferably couple the switch shown with a switch to break the filament of the second valve (as shown) when not required, and use separate filament resistances for each valve. (2) Very doubtful.

**"LUX" (Greenock)** *asks (1) For a diagram of a two-valve set. (2) If the Broadcasting Stations would be audible at 23 and 70 miles with crystal set and a single valve set respectively. (3) If an aerial 25 ft. high at one end and 35 ft. at the other would give as good results as an aerial parallel to the ground*

(1) See diagram, Fig. 3. More than one H.F. transformer would be necessary for as big a range as 150/5,000 metres. (2) Weak but readable signals should be obtained at 23 miles with a crystal set. Similar results *might* be obtained at 70 miles with a single valve set, but only if critical reaction were used. (3) Yes, if the height of the level aerial were about 30 ft.

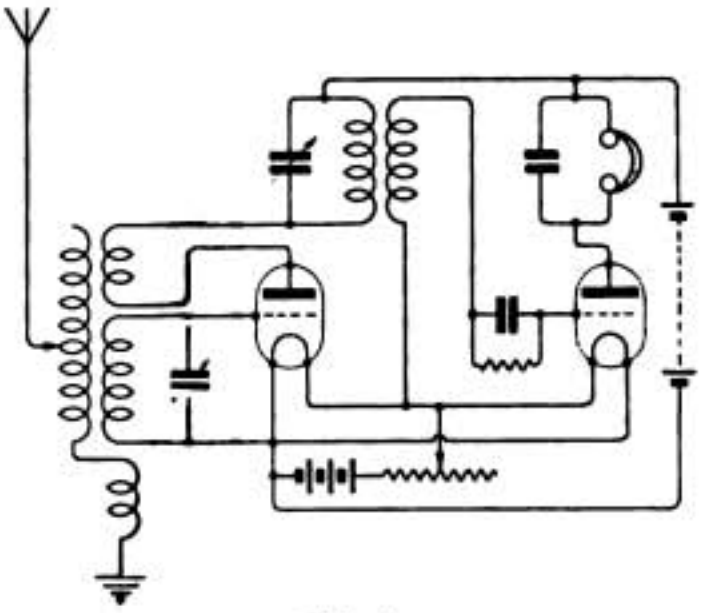


*Fig. 3.*

**——— (South Norwood)** *asks (1) Why he gets "howling" when the condenser is put in series with the aerial and coil. (2) How to wind an inductance to cover a range of from 180/600 metres when shunted by a condenser of 0·001 mfd. (3) How could the "howling" be prevented. (4) Is it possible to get PCGG on the above set.*

(1) and (3) At is impossible to give reasons as you neither describe nor sketch your set. It may perhaps be due to the leads being crowded too closely together. The howl may possibly be just induction from the A.C. supply. (2) Results would be very poor as suggested. Put the condenser in series with the A.T.I. which should be 3" × 4" of No. 24, with say, three taps. Reaction coil 3" × 2" of No. 24. (4) We cannot say without seeing a circuit diagram, which should be possible with a well laid out set.

**"A.B.C." (Sheffield)** *has bought a loud speaker which will not work on his set, of which he encloses a diagram.*

You give us very little information about your loud speaker, but the reason for its bad performance is probably that its resistance is unsuitable. For your set the speaker should have a high resistance. The one you possess is probably low. If so, you should use it with a transformer. A standard telephone transformer will be all right if the resistance of the speaker is about 100 ohms.

**"VINCAM" (Framlingham)** *asks if a list of instruments he gives will enable him to receive music and speech from Holland. (2) If they are correctly wired in his diagram. (3) Suggestions for alterations*

(1) PCGG should be obtainable in Suffolk on a single valve set of good type skilfully used. (2) and (3) The type of circuit suggested is quite useless. Your circuit might be on the lines of that shown in Fig. 4, page 372, June 17th.

**"A.R.O.S." (Paris)** *asks* (1) *For diagram of circuit for a reliable four-valve set, with range between 400 and 500 metres.* (2) *Would this circuit receive weak signals on 440 metres with Eiffel Tower transmitting on damped waves at the same time 8 miles away.*

(1) See diagram, Fig. 4. (2) It is difficult to say without test. You will probably have considerable difficulty, but this is about the best you can do with any ordinary method.

**"C.L." (Malvern)** *sends a diagram of his set and asks* (1) *Whether the condenser should be as shown or across the reaction coil.* (2) *Whether 50 volt H.T. is sufficient for good results.* (3) *The best way to add one stage of L.F. to the set.* (4) *The cost of doing this.*

(1) Condenser is best as shown in your diagram. (2) Yes. (3) See the amended diagram, Fig. 5. (4) About 35s. to 50s.

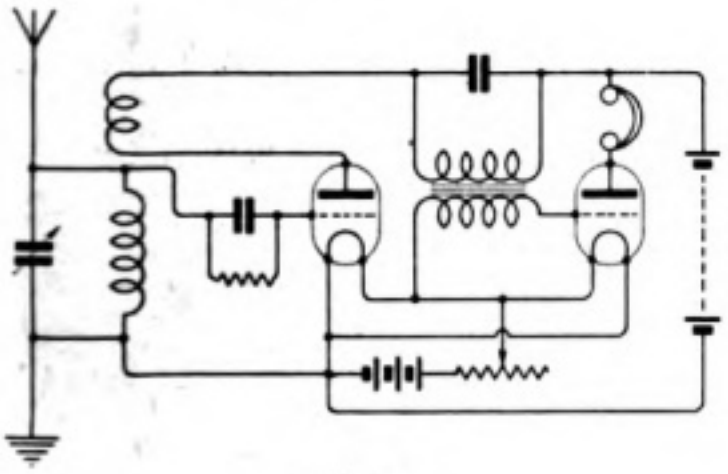


*Fig. 5.*

**"HAVANA" (Ealing Common)** *wishes to know* (1) *The best method for connecting up a two-slide tuning coil, variable condenser, galena detector and fixed telephone condenser* (2) *Whether such apparatus can be operated from a frame aerial.* (3) *Receiving range.*

(1) See diagram, Fig. 6. We do not know of an Army pattern double slide tuning coil. (2) Crystal detectors cannot be used with indoor frame aerials. (3) Range depends upon the transmitting station and aerial dimensions. You should receive all the European high power spark stations, also some ship and coast stations and London telephony transmitted with large power.

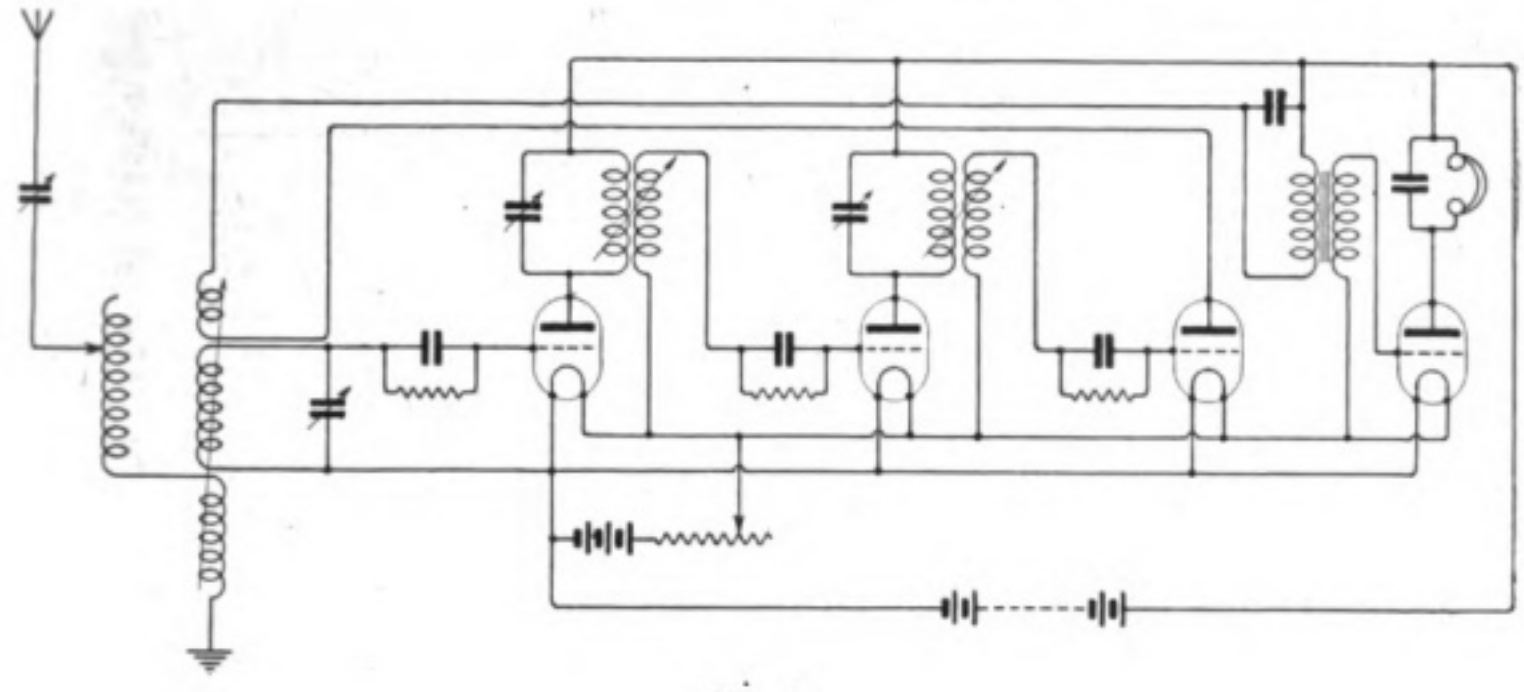


*Fig. 4.*

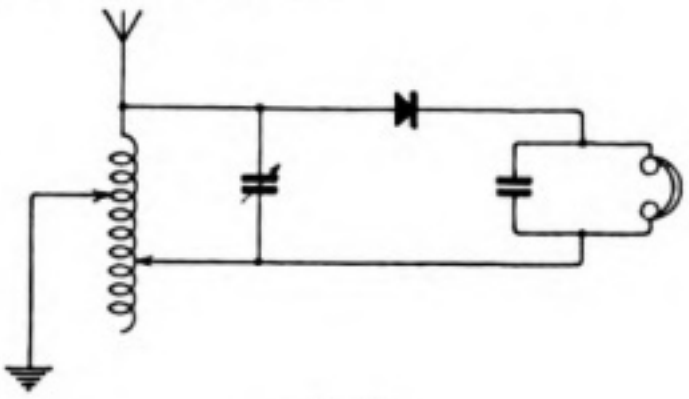


*Fig. 6.*

**"J.W." (Eglington)** *asks* (1) *What kind of a set he would require to receive Broadcasting Stations in England.* (2) *For a diagram for erecting an aerial.*

(1) For good results you will probably require a three-valve set, preferably with one stage of H.F. amplification, one detector and one L.F. amplification. (2) Many types of aerial are possible. The main points are (*a*) to use as great a length as possible up to the 100 ft. allowed. (*b*) insulate the wire from all supports, and keep it as far as possible from buildings; (*c*) avoid sharp bends in the wire; (*d*) erect the wires as high as possible.

**"DE RESKE" (Ashfield)** *asks for circuit comprising 1 H.F., 1 rectifying and 2 L.F. valves with magnetic reaction and transformer coupled and having switches arranged for using either first two valves shown or all four valves.*

See circuit Fig. 7.

**"RADIO" (Bolton-on-Dearne)** *sends diagram of a circuit given in "The Wireless World" of December 11th, 1920, and asks with regard to it* (1) *Length and gauge of wire for the aerial.* (2) *Gauge and number of turns for the inductance.* (3) *If a condenser of* 0·0015 *mfds. would be suitable.*

(1) The aerial might be 7/26 or 3/22 cable, or of No. 16 or 18 phosphor bronze wire. The length should be as great as possible up to the maximum of 100 ft. allowed by the P.M.G., and height as great as possible. (2) Wind a former 8" × 6" with a single layer of No. 24 wire, fitting it with a slider or number of tappings. (3) Suitable for a series A.T.C. If used as a shunt condenser, capacity is rather high and the setting should therefore be kept as near maximum as possible.

**"W.E.N." (East Finchley)** *sends diagram of a three valve receiving set and asks* (1) *Wavelength of a certain circuit.* (2) *Criticism of enclosed circuit.* (3) *Wavelength of the whole set.* (4) *How should the set be altered so as to receive short wave signals.*

(1) The inductance would be 1,200 mhys. The wavelength will, of course, depend upon how it is used. It could be used for $L_1$, but will not give very great increase of wavelength if L is fairly large. Your reaction coil is wrongly connected. Put it in series with anode circuit of the valve. The telephone transformer should be iron core. C.2 equals 0·0005 mfds. (3) This depends entirely upon L, about which you say nothing. (4) By putting the A.T.C. in series with the A.T.I., instead of in parallel with it.

**"OPTIMIST" (Orrall Park).** *With regard to a two-valve circuit described in the issue of May 28th, 1921, he asks* (1) *The size of former for L.2 to reach* **PCGG**, *with tappings for* 300, 600 *and* 1,070 *metres.* (2) *Dimensions for a reaction coil to rotate inside L.2.* (3) *Values for grid condenser and leak.* (4) *If* **PCGG** *would be heard on this set.*

(1) Coil should be 4" × 4" of No. 24 with tappings at 1" and 2½". (2) 3" × 3" of No. 24 should be sufficient. (3) 0·0002 mfds. and 3 meghoms. (4) Yes. N.B.—This circuit is liable to give serious re-radiation trouble.

**"F.C." (Nelson)** *has constructed a three-valve set as described in the issue of April 8th, on which he can get no telephony. He asks why.*

The set shown is of very good type. Failure to get telephony is probably due to there being none within reasonable distance. Also a set of this type generally needs much patient adjustment to work it up to its maximum sensitivity. An alternative multi-valve arrangement, which is possibly of somewhat simpler type, is given on page 368, June 17th issue, which need not of course be used with a frame aerial.

**"E.M.B." (Penarth)** *has a receiving set made on the lines of that given in the issue of February 18th. He asks* (1) *Will the set receive telephony with slab coils, including* **PCGG**. (2) *Can he make any improvement in the circuit to make telephony clearer.* (3) *What resistance telephones are most suitable for the circuit.* (4) *Can a reactance condenser be used in the circuit instead of a coil.*

(1) It is very unlikely to receive **PCGG** in Wales. The range on Broadcasting transmission is possibly 50 miles. (2) No, except possibly with the addition of a grid condenser and leak, or additional valves. (3) 8,000 ohms, but either 4,000 or 2,000 ohms will give quite good results. (4) Yes, but we doubt if this would be an improvement, either as regards results or ease of handling.

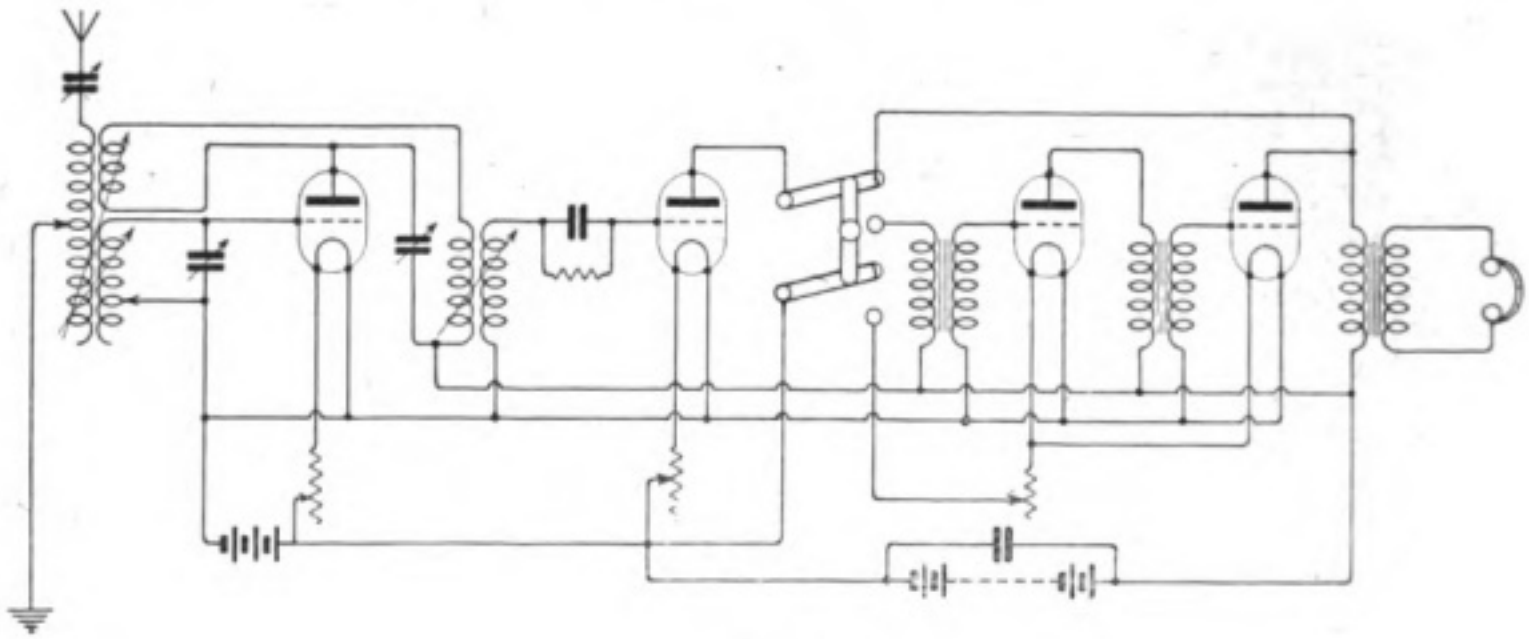


*Fig. 7.*

## SHARE MARKET REPORT

Prices as we go to press on June 23rd, are :—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 10 | 0 |
| ,, Preference .. .. | 2 | 5 | 0 |
| ,, Inter. Marine.. .. | 1 | 12 | 0 |
| ,, Canadian .. .. | | 11 | 0 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 15 | 0 |

8th JULY, 1922. PRICE 6D. NET.

# WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 15. 8th JULY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X., No. 15. JULY 8TH, 1922 WEEKLY

## Berne Radio Station

### A DESCRIPTION OF THE TRANSMITTING APPARATUS OF THE NEW SWISS INSTALLATION.

AS in most modern wireless stations the general arrangement is one of "central control." This system allows of direct duplex communication from one large centre to another, when from technical and other reasons the transmitting and receiving stations are situated some distance from such a centre: this arrangement also facilitates the handling of traffic. In the case of the Berne Station the control or operating office is contained in the main post office in the Swiss capital.

The transmitting station is situated on a plateau about 1,800 feet above sea level on the outskirts of the village of Munchenbuchsee. A good idea of the site and surrounding country can be seen from Figs. 1 & 2 which give a general idea of the station.

The transmitting and receiving stations are located some 10 kilometres North and 5 kilometres West of Berne respectively.

The transmitter is a coupled circuit Marconi valve set, employing 12 MT6 three-electrode valves in parallel and a total input of 25 kW. The electric supply for the station is taken from the Berne Power Supply Company at 16,000 volts 3 phase 50 cycles, transformed down to 500 volts at a sub. transformer station, and brought in on to the main switchboard by underground cable.

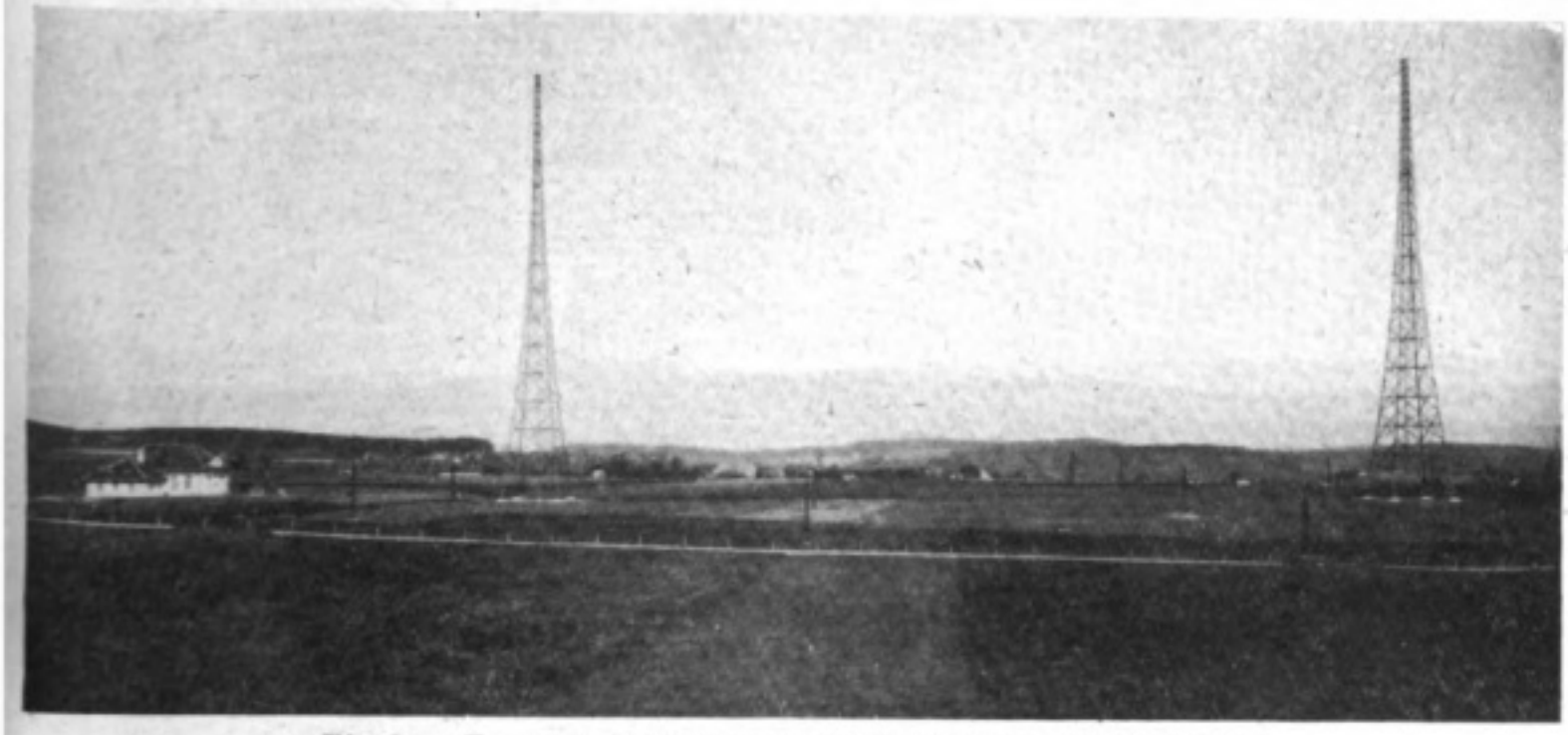


*Fig.* 1. *Transmitting Station on the Plateau at Munchenbuchsee.*

The necessary H.T. D.C. voltage for the anodes of the oscillating valves is obtained by double rectifying the three phase supply by means of 12 two-electrode valves, type MR6. For this purpose the main supply is led in to the primaries of three transformers, the windings of which are delta connected. The secondaries are star connected, the

end of each winding being connected to the plates of 2 valves and the D.C. output taken from the filament circuit and the mid-point, see Fig. 3.

The characteristic of this three-phase double rectification is that the resultant consists of about 90 per cent. D.C. component plus 10 per cent. ripple of six times the original frequency; very little filtering is necessary to transform it into a constant D.C. supply.

The connections of the oscillating valves is the usual top feed arrangement and the general scheme of connections of the oscillating circuit shown in Fig. 4.

As will be seen from Fig. 4, a separate anode tap coil coupled to the closed circuit inductance is used; this arrangement on medium power is more satisfactory and also simplifies the design of the main inductance. The closed circuit is completed

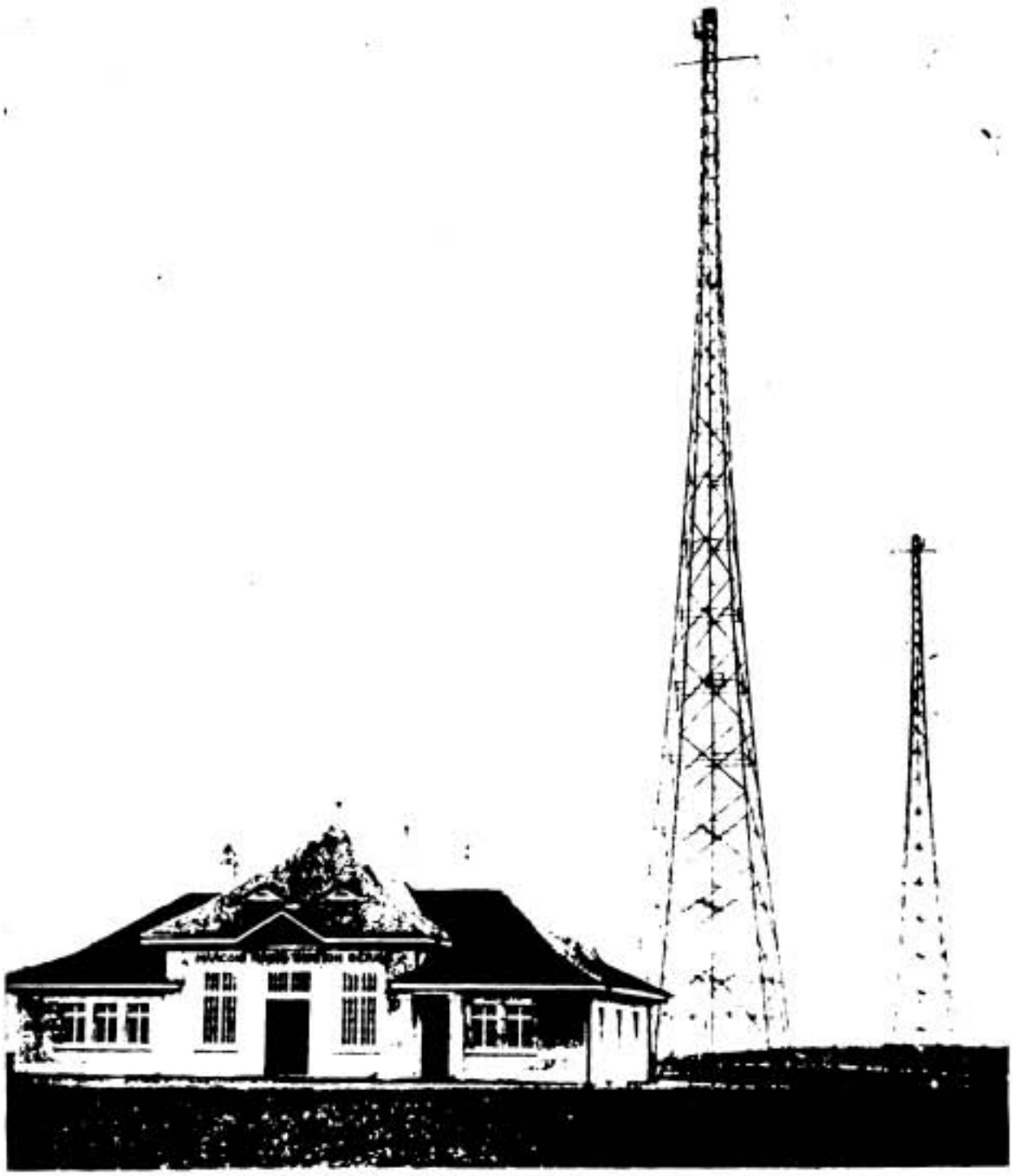


*Fig. 2. Towers and Aerial of the Berne Station.*

The primary power input can be varied from 8 kW. to full power by means of variable iron core chokes, one being connected in each phase and capable of synchronous adjustment. The lighting of the rectifier and oscillating valve filaments is accomplished by transforming the three-phase main supply into two phase by means of a "Scott" connected transformer, one phase each being used for the oscillator and rectifier filaments respectively, through an air condenser of 0·006 mfd., and is coupled to the aerial inductance by two adjustable coils which are normally in opposition.

Control of energy to the aerial is effected by shorting or un-shorting one of these coils by means of a specially designed single contact key operated by a Creed compressed air engine.

It may be pointed out, that nowadays, if the transmitting wave can be kept absolutely constant, the

receiving side has available circuits which greatly decrease atmospherics and other disturbances and allow the use of mechanical recording devices, such as direct printers, etc., also duplex conditions to avail irrespective of directional aerials. This is the reason why the somewhat novel method of keying described has been employed; it possesses

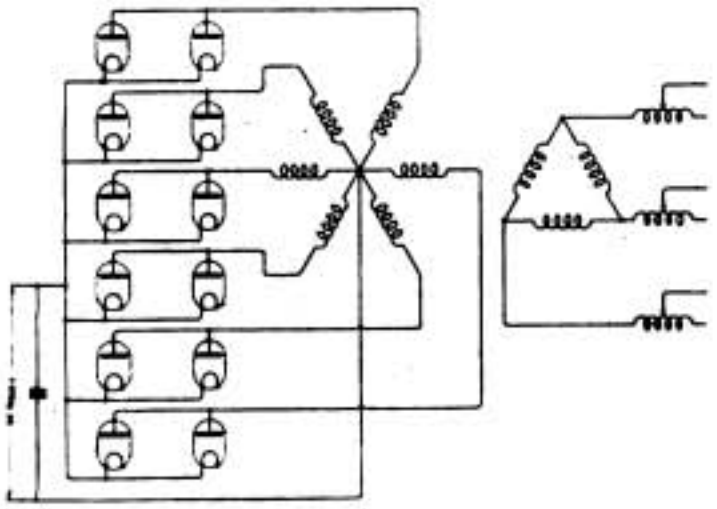


*Fig. 3. The connections of the Rectifier Circuit, giving three-phase double rectification.*

this great advantage of giving steadiness of wave without bringing in any appreciable undertone or compensation wave. It is especially applicable to high speed signalling owing to the quick cut on and off of the signal, and almost complete absence of sparking at the key contacts.

By careful design of the closed circuit the high frequency resistance has been brought down to 0.6 ohms at the normal wave of 3,400 metres, thus giving an efficient transfer of energy to the aerial circuit.

The aerial is an inverted "L" made up of two four-wire cages, carried on two self-supporting towers, each 300 ft. high, spaced 600 ft. apart, the natural period of the aerial being 1,600 metres and the capacity of 0.0042 mfd.

In accordance with the latest practice the earth coming under the influence of the aerial field is efficiently screened by means of 18 wires supported on 30 ft. lattice steel poles, and which, connected

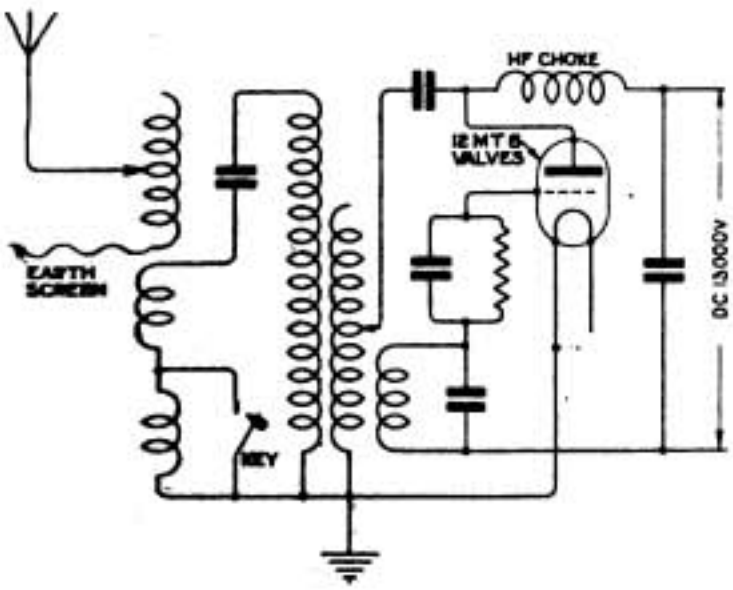



*Fig. 4. The Aerial Circuit showing signalling arrangement and also the Oscillator Valve Circuit.*

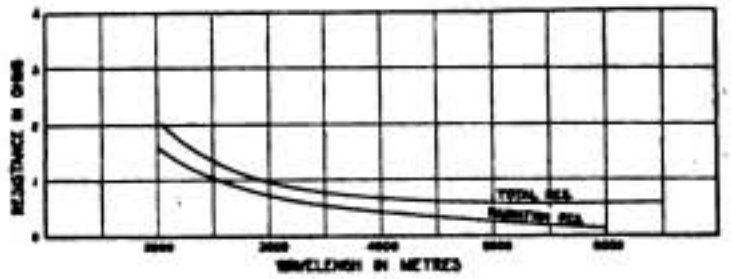


*Fig. 5. Resistance-Radiation Curves of the Aerial at Ongar.*

to the lower end of the aerial tuning inductance, form the return path of the aerial circuit.

Resistance measurements taken show the efficiency of the aerial at 3,400 metres to be of high order.

The curves of the total resistance and radiation resistance of the similar aerial at Ongar (the English end of the service) are shown in Fig. 5, plotted against wavelength.

In case of any failure from the outside source of supply a reserve power plant is installed consisting

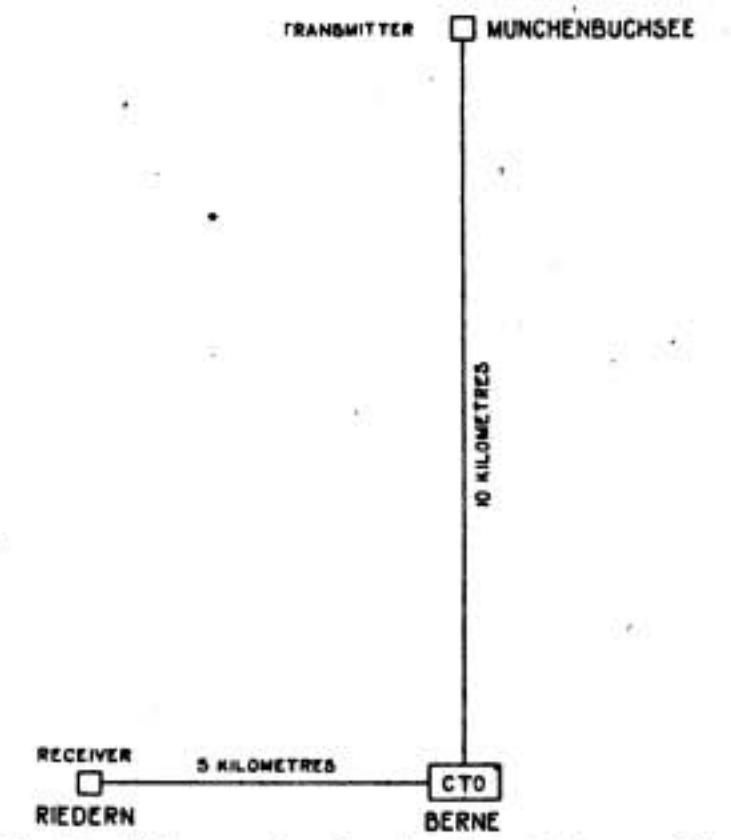



*Fig. 6. Diagram showing location of Transmitting and Receiving Stations.*

of 80 h.p. Diesel engine, driving a 50 K.V.A. three-phase generator, 500 volt 50 cycles, Fig. 7.

The necessary auxiliary machines are installed in a room adjoining the main transmitting room and consist of :—

AC/DC motor generator groups for supplying the necessary current for signalling keys and various relay circuits. Motor driven air compressors for supplying compressed air working the Creed engines, and blower motors for cooling the filament seals of the oscillating valves, and cooling key contacts. All the auxiliaries are in duplicate in case of breakdown.

The central control and operating office is on the third floor of the Berne main Post Office, and has direct telephone communication with all the

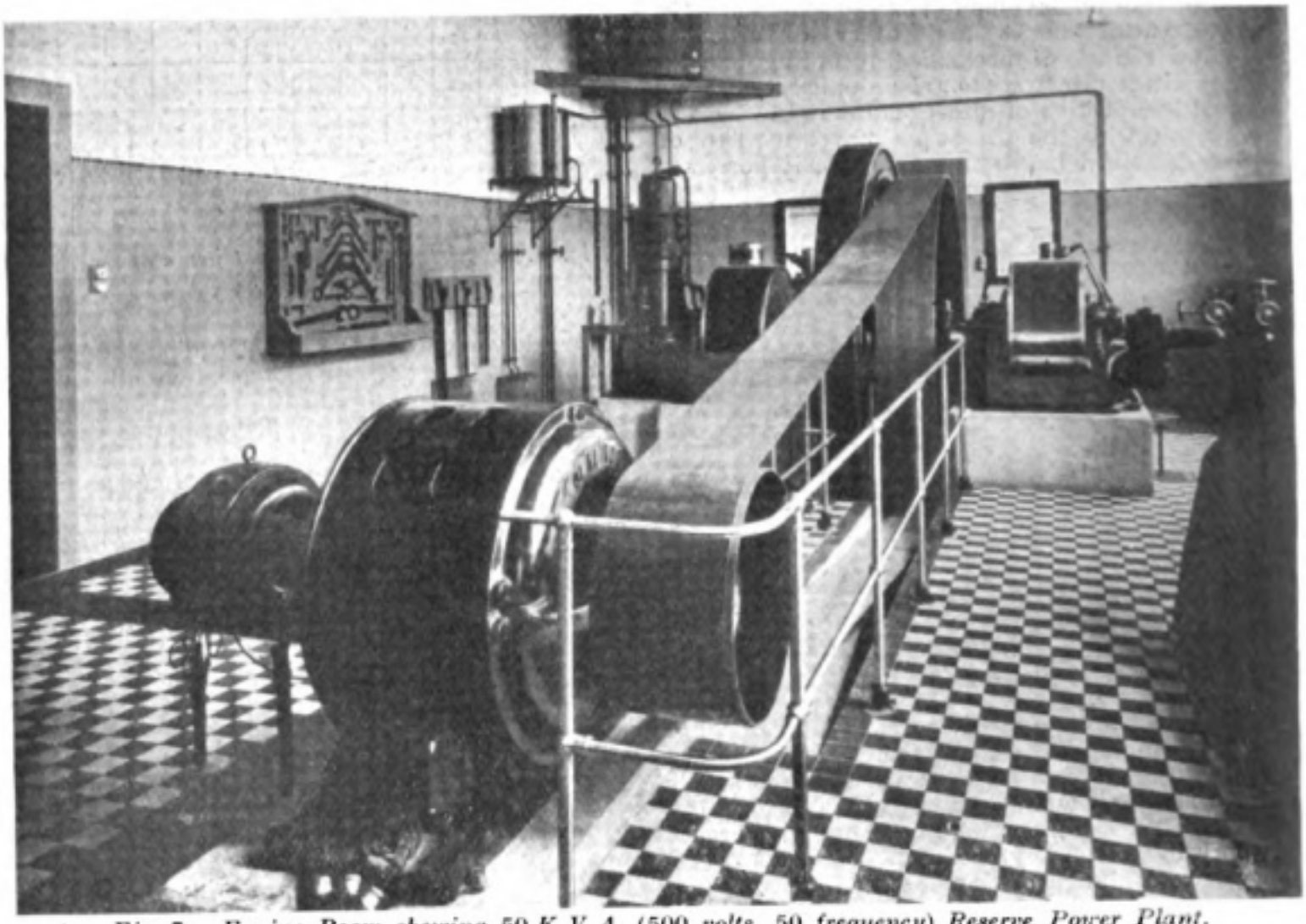


*Fig. 7. Engine Room shewing 50 K.V.A. (500 volts, 50 frequency) Reserve Power Plant.*

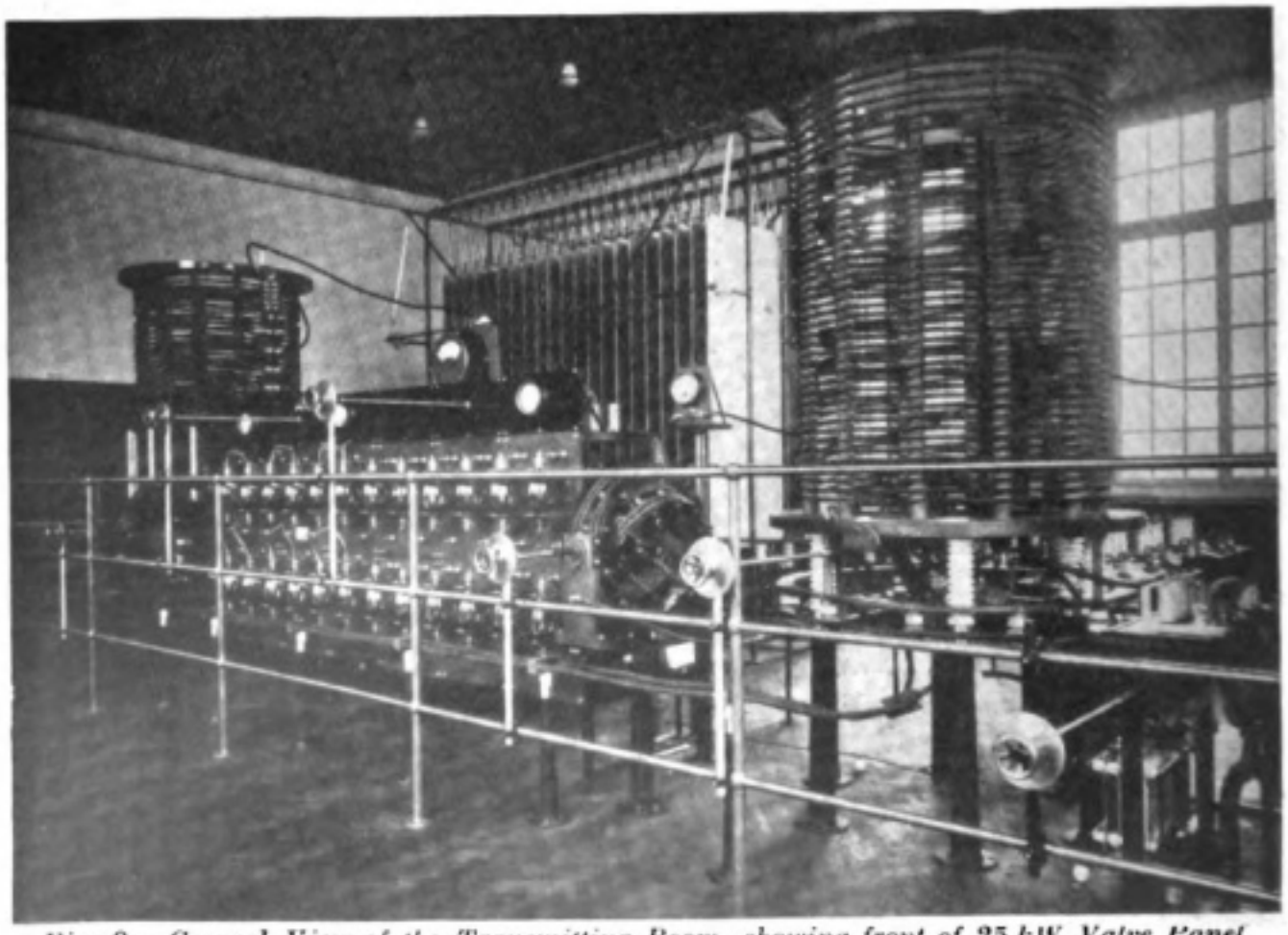


*Fig. 8. General View of the Transmitting Room, showing front of 25 kW Valve Panel, Main Air Condenser and Inductances.*

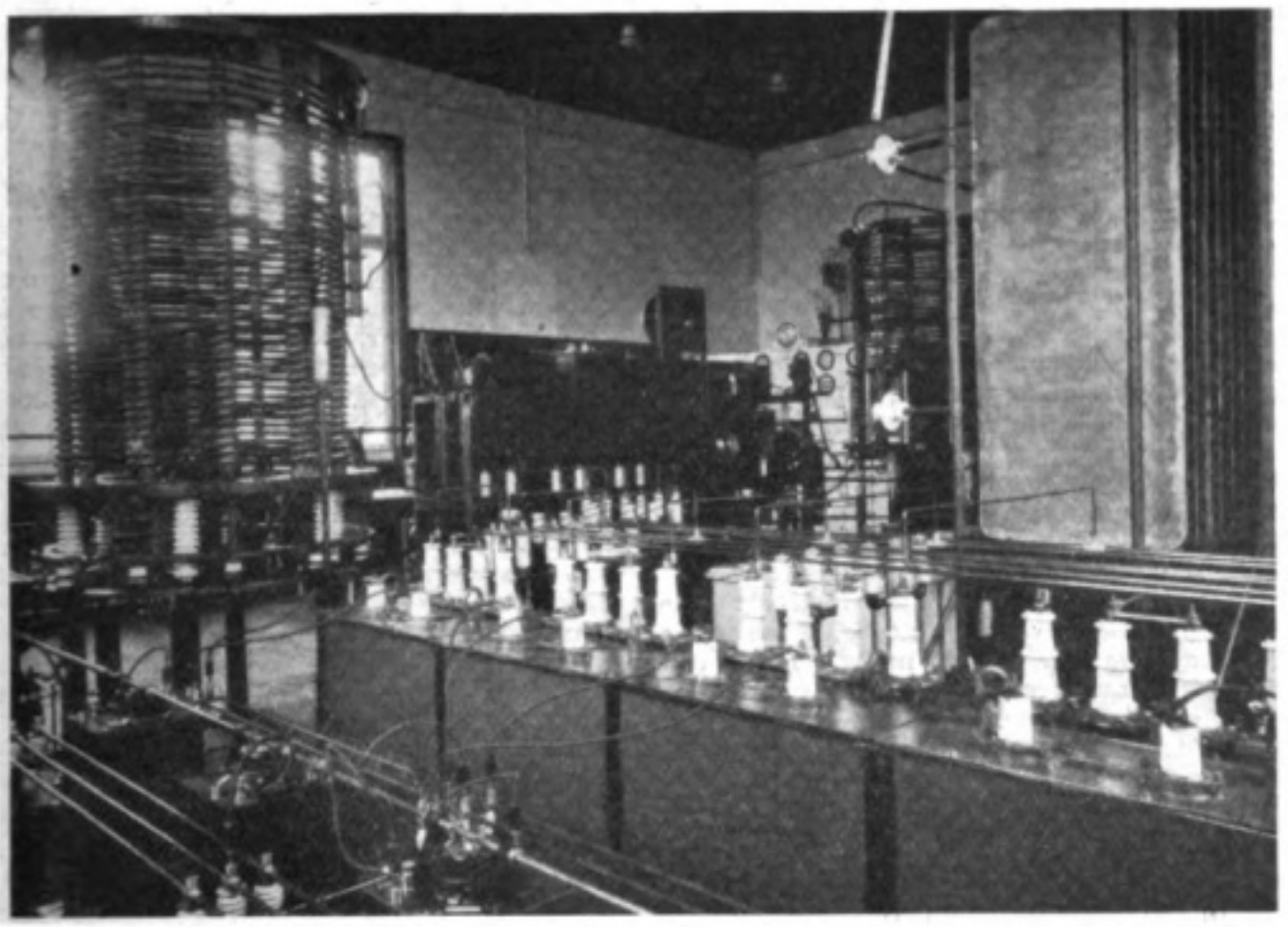


*Fig. 9. Another View in the Transmitting Room, showing High-tension Transformers, L.F. Chokes, and on the right the Main Air Condenser.*

principal towns in Switzerland and also Milan. Control of the transmitting station is arranged for both hand and high speed working. The high speed apparatus consists of three Gell automatic perforators for punching up the Wheatstone slip and two Creed Wheatstone transmitters, capable of working up to 150 w.p.m. The high speed received signals are passed on from the receiving station over ordinary land lines, and the signals are recorded on Marconi undulators, which are capable of speeds up to 120 w.p.m. For normal hand speed working the received signals operate a P.O. type sounder, but provision is also made for receiving by the ordinary method of aural reception by telephones, during bad receiving conditions or when receiving from stations, the transmission from which is not steady enough for automatic recording or which are not equipped for working at high speed. All instruments and circuits are in duplicate so that in case of breakdown or the necessity to make any adjustment, this can be done without interrupting the service. The necessary current required for the land line circuits is provided from the Berne Post Office central battery.

Figs. 8 and 9 are general views of the transmitting room.

## LIST OF EXPERIMENTAL STATIONS LICENSED IN THE UNITED KINGDOM.

Will holders of Experimental Transmitting Licences kindly notify the Editor of any changes that may be desired in the particulars of their stations published in the last issue. It is intended to reprint this list for handy reference, and amendments and additions must be received not later than the 15th July next.

# Increasing the Traffic Carrying Capacity of a Radio Station.

THE output of a large wireless station from a commercial point of view is reckoned, not in electrical units, such as kilowatts, or kilowatt-hours, but in the number of words of traffic that it can effectively handle per hour, which quantity determines the earning capacity of the station. In ordinary practice this commercial output of a station is limited by many electrical considerations. It may be limited by the power expenditure in the transmitting plant, which may be sufficient to communicate over the desired range only during certain hours of the day, or it may be limited by the wavelength that it is necessary to employ in order to signal at all effectively over the desired range. In the latter case, if the wavelength is large, such as must necessarily be the case with high-power stations for communication over long distances, since a large aerial is required to absorb a large amount of energy, and a large aerial means a large capacity and consequently a long wavelength, the workable speed of transmission may be limited by the wavelength.

The use of a long wavelength means that the frequency of the oscillations in the aerial circuit must be comparatively low. Thus, for a wavelength of 20,000 metres, the oscillation frequency is only 15,000 per second, and if we want to signal at 120 words per minute, it means that the average "dot" signal lasts for not more than 1/300th of a second. Hence, during a single "dot" there cannot be more than 50 complete oscillations. In any oscillation circuit the current takes an appreciable time to build up to its final value after the application of the driving electromotive force, and in oscillation circuits employing resonance quite a considerable time—reckoned as number of cycles of E.M.F.—may elapse before the current approaches its maximum value. Hence, in the case of high-speed signalling at long wavelengths, there is not sufficient time for the currents to build up to their final steady values during the dot signals, and consequently either the effective signalling range of the station is reduced, or it must be operated at lower speeds of signalling.

In a recent communication to the French Academy of Sciences MM. Abraham and Planiol have outlined another method of reducing this difficulty. They have suggested that it is more profitable to operate the stations with "diplex" transmission, *i.e.*, with two simultaneous transmissions from the same transmitting aerials. Using the ordinary methods of working, this cannot be done without either duplication of a large part of the plant, with consequent increased capital cost for the station, or the sacrifice of a large proportion of the available power for radiation. Neither of these alternatives is attractive, and to avoid these difficulties it has been suggested that the emission of signalling energy from the transmitting aerials should be effected on any one of three alternative wavelengths, much as signalling is now often accomplished on two wavelengths—one for the "marking" signals and the other the "spacing" or "compensating" wave.

If now one of the transmitting keys is so arranged that when it is depressed it causes the radiation of a signal at a wavelength of $\lambda_1$, while the other likewise causes a signal to be sent out at a wavelength of $\lambda_2$, double transmission will be possible only so long as it is possible to ensure that only one of the keys is depressed at a time—a condition that is obviously not workable in practice. If now the circuits of the apparatus are so arranged that should both keys be depressed at the same time, the energy from the aerials is radiated, not at either of the above wavelengths, but at a new wavelength $\lambda_3$, the problem seems to be solved, as we have a characteristic radiation for each of the possible combinations of the positions of the two signalling keys.

To pick up such a transmission, each receiver must evidently be arranged so as to be equally responsive to two wavelengths simultaneously, *viz.*, $\lambda_1$ and $\lambda_3$, or $\lambda_2$ and $\lambda_3$, and not to be affected by the other transmission wavelength. This can be done comparatively easily by appropriate resonance and rejector circuits. Each receiver will then be enabled to hear its own transmission quite undisturbed by the other transmission which is going on at the same time from the same transmitting station.

Tests which have been carried out successfully between Nantes and Paris recently seem to show that the method is good in practice as well as on paper, and that in consequence it may soon find some practical application in commercial work. In addition to increasing the signalling capacity of the transmitting station, the method is also likely to add to the secrecy of the transmissions, since if the three wavelengths are not very close together, an ordinary type of radio receiver would be able to pick up one of the wavelengths only, and would consequently hear an unintelligible part only of one of the transmissions, or an equally unintelligible mixture of parts of the two. Should the three wavelengths be close enough together to affect an ordinary not specially selective receiver simultaneously, it would prove almost equally difficult to decipher the messages, since what would be heard would be a thorough mixture of the two sets of signals. With C.W. transmission this mixture would be heard by ordinary heterodyne methods as three different notes, one note conveying parts of the Morse signals of one of the transmissions, another note conveying parts of the other, and the third the remaining parts of the two mixed together—a combination which would appear to be not at all easy to unravel by ear.

As compared with the other methods, this one enables the full power of the transmitting apparatus to be employed all the time, so that not only is there no falling off in the signalling range of the station by its use, but the traffic-carrying capacity of the station would be approximately doubled.

P. R. C.

# The Addition of One Stage of H.F. Amplification to the Reinartz Tuner.

By G. G. BLAKE, M.I.E.E., A.Inst.P.

IN *The Wireless World and Radio Review* for May 13th last, Mr. Percy W. Harris wrote an article on the Reinartz Tuner. As this tuner makes use of combined capacity and magnetic reactance, I gave a short description of my own Reinartz set at the conclusion of Mr. Reeves' paper at the last meeting of the London Wireless Society, a report of which appears in *The Wireless World and Radio Review* for June 24th.

It is one of the most selective tuners with which I have experimented, and almost entirely prevents jamming. I have listened in amongst the shipping on an openly tuned set, and heard several ships jamming one another, and have then changed over to the Reinartz Tuner and been able to separate them quite easily and hear the signals from any one of them without the least interference.

Against this advantage of great selectivity, and the fact that it reduces atmospheric interference to a minimum, this set reduces the signal strength to about two-thirds of its original value, so that although it is excellent for receiving loud signals or telephony from a powerful broadcasting station, it is of little use in picking up the weak telephony from amateur stations.

To overcome this defect I have added one stage of H.F. amplification which has very greatly increased the strength of weak signals and telephony.

The following are the connections employed:

Fig. 1 shows the ordinary single valve connections for a Reinartz Tuner. As this has already been fully described in the two issues of *The Wireless World and Radio Review* above mentioned, the diagram needs no further explanation. It will be remembered that the grid inductance G, aerial inductance A, and magnetic reactance R, are all wound on one former (and in the same direction).

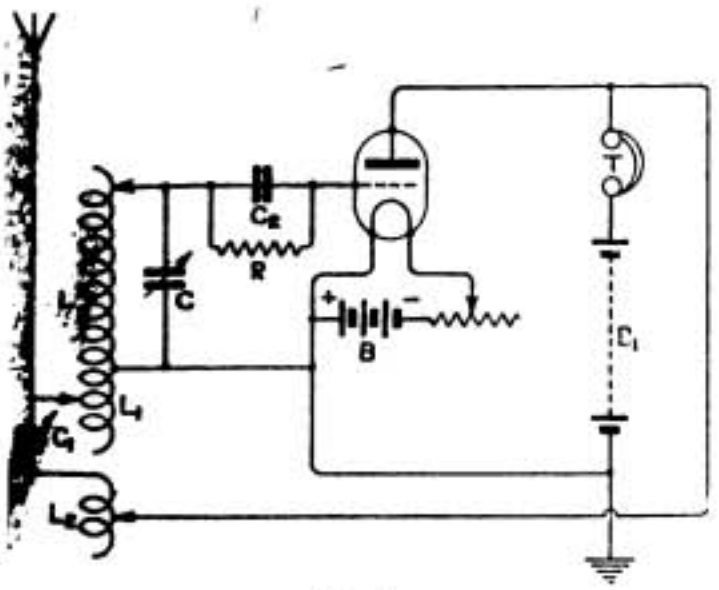



*Fig. 1.*

Fig. 2 shows the addition of one stage of H.F. amplification.

This set is intended for the reception of telephony from the broadcasting stations, and amateur short wave transmissions; its range is therefore anything from just below 180 metres up to 650 metres, and the number of tappings on the inductance is reduced

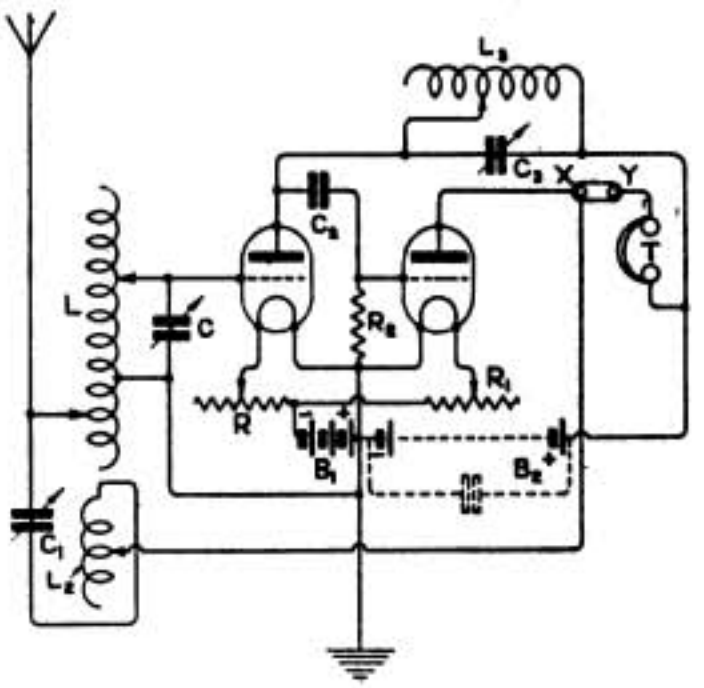



*Fig. 2.*

to a minimum. All are wound with No. 22 double cotton-covered wire on a 3 in. former. The grid inductance G has three tappings, one 20 turns from the point where the earth wire is attached to the inductance, one at the 35th turn, and the last one which is the end of the inductance is 50 turns from the earth.

The portion of the inductance below the earth terminal marked A on the diagram is shown with an adjustable connection to the aerial L. I find, however, in practice that a fixed 10 turns serves every purpose, as the aerial circuit functions aperiodically.

Now, with regard to the magnetic component of the reactance circuit. In order to conform strictly to the Reinartz plan, R should be wound on the same former as G and A, except that owing to the addition of the second valve, the direction of its winding must be reversed. I have tried it wound in this way with a fixed 40 turns and obtained quite good results; but I have found it decidedly better to wind it on a separate former a little smaller in diameter than that used for the inductance, and fix it permanently just inside the aerial portion of the inductance. The best position which will suit all wavelengths is arrived at after the set has been assembled by setting the variable reactance

condenser C′, which should have a capacity of at least 0·001 M.F. at the midway point on its scale, and then introducing the reactance coil until reaction just occurs. After this reactance is regulated entirely by altering the capacity of C′.

The other components of the set are, variable condenser C, grid condenser $C_2$, with grid leak K, filament battery B (6 volts), H.T. battery B1 (60 to 75 volts),* 2 separate filament resistances, F and $F_1$, and pair of high resistance telephones T.

High frequency amplification is obtained by means of auto-transformer coupling. It will be seen that the plate circuit of the first valve contains an inductance H, tuned by variable condenser $C_3$ (capacity 0·001).

The inductance H is wound with 36 turns of double cotton-covered copper wire 16 gauge on a 3 in. former, it is shown adjustable on the diagram, but in practice a fixed coil of 36 turns will cover the entire range of wavelengths for which this tuner is intended. This inductance H should be arranged at right angles to the grid inductance and as far as possible from it to avoid induction effects. Two terminals X and Y are shorted by a copper connector, and when it is desired to use the set in conjunction with a note magnifer, the connector is removed and X and Y are connected to the terminals of the input transformer of the note magnifier.

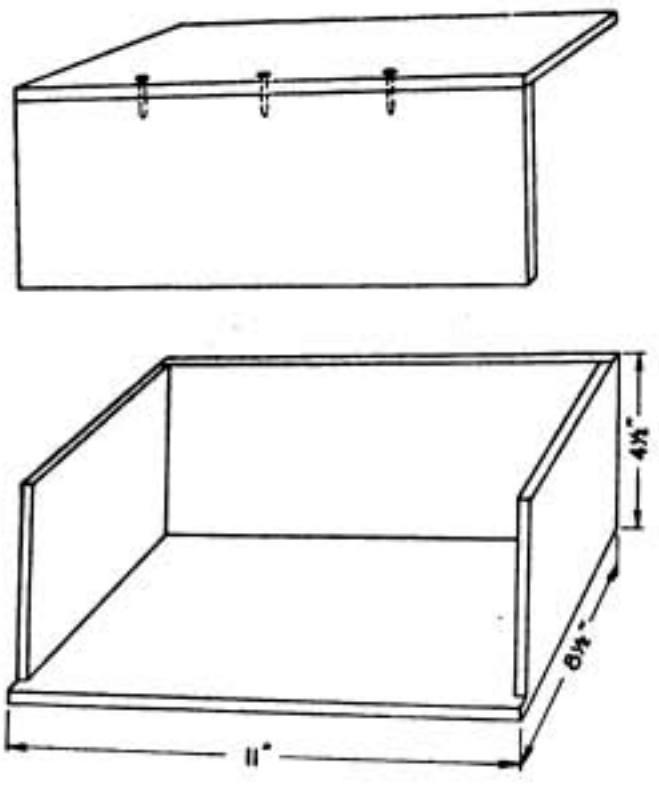



*Fig.* 3.

It will be noted that the high resistance telephones are left connected in order that they may act as an impedance. E in the diagram represents the earth terminal which is connected to the bottom of the grid inductance, between the positive of the L.T. and the negative of the H.T. batteries, also to the side of each of the valve filaments remote from the filament resistances.

The simplest method of tuning in a station is to buzz a wavemeter to approximately the required wavelength, and having set the reactance $C_1$ just over half in, tune C and $C_3$ simultaneously until the buzzer is most loudly heard in the telephones. It will be found that there is only one very sharp point on the scales of each condenser for each wavelength.

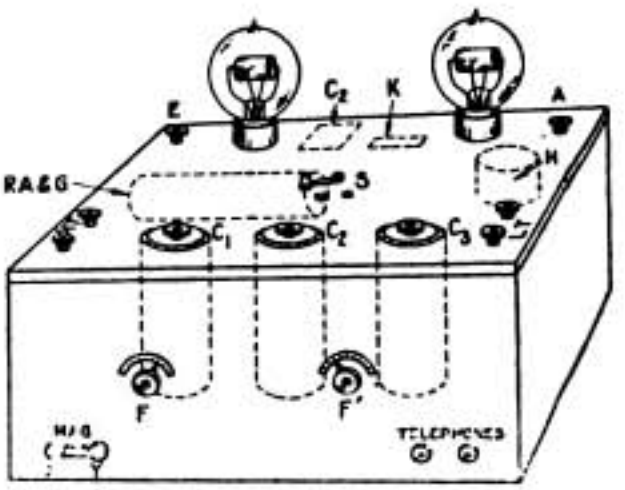



*Fig.* 4.

The signals are then brought up to the loudest possible value by varying the capacity of the reactance condenser C′.

Having tuned in the wavemeter its buzzer is stopped, and a very little further variation of C and $C_2$ brings in the signals from the distant station.

Of course if no wavemeter is at hand its use may be dispensed with; but it then becomes a rather difficult matter, as the tuning is so exceedingly sharp.

The following constructional details may be of use to those readers who intend to make up a set.

Fig. 3 shows the dimensions of a suitable wooden case in which to mount the set. 11 in. by 8½ in. by 4½ in. (outside measurements).

The top and front are made of sheet ebonite and screwed together as indicated in Fig. 4, and the whole of the set being attached to these, comes away intact from the rest of the box, should repairs be necessary at any time.

Fig. 4. shows the whole set assembled. The dotted lines indicate how the various components are arranged below the ebonite top. R, A, and G represent the reactance, aerial and grid inductances, $C_2$ is the grid condenser, K the grid leak; all the other parts are lettered to correspond with the diagram.

The arm of switch S is connected to the grid of the first valve and condenser $C_2$, and is employed to connect up to one or other of the three grid inductance tappings. It should also be noted that H is placed at right angles to R, A, and G, and at as great a distance from it as possible.

* It is just as well to put a fairly large condenser across the H.T. Battery to serve the double purpose of smoothing out any slight irregularities in the output of the H.T. current and as a by-pass for high frequency oscillations. Quite good results, however, can be obtained without it.

# The Reinartz Transmitter*

THE originator of the "Reinartz Tuner" for the reception of C.W. telegraph signals, has now produced a transmitter at his station that makes use of much the same principles as the receiver, and is quite as novel.

His set is a panel using four U.V.202 "Radiotrons," with 700 volts of rectified but unfiltered A.C. on the anodes, antenna currents up to 3½ amperes being obtained. Photographs with this article show front and rear views of the panel, about which there is nothing particularly unusual except the two spider-web coils, one at either end of the main inductance.

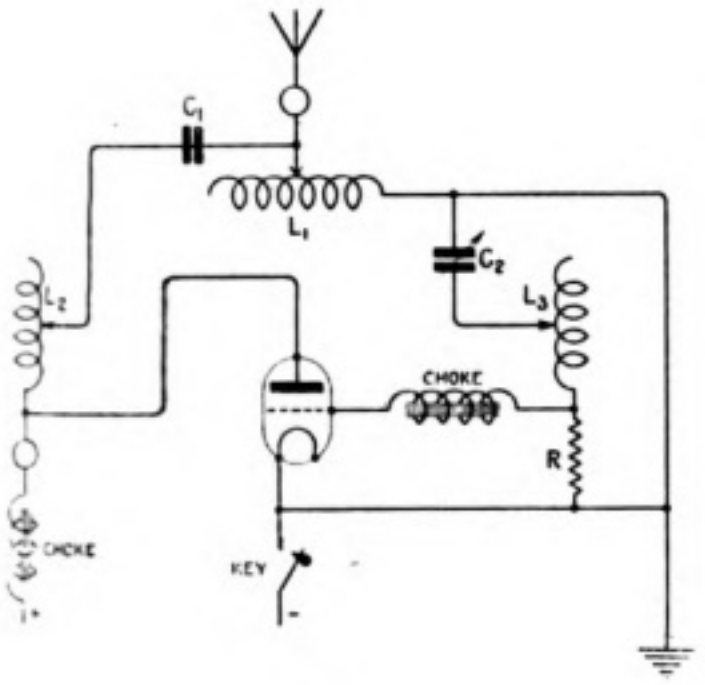
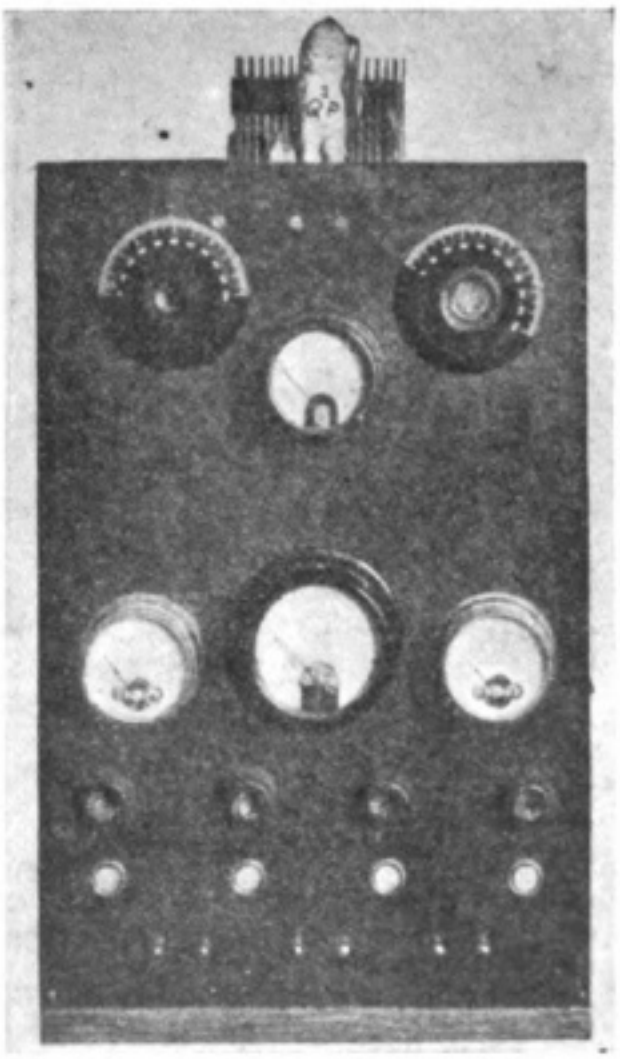



*Fig.* 1.

The wiring diagram is shown in Fig. 1. $L_1$, the main tuning inductance, is a helix of 8 ins. by ½ in. edgewise-wound copper strip. $L_2$ and $L_3$ are the spider-webs, respectively in the plate and grid circuits, both wound of No. 24 D.C.C. wire on 2½ in. centres. $L_3$ has a total of 75 turns, tapped every 15 turns, while $L_2$ has ten taps of 5 turns each. $C_1$ is a fixed mica condenser, high-voltage type, capacity 0·002 mfd. or thereabouts, while $C_2$, the grid condenser, is an air variable of 7 plates widely spaced to stand the voltage, built up from a 13 plate of ordinary construction, with movable plates to ground. $C_2$ is operated at very low values of capacity but must be variable. The grid leak R has a resistance of 10,000 ohms and the same value is used for any number of tubes from one to four, correction apparently being got by adjusting the value of C.

It will be remembered that in the Reinartz receiving tuner the aerial circuit is untuned and shocks the tuned secondary circuit into oscillation at the latter's period, reducing tuning to one control. (Because of the loose coupling afforded by the fact that the aerial circuit consists of but a turn or two of the coil, the tuning is much sharper than in the usual single-circuit tuner.) Rather naturally, the transmitter observes the reverse of the receiver performance—over a considerable band of wavelengths the grid and plate circuits operate aperiodically and the radiated wavelength is determined solely by the position of the antenna clip on $L_1$. Thus a wavelength of 174 metres is produced when but one turn of aerial inductance is used, climbing to 212 when 6 turns are used, and the antenna current remains constant regardless of the shortness of wave.

It is a little puzzling to trace out the theory of the thing from Fig. 1, so let us turn to "A" in Fig. 2, which shows the same thing. Immediately we recognise the circuit of the Reinartz receiving tuner, except that the location of the grid condenser has been changed. Compare this with "B," which is the popular circuit giving such excellent results in many amateur stations. $L_1$ and $L_3$ are the same and the only difference is that where "B" uses the unused turns of the main helix for the inductance $L_2$, circuit "A" uses a separate



*The Reinartz Transmitter (Front View).*

* Extracted from "*QST*," June 1922.

winding $L_2$. It is quite permissible to have this inductance separate; it is a reactance for the adjustment of the output impedance of the tube and does not even have to be coupled to $L_1$. In fact in the Reinartz set neither $L_2$ nor $L_3$ need to be coupled to the main helix and are placed at the ends of the winding merely because it was convenient structurally to arrange them there. When so coupled, however, the polarity is important of course—in one direction only do they work well. Fig. 1 shows no coupling between them.

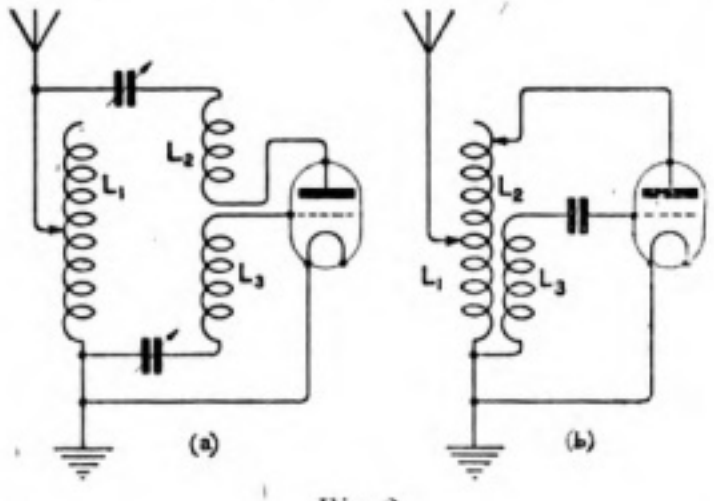
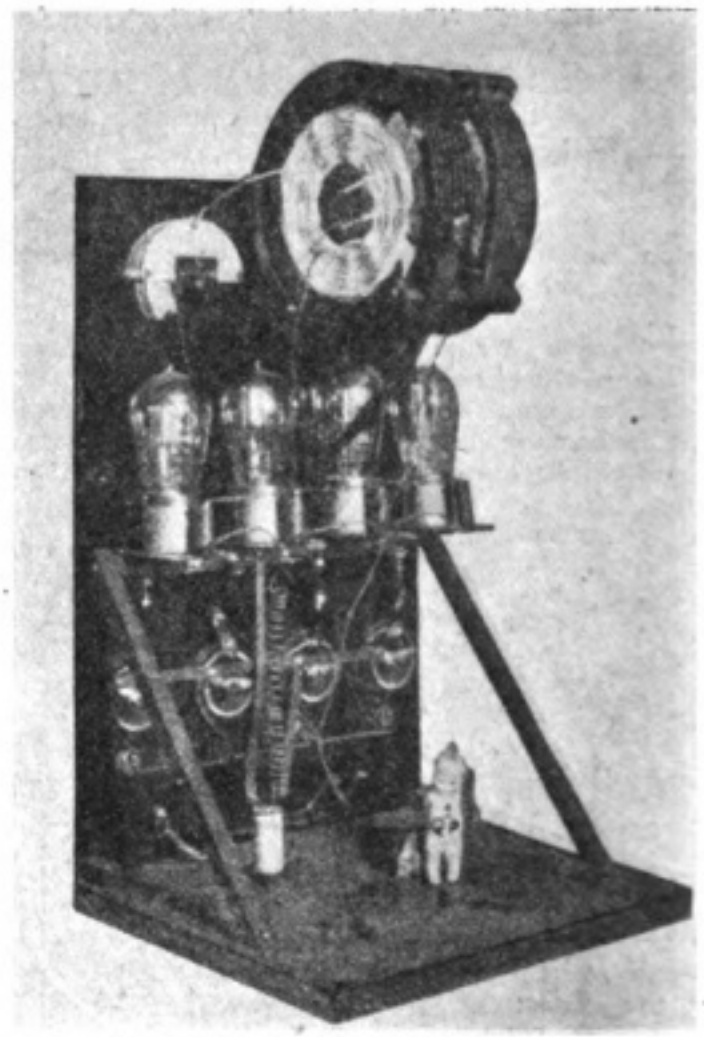



*Fig. 2.*

The set is easy to adjust. The antenna clip determines the wavelength. Grid circuit $C_2$ $L_3$ must be set approximately right by selecting the proper tap on $L_3$ and getting final adjustment by securing the best value of $C_2$. As in any such circuit, preliminary adjustments are made using all of the inductance of $L_2$ gradually cutting it down as the efficiency is improved. If the anode voltage is variable it too should be reduced while first adjustments are being made. As the adjustments proceed increased efficiency will be apparent mainly by a reduction of the input to the tube—a reduction that drops it below the normal safe rating—whereupon the voltage is increased to bring the input up to normal, the output increasing proportionately, with about the same efficiency as before.



*The Reinartz Transmitter (back view).*

# A Method of Increasing the Life of a Valve.

By W. M. BUCHANAN, JR.

ECONOMICS, the subject perplexing the political world of the present day, can be applied to the wireless amateur with reference to his valves, not that it will save him from buying one, but rather that the valve, when once purchased, may live a little longer than is usual.

In this article I will attempt to explain a weakness which has come under my notice and propose a method of reducing this disadvantage to a minimum. The weakest part of the valve (needless to say) is the filament, and to this part I will confine my arguments.

In any text-book on the valve it will be stated that if a heated filament comes under the influence of a *positively* charged body such as the plate of a valve, electrons will be emitted from the filament to this body, as in Fig. 1a, but in the case of Fig. 1b where the plate is *negatively* charged, no emission will take place. It is therefore obvious (and will be found if the above experiment be carried out using a milliammeter in the plate circuit for determination of emission current), that the electrons emitted from the filament are negatively charged. Since the filament generates negative electrons (or rather that the plate attracts only these negative electrons), it is evident that the greatest number of electrons will be emitted from the negative end. This means that the negative end having the largest strain will ultimately break down leaving the remaining part of the filament in good condition.

The method I had in view was not exactly to minimise this effect, but rather to balance it by altering the polarity of the filament at will, by means of a change-over switch as shown in Fig. 2, and working the valve off both sides alternatively for equal periods of time.

The above method will naturally increase the life of a valve, and I leave it to the reader as to whether he thinks it more economical to use perhaps two valves in place of one with the addition of a double pole change-over switch.

# Practical Notes on Building a Long-Wave Heterodyne

By PERCY W. HARRIS.

THE many advantages to be obtained by the use of a separate heterodyne can only be appreciated by those who have worked with these instruments. In particular, of course, the radiation from receiving aerials—inevitable with simple autodyne circuits—is cut down to a negligible point, and tuning and strength of signals are both improved. In conjunction with reaction* a separate heterodyne will enable the strength of signals from long-wave stations to be increased to a remarkable degree.

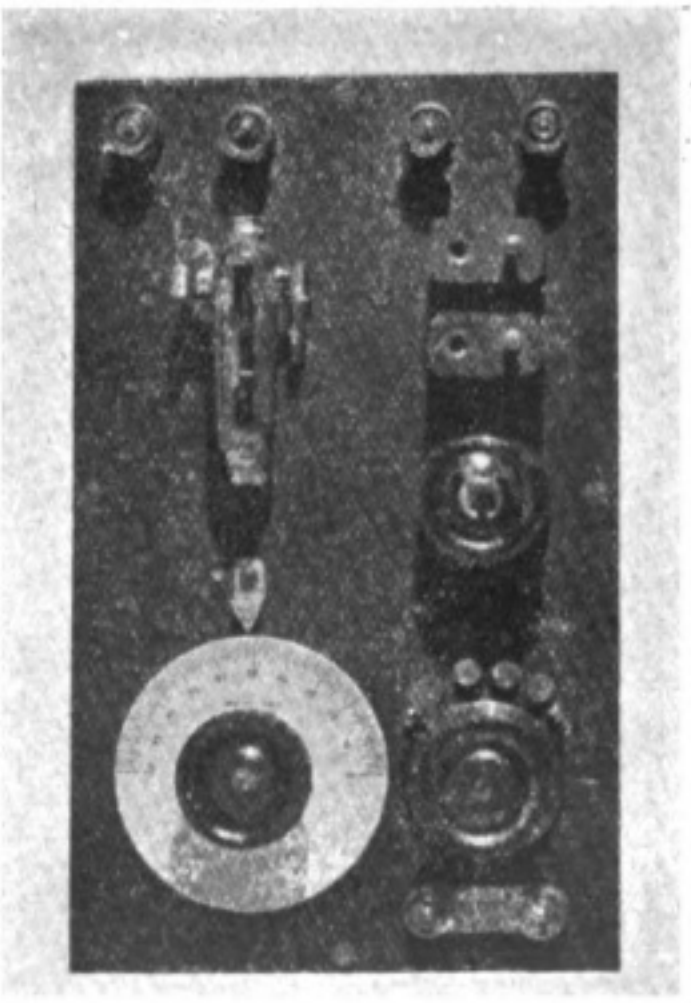
*The finished instrument with 2 coils in place.*

The excellent articles by Mr. Philip R. Coursey in *The Wireless World and Radio Review*† contained particulars of, and designs for, some very useful heterodynes. It occurred to the writer that the less experienced readers might like particulars and constructional details of one such instrument, constructed strictly on the lines laid down in the articles, and used with great success for long-wave reception.

The design chosen was that described in the issues of May 6th and 13th, using two coils, a variable condenser and three additional fixed condensers, with a V24 valve. The finished instrument is illustrated in the first photograph, which shows the two coils in place.

The box was made from ⅜ walnut, purchased from a dealer in fretwork materials. This wood looks well, and takes a good finish. The top is of ⅜ ebonite, the original skin being removed with fine emery. A view of the top is given in the second illustration. The terminals are the well-known Mark Three type, a ring of black and red paint being made on the negative and positive terminals respectively. The on-and-off switch was purchased from a dealer in motor-car fittings, and the switch below it is taken from an old Mark Three tuner, on which it was used for secondary tappings.

The plugs are "Burndept," with the curved portions sawn off. (This is not a very simple task, and needs care.) The condenser is of the well-known army pattern, value 0·0015 mfd., with a white 100 degree dial and the standard ebonite knob



*A top view of the long-wave heterodyne.*

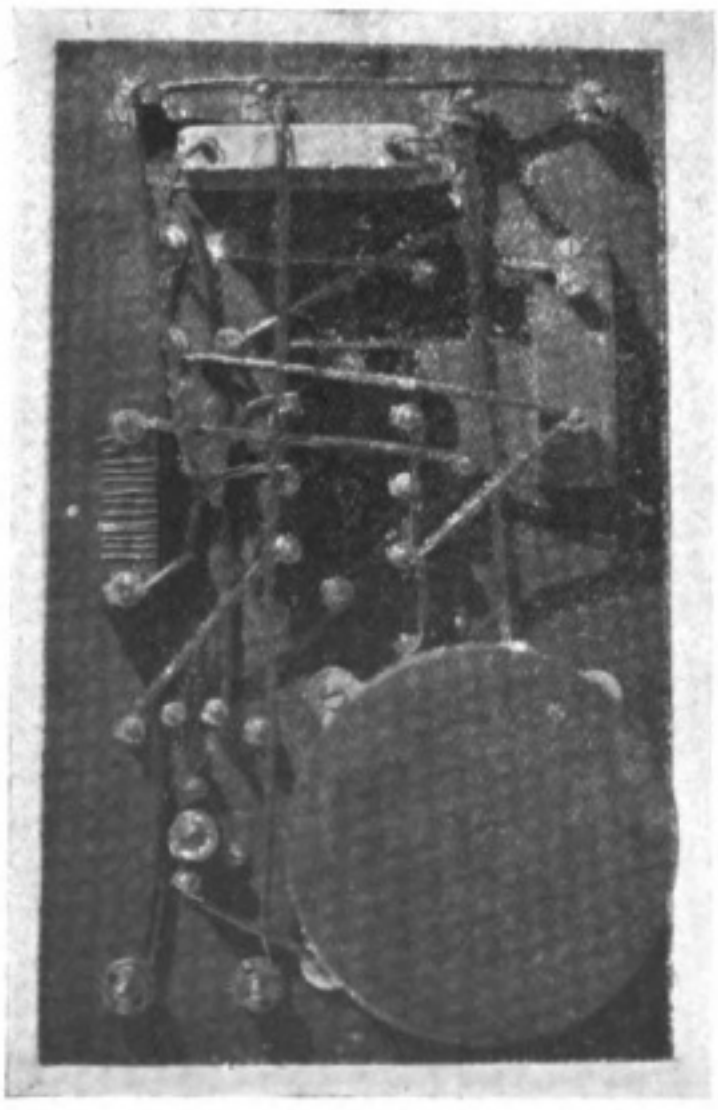
* *The Wireless World*, February 4th, p. 696.

† *The Wireless World and Radio Review* of May 6th, *et seq.*

substituted for the better-known graduated dial usually fitted. The white dial is the more pleasant to use, and the 100 degree scale is, in the writer's opinion, much better than the conventional 180 degrees dial. On this latter each division stands for *two* degrees of the scale, so that there are only 90 markings. Experience shows that in quick work the first division after a marked figure is often taken as *one* more than the marking (*e.g.*, one degree after twenty is often counted as twenty-one, whereas it is really twenty-two). With the hundred-degree scale with a hundred markings this cannot give rise to any misunderstanding, and, in addition, one has the advantage of a little finer graduation.

Valve clips were purchased ready made, and fitted with 6 BA screws and nuts. The condenser pointer was cut from strip brass and similarly fixed.

The third photograph shows the underside of the panel with the wiring, all of which is covered with "Sistoflex" insulation. The fixed condenser at the top is a Dubilier. The grid leak is the pencil-mark type (on the right), and the filament resistance was made from one ohm of eureka wire wound on a strip of ebonite held away from the panel by two small pieces of the same material beneath the securing screws (on the left).



*The underside of the panel showing the wiring.*

The three fixed mica condensers were first of all secured side by side by their lugs to a strip of ebonite, about $1\frac{1}{2}$ by $2\frac{1}{2}$ ins., the screws securing them passing through the ebonite and terminating in locknuts. The strip was then secured to the underside of the panel, the condensers upwards and the projecting screws downwards. This fitting is seen in the centre of the underside of the panel.

Examination of the illustration will show the six terminals of these condensers in two rows. The three on the right are joined to a common wire which is taken to one terminal of the variable condenser. The three on the left are taken to their respective studs on the four-stud switch, the arm of which is connected (by a lead which passes round the underside of the case) to the other variable condenser terminal.

The measurements given by Mr. Coursey for the placing of the plug sockets are correct for Burndept coils, but are rather too close together for Igranic coils, which are wider than the Burndept. Users of the Igranic pattern should therefore allow another $\frac{1}{4}$ in. separation.

The writer takes this opportunity of confirming Mr. Clinker's observations on the use of reaction with a separate heterodyne. His article understates, if anything, the strength of signal obtainable.


*Memorial Tablet recently unveiled at Marconi House to the Memory of those who gave their lives in the War.*

# Oscillations in Three Coupled Electric Circuits.*

By S. P. OWEN, M. Sc., A. Inst. P.

A GENERAL solution containing arbitrary constants was given by Jackson (*Philosophical Magazine* 42, Sixth Series, p. 35). Apart from his work and that of Bellini, the attention given to the problem has been very scanty.

Owing to its increasing importance in Wireless Telegraphy, the present paper is written with the purpose of obtaining a general solution in terms of the general initial conditions. A solution in this form does away with the necessity of solving for the values of the arbitrary constants, a process which usually involves a large amount of analysis.

(a) Writing the equations of motion in the form

$$\left.\begin{aligned} e_1 + R_1C_1\frac{de_1}{dt} + L_1C_1\frac{d^2e_1}{dt^2} + M_{12}C_1\frac{d^2e_2}{dt^2} + M_{13}C_1\frac{d^2e_3}{dt^2} &= 0 \\ e_2 + R_2C_2\frac{de_2}{dt} + L_2C_2\frac{d^2e_2}{dt^2} + M_{22}C_2\frac{d^2e_2}{dt^2} + M_{21}C_2\frac{d^2e_1}{dt^2} &= 0 \\ e_3 + R_3C_3\frac{de_3}{dt} + L_3C_3\frac{d^2e_3}{dt^2} + M_{31}C_3\frac{d^2e_1}{dt^2} + M_{32}C_3\frac{d^2e_2}{dt^2} &= 0 \end{aligned}\right\} \quad \ldots\ldots (1)$$

where $e_1$ $R_1$ $C_1$ $L$ and $M$ represent the charge on the condenser at time $t$, resistance, capacity, self-inductance and mutual inductance respectively, the circuits being distinguished by the suffixes 1, 2, 3, the solutions may be written in the form†

$$e_1 = \frac{1}{2\pi j}\int \xi\, \epsilon^{\alpha t} d\alpha \qquad e_2 = \frac{1}{2\pi j}\int \eta\, \epsilon^{\alpha t} d\alpha \qquad e_3 = \frac{1}{2\pi j}\int \zeta\, \epsilon^{\alpha t} d\alpha \qquad (j = \sqrt{-1})$$

where $\xi$, $\eta$, $\zeta$ are functions of $\alpha$ to be determined, and the integrals taken over a table contour in the $x$ plane, so as to contain all the poles of the functions $\xi$, $\eta$, $\zeta$.

Substituting these integrals in the equations (1).

$$\left.\begin{aligned} \xi(1 + R_1C_1\alpha + L_1C_1\alpha^2) + \eta M_{12}C_1\alpha^2 + \zeta M_{13}C_1\alpha^2 &= p \\ \xi M_{21}C_2\alpha^2 + \eta(1 + R_2C_2\alpha + L_2C_2\alpha) + \zeta C_2M_{23}\alpha^2 &= q \\ \xi M_{31}C_3\alpha^2 + \eta M_{32}C_3\alpha^2 + \zeta(1 + R_3C_3\alpha + L_3C_3\alpha) &= r \end{aligned}\right\} \quad \ldots\ldots (2)$$

where $p$, $q$ and $r$ are determined by putting

$$\xi = \frac{e_{10}}{\alpha} - \frac{i_{10}}{\alpha^2} \qquad \eta = \frac{e_{20}}{\alpha} - \frac{i_{20}}{\alpha^2} \qquad \zeta = \frac{e_{30}}{\alpha} - \frac{i_{30}}{\alpha^2}$$

in the left-hand side of equations (2), and rejecting all negative powers of $\alpha$ (Bromwich, *loc. cit.* p. 404).

The added suffix 0 denotes the initial values of the charges and currents respectively.

Clearly we have

$$p = (R_1C_1 + L_1C_1\alpha)e_{10} - L_1C_1i_{10} - M_{12}C_1i_{20} - M_{13}C_1i_{30}$$

and similar values for $q$ and $r$.

Writing the equations (2) in the form

$$\begin{aligned} a_1\xi + b_1\eta + c_1\zeta - p &= 0 \\ a_2\xi + b_2\eta + c_2\zeta - q &= 0 \\ a_3\xi + b_3\eta + c_3\zeta - r &= 0 \end{aligned}$$

we have

$$\frac{\xi}{\begin{vmatrix} b_1 & c_1 & -p \\ b_2 & c_2 & -q \\ b_3 & c_3 & -r \end{vmatrix}} = \frac{-\eta}{\begin{vmatrix} a_1 & c_1 & -p \\ a_2 & c_2 & -q \\ a_3 & c_3 & -r \end{vmatrix}} = \frac{\zeta}{\begin{vmatrix} a_1 & b_1 & -p \\ a_2 & b_2 & -q \\ a_3 & b_3 & -r \end{vmatrix}} = \frac{-1}{\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}}$$

$$\text{or } \frac{\xi}{f_1(\alpha)} = \frac{-\eta}{f_2(\alpha)} = \frac{\zeta}{f_3(\alpha)} = \frac{-1}{F(\alpha)}$$

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* Received

† Bromwich, *Proceedings of the London Mathematical Society*, 15, p. 401, 1916.

Then

$$e_1 = -\frac{1}{2\pi j}\int \frac{f_1(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha \qquad e_2 = \frac{1}{2\pi j}\int \frac{f_2(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha \qquad e_3 = -\frac{1}{2\pi j}\int \frac{f_3(\alpha)}{F(\alpha)}\epsilon^{\alpha t}d\alpha.$$

Choosing a suitable contour enclosing all the zeros of $F(\alpha) = 0$ we have by Cauchy's Theorem—

$$e_1 = -\Sigma_1 \frac{f_1(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t} \qquad e_2 = \Sigma \frac{f_2(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t} \qquad e_3 = -\Sigma_1 \frac{f_3(\alpha_n)}{F'(\alpha_n)}\epsilon^{\alpha_n t}$$

where $\alpha_n$ is the $n^{th}$ root of $F(\alpha) = 0$, the summation taking place over all the roots and $F'(\alpha) = \frac{dF(\alpha)}{d\alpha}$.

The equation $F(\alpha) = 0$, i.e.,

$$\begin{vmatrix} 1 + R_1C_1\alpha + L_1C_1\alpha^2, & M_{12}C_1\alpha^2, & M_{13}C_1\alpha^2 \\ M_{21}C_2\alpha^2, & 1 + R_2C_2\alpha + L_2C_2\alpha^2, & M_{23}C_2\alpha^2 \\ M_{31}C_3\alpha^2, & M_{32}C_3\alpha^2, & 1 + R_3C_3\alpha + L_3C_3\alpha^2 \end{vmatrix} = 0$$

is clearly of the sixth degree and the numerical values of the coefficients are such, in practice, that it has roots of the form $-p \pm j\omega_1$, $-q \pm j\omega_2$, $-r \pm j\omega_3$. From this it follows that the charge and current in each circuit consist of three damped oscillations, the periods of the oscillations being the same in each circuit, differing only in amplitude.

A general solution of $F(\alpha) = 0$ is difficult to obtain. If the numerical values of the coefficients are known, graphical methods may be employed.

(b) The above solution may be verified by taking the simple case where the circuits are completely separated and the initial conditions

$$e_{10} = C_1V_0. \qquad e_{20} = e_{30} = i_{10} = i_{20} = i_{30} = 0.$$

Also it will be assumed that the resistances $R_1$ $R_2$ $R_3$ are negligible.

Since $M_{12} = M_{13} = M_{23} = 0$

then $p = C_1V_0L_1C_1\alpha$ where $V_0$ is the potential initially

$$q = 0$$
$$r = 0$$
$$f_1(\alpha) = -C_1^2V_0L_1\alpha(1 + L_2C_2\alpha^2)(1 + L_3C_3\alpha^2)$$
$$f_2(\alpha) = f_3(\alpha) = 0$$
$$F(\alpha) = (1 + L_1C_1\alpha^2)(1 + L_2C_2\alpha^2)(1 + L_3C_3\alpha^2)$$
$$\therefore e_1 = \frac{1}{2\pi j}\int \frac{C_1^2V_0L_1\alpha}{1 + L_1C_1\alpha^2}\epsilon^{\alpha t}d\alpha.$$
$$e_2 = e_3 = 0.$$

Roots of $1 + L_1C_1\alpha^2 = 0$ are $\alpha = \pm \frac{j}{\sqrt{LC}}$.

$$F'(\alpha) = 2\alpha L_1C_1$$
$$\therefore e_1 = \tfrac{1}{2}C_1V_0\int \epsilon^{j(t/\sqrt{L_1C_1})} + \epsilon^{-j(t/\sqrt{L_1C_1})}$$
$$= C_1V_0\cos\left(\frac{t}{\sqrt{L_1C_1}}\right)$$

which is the result obtained by solving the equation $L_1C_1\frac{d^2e}{dt^2} + e = 0$ with the initial condition $e_0 = C_1V_0$.

ROYAL GRAMMAR SCHOOL,
NEWCASTLE-ON-TYNE.

*April 8th, 1922.*

# How to Get the Best from Your Set

## HINTS ON THE MAINTENANCE OF RECEIVING APPARATUS

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

### IV.—THE SELECTION AND CARE OF ACCUMULATORS.—(*Continued.*)

WHEN cells are purchased new, they are dry and need acid to be added to them. The composition and purity of this acid solution is of the utmost importance, and the beginner is well advised to purchase the ready made-up solution from a reputable firm. The more experienced man can prepare it by adding pure sulphuric acid to distilled water, following the makers' instructions as to specific gravity of the resultant liquid. Generally, and unless the user is experienced, the cell should be taken new to a firm who will undertake the first charge, as this is always lengthy. It will then be returned fully charged and filled with acid at the correct specific gravity for the particular cell.

Every accumulator user should provide himself with two instruments—a voltmeter and a hydrometer. The first should read to eight or ten volts at the most (otherwise the scale will be too compressed for accurate reading) and should be of good make. Any cheap voltmeter will not do, as an error of half a volt either way may lead to serious consequences in using accumulators. Battery-testing voltmeters are listed by every dealer of repute.

Improperly used, a voltmeter may give very misleading indications of the condition of an accumulator. When fully charged, each cell should give very slightly over two volts. The voltage soon drops to two and remains at this figure until nearly all the useful charge is dissipated. Towards the end of the discharge period, the voltage begins to fall rapidly, and in no circumstances should the cell be discharged below 1·8 volts, *the reading being taken whilst the battery is passing current through the circuit for which it is normally used.* It is necessary to emphasise this point, as a cell which has been discharged below the safe limit can, after standing disconnected for a short period, give a reading of about two volts provided it is not in circuit. It will be clear from the explanation given above that the fact that a cell shows two volts is no indication whatever that it is fully charged, even if the reading is taken during discharge. The two-volt reading is simply an indication that the cell has not yet been discharged to the safe limit.

The second instrument mentioned as a necessary part of the accumulator user's equipment is the hydrometer. This is a device for showing the specific gravity of the acid, which itself indicates far better than anything else the condition of the cell. When fully charged (and of course provided the correct acid has been used in the first place) the specific gravity (S.G. for short) should be about ·2 in each cell, and as the charge is withdrawn the S.G. steadily falls until at the safe limit of discharge it is about 1·185. Precise figures cannot be given here, as different makes of cell have different figures. Practically every maker marks the cells with the correct S.G. figures for charge and discharge.

If, then, we take a reading of the S.G. of the acid in a cell, we shall be able to learn whether the cell is fully charged, discharged to the safe limit, or of what amount of charge is still available.

When cells are nearing the completion of their charge, a fine spray is emitted from the surface of the acid, due to the bursting of innumerable bubbles of gas. The gas is inflammable and should therefore be kept away from an open flame, and the acid spray is very corrosive. After a time the level of the acid may sink from evaporation of the water, and should be brought up to the original point (just above the plates) by the addition of distilled water. The correct S.G. will in this way be maintained, as the evaporation of the water concentrates the acid. If further *acid* were added, the S.G. would be too high.

On no account should tap water be used for "topping" cells, as the mineral salts contained in the water are highly injurious to the plates. Distilled water only is permissible.

All terminals should be kept covered with a thin coating of non-corrosive vaseline, to prevent bad effects from the acid spray and from "creeping." It should be unnecessary to point out that furniture and carpets are not improved by accumulator acid, and if cells are used in living-rooms, adequate precautions should be taken.

There are several types of hydrometer on the market for accumulator testing. Perhaps the most generally useful for the amateur is the type consisting of a glass tube fitted with a rubber bulb with which the acid can be drawn up into the tube. Inside the tube are three glass beads of different colours. When the S.G. is highest all three beads float, and when it is lowest none will rise. At an intermediate value two out of the three will float. In this way a good general idea of the state of the acid is obtainable.

For general valve work a six-volt battery should be purchased, as although a four-volt battery will suit many valves, this voltage leaves little to spare for adjustment through a rheostat. A good size for a three-valve set is a 40 ampere hour (actual). For a two or one-valve set the battery can be proportionately smaller, although a larger battery will of course last longer without charging.

EDISON ACCUMULATORS.

A type of accumulator which has been used for wireless purposes abroad a great deal, and to a small extent in this country, is the Edison, which differs radically from the type of cell we have been describing. In the Edison the positive plates consist of a series of perforated nickel-steel tubes, containing many layers of tightly rammed nickel oxide and pure nickel in flakes. The negative elements are also of steel, with a number of pockets filled with iron oxide. Steel containers, ribbed for strength, are used throughout. The electrolyte is a 21 per cent. solution of potassium hydrate (caustic potash solution) with a certain amount of lithium hydrate added. The S.G. of this solution is 1·21, and this figure does not vary throughout charge and discharge. Evaporation is made up by adding distilled water only. The voltage per cell is low, averaging on discharge 1·2. The battery is usually discharged down to 1 volt per cell. The whole battery can be completely discharged and left in this condition for months without injury. Even short-circuiting does no harm.

# Experimental Station Design

(*Continued from page 393, June 24th, 1922.*)

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

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

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

## VII. A SIMPLE VALVE PANEL.

THE complete panel is shown in Figs. 1 and 2. Fig. 1 represents the top and Fig. 2 is a view of the under side when the instrument is turned over. Both drawings are exact full size.

One edge of the ¼ in. polished ebonite sheet must first be filed straight and true and at right-angles to the faces. As the piece of ebonite is 6 ins. wide it may not be possible to insert it far into the vice, and it will therefore be necessary to prevent vibration while filing. This can be done by clamping a piece of planed inch board on either side of the ebonite, leaving only ¼ in. projecting. One of the end edges must next be squared off in the same way as was described for the construction of the small wavemeter condenser, though it will be a little more difficult in this case owing to the increased dimensions. Measuring back along the trued edge from this end, mark off 5 ins. for the length of the panel and scratch a line across the face exactly at right angles to the edge. Saw off the spare portion and file true to the line. The width of the panel is 4¼ ins. and points are marked off along either end at this distance from the trued edge, and a scratch line ruled between them. If the two ends are at true right angles to the edge this line should prove to be also at right angles to either of the ends. In order to give good finish to the edges they may be rubbed down by firmly holding the panel and sliding the edges in turn along a piece of emery nailed to the bench. Care must be taken to keep the panel standing exactly vertical during the process, and giving even pressure along the whole edge. Too much stress cannot be laid upon the necessity for care and accuracy. Good workmanship is evidenced by attention to detail, and as the processes described are quite simple and require no special skill, but merely a little patience, the reader is entreated to do his best to obtain a good finish to his instrument.

The next step is to make the two condenser covers, marked G and P in Fig. 1. These are exactly square, and measure 1¾ ins. each way. They are made from the spare end piece and by the methods already described. Holes are put through their four corners to give clearance for No. 6 BA screws, and a No. 28 or 7/64 in. drill will make a suitable hole. No countersinking is necessary as round-headed screws are used.

Putting these pieces aside, the next consideration is the marking out of the top for the various holes. This is done on the under side, that is the view shown in Fig. 2. Where two or more screws are in line, a fine scratch line must be made with a divider point, scriber, or a sharpened up tag of a file, and the spacing between the holes marked up along the line. Endeavour, as far as possible, to make all measurements from two edges only, which are at right angles to one another. Make all measurements with the utmost precision, as the eye can distinguish the minutest discrepancy, or lack of balance due to erroneous setting out. The position for the holes for the valve socket is particularly important and a slight inaccuracy will result in a bad fitting for the valve. All points where holes are to be put through must be centre-punched to prevent the drill from wandering over the smooth surface. Before drilling it is worth while to one unaccustomed to this work to go over all the points with a rule and confirm that they are correctly located. The point of intersection of the diagonals of the valve socket is ¾ in. from the top edge, and the centre for the resistance lever bearing ⅞ in. lower. The first holes to be made are those near the edges which are to carry the twelve 4 BA screws for terminals. These are made with a 5/32 in. drill and in putting them through, a piece of hard wood or scrap ebonite should be clamped to the back face to prevent cracking away as the drill passes through. Two 5/32 in. holes are made to pass the screws which hold down the former on which the filament resistance is wound. Holes must also be made to pass the ends of the resistance wire, and likewise the leads to the condensers. If the four valve stems have 4 BA threads, holes can be put through to give clearance for them without changing the drill. It is more usual, however, for them to be 6 BA, in which case the No. 28 drill should be employed. Using this drill the eight holes can be made to pass the 6 BA screws which hold down the condenser covers. In order that these holes may exactly coincide with those already made in the cover pieces, it will be found convenient to drill one only of each of the four holes. By using these holes to keep the covers in position the remaining holes are made by passing the drill through the other holes already in them. Before putting the cover pieces aside again they should be marked to show the exact position they occupied when the holes were made so as to avoid any risk of them

being interchanged, turned over, or turned round. Four holes will now complete the drilling, which are those passing through the four wooden battens. These battens are to space the panel above the surface of the operating table, and are ½ in. thick. The holes made in them are to give clearance to the 1½ in. by No. 6 brass wood screws which hold the panel in position.

These battens should preferably be made of hard wood, and may be planed or filed to size.

traction which would slacken the winding. The wire must be entirely free from kinks, and having determined approximately the length required, one end is held in the vice, and keeping it taut, the former is revolved and the wire wound on.

The resistance arm is made from a piece of hard brass of thickness of about 20 S.W.G., and is shaped as shown in Fig. 1. One edge of the brass is turned up to a height of ½ in. to give stiffness. The end is also turned up, giving a projection of ½ in. to act

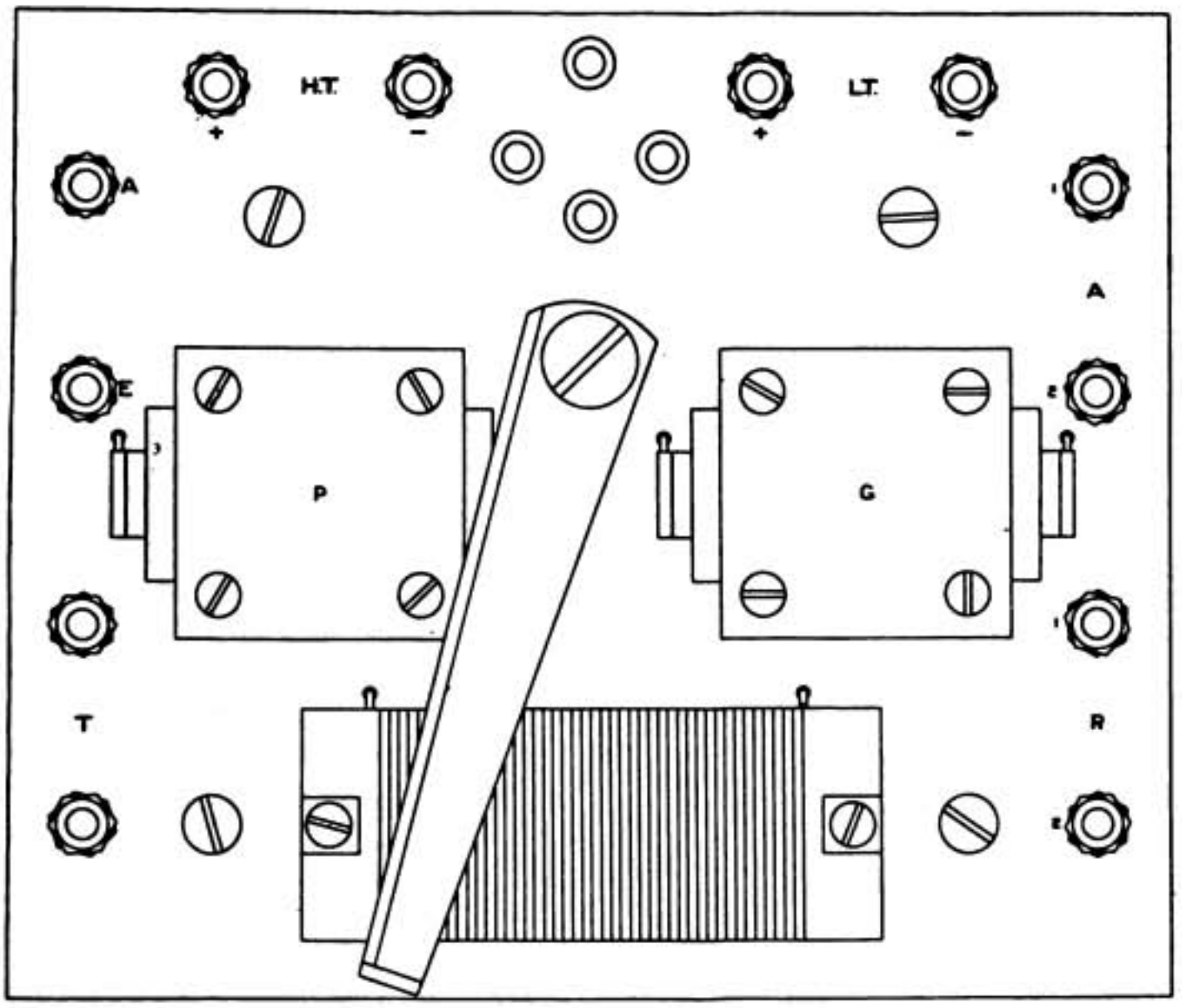



*Fig. 1. The valve panel (top) drawn to full size.*

The wooden former, Fig. 3, on which the resistance wire is to be wound, can also be filed to size, and it is important that the top edge shall be quite straight and parallel to the under edge in order that the rubbing arm may give even pressure throughout the length. The ridge along the top is filed away at the ends to give flat faces for the screws, holes for which are made with the 5 32 in. drill. Two other holes are made near the ends for the purpose of passing through and holding the resistance wire. In winding the former it is necessary to keep a strong tension on the wire and make it bind into the surface of the wood. It is as well to dry the wood before commencing to wind in order to prevent any subsequent con-

as a handle. If there is any tendency for the brass to break while making these bends it should be held in a flame until it is a dull red heat, and then dipped in cold water. This will soften it and with care is unnecessary, but should it have been done the flat portion of the arm must be carefully hammered in order to renew the stiffness. The bearing for the arm is made from a large O BA terminal with a screw-on top, or with a screw top as shown in the figure. If a screw-on top is used it will need to be hammered over when in position or treated with a little solder to prevent it coming unscrewed. Before attempting to assemble, all of the ebonite faces must be rubbed down with very fine emery paper, which, if used attached to a

small block of wood and revolved in small circles, a good matt finish will be obtained entirely free from scratches.

In placing the resistance in position and obtaining the correct pressure by the arm on the wire, small ebonite or wood spacing pieces are inserted as shown in Fig. 3, their exact thickness depending upon the height of the terminal. The building up of the condensers is as described in the previous article. Fifteen pieces of mica interleaved with copper foils passing out alternately to opposite ends will be required for the condenser marked "P." For that marked "G" four pieces of mica will be required and one foil will project out at one end and two, being one on either side of it with mica interleaved, out of the other. The two other micas are on the outer faces. This latter condenser is bridged with a high resistance leak.

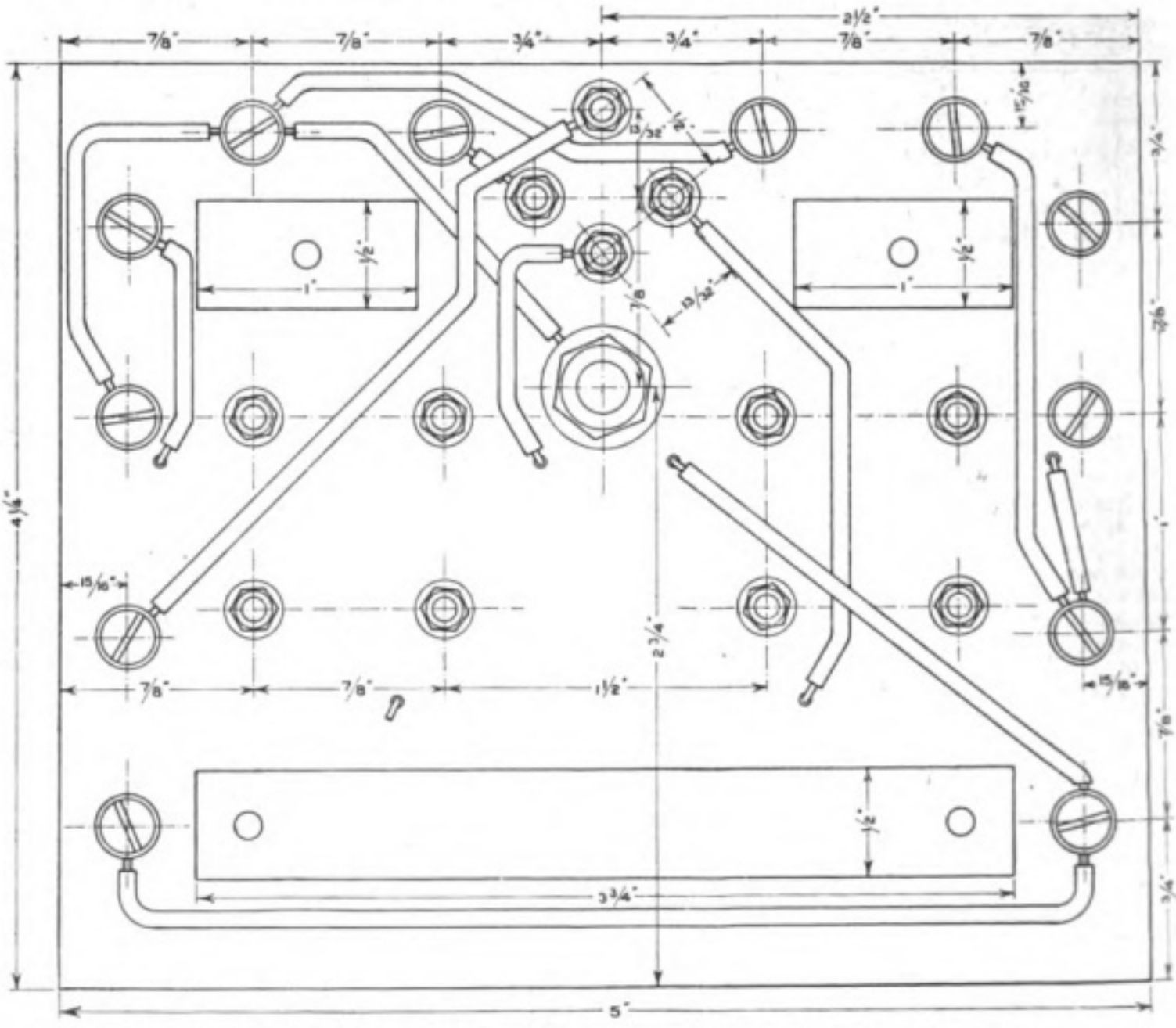
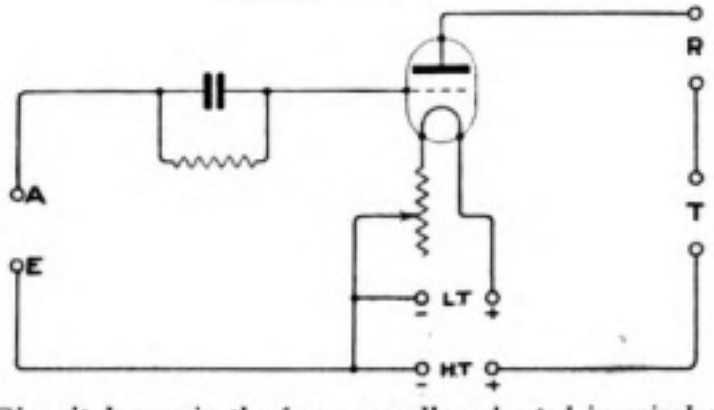



*Fig. 2. A view of the underside of the panel showing the wiring drawn to full size.*




*Circuit drawn in the form usually adopted in wireless circuit diagrams. The condenser across the telephone terminals is omitted.*

It is arranged by laying in with the plates of the condenser two additional strips of foil, one connected to either end, which, when assembled, will rest against the ebonite top. The pieces will be shorter than the plates and approach each other from opposite ends, leaving a ¼ in. in the middle spare. Taking a pencil of medium hardness an area of about a square quarter inch is well pencilled over at either end of the condensers, on the points where the two short strips will rest. This pencilling is to make good contact with the strips. Between these points a uniform and unbroken line is made about 1/16 in. wide, which forms a leak path for charges acquired by the condenser.

Using No. 22 tinned or bare copper wire the various connections are made as shown in Fig. 2. These

connections are also represented below Fig. 2 in the form usually adopted in wireless circuit diagrams. The "Sistoflex" tubing is fitted over the wire, giving a very neat appearance, ensuring perfect insulation, and helping to keep the wires in position. The leads passing out to the condensers are soldered to the ends of the copper foil with which they are wrapped.

Having put on all necessary nuts to act as terminals the instrument is complete except perhaps for the marking of the terminals. This can be done boldly with white enamel or, if a really smart instrument is desired, may be engraved by handing the panel over, carefully marked, to an engraver or firm undertaking such work, before the screws and other components are fitted. Engraving is filled in with a white wax, resembling sealing wax except in colour. No mention has been made of lacquering, and if the reader is acquainted with the process and cares to so treat the brass parts, the finish will be considerably improved. Lacquering will be dealt with in a subsequent article, in the description of instruments having a bigger display of brass.

F. H. H.

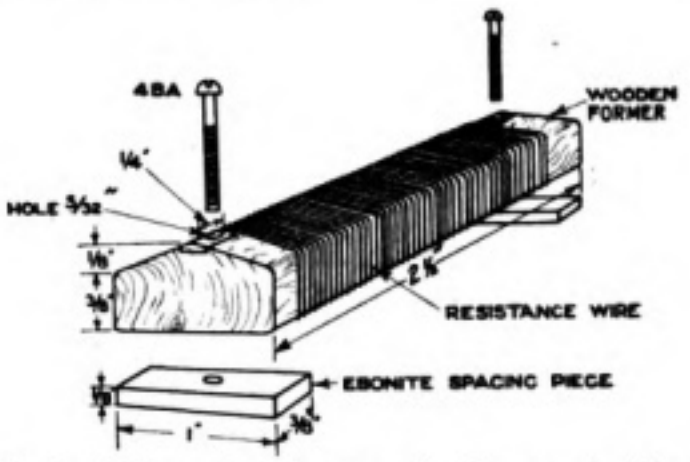



*Fig. 3. The wooden former, showing constructional measurements.*

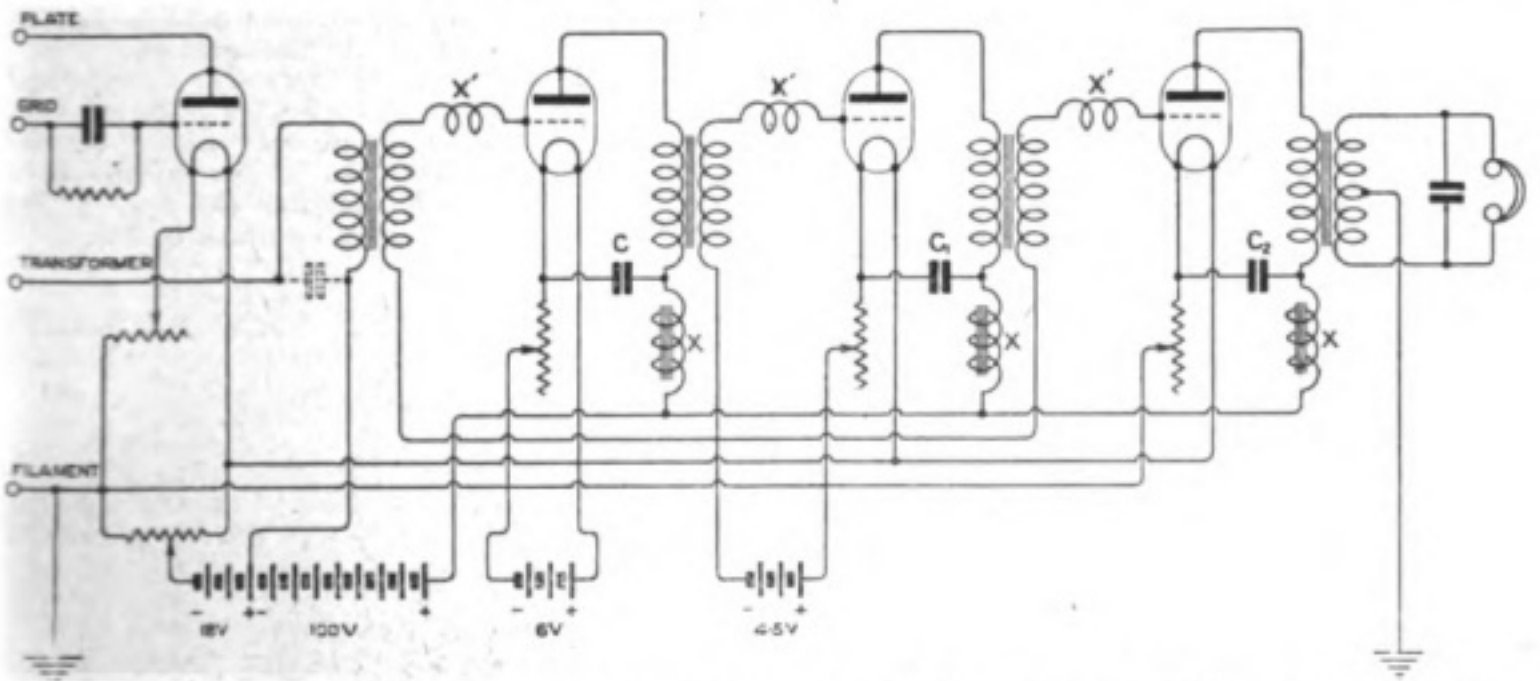
# Improvements in Audio Frequency Amplifiers

ANYONE who has tried to employ several stages of low frequency amplification soon discovers two things: first, the fact that noises are produced locally in the low frequency circuit itself, and second, that successive stages of amplification do not give the progressive increase in the strength of signals which one might be led to expect.

These objections to several stages of low frequency amplification are bad enough in the case of the amplification of telegraphy signals, but it becomes a far more serious matter where telephony and music are required to be amplified.

The ideal case would be that of an amplifier which through successive stages gives maximum amplification of the signals through each successive valve without distortion and without producing any reaction between one circuit and the preceding circuit.

The cause of the distortion of signals and absence of silence of the circuit is due principally to electromagnetic and electrostatic couplings between successive stages of amplification, and in addition oscillations set up in any one stage will tend to interfere with the amplification. If these oscillations are of audible frequency the circuit commences to howl, but there may also be high frequency oscillations produced which would not be readily detected.




In an article which appeared in a recent issue of "*QST*," Mr. H. E. Bussey describes improvements which he has applied to low frequency amplifier circuits for the purpose of controlling or preventing interaction between stages of amplification, comprising thorough shielding for both magnetic and static coupling effects by completely enclosing each stage, including the detector stage, with sheet

steel. In the tests made 1/16th inch sheet steel was employed.

In proceeding with the experiments, as a means of gauging what effect the shielding had, an amplifier was first constructed without shields, but with arrangements made for the inclusion of shields if required. It was found that two stages of amplification without shielding were practicable, but the degree of amplification fell short of expectations. The shields were then inserted, the leads to each succeeding stage being taken through slots in the shields, and a remarkable improvement is stated to have resulted. The metallic shields themselves and the cores of the transformers were connected to the positive of the H.T. battery.

This shielding was found to effect a very considerable improvement, but interaction between successive stages was not entirely eliminated, and it was suggested that this was due to the coupling given by the H.T. battery. In order to overcome this, iron core chokes (X) were next inserted in the anode circuit of each stage and condensers (C) of the value of 1 microfarad as indicated in the accompanying diagram. It is stated that this arrangement gave a very marked improvement, it being possible to employ three stages of amplification under these conditions with greater silence of operation than had been possible with only two stages previously, and with a very marked increase in signal strength. It was arranged that each choke and condenser was included within the shield of the stage to which it belonged.

To prevent oscillation at high frequencies within stages a further refinement was introduced. This consisted of radio-frequency chokes (X') inserted in the grid lead of each valve. These radio frequency chokes may consist of 25 turns of No. 32 S.W.G. double cotton covered, wound on a former of 1 inch diameter in single layer.

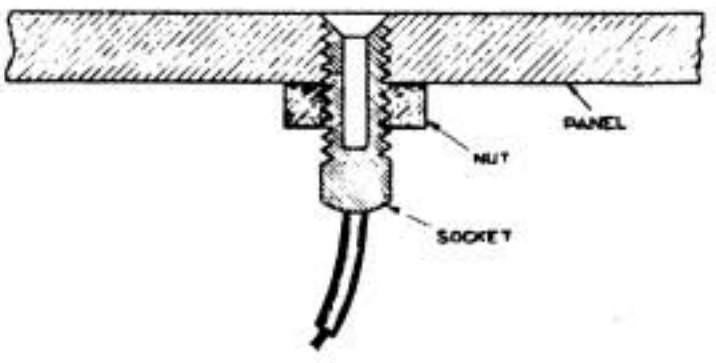
It is further recommended that telephones should not be inserted direct in the plate circuit of the last valve, but that a telephone transformer should be employed and the centre point of the secondary preferably earthed.

The condenser shown dotted in the diagram was not included in the diagram which appeared in "*QST*."

# A Simple Plug and Socket

By G. P. KENDALL, B.Sc.

ONE sees so many makeshift plug-in devices giving unsatisfactory service in amateur sets that one wonders greatly why so few experimenters have realised the potentialities of valve




*Method of mounting socket flush with top of instrument.*

pins and valve socket legs. If they did but know it, they have here the ideal materials for making battery plugs and jacks, tapping plugs for H.T. variation, coil-holder plugs and sockets, plug-in devices for changing circuits in experimental sets and a host of other useful accessories. True, H.F. transformers are often fitted with pins to plug into ordinary valve sockets, but one does not begin to perceive the possibilities of the method until one starts to use the separate socket legs. With these as sockets it is easy to make up plugs and jacks having any number of "ways," and with the advantages of neatness, good contact and cheapness; also the sockets can be spaced well apart—a distinct advantage in some circuits.

The best appearance is obtained when the sockets are mounted flush with the surface of the panel, which can be easily done by threading the barrel of the socket and tapping the hole in the panel. The socket can be locked in position by means of a nut on the underside of the panel. It happens that the sockets are just the right size to take a quarter-inch Whitworth thread, and this serves fairly well; a finer thread would be better. To give a neat finish to the panel, fix the socket so that it projects very slightly above the surface. then, with a "rose-head" (or a $\frac{3}{8}$" or $\frac{1}{2}$" twist drill) reduce the socket to the section shown in the figure. Each socket is then in the middle of a little conical depression in the ebonite, which makes the insertion of the plug much easier.

## WIRELESS IN THE SICK ROOM.

The accompanying photograph, sent to us by the Rev. H. W. Doudney, shows his son enjoying the companionship of a wireless set during an illness when he was confined to his room.

# Notes.

### Elimination of Static Interference.

Mr. J. H. Reeves reports, apropos of his remarks on X's, June 29th, 1.00–1.30 B.S.T., while the thunderstorm was raging he listened-in on 600 and could read **FFU** with only occasional loss of a letter.

### Coming Conference of Government Representatives.

In the House of Commons Mr. Pike Pease stated that the Canadian Government will shortly send two technical representatives to discuss the whole subject of the Empire wireless chain with representatives of his Majesty's Government.

### Amateur Telephony Transmission.

A Doncaster reader states that he is receiving very good telephony from **2 ND** and **2 GJ**, and is desirous of being informed of their location. He further says that the speech and music on 280 metres is the finest he has heard.

### Equipment for American Army Aeroplanes.

America's Army aeroplanes are soon to be equipped with radio apparatus claimed to be the best in the world.

Service machines are to be equipped with new sets capable of transmitting both telegraph and telephone messages during flight to the ground, or from machine to machine in the air. The new sets are of three types, designed for pursuit, observation and bombing aeroplanes, and are the latest development of the Signal Corps Radio Section. Although the specifications have been drawn up and tenders invited by the Signal Corps, no description of the new equipment has been released. It is said, however, that they are a big improvement on the sets now in use in the American Army Air Service. The largest and strongest set, S.C.R. 135, designed for bombing planes such as the dual-engined Martins, will have a telephone radius for machine-to-ground of about 75 miles, and a telegraph radius from machine-to-ground of about 200 miles.

For pursuit machines, S.C.R. 133 is designed to give a reliable telephone radius for aeroplanes in flight up to 5 miles. Set 134, for observation machines, like the DH-4's, will ensure radio-telephony between two aeroplanes on the wing up to about 10 miles. The largest sets which are to be installed in the Martins, it is expected, will make aerial conversation possible up to 25 miles. In aerial work a trailing antenna is used as an aerial, and for ground work the metal parts of the plane.

Previously, radiophone messages have only been carried on between aeroplanes over short distances as in "voice-control" flying, where the commander of a squadron directs the manœuvres of his pilots, but with the new sets officers of the Army Air Service hope to employ radiotelephony to a greater extent and see far larger applications of radio in flying operations.

### Receiving Sets for Broadcasting.

Mr. J. R. Schofield, of the South Wales Wireless Training College, Cardiff, in a letter to the *South Wales Daily News*, says:—"Having had numerous inquiries and offers to purchase receiving sets, and inquiries *re* the kind to purchase, I strongly advise merchants and private buyers not to purchase any kind of instruments until the Government and manufacturers have agreed on a standard wave-length, otherwise they will be loaded with worthless goods and have to purchase numerous accessories. I turned down an offer last week to purchase 250 sets, knowing the present state of things. When broadcasting sets are purchased, buyers would be well advised to buy only the instruments of recognised makes. Cheap goods prove the dearest in the end, and never give the best results."

### Civil Engineers' Conversazione.

Mr. W. B. Worthington, President of the Institution of Civil Engineers, received the guests at the Annual Conversazione held on June 27th, at Great George Street.

A lecture was given by Capt. H. Riall Sankey, on "Broadcasting," who demonstrated by the aid of old and new apparatus by the Marconi Company. Engineering models and scientific devices were placed round the library for inspection.

### Transmission by Air Ministry.

The Air Ministry notifies that:—

(1) With effect from the 1st July, the Synoptic Reports and General Inferences issued on 1400 metres C.W. by Air Ministry daily at 0600, 0800, 1400 and 1900 (G.M.T.); and 0915 and 2000 (G.M.T.) respectively will be transmitted on 4100 metres C.W. The Synoptic at 0200 will continue on 1400 metres as hitherto. The 0830 report will cease.

(2) In cases where breakdown of the main set, or other delay in commencing transmission on 4100 metres is occasioned, should transmission not have been commenced at the expiration of ten minutes, the message will be issued on 1400 metres commencing at ten minutes after the routine hour.

### Telephony Transmission.

Marconi House **2 LO** hopes to carry out telephony transmission tests as follows:—

7th July, every alternate 20 minutes from 5 to 8 p.m. 10th July, 2.30 p.m. 11th July, 7.30 to 8.30 p.m. 12th July, 5 to 5.20 p.m., 6 to 6.20 p.m., 7.30 to 8.30 p.m. 20th July, 8 to 9 p.m.

### Imprisonment for Fraud.

William Parsons, a dental mechanic, of Bayswater, pleaded guilty at the Marylebone Police Court on June 29th, to a charge of being in the supposed unlawful possession of a number of postal orders, a cheque and a money order, and obtaining two guineas by fraud from Leonard William Sims. It was stated that defendant had advertised for sale "ten-guinea wireless sets for two guineas," in the name of Messrs. Barkers, Ltd., Queen's Road, Bayswater, which was an accommodation address. Inquiries were made by the police, and it was found that he was not in a position to supply the sets. A sentence of six months imprisonment in the second division was passed.

This case should serve as a caution to those about to purchase wireless sets. Not only does the sudden demand for apparatus bring with it opportunities for fraud, but also provides a field for

the sale of equipments of uncertain reliability. Purchasers are advised to see the apparatus actually working on an aerial of similar dimensions to the one they propose to instal, or if ordering through the post, a guarantee that the apparatus will function correctly under the conditions for which it is required, should be asked for.

We take this opportunity of advising our readers that every care is taken to ensure, as far as is possible, that apparatus advertised in the journal is reliable, and that the firms offering it can be depended upon for fair dealing. In this connection we shall be indebted to readers for bringing to our notice any instances of unsatisfactory treatment by our advertisers.

### The Institution of Electrical Engineers: Wireless Section Committee, 1922-23.

The following members have been nominated to serve on the Wireless Section Committee for 1922-23:—Chairman: Professor G. W. O. Howe. New nominations for membership of the Committee: Mr. S. Brydon, Mr. J. St. Vincent Pletts, Captain H. R. Sankey, C.B., C.B.E., R.E., and Mr. R. L. Smith-Rose. The following will continue to serve as members of the Committee: Mr. B. Binyon, O.B.E., Mr. R. C. Clinker, Dr. W. H. Eccles, Professor C. L. Fortescue, Mr. G. H. Nash, C.B.E., Mr. C. C. Paterson, O.B.E., Captain H. J. Round, M.C., Mr. L. B. Turner. Other nominations may be made within fourteen days of the publication of the Committee's list.

### Long Distance Amateur Reception.

Mr. F. Dillon Bell, of Otago, New Zealand, states that he is frequently able to get **LY** (Bordeaux) on a single valve, and with three valves **IDO**, **POZ** and all the louder U.S.A. stations can be heard. The apparatus used by Mr. Bell is of Burndept manufacture and Burndept coils are used.

## Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—An error in your reply to the query of "Radio-Lantic" (Newark), in the May 6th issue of your paper, has just come to my attention, and for the benefit of others interested the following information is submitted.

During the war all commercial stations in this country were taken over by the Navy Department and were thus allotted calls with the Naval prefix "N." In this manner New Brunswick became **NFF** and kept this call until the station was returned to the Radio Corporation of America, at which time the call became **WII**, although still appearing in some of the older lists as **NFF**.

The station at Tuckerton, New Jersey, appearing on the call lists as **NWW**, its Naval call, now has two transmitting units with the calls **WGG** and **WGI**.

For those of you who are keen on long distance reception on the higher wavelengths the reception of the Radio Corporation's Trans-Pacific stations should afford a good test of an efficient receiver. The Pacific Coast end of this link is a 200 kW. alternator unit, situated at Bolinas, California, working on 13,100 metres, call letters **KET**, in communication with two other transmitters of the same power at Kahuka, Island of Ohau, Territory of Hawaii, working on 16,975 and 16,435 metres, call signs **KIE** and **KGI** respectively.

G. A. BURNS.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—It would appear that, in view of the rapid extension in the use of wireless apparatus by private individuals, we shall soon be requiring some distinct type of classification between technical and non-technical "amateurs."

Up to the present time the so-called wireless amateur has, as a general rule, been an individual displaying considerable skill in the utilisation of his instruments, and having very high technical knowledge. From now onwards there will enter into the field a large number of wireless enthusiasts who are much more interested in hearing music and signals than in carrying out experimental and research work, and it would appear that it will be necessary to find some sort of a name under which to head these individuals if the private technical enthisiasts are still to be called amateurs. No doubt some of your numerous readers will be glad to offer suggestions for a suitable name.

At any rate, Mr. Editor, I am sure the ingenuity of some of your staff will solve the problem so that in discussions in the future no confusion may exist between the two very distinct classes of amateur wireless enthusiasts.

Yours faithfully,

**2 WQ.**

## Calendar of Current Events

**Saturday, July 8th.**

WANDSWORTH WIRELESS SOCIETY.

Field Day.—Outing to Box Hill.

**Sunday, July 9th.**

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

**Monday, July 10th.**

WIRELESS SOCIETY OF HULL AND DISTRICT.

7.30 *p.m.*—Annual Meeting for election of officers.

**Tuesday, July 11th.**

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

**Friday, July 14th.**

LEEDS AND DISTRICT AMATEUR WIRELESS SOCIETY.

8 *p.m.*—Lecture on "Maritime Radio Communication," by Mr. D. E. Pettigrew.

**Sunday, July 16th.**

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

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY.

Field Day.

**Monday, July 17th.**

LEICESTERSHIRE RADIO AND SCIENTIFIC SOCIETY.

General Meeting, Vaughan Cottage, Leicester. Lecture on "Continuous Wave Transmission," by Mr. J. W. Pallett.

**Tuesday, July 18th.**

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

# Wireless Club Reports

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

### The West London Wireless and Experimental Association.*

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

Hon. Secretary, Horace W. Cotton, 19, Bushey Road, Harlington, Middlesex.

On Thursday evening, June 15th, the members of the Association had the pleasure of hearing its Vice-President, Mr. F. E Studt, read his paper entitled "Interpretation of Wireless Circuits"

The subject is one that is of great educational value and assistance to the wireless amateur. The lecturer having drawn a single valve circuit diagram on the board, commenced with the aerial circuit and explained most minutely the functions of each small part of the circuit throughout. The other individual circuits, collectively forming the whole circuit were in turn dealt with, and expounded carefully and to the fullest extent—owing to the length of the subject the lecturer was unable to conclude the paper and this will be continued at a subsequent meeting. It is hoped that members will have the opportunity of visiting the Slough Experimental Station at an early date. The Secretary will be pleased to reply to all applicants for part culars of membership and objects of the Association. Members are still rolling in so that they will be more versed in the science of wireless by the time "broadcasting" comes into operation.

### Wakefield and District Wireless Society.*

A meeting of the Society was held at the Y.M.C.A., Grove Road at 8 p.m., June 16th, when the Chair was taken by the President, Mr H. H. T. Burbury.

After the minutes had been read by the Secretary, Mr. Ed Swale, the Chairman, after a few remarks, called upon Mr, Swale to give his lecture on "The Tuner," and by the means of diagrams on the blackboard he explained the characteristics of the tuner, much to the interest of all present who numbered 42, including two ladies.

Instruments were passed round for inspection. The Chairman moved a vote of thanks both to the lecturer and to members who kindly brought apparatus which contributed to making the meeting such a success. The motion was carried with enthusiasm.

All desirous of becoming members are invited to communicate with Hon. Secretary, Mr. Ed. Swale, 11, Thornes Road, Wakefield.

### The North London Wireless Association.*

Hon. Secretary (pro tem.), Mr V J. Hinkley, Northern Polytechnic Institute, Holloway, N.7.

At a meeting of the above, held on Monday, June 19th, a very successful demonstration of telephony was given, the station **2VW**, run by one of our members, specially transmitting for the occasion.

Our friend at **2VW**, besides having time for experimental wireless, also turns his attention to music and gave selections on the cornet, tin whistle, and flute, which instruments, having a considerable range of pitch and quality, proved a good test for modulation.

The Association will welcome any inquiries from prospective members addressed to the Hon. Secretary as above.

### The Dewsbury and District Wireless Society.

Hon. Secretary, Mr. A. Horsfall, Willow Grove, Lee Street, Ravensthorpe, Dewsbury.

On Thursday last, June 8th at 7.30 p.m., the above Society opened its new rooms in South Street, Dewsbury, by an open meeting and lecture, the President, Mr. S. S. Davies, presided.

Mr. Yardley, of Leeds, was to have lectured but was unable to attend, and the Society was very fortunate in being able to obtain the services of Mr. Denison, of Messrs. Denison Bros., Halifax, better known as **2KD**.

His lecture was illustrated by blackboard diagrams, and dealt chiefly with the erection of aerials, the working of thermionic valves, and reception on short wavelengths. It was a most instructive and interesting lecture, especially the latter, in view of the reduction in the amateur wavelength.

At 8.30 p.m., according to programme, music and speech was picked up (transmitted by Mr. Burbury, of Crigglestone, **2AW**), and was audible all over the room.

At the close of the meeting the usual vote of thanks was expressed to the speaker (Mr. Denison), and Mr. Burbury who so kindly sent the transmission.

Almost 100 persons were present, and although the Society is only four months old, 50 members have been enrolled to date.

The members have been informed that the Club-rooms will be open on Tuesdays and Thursdays. Club night is Thursday.

Prospective members will be welcome at the Club-rooms on Thursday evening. Further particulars from the Hon. Secretary.

### Smethwick Wireless Society.

Hon. Secretary, Ralph H. Parker, Radio House, Wilson Road, Smethwick, Staffs.

The above Society held its annual meeting on Friday, June 2nd. A statement of accounts was submitted by the Treasurer which showed that the Society was in a very satisfactory position financially. The report for the year was read by the Secretary, and the following officers were elected:—President, Mr. R. W. Hutchinson, M.Sc., A.M.I.E.E., F.R.G.S., F.G.I.; Vice-Presidents, Mr. A. Adams, F.G.S., Mr. A. J. Hulme, Mr. J. Stoney, B.Sc., A.M.I.M.E., Mr. C. Grew, Mr. H. Garrett, B.Sc., Mr. Sidney D. Waltho, Major Thompson, Mr. S. W. B. Stephens, Mr. McKale; Secretary, Mr. Ralph H. Parker;

Assistant Secretary, Mr. L. Lee; Treasurer, Mr. A. Allen: Committee, Messrs. Bryant, Sessions, Whitehouse, Kay Evans, Ben.

It was also decided to apply for affiliation. During summer months meetings will be held monthly.

On June 30th, Mr. L. Lee, of the Smethwick Technical Institute, lectured on telephony

### Leicestershire Radio and Scientific Society.

The monthly meeting of the Leicestershire Radio and Scientific Society took place on Monday, June 19th, at headquarters.

The balance sheet of a recent dance was read and accepted, it showing a substantial profit of £5 2s. 5d.

Three new members were accepted, bringing the total to 43 members.

The lecturer for the evening was the Society's President, Mr. Cyril T. Atkinson, and the subject, "Short Wave Reception." Mr. Atkinson first of all pointed out the reasons for the special measures necessary for short wave receiving the short aether waves of below 300 metres, and then described, step by step, the various classes of gear and methods of construction.

The lecture was illustrated by a number of pieces of apparatus of the lecturer's own construction, and an extremely interesting evening was spent.

At the conclusion a very hearty vote of thanks was accorded to the lecturer, proposed by Mr. Pallett and seconded by Mr. Yates, being heartily acclaimed by the whole assembly.

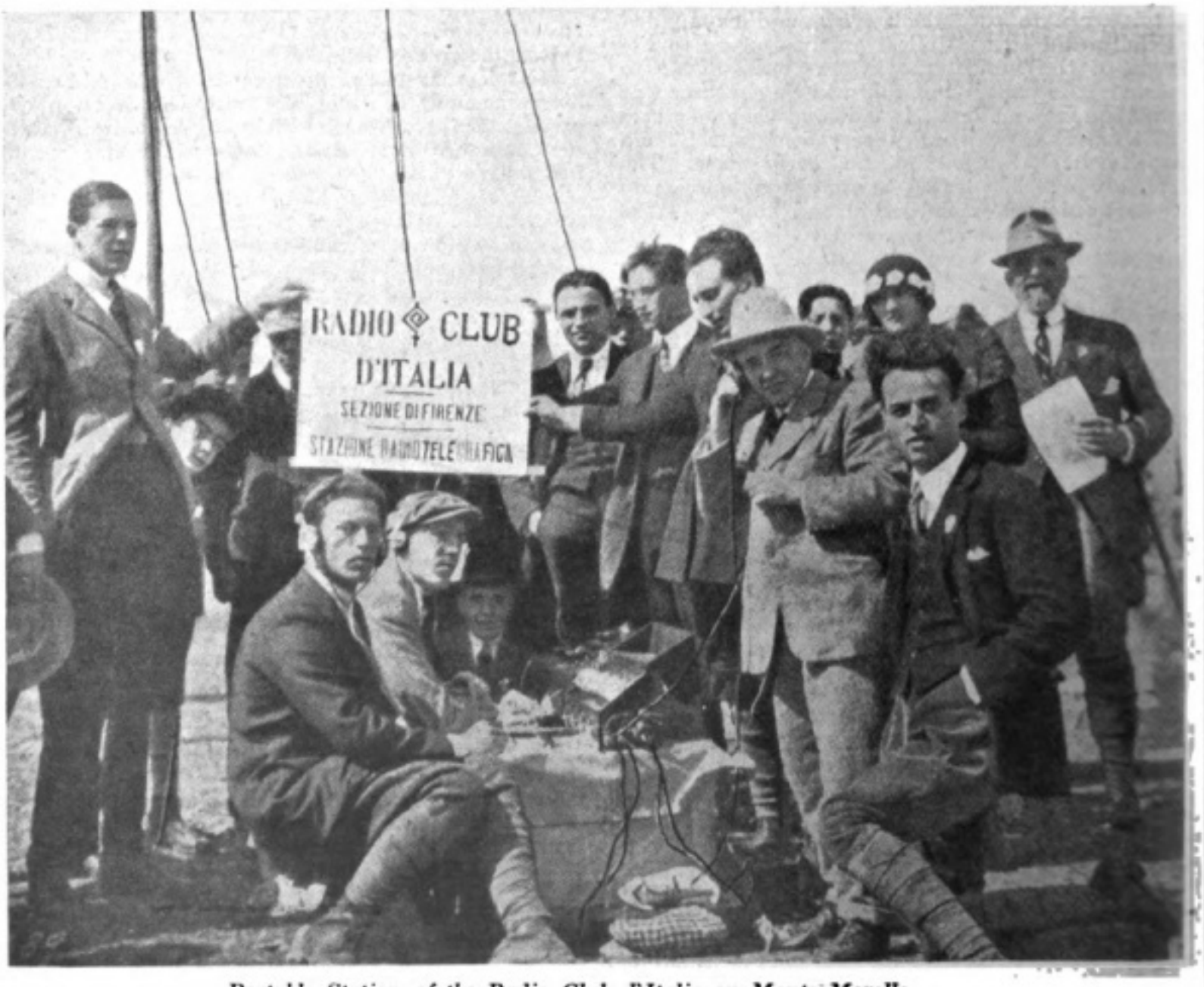
The meeting closed at 9.30.

Secretary, Mr. J. R. Crawley, 269, Mere Road Leicester.

### Southampton and District Wireless Society.

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

A meeting of the above Society was held on Wednesday, June 14th, at Kingsland Assembly Room. A large gathering was present and an enjoyable evening spent. Mr. Bateman demonstrated on his "single valve set," on which, by the way, he receives the Hague very loud and clear. A special message sent out by the Hague to the secretary of the above Society was logged by him and forwarded to the Secretary for confirmation. He also received by telephony the result of the Derby. Mr. Bateman is an ex-soldier, and having the use of only one hand is greatly handicapped. He has only taken up wireless two months, and has




*Portable Station of the Radio Club d'Italia on Monte Morello.*

belonged to the above Society during that time. Great credit is due to him for the rapid advancement he has made.

All questions asked Mr. Bateman were answered with satisfaction. Buzzer practice brought the evening to a close. The Club is now open to accept associate members. Full particulars will be sent on application to the Secretary.

### Wolverhampton and District Wireless Society.

A Committee meeting of the above-named Society was held at Headquarters, 26, King Street, on June 12th, Mr. H. H. Speke in the Chair. The chief item on the agenda for discussion, was the arrangement of a programme for future meetings. Messrs. D. Baker, H. Taylor, and Geo. W. Fairall, members of the Committee, who have transmitting stations, suggested a visit of members on June 28th, to see them. This idea was gladly received and adopted. A general meeting was held on June 13th, when Mr. Blakemore, A.M.I.E.E., delivered the third and last of his series of lectures, the subject being "Electrical Terms and their Meaning." With practical demonstrations in static and current electricity the lecturer held the attention of his audience from beginning to end. At the conclusion of the lecture the hope was expressed that Mr. Blakemore would again favour the Society at an early date. An invitation was then extended to members, to visit the stations of Messrs. D. Baker, H. Taylor, and Geo. W. Fairall, and names taken of those members who were able to accept. In addition to the visitation a general meeting will be held at Headquarters, 26, King Street, on June 28th, at 8 o'clock. Buzzer practice at 7 o'clock.

Hon. Secretary, Mr. Geo. W. Jones, 8, Rosebery Street, Wolverhampton.

### The Hackney and District Radio Society.

The first general meeting to discuss the formation of a Radio Society, was held at 111, Chatsworth Road, Clapton, E.5, on Thursday, June 8th.

It was decided to carry out all activities under the above title. Being the first meeting the members were more or less strange to one another. The good number of the attendance was surprising.

Officers were elected as follows:—Mr. D. Street, Chairman; Mr. E. R. Walter, Secretary; Messrs. Douglass, R. Ison, A. Valin, F. Jenkins, A. V. Morgan, T. Kiernan, Committee.

Several resolutions were passed which the Committee considered after the meeting, so as to bring into motion at the next meeting A general conversation took place, which ran into many interesting subjects on Wireless. Mr. A. Valin exhibited some high frequency transformers.

It was decided to start a Morse class, and instructional help to members who are young with the subject, at the meetings on every Thursday, at 8 p.m.

The second meeting of the above Society was held on June 15th, at 111, Chatsworth Road, Clapton, Mr. D. Street in the Chair. The minutes of the previous meeting were read and confirmed. Further arrangements for the management of the Society were discussed, and a list of rules and regulations was compiled This was read and confirmed at the next meeting, on June 22nd, at the above address.

Morse practice was carried out. The meeting was of an informal nature. Wireless instrumental parts, chiefly condensers and coils apart were produced. The major part of the conversation was concerning the making and sizes of efficient broadcasting coil.

All enquiries should be addressed to the Secretary, Mr. E. R. Walter, 48, Dagmar Road, South Hackney, who would also be glad to receive catalogues.

### Ilford and District Radio Society.

On Thursday, June 15th, our Chairman, Mr. H. H. Lassman, gave a lecture on "A Single Valve Receiver."

The lecturer first dealt with the subject from the point of view of apparatus required, the functions of each individual part, and built up the circuit in diagram form.

The making of the set was then explained, suitable values of leak and condensers and sizes of coils for the 440 metre wave were given. The general working of the set was detailed and many hints and precautions given. A large number of questions were asked, and a very lively discussion arose on the size of coils required, and the best form to be used for the 440 metre wave. The merits of every form of coil were discussed and easy methods of making described.

The Society has pleasure in announcing that Mr. Fredk. Wise, M.P., and Mr. W. W. Burnham have very kindly consented to become Vice-Presidents of the Society.

A series of junior constructional classes is being run under the supervision of Mr. F. C. Grover. This should be of particular interest to those just starting.

Hon. Secretary, Mr. A. E. Gregory, 77, Khedive Road, Forest Gate, E.7.

### Tunbridge Wells and District Wireless Society.

On Wednesday, June 7th, the Society, which has changed its address to 81, Calverley Road, Tunbridge Wells, accepted the kind invitation of Sir Robert Gower to visit him at Sandown Court, on the outskirts of Tunbridge Wells.

After inspecting the large new aerial which had recently been erected, the party adjourned to the house to listen-in to the Marconi Concert. This was successfully picked up and rendered audible to all present by means of a Marconi M16 receiver, four-valve amplifier and loud speaker.

Sir Robert, after a short interval for refreshments, exhibited further apparatus supplied by W. R. H. Tingey (unit system), in which five valves were employed, followed by a Brown's relay and loud speaker. Considerable interest was shown by the visitors in the tuning arrangements and the remarkable powers of amplification possessed by this set.

The Marconi receiver and amplifier previously referred to, were then formally presented to the Society. Mr. G. W. Howard, the President, on behalf of the members, expressed his thanks and great appreciation of their host's generous gift. He stated that it supplied a long-felt want, and he was sure that it would assist the Society in its endeavours to obtain new members.

Amateurs in the district who may wish to join the Society should apply to the Hon. Secretary, Mr. W. P. Burrin, 86, Stephens Road, Tunbridge Wells.

### The Watford Grammar School Wireless Society.

A Society has recently been formed at the above school, membership being open to the senior scholars. At the inaugural meeting the following officers were elected:—President, H. Nicholson, Esq., M.A.; Vice-President, A. H. Cooper, Esq., M.Sc., B.A.; Hon. Secretary, Mr. J. W. Crichton. The activities of the Society are under the direction of the officers who are assisted by a small committee.

A General Meeting was held on May 15th, Mr. A. H. Cooper was in the chair, and the general business having been completed, he introduced Mr. Paul D. Tyers who was to open a discussion on "The Valve as a Detector of Damped Waves." The function of a valve as a detector was illustrated by means of a number of experiments, the necessary apparatus being supplied by the school science department. A number of curves were made during the evening, the actual anode currents and grid potentials being made visible by means of large scale meters mounted on the wall. At the close of the address Mr. Paul D. Tyers expressed his thanks for the way in which his remarks had been received and stated that he was indebted to the Marconi Scientific Instrument Co. for supplying a large number of the slides which he had been able to show them.

The interest in the Society is increasing, and it is hoped to arrange a definite programme very shortly. The Society has in its possession an excellent aerial and a large amount of apparatus. Listening-in is a regular feature among the members and many are becoming expert with the Morse code.

Hon. Secretary, Mr. J. W. Crichton, Watford Grammar School.

### Cercle Anversois d'Etudes de T.S.F.

This Society, recently formed in Antwerp, comprises already some sixty-five members, and has succeeded in obtaining the Physics Lecture Theatre of the Lycée d'Anvers for its meetings and lectures. A monthly bulletin is being published, the first copy of which was due to appear the beginning of June. They will be pleased to insert any important communication emanating from either amateurs or societies in England, and invite correspondence on wireless matters. Some of the Antwerp amateurs possessing very complete apparatus, the Secretary wishes to get into touch with British amateurs possessing transmission licences in view of proceeding to some trans-North Sea tests, the importance of which will no doubt appeal to readers. The Belgian amateurs hope that they will be granted transmission licences shortly.

At present informal meetings are held, and a course of lectures on apparatus construction and electricity and wireless has been started.

Anyone interested should write to the Secretary, Mr. A. Wust, A.C.G.I., Engineer-in-Charge, Central Station of the Société d'Electricité de l'Escaut, Merxem-Antwerp.

### Cannock and District Wireless Society.

At a meeting held on June 5th it was decided to form the above Society. Mr. G. M. Whitehouse was elected chairman and Mr. T. Ball, Secretary. A good membership is expected, and affiliation to the London Wireless Society has been applied for.

### Proposed Wireless Club at Deptford.

Mr. Henry C. Cook is desirous of forming a Wireless Club under the name of "The New Cross and Deptford Radio Society." He has two first-class sets of instruments with a loud speaker, a 90 ft. mast and a generator for charging batteries, which he will place at the disposal of the Society, with a club-room and necessary fittings.

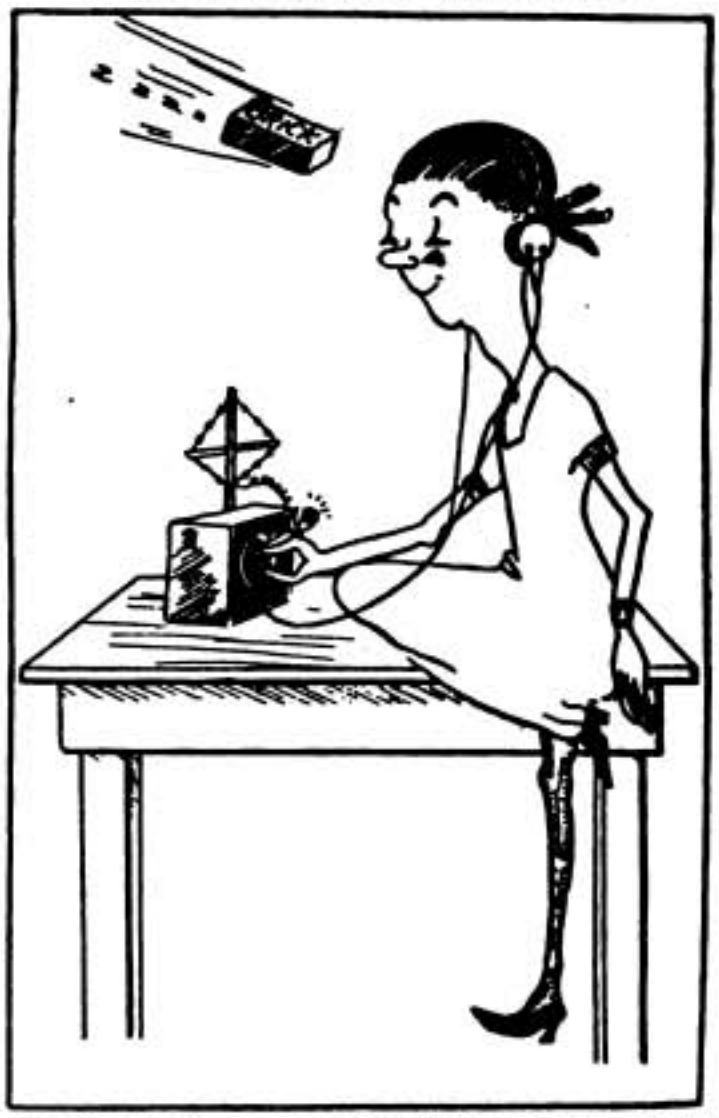
### Clapham Park Wireless Club.

Mr. J. C. Elvy, A.M.I.E.E., M.I.E.S., 3, Fontenoy Road, Bedford Hill, S.W.12, will be glad to hear from amateurs in the Clapham Park district with a view to their co-operation with him and a number of others in the formation of a wireless club.

### Bedford and District Radio Association.

Mr. C. W. Clarabut, of Beverley Crescent, Bedford, is making an effort to establish a Radio Association in his locality. He finds it difficult to get in touch with actual manufacturers of radio accessories such as condenser plates, contact studs, terminals, switch-knobs, etc. Those interested should communicate direct to Mr. Clarabut.

### OUR PICTURE OF THE WEEK.



We feel that an apology is due to readers of the *Wireless World* for our remissness in not previously publishing the type of wireless picture that is so popular with our contemporaries. The defect is hereby remedied with acknowledgements to the American wireless magazine *QST*, from which the drawing is taken.

# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"C.G.B." (Wimbledon Park),** *with reference to the Reinartz Tuner, asks* (1) *Will the winding for 600 metres tune down below 400 metres.* (2) *The size of windings for a range of from 300 to 600 metres.* (3) *If any tappings are required in either aerial coil or grid coil. If so, how many.* (4) *What other types of valves besides a QX will be suitable.*

(1) Not as shown. It is intended for the 600 metres only. (2) and (3) A 70-turn coil would probably cover this range if provided with aerial and earth taps of approximately the same number and proportionate size as those in the original receiver, but it would be safer to increase the size of the coil to about 80 turns. The exact number will have to be determined by experiment. (4) Almost any hard valve.

**"SPARKS" (Birmingham)** *asks* (1) *For a diagram of a two-valve circuit.* (2) *Could he get* PCGG *with a two-wire aerial* 30 *ft. high.* (3) *Could he make a reaction coil.* (4) *What would the inductance of a basket coil be wound with* 44 *turns of No.* 30 *S.C.C. wire.*

(1) See diagram. (2) Doubtful, but possible. (3) Yes, a reaction coil is made in exactly the same way as any other coil. (4) The dimensions given for the coil do not appear to be self-consistent. Assuming the number of turns is correct as stated, the inductance would be approximately 300 mhys.

**"W.H.S." (Sutton-on-Sea)** *gives a list of apparatus and asks if this is complete, and how to connect up the various pieces.* (2) *Is it necessary to have a licence before purchasing apparatus.*

(1) The apparatus suggested would be sufficient, but a grid condenser and leak would be an advantage. Connect up as in diagram. (2) No, but a licence must be obtained before the apparatus is used.

**"W.H.K." (Hurlingham)** *asks* (1) *How to add an L.F. amplifier to a circuit sketched.* (2) *How to add an H.F. amplifier to the circuit without alteration, if possible.*

(1) In spite of the way in which the diagram is arranged this circuit is of quite ordinary type. The additions required will make the circuit essentially that of Fig. 3, page 340, June 10th issue, H.R. telephones being retained if required.

**"B.D.C." (Chepstow).**—The circuit is O.K., and should give most of the stations you suggest, but we doubt if you will get useful results with 2MT. The maximum wavelength is probably not less than 3,000 metres, but we cannot give the actual value as you do not state the capacity of the A.T.C. A condenser across the telephones would improve the set. There is probably not much difference between the telephones you mention, though with equal design and workmanship 4,000 ohm telephones would be better than 2,000 ohms.

**"R.P.H." (Parkstone)** *gives a diagram and asks* (1) *Are the connections correct.* (2) *Would a reaction circuit improve the results.*

(1) The circuit is quite O.K. (2) Reaction might be used to increase the range, but great care should be taken if this is done to prevent the set from oscillating.

**"BEGINNER" (Hampstead)** *asks* (1) *For a single valve circuit using basket coils.* (2) *What range would it have with an indoor aerial* 80 *ft. long of No.* 26 *enamelled copper wire.* (3) *Does the markings on Sullivan's* 120 *ohms headgear receivers mean the resistance of each ear-piece or the two together.*

(1) See diagram (Fig. 1). (2) It depends on the power and wavelength of the transmitting station, and also how badly the receiver is shielded by the walls of the house. It is impossible to give any useful figures. (3) 120 ohms is the total resistance of the pair.

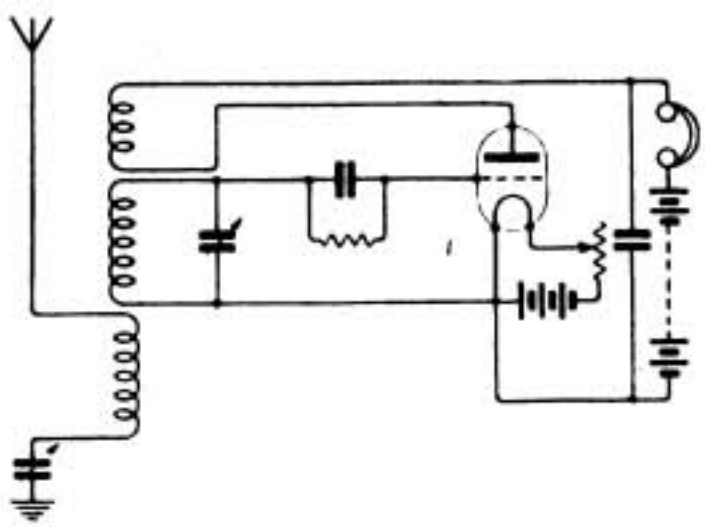


*Fig.* 1.

**"H.E.C." (Kentish Town)** *asks for a diagram of a resistance coupled circuit, using two R type H.F. valves followed by crystal rectification and one R type L.F. valve, and giving the respective values of the resistances of condensers required.*

See diagram. (Fig. 2.)

**"H.B." (Forest Gate)** *wishes to construct a frame aerial for 350 metres and asks* (1) *Size of frame.* (2) *Number of turns and size of wire.* (3) *Is the shape sketched correct.* (4) *Where to connect the two ends of the winding.*

(1) About 3 ft. square. (2) Six turns, spaced 1 cm. apart of about No. 18 wire. (3) This type will be satisfactory. (4) Across the terminals of a small variable condenser, which itself is connected across the grid and filament of the first valve.

*and asks* (1) *How he can estimate the capacity of the aerial to get 0·00035 mfds.* (2) *What should be the capacity of the A.T.C.* (3) *For a diagram to supplement the Figs. 3 and 9 of this article showing connections.*

(1) Accurate computation of the capacity of an aerial is a lengthy and difficult process. You will find the method described in Nottage's "Calculations of Inductance and Capacity." The value of 0·00035 mfd. is somewhat high for a P.M.G. aerial. Yours will probably be rather less, giving you a somewhat smaller maximum wavelength. (2) See page 350 in the article referred to. (3) The amplified diagrams you ask for are given in figures 8a and 8b of the article. We think these are about the only useful simplifications of Fig. 9 which it is possible to make.

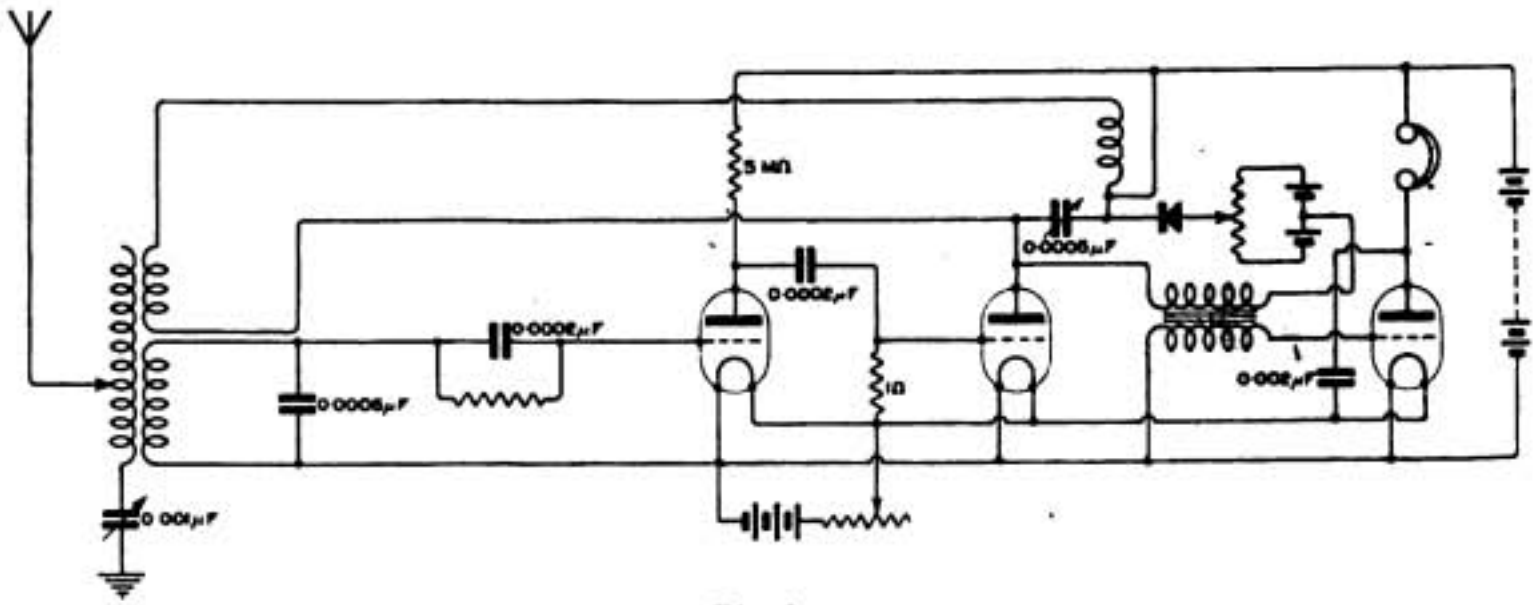



*Fig. 2.*

**"AFICIONADO" (Madrid)** *asks* (1) *The gauge of a sample of wire.* (2) *If this would be suitable for a reaction coil of a single valve receiver described in February, 1921.*

(1) No. 36. (2) Yes, provided about the same number of turns are used, that is 50 and 200 for the two sections.

**"H.M.R." (Newcastle-on-Tyne)** *submits a diagram of four-valve set with jacks for switching in one to four valves and asks* (1) *If satisfactory.* (2) *How many foils and what size with mica 0·002" thick, and 2" × 1½" for condensers of capacities 0·0003, 0·001 and 0·004 mfds.* (3) *If certain data for an inter-valve transformer will be correct.* (4) *For information about certain coils.*

(1) Yes, except that jacks used for H.F. in this way lead to a certain amount of inefficiency, and are liable to oscillation owing to the capacity of the jacks and the connections. (2) For 0·0003 mfd. two foils 1 cm. wide, overlap 2 cms. For 0·001 two foils, 2 cms. wide, 3 cms. overlap. 0·004 mfd. five coils, 2 cms. wide, 3 cms. overlap. (3) Quantities suggested and size of formers O.K. (4) We should advise making reaction coil to slide within the other former if possible. If so, probably 100 turns sufficient. If not, wind it full. Re-wind the tuning former with about No. 30.

**"HINAIDO" (Portsmouth)** *proposes to construct a set described in the issue of September, 1921,*

**"W.H.T." (Newcastle)** *sends a diagram of his set and asks how it could be improved for the reception of telephony.*

The set is of quite good type and not capable of any considerable improvement. We dislike, however, the L.F. reaction shown, which is liable to produce distortion and howling. The fact that the grid leak has no effect points to the insulation of the valve holder being defective to an extent which is probably enough to weaken your signals.

**"A.C.M." (Woolwich).**—We regret having no information regarding the receiver you describe.

**"A.C.R." (Blackpool)** *asks why he gets signals on short wave by putting his hand on the top of the tuning coil.* (2) *How to construct honeycomb coils on a former 1¼" × 1¼"—the number of pegs and number of turns for each coil.* (3) *A suitable reaction coil for use with the above.* (4) *Should he get* **2 MT** *or* **FL** *telephony on a single valve.*

(1) The effect is practically equivalent to the rearrangement of set on the lines of the diagram, which should, and evidently does, tune the set to a much lower wavelength than is obtained with the additional earth removed. (2) 15 pegs required. Try number of turns as follows: 40, 80, 150, 250, 400, 600, 1,000 and 1,500. (3) For the reaction use the coil next smaller than the one in use for tuning. (4) **2 MT** very doubtful: **FL** possible.

**"WIRELESS BUG" (Brighton)** *asks* (1) *How to renovate Perikon crystals.* (2) *Whether* LP *now transmits telephony on* 2,500 *metres. If so, at what times.* (3) *If a P.O. telephone relay,* 500 *ohms, can be used in conjunction with* 150 *ohm telephone receiver for a loud speaker.* (4) *What is the wavelength used by aeroplanes calling Croydon, and why the noise of the engines does not interfere with their speech.*

(1) The only thing that we can suggest is to take them out of the mountings (*i.e.*, by careful application of heat) and turn them into new positions and search for new sensitive regions, or careful chipping to expose new surfaces, afterwards remounting them. (2) We regret we have no knowledge of telephony transmission by this station. (3) We are afraid this instrument would not be of much use for this purpose. (4) 800 to 1,000 metres. Careful arrangements of various types are made to make the microphone respond only to the localised sound of the operator's voice and not to the general distributed noise of the engine of the machine. The problem is similar to the use of a speaking-tube in a very noisy building, which is quite practicable.

**"J.W.T." (West Kirby)** *asks for a diagram of a circuit for a certain three-valve receiver.*

See diagram. (Fig. 3).

**"RECEIVER" (Beds.)** *refers to a certain set and asks* (1) *Whether it will give good results.* (2) *Why he gets "echoes" in receiving telephony.* (3) *Would Brown's A* 8,000 *ohm telephones be liable to be damaged in the* 30 *volt circuit of a plate.*

(1) This set should be capable of giving quite good results. (2) This effect is generally due to the reaction being adjusted too near the oscillation point. Try rearranging the reaction coupling. (3) Yes, frequently, but no definite programme is at present arranged. (4) No.

**"E.F." (Sussex)** *has constructed the school receiving set described in the October issue, and asks* (1) *Why the* 500 *turn coil used as A.T.I. gives no signals unless the hand is placed on the tuning condenser or the telephone terminals,* (2) *Would the addition of another valve enable him to hear Dutch Concerts.* (3) *For a diagram of a circuit using another valve.* (4) *How to prevent howling when listening to telephony.*

(1) Impossible to say without examination. It might possibly be due to a break in the coil, or a bad connection between it and the earth. (2) Yes, preferably as an H.F. amplifier. (3) See diagram (Fig. 4). (4) If the howls are due to your neighbour's radiating receiver you can do nothing If owing to your own set oscillating, weaken the reaction.

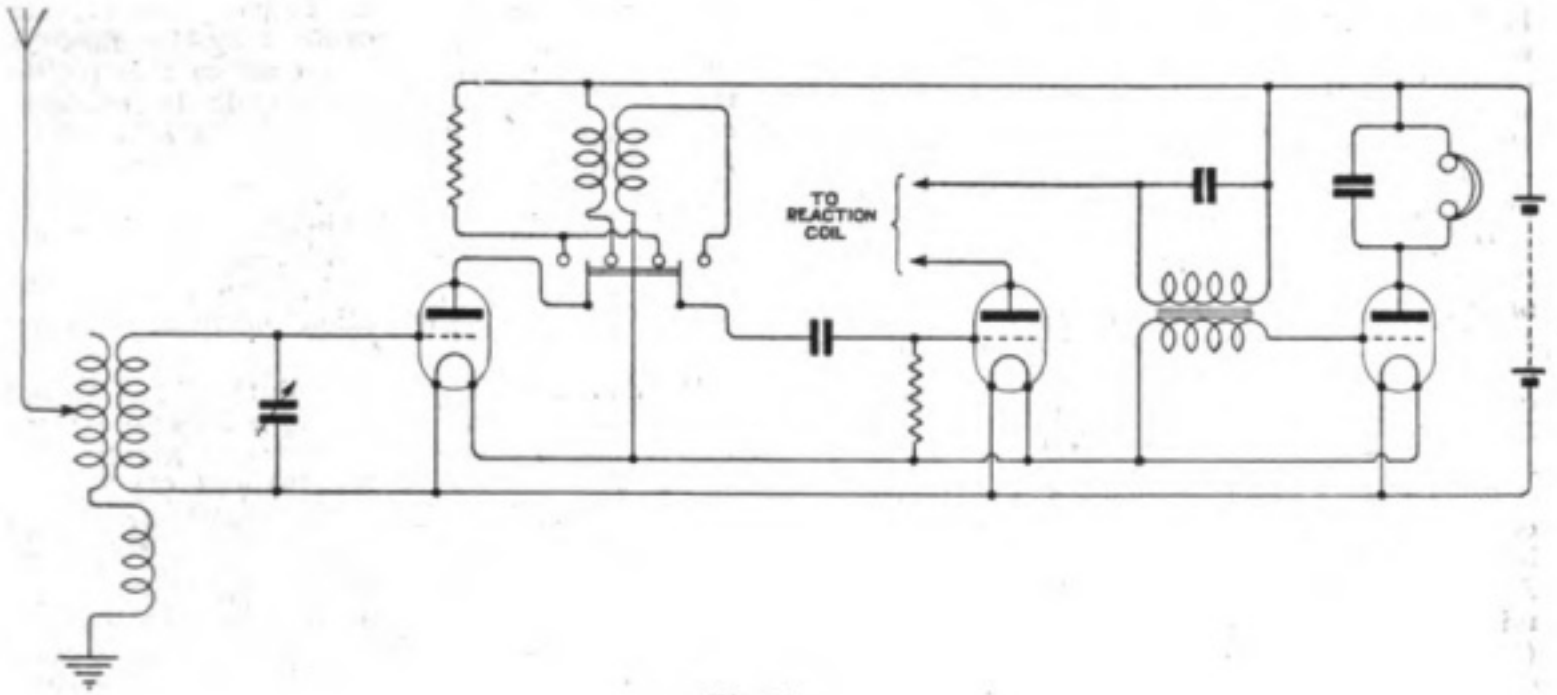



*Fig.* 3.

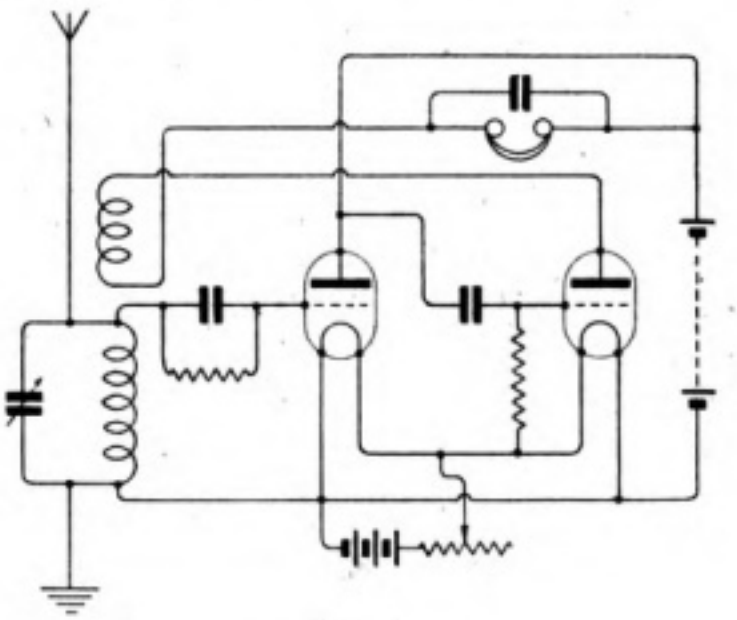


*Fig.* 4.

**"R.E.W." (Holyhead)** *asks with regard to the shunt control method for a radiophone transmitter* (1) *Is this system of radiophone transmission used successfully by amateurs.* (2) *In Mr. P. R. Coursey's article on this subject in the April issue,*

*what should be the value of B.2 (Fig. 2) to give a total input of 10 watts, using R type valves with V.1 and V.2. (3) Can this circuit be used for C.W., if so, where should the key be connected. (4) Is it necessary to have L.3 and L.4 (Fig. 2) of heavy gauge wire.*

(1) The system is quite a good one. It has undoubtedly been used in certain forms by amateurs, but we do not know how far this particular modification has been applied. (2) You will not get a full 10 watts from 2 R valves efficiently. The 10 watts could be obtained by putting up the H.T. voltage, but the power radiated would not be increased. 150 volts will be as high as you can usefully apply. (3) Yes, insert the key in the grid circuit of the control valve, adjusting the static potential of the grid with a potentiometer until the best results are obtained. (4) The wire need not be of very heavy gauge for this power. Use, say, No. 18, or better, 7/24 or 7/26 stranded cable.

**"V.H.T." (Canterbury)** *asks (1) For criticism of enclosed diagram of circuit with possible improvements. (2) Why do single honeycomb coils made by different firms vary as to wavelength. (3) Which type of coil should be best, those covering the smaller wavelength or those covering the greater. (4) Could he receive* **PCGG, 2MT, LP, NSS** *and aircraft telephony with the set described.*

(1) The circuit is O.K., except that the reaction coil should be in series with the primary of the inter-valve transformer, and not in shunt across it. Also, the use of loose coupled circuits would minimise the danger of considerable re-radiation. (2) This may be due to the difference in the condensers (some have a much lower minimum capacity than others), or more probably to differences in the self-capacities of the coils. (3) The latter. (4) You should do if the inductances of the coils used are suitable.

**"G.A.H." (Farnborough)** *asks (1) The capacity of a certain variable air condenser. (2) What would be the capacity if the fixed vane spacing was ½" instead of 5/16". (3) What weight and gauge of wire is required for a 2" former for use as a telephone transformer.*

(1) Approximately 0·0002 mfd. (2) Approximately 0·00026 mfds. (3) 2" is too big a diameter for efficiency. Make the core ½" diameter, the windings may then be 6 ozs. No. 30 S.W.G., and 3 ozs. No. 44 S.W.G.

**"S.W.B." (Manchester)** *asks for advice with regard to certain troubles in his receiving set.*

We are afraid there is no certain cure for the induction troubles you complain of. It might help to abandon the use of grid condensers and leaks. Also put a condenser across the winding of the inter-valve transformer in series with the reaction. Try shielding the apparatus, particularly the iron cored transformers, in an iron, or iron-covered box. If possible get the aerial at right angles to the tram wires, or as far as possible from the telephone wires. Do not use a too critical reaction.

**"H.F.L." (Chesterfield)** *asks (1) the difference between high and low frequency transformers. (2) If a circuit sketched will receive* **PCGG**. *(3) Maximum and minimum wavelength of the circuit. (4) Windings for the coils.*

(1) H.F. transformers are in general air-cored and are designed to efficiently transform radio-frequency currents before rectification. L.F. transformers are iron-cored, and arranged to transform currents of auto-frequency. (2) No, not without additional amplification. Moreover, a grid leak is useless without a grid condenser, and L.R. telephones cannot be used in such a circuit without a transformer. (3) Impossible to say as no dimensions of coils are given. (4) 6" × 4" of No. 24 for the A.T.I., and 4" × 3" of No. 28 for the reaction coil will give a useful range.

**"L.U.C." (Brighton).**—(1) This condenser is useful for long wavelengths, but will not be necessary under about 1,000 metres. Capacity can be about 0·0005 mfds. Arrangements may be made to switch the series condenser over to this position if desired. (2) Telephones should be connected across the I.P. and O.P. terminals as shown in the diagram. (3) This tuner is unsuitable for alteration for so large a range. Dismantle and use the pieces for incorporation in a new set with honeycomb coils. (4) Current always flowing in one direction through a circuit. See any electrical textbook for the distinction between this and A.C.

**"E.W.S." (Hurstpierpoint)** *wishes to make up a panel receiver embodying a detector oscillator valve, and one note magnifier and tuning up to 4,000 metres, and asks (1), (2) and (3) Types of coils to adopt. (4) Whether the results that his present single-valve set gives are satisfactory. He receives* **2MT** *comfortably at Southend-on-Sea.*

(1), (2) and (3) For compactness and at the same time keeping self-capacity to a minimum, you would be well advised to make up coils of the style shown on page 328, June 10th issue. These can be mounted to take up very little space by making a ¼" hole through the centre of each card, and assembling them on an ebonite rod fixed to the under face of the panel, and putting a thick cardboard ring, 1½" in diameter, between each inductance card (4) Yes.

**"T.S.F." (Edinburgh)** *asks for a circuit for a four-valve set comprising 1 H.F., 1 rectifying and 2 L.F. valves, with switching arrangement for transferring telephone transformer primary from last valve to plate circuit of second valve, and at the same time switching off the filament current of the two L.F. valves.*

For circuit see reply given to **"DE RESKE" (Ashfield).**

**"J.G.W." (Loughborough)** *wishes to know (1) What posts are obtainable connected with wireless other than operating. (2) The qualifications necessary for such posts. (3) How to obtain such qualifications. (4) Probable pay.*

There are many posts, such as designer, research engineer, maintenance or installing engineer, wireless instrument maker, salesman, demonstrator, etc. (2) A thorough knowledge of all branches of modern wireless telegraphy, together with such specialised ability as the post may demand. (3) A sound grounding in electrical, physical and general scientific work, such as can be obtained at any of the recognised university centres, followed by experience in the class of employment selected. As with all other occupations a keen interest in this very specialised work is essential. (4) Varies according to ability, but equal to that in other branches of electrical engineering.

**"K.C.L." (Bedford)** *asks* (1) *If crystal circuit which is that shown on page* 120, *April 22nd issue, but without potentiometer and with blocking condenser can be recommended.* (2) *Windings for coils to tune up to* 4,500 *metres.* (3) *Dimensions for making variable condenser with large test tube.* (4) *Whether it would be an advantage to use smaller tuning condensers but connected in parallel to make up the necessary total capacity.*

(1) Yes. (2) Aerial coil of loose coupler, 4" of winding on 4" former of No. 26 D.C.C. Loading coil 8" of winding on 4" former No. 26 D.C.C. Secondary 4" of winding, No. 28 D.C.C. with tappings according to your switches. (3) This method will not give sufficient capacity (0·0005 mfd.), but if you are particularly desirous of working somewhat to these lines see page 197, May 13th issue. You may increase the capacity by completely covering the outer face with foil, and arranging inner plate which extends round the wooden cylinder slide, instead of revolve. (4) Little would be gained.

**"H.E.P." (Birmingham).**—(1) The address of Messrs. Robert W. Paul is 69, Addison Road, W.14, and their works are at New Southgate, London, N. (2) Without a description of the set it is quite impossible to give you a diagram or (3) advise you on its capabilities.

**"T.H." (Marske-by-the-Sea)** *submits two circuit diagrams and wishes to know* (1) *If they are correct.* (2) *Which would give the better results.* (3) *Which would be the easier to construct and manipulate.*

In your circuit (1) you show both potentiometer and grid condenser, grid potential control, on the rectifier valve. Both are not necessary but, of course, would not be detrimental. As you tune the plate circuit with the intervalve oscillation transformer, in construction you might provide a varying coupling. It is not necessary to bridge the primaries of the second intervalve transformer and telephone transformer with condensers. Do not connect the aerial tuning condenser on the earth side of the aerial tuning inductance when in series, for if you do you will have the whole of your receiving apparatus insulated from earth and above earth potential. (2) Circuit No. 1, as rectification, must be arranged after high frequency amplification. (3) Very little to choose between with regard to construction, but the operation of reaction coil in the plate circuit of the second valve as in circuit 1 would be easier.

**"S.T." (Manchester)** *asks* (1) *For approximate windings for H.F. transformers for operating on wavelengths of* 600/10,000 *metres.* (2) *Dimensions of formers for these tranformers and sizes of wire.* (3) *Diagram for two-valve circuit for telephony, using transformer coupling and tunable to* 24,000 *metres.* (4) *Whether slab coils are suitable for telephony.*

(1) and (2) Use former of ebonite rod 1" in diameter, and wind with Nos. 28 to 42 S.S.C. wire. For wavelengths up to 300 metres use 150 turns for primary and the same number for the secondary, wound over one another and insulated with a single layer of empire cloth. For 600 metres use 600 turns each. For 1,200 metres use 1,500 turns each, or, as this will be rather long, 800 turns on a 2" ebonite tube may be used Beyond this wavelength use resistance capacity intervalve couplings. (3) For circuits see Fig. 1, page 235, May 20th issue; Fig. 2, page 213, May 13th issue, and read also article by H. G. Evans, M.Sc., page 133, April 29th issue. (4) Yes, and you would be well advised to construct them in the manner shown on page 328, June 10th issue.

**"GRID LEAK" (Glasgow)** *asks* (1) *How to convert "office" receivers into L.R. head telephones* (2) *Windings for a suitable transformer for use in connection with these receivers.* (3) *Names of firms supplying wireless apparatus on a deferred payment system.* (4) *Capacity of a given condenser.*

(1) and (2) We do not understand what type of receivers you refer to, but if you mean receivers such as are used for land-line telephony, we do not think that these can be successfully rewound for wireless use. (3) We are not aware of any firm undertaking this class of business. (4) About 0·0002 mfd.

**"J.H.A." (Bedford)** *wishes to make a receiver for the reception of telephony, C.W. and spark signals up to* 3,500 *metres. He has aerial and a pair of telephones and proposes adopting the circuit shown on page* 100, *April 22nd issue, and does not want to spend more than* £6. *He asks for windings for inductances and values of condensers.*

The aerial tuning condenser should be of the air dielectric type, and have a maximum value of 0·001 mfds. This can be purchased from any of the dealers in surplus Government wireless apparatus, to whom you should apply for prices. The aerial inductances may consist of a total of 8" of winding of No. 28 D.C.C. on a 5' former, and the reaction coil 4" of winding on a 3½" former and sliding inside the aerial inductance. Both inductances tapped out. The aerial at about 20 points and the reaction circuit about 7. Special coils should be made for 400 metres telephony of the style shown on page 328, June 10th issue, using one in the aerial and one in the reaction circuit. The grid condenser should consist of three strips of metal foil, ¾" wide by 1¼" overlap, and separated with two of mica 0·002 in thickness. The leak should have a valve of about two megohms, and you are recommended to purchase one of reliable make. The intervalve transformer may also be purchased from dealers in ex-Government wireless apparatus, or made up as described on page 152, May 28th, 1921, issue. Condensers C2 and C3 should consist of 15 metal foils of above dimensions, separated with 16 micas.

**"N.H." (Shrewsbury)** *wishes to know* (1) *Power required to communicate over a distance of* 190 *miles, using P.M.G aerial and single valve receivers.* (2) *What valves to use in circuit diagram.* (3) *Dimensions of A.T.I. and A.T.C.* (4) *Whether he would be permitted to communicate over this distance.*

(1) With efficient apparatus 50 watt valve transmitters should be suitable for signalling over this distance (2) and (3) The "U" type, made by the General Electric Company, would be suitable, but write to the valve manufacturers stating your requirements. 240 volts is too low for the power stated in (1). For circuit diagrams and windings see pages 127 to 144, May 28th, 1921, issue, omitting, of course, microphone and modulating valves. (4) Depends upon circumstances, and judging from your letter we should think improbable but ask the Postmaster-General, giving him your reasons

**"H.W.W." (Walthamstow)** —Your circuit A is satisfactory, excepting that you have omitted

a condenser 0·002 mfd across the telephone receivers, and also it is better to connect the aerial tuning condenser on the aerial side of the inductance than in the earth lead, so that the whole of the apparatus is not insulated from earth with its components all above earth potential. Your circuit B is not recommended, whilst circuit C is quite good, but try loose coupling in the aerial circuit.

**"W.G.M." (Bristol).**—(1) The circuit you submit is quite good, but you omit to show a condenser (0·002 mfd.) across the telephone receivers. For the construction of such a set see page 140, April 29th issue, and also watch the "Experimental Station Design" appearing in alternate issues. (2) Receiving range will depend upon efficiency of aerial and power of transmitting station, but as an example it should be capable of receiving the telephony transmitted by Writtle **(2 MT)** up to 50 miles. (3) and (4) Extra valves can be added in the many ways shown from time to time in this journal. See page 100, April 22nd issue.

**"S.A.R." (Croydon).**—(1) Your circuit Fig. 1 is quite correct, but without further practical details we cannot suggest cause of your trouble, as it must obviously lie in some constructional error. Your Fig. 2 is rather strange. For the reception of Croydon telephony transfer the variable condenser to the aerial circuit. No circuit termed "reaction" is required with a crystal receiver. (2) You can easily add H.F. valve and for circuit see Fig 8, page 217, May 13th issue, using common H.T. and L.T. batteries for the operation of both valves. (3) "Note magnifying" or "L.F valves" magnify after rectification of oscillations. "H.F." valves increase the amplitude of high frequency oscillations. (4) The basket coils you propose making are quite unsuitable for 400 metre reception. The aerial coil 1" inside diameter × 4" outside, wound with No. 36, would tune a P.M.G. aerial up to approximately 1,200 metres, and such fine wire is not recommended. Make up flat coils similar to those shown on pages 327 and 328 June 10th issue.

**"R.W.D." (Derby).**—(1) and (2) Your trouble in the reception of telephony, inasmuch as signals are strong but undecipherable, is probably due to difficulties in the manipulation of reaction.

**"E.W.M." (W.C.2)** *wishes to know with regard to a C.W. Mark III receiver.* (1) *Whether it wil receive the Dutch Concert.* (2) *If it is a good set for telephony reception.* (3) *Whether the oscillations it is likely to set up will prove a nuisance to other amateurs in the neighbourhood, and if so how far will its effects be felt.* (4) *For suggestions for improvement.*

(1) Suitable, but the inductances may need to be rewound to suit the dimensions of your aerial. The Dutch Concert is difficult to receive compared with the British telephony transmission, particularly that occasionally transmitted by Marconi House **(2 LO)**. (2) Quite good. (3) Yes, in the immediate vicinity, say up to half a mile, and depending upon the degree of amplification used by the stations affected. It is a record that oscillating receiving sets using less than 70 volts H.T. have interferred with other stations 15 miles away. (4) For short wave work connect the aerial tuning condenser in series with the aerial tuning inductance.

**"T.R.S.S." (Perth)** *asks* (1) *Will the Paris time, English and Hague Concerts be heard distinctly at Perth with a Sullivan two-valve amplifying receiving panel.* (2) *Is a twin aerial earth wire 47' long and 2½' apart sufficient.*

(1) Paris time probably, but English and Dutch Concerts very doubtful. (2) Yes, if the aerial is well above the level of the roof. It is better to separate the wires more than 2½'.

**"S.W." (London)** *asks* (1) *If amateur receiving is allowed in Ulster.* (2) *Where to apply for the necessary licence.*

(1) and (2) Write to the Secretary, G.P.O., London and he will no doubt pass your letter to the administrative authority concerned.

**"DABBLER" (Partick)** *asks* (1) *The name and address of a firm which makes or sells the "Johnsen Rahbek" loud speaker.* (2) *Where it would be possible to obtain an agate cylinder.*

(1) To the best of our belief this instrument has never been made commercially, at all events in this country. (2) Any good firm of lapidaries would probably undertake grinding the agate cylinder for you or one of the firms advertising experimental work in the columns of this, or other scientific periodicals, would probably undertake the construction of the complete apparatus. A letter on the subject addressed to author of recent article, care of this Journal, would be forwarded and might bring you helpful information.

**"SPARKS" (Grimsby)** *asks with regard to a crystal set* (1) *What distance or wavelengths he will get.* (2) *Any suggested improvements.* (3) *What apparatus is required for a two-valve set capable of receiving Dutch Concerts.* (4) *Diagram of a two-valve set showing arrangement.*

(1) A properly arranged set would tune to about 2,000 metres, but would not be efficient above about 800 with so small a coil. (2) The suggested scheme is very poor. Try the circuit of Fig. 2, page 120, April 22nd issue. (3) Apparatus required :—

- H.T. Battery.
- L.T. Battery.
- 2 valves.
- 2 Valve holders.
- 1 Grid condenser and leak.
- 1 Filament resistance.
- 1 Anode resistance.
- 1 Reaction coil.
- 1 Blocking condenser.

(4) See diagram in Fig. 2, page 213, May 13th.

## SHARE MARKET REPORT

Prices as we go to press on June 30th, are :—

| | | | | |
|---|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 6 | 9 |
| ,, Preference .. .. | 2 | 3 | 6 |
| ,, Inter. Marine .. .. | 1 | 10 | 0 |
| ,, Canadian .. .. | | 10 | 9 |
| Radio Corporation of America :— | | | |
| Ordinary .. .. .. | 1 | 0 | 3 |
| Preference .. .. .. | | 14 | 6 |

15th JULY, 1922. THE PRICE 6D. NET.

# WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 16. 15th JULY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE
# WIRELESS WORLD
AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 16. JULY 15TH, 1922. WEEKLY

## A Four Valve Station Particularly Suitable for Short Wavelengths

By PERCY W. HARRIS.

IT is generally accepted that to obtain the highest efficiency of reception on all wavelengths from the very shortest in everyday use (about 180 metres) to the great wavelengths used for long distance communication, two distinct sets of apparatus should be used, one for the short waves and one for the longer. The several reasons for this have frequently been discussed in this magazine and have been pointed out in answers to correspondents. The growing use of short waves for amateur communication, and particularly the adoption of short waves for broadcasting, has drawn renewed attention to the subject, and the writer ventures to think that a description of a special short wave set which he has recently constructed may aid those amateurs whose attention so far has been concentrated on wavelengths above the 400 mark.

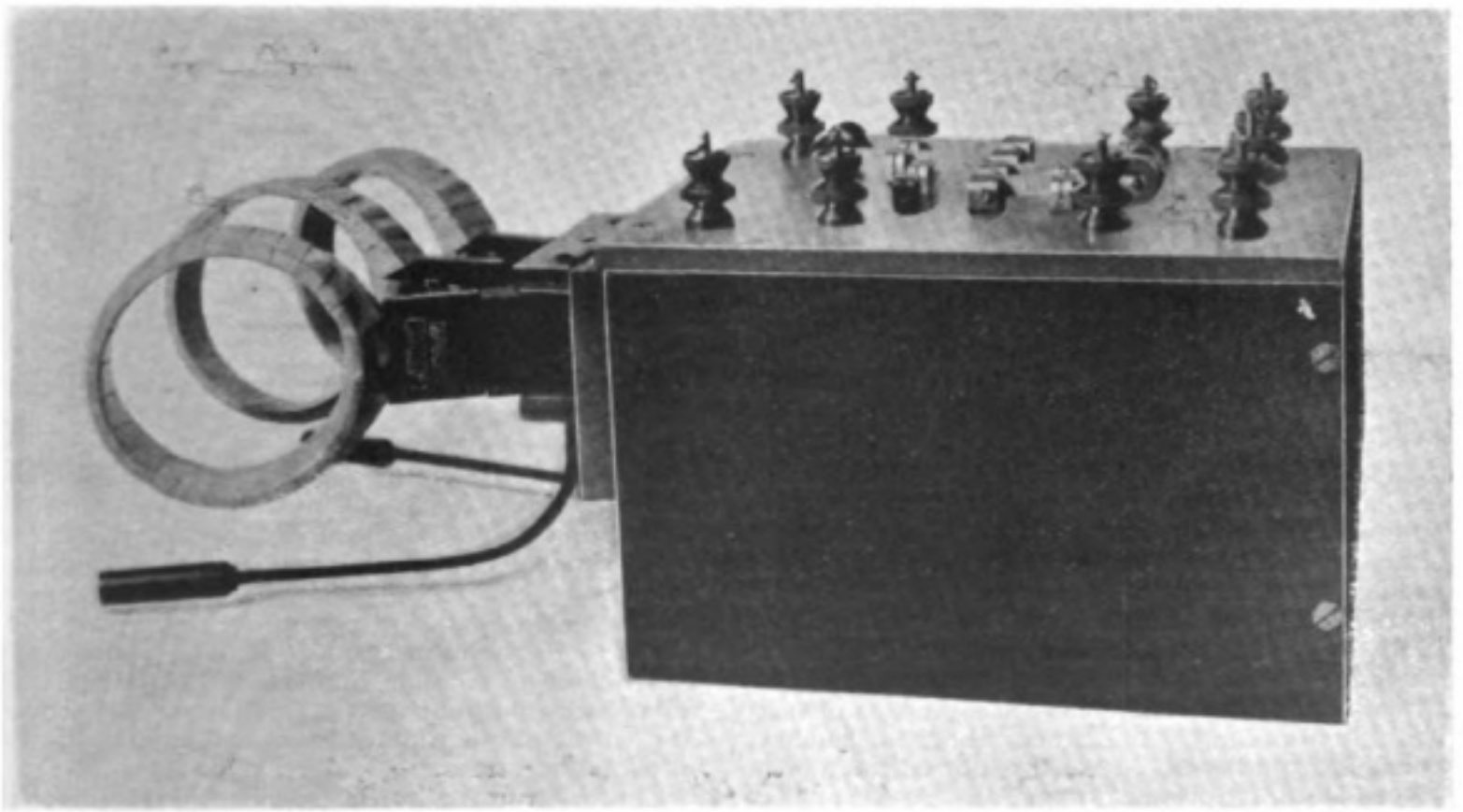


*Fig. 1. The Tuning Unit with three short-wave coils in place.*

As a preliminary it should be stated that the efficient reception of short waves is by no means easy, and if efficient high frequency amplification is also desired it is hopeless to expect a set of the "one-control" variety. The apparatus to be described is therefore designed, not for the actual beginner, but for the serious experimenter who is prepared to take a little trouble in adjustment to obtain the best results. Incidentally the reception of long wavelengths has also been borne in mind, as well as the adaptability of the component parts to general reception work, and the construction is such that it can be attempted with a minimum of tools.

## THE TUNER.

Short wave reception can be carried out with the detector shunted across the aerial inductance, and not placed in a secondary circuit. In such cases a variable condenser may be connected either in series or parallel. In the first case there is loss of efficiency, and in the second very few turns, and therefore low potentials on the grid, are the inevitable consequence. For this reason, at least, it is advisable to place the detector in a secondary tuned circuit where a greater potential is obtainable, and a further advantage consists in the greater selectivity which results. A reaction coil is also desirable if the best is to be obtained from the valve.

Interchangable plug-in coils, of the honeycomb, duo-lateral and other types are very popular, but until recently have not been available in efficient forms for short-wave working. Within the last month or two a series of short-wave coils have been placed on the market by one of the firms in the trade, consisting of single-layer inductances wound on ebonite formers of about three inches in diameter. These are eminently suitable for short-wave work, the self capacity being low, and were chosen by the writer for the set under description.

Strangely enough, there appears to be no *tuner* on the market designed to take three coils. Several devices are given this name, but on examination they prove to be nothing but three-coil holders, without any means of changing from "stand-by" to "tune," or from "series" to "parallel" in the case of the aerial tuning condenser, other than by disconnecting the several leads and reconnecting them in the desired fashion. The writer therefore set to work to design and make a tuner to fill his requirements, detailed drawings and photographs being given here.

Bearing in mind that variable condensers are expensive, and that most workers use all they have for general experimental work, the variable condensers are not built into the tuner, but are connected to the necessary terminals. This has the further advantage that for very short wave work, small variables can be used, and for long wave working, condensers of larger value can be connected up. The general appearance of the finished instrument will be seen in the first photograph.

On the top of the panel, which is made of ¼-inch ebonite, there are ten terminals in all. Of the back row the two on the left are for aerial and earth respectively, and the pair on the right for reaction. The terminals for connecting the detector or first valve are on the right (middle), the two lower pairs being reserved for the primary and secondary condensers.

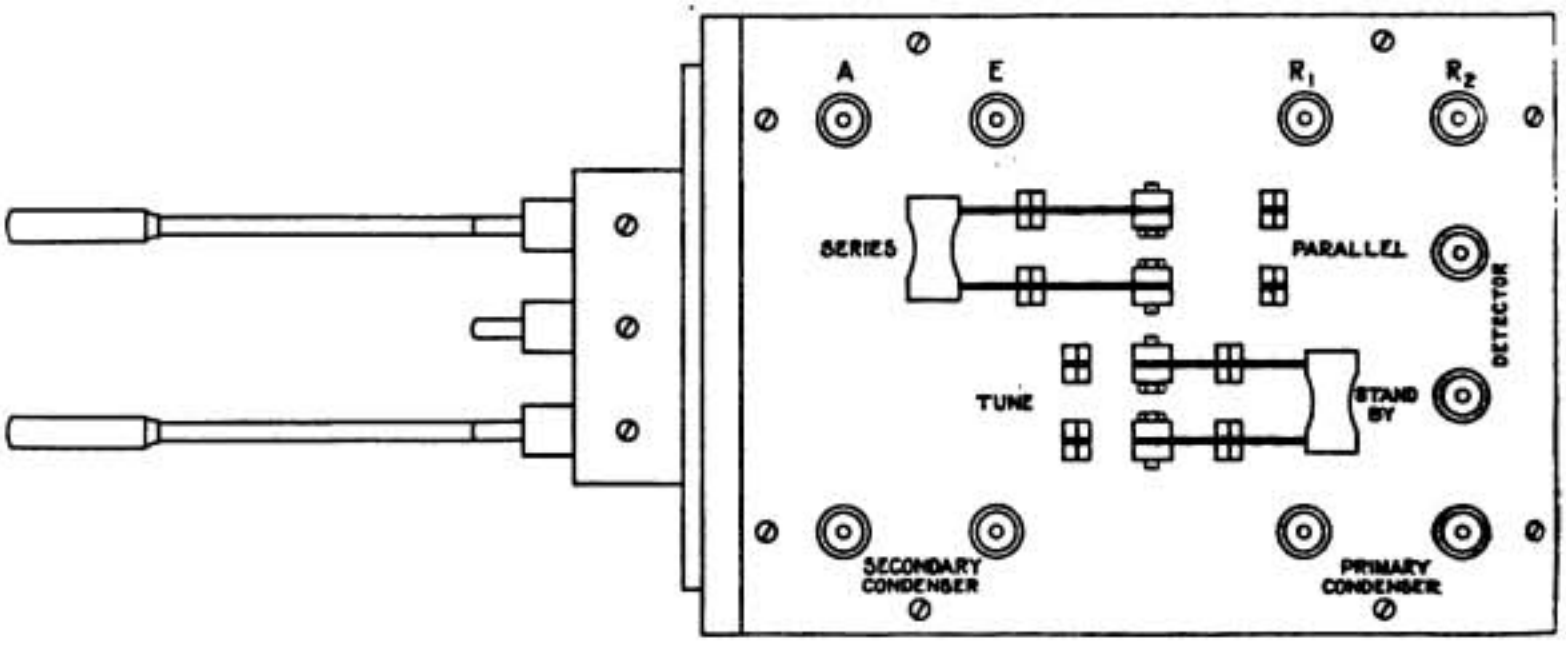



*Fig. 2. Arrangement of terminals and switches.*

In the middle of the panel are two double-pole, double-throw switches (taken from an old Mark III tuner, in this case), the upper of which changes the primary condenser from series to parallel, the lower changing the detector from across the primary inductance to across the secondary. On the left of the instrument is mounted a three-coil holder purchased complete from one of the advertisers in this paper. The actual connections are shown photographically and diagrammatically in the illustrations.

This instrument works excellently in practice. A further refinement might have been added by making the reaction connections reversible

by a switch, but this would have added to the complications of the wiring, which is inadvisable in short-wave work. Further, it is necessary when working on "stand-bi" to swing the secondary coil well away from the primary, or some of the energy will be absorbed in the closed circuit. In the army tuners arrangements were made to disconnect one lead of the secondary circuit when working on the primary side, but in the set described this was not done—once more to avoid complications. If the secondary coil is swung back, no trouble will be experienced, while the wiring is much simpler.

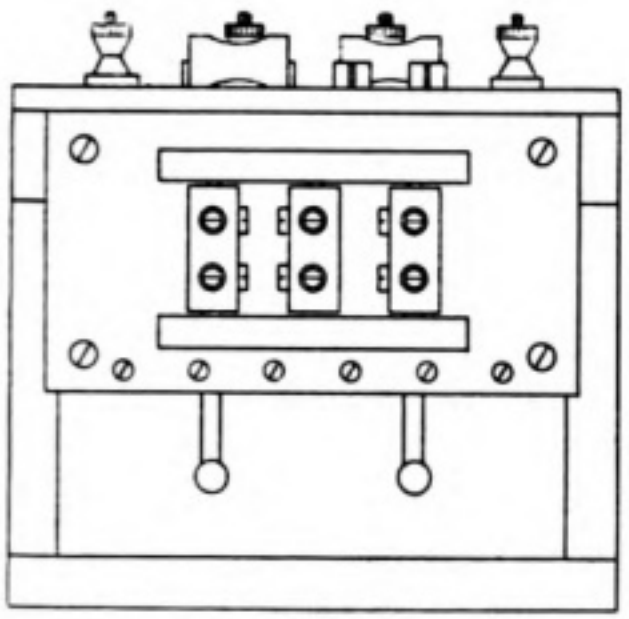


*Fig. 3. End view showing three-coil holder.*

Wiring is effected with No. 18 tinned copper, with the exception of the leads from the coil holder, which are No. 24. Connections are soldered throughout and sistoflex tubing fitted to each lead. The box measures five inches deep by six inches wide, this measurement being standard throughout the set. The tuner is eight inches long. The other units are longer.

In building up the set the box should be obtained or constructed first, the bottom being left unattached. Then obtain the sheet of ebonite and cut it to the exact measurements of the top of the box, and drill the necessary holes for switches and terminals. When these are fitted attach the three-coil holder to the side of the box, previously connecting long leads to each of its six terminals. These leads should be threaded through six holes in the box, the holes being made large so that subsequently insulating tubing can be slipped through in a way to be described. Quarter-inch holes will do for this purpose. In mounting the holder, see that none of its terminals touch the wood of the box, or there may be leakage.

All connections, save those to the three-coil holder, can be made on the panel before it is fitted to the box. When this is done attach the panel with eight wood screws in counter-sunk holes, as shown, and invert the whole box.

Take each of the leads from the three-coil holder, stretch it across to its correct terminal and cut off just enough wire to reach. Then cut a length of insulating tubing about a quarter of an inch less than the length of the lead, and slip it over the wire, forcing it through the hole in the box right up to the terminal of the coil holder outside. This will effectively insulate the wire from the box. The tip of the terminal should have been "tinned" previously, and if a well-heated soldering bolt is used, each lead can be neatly joined without difficulty to its proper terminal.

A tuner constructed in this way will be found to be equally efficient on long and short waves, if for the latter single-layer coils are used. Such coils are easy to construct, and can be wound on ebonite tube of three inches or more in diameter, subsequently being fixed to the well-known plug mountings. As, however, a set of four such coils can be bought for about 25s., they are scarcely worth the trouble of making, taking into account that the plugs must be purchased in any case. For long waves any of the well-known multi-layer

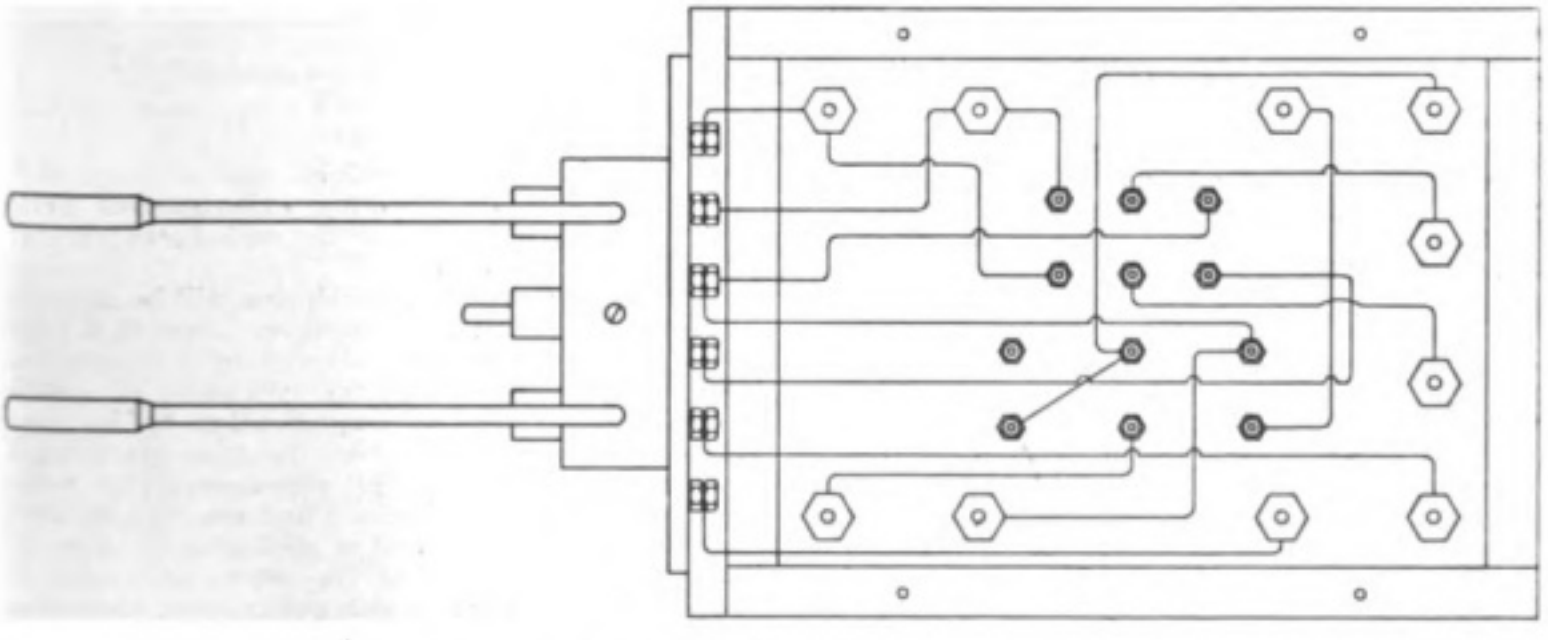


*Fig. 4. Under side of panel to show wiring.*

coils will suit, as the plug fittings are now standardised.

For short wave working a pair of 0·0005 mfd. variable condensers will serve quite well, although on "concert" wavelengths a 0·001 mfd. is not too large to handle when practice has been obtained. Those who have them can use vernier condensers in addition. The best reaction coil for the particular wavelength will be found by trial, but usually one number above or below that used for the detector circuit will be found about right. Thus a "50" coil will work well with a "75" for reaction, or a No. 4 short-wave coil with a No. 3.

It will be noticed that the reaction coil is arranged to act on the aerial circuit. It would be difficult to arrange otherwise, for it must act on the aerial circuit when "stand-bi" is used, and to act on the secondary on "tune" adjustment would need an elaborate change-over switch which would again complicate the device. The writer always uses a separate heterodyne for C.W. reception, so that this reaction on the aerial does not cause radiation in his case. If, however, the user wishes the reaction to act on a loosely coupled secondary, it is only necessary to place the switch on "stand-bi," the condenser switch on parallel, connect the aerial and earth to the secondary condenser terminals, and leave the other connections as they are. If the aerial condenser is needed in series and not in parallel, the condenser which is normally the secondary should be placed in series with the aerial wire, the switch on the tuner being still left at parallel, as this is, at the moment, controlling the secondary circuit. The fact that all leads are brought out to terminals makes it possible to use this tuner for other experimental work, such as using the third coil for variometer working with one of the others.

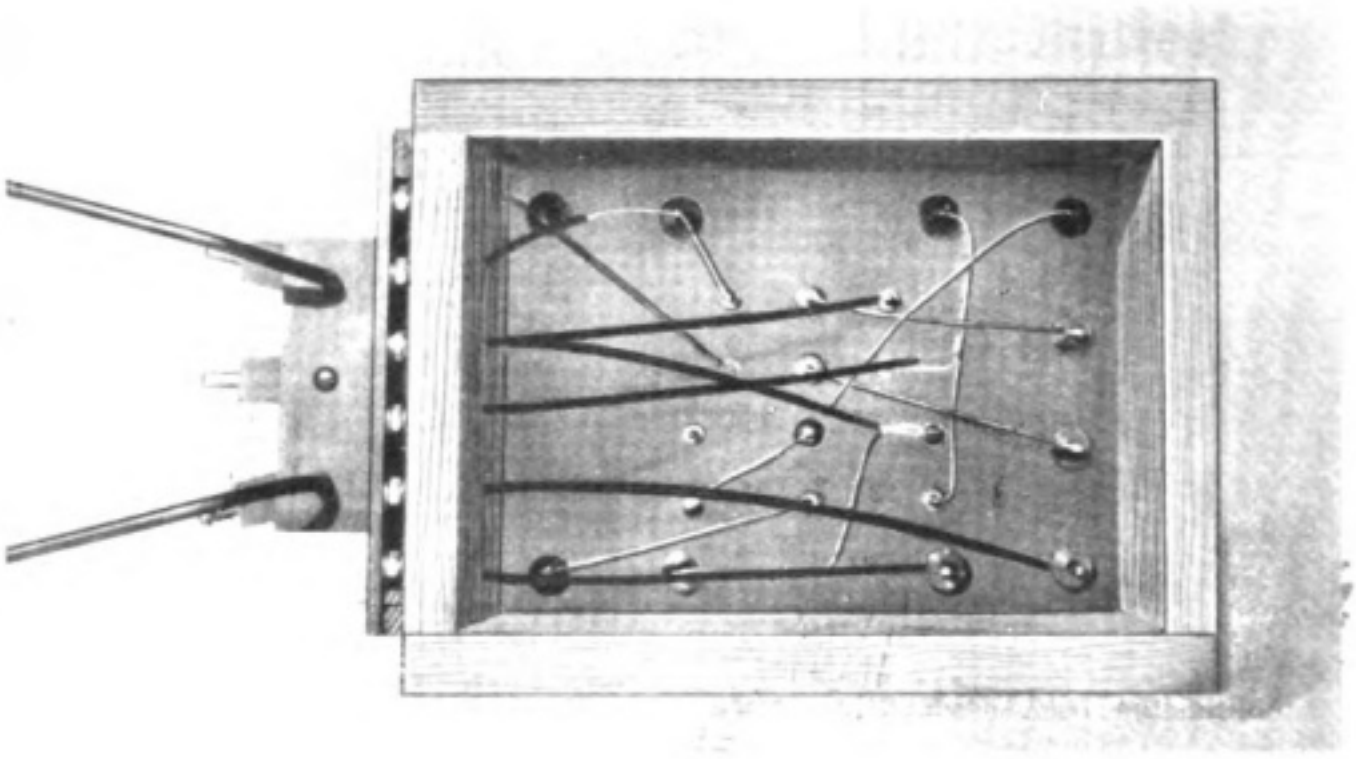


*Fig. 5. A photograph of the under side of the tuner, with bottom of box removed.*

In the next article a description will be given of a two-valve short-wave receiver (one H.F. and detector). This will be followed by a description of a two-valve note magnifier with switch to enable one or two stages of magnification to be used at will, the whole set, with the tuner, forming a four-valve station of high efficiency. The tuner and the two-note magnifying unit are both suitable for long-wave work, and a method will later be described for converting the short-wave unit to long-wave working at a moment's notice. Questions on this set will willingly be answered through the columns of the magazine.

# Time Signals

## HOW CLOCKS ARE CHECKED WITH SCIENTIFIC PRECISION.

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

**(1) Historical.**

AS the practical outcome of efforts made by the *Bureau des Longitudes*, a time-signal service was established in 1909. Signals were first transmitted twice daily by the radio-telegraphic station at the Eiffel Tower and were primarily intended for navigation purposes. Shortly afterwards, the German wireless station at Norddeich established a time service, using a different code from that used in the Eiffel Tower transmissions. The practical value of these two services having been demonstrated and their usefulness to navigation and other purposes having been proved, a conference was called in 1912 to consider the whole question upon a world basis and to devise an International Code for transmission. Accordingly, a new system was drawn up and was first employed on 1st July, 1913, by the Eiffel Tower. This system is still used by this station at 0923 every day and by nine other stations in different parts of the world. The original system, generally known as the French system, is, however, still used by FL at 1044 and 2244. At the present time there are 45 stations which send out T.S. regularly. Unfortunately there has been but little co-operation among the various countries in the use of a standard code, with the result that these 45 stations use no less than 15 different codes between them.

A list of stations and their transmissions is given in the table below in connection with which the following points should be noted :—

i. Times of sending are given in G.M.T., civil reckoning (*i.e.*, 0000 corresponds to midnight, 1200 midday, the third and fourth figures signifying minutes past the hour).

ii. In most cases the Greenwich mean times are adhered to both in summer and winter.

### TABLE

COMPLETE LIST OF STATIONS TRANSMITTING TIME SIGNALS

| Country. | Station. | Call. | Wave-length. | G.M.T. Times. | Notes. |
|---|---|---|---|---|---|
| Australia .. .. | Adelaide .. .. | VIA | 2,600 | 0227–0230<br>1427–1430 | International. |
| .. .. .. | Melbourne .. .. | VIM | 600 | 0157–0200<br>1357–1400 | .. |
| .. .. .. | Perth .. .. | VIP | 600 | 2257–2300<br>1057–1100 | .. |
| .. .. .. | Sydney .. .. | VIS | 600 | 2257–2300<br>1057–1100 | .. |
| New Zealand .. | Wellington .. .. | VCW | 600 | 0859–0905 | Automatic ; dashes begin at 0900–1–2–4–5. |
| South Africa .. | Capetown .. .. | VNC | 600 | 2059–2100 | Special Code. |
| Portuguese S. Africa | Lourenço Marques .. | CRZ | 600 | 0757–0800<br>1857–1900 | International. |
| Canada .. .. | Camperdown .. | VCS | 600 | 1358–1400 | Special code. |
| U.S.A. .. .. | Annapolis .. .. | NSS | 17,000 arc | 0255–0300<br>1655–1700 | American system ; daily. |
| .. .. .. | Eureka .. .. | NPW | 2,000 | 1955–2000 | .. .. .. |
| .. .. .. | Great Lakes .. | NAJ | 1,512 | 1655–1700 | .. .. ..* |
| .. .. .. | Key West .. .. | NAR | 1,500 | 0255–0300<br>1655–1700 | .. .. .. |
| .. .. .. | New Orleans .. | NAT | 1,000 | 1655–1700 | .. .. .. |
| .. .. .. | North Head .. .. | NPE | 2,800 | 1955–2000 | .. .. .. |
| .. .. .. | Point Arguello .. | NPK | 1,512 | 1955–2000 | .. .. ..* |
| .. .. .. | San Diego .. .. | NPL | 2,400<br>9,800 | 1955–2000 | .. .. ..* |
| .. .. .. | San Francisco .. | NPG | 2,400 spk.<br>4,800 arc | 1955–2000<br>0555–0600 | .. .. ..<br>.. .. .. |
| .. .. .. | Washington .. .. | NAA | 2,500 spk. | 0255–0300<br>1655–1700 | .. .. .. |
| Panama .. .. | Balboa .. .. | NBA | 7,000 arc. | 1755–1800<br>0955–1000 | .. .. .. |
| .. .. .. | Colon .. .. | NAX | 1,500 spk. | 1755–1800<br>0955–1000 | .. .. .. |

* Except Sundays and holidays.

| Country. | Station. | Call. | Wave-length. | G.M.T. Times. | Notes. |
|---|---|---|---|---|---|
| Panama .. .. | Darien .. .. | **NBA** | 10,110 | 1755–1800<br>0955–1000 | Operated under distant control from Balboa. |
| Hawaii .. .. | Pearl Harbour .. | **NPM** | 600 damped<br>11,200 undamped | 2355–2400 | American system. |
| Brazil .. .. | Rio de Janeiro .. (Ilha de Governador) | **SOH** | 1,800 | 1355–1400<br>2355–2400 | International.<br>(Signals sent 30 minutes later in case of accident preventing transmission at correct time.) |
| Argentine .. | Buenos Ayres .. | **LIA** | 800 | 0155–0200 | Dots (duration ½ sec.) at end of each minute Daily, except Sundays and holidays. |
| Chili .. .. | Valparaiso .. .. | **CCE** | 600 | 1255–1300 | Dots every sec., except 29 and 51–58 inclusive, daily, except Saturdays, Sundays and holidays. |
| India .. .. | Bombay .. .. | **VWB** | 2,000 | 0057–0100<br>1257–1300 | International. |
| ,, .. .. | Calcutta .. .. | **VWC** | 2,000 | 0127–0130<br>1327–1330 | ,, |
| Dutch E. Indies.. | Soerabaya (Java) .. | **PKH** | 600 | 0209–0214 | Dots at 0210–12–14. |
| ,, .. | Weltevreden (near Batavia). | **PKB** | 600 | 0059–0104 | Dots at 0100–1–2–3–4. |
| Borneo .. .. | Kucking (Sarawak).. | **VQF** | 600 | 0039 | Special code. |
| Philippines .. | Cavite .. .. | **NPO** | 952 spk.<br>5,000 arc. | 0255–0300<br>1355–1400 | Dots every sec., except 28, 29 and 54-59 inclusive of each min., daily. |
| China .. .. | Hongkong .. .. | **BXY** | 2,000 | 0156–0200<br>1256–1300 | Dots of about 0·2 sec. duration at even secs.: 2, 28, 50, 52, 54 secs. omitted. |
| ,, .. .. | Shanghai .. .. | **FFZ** | 600 | 0253–0259<br>0853–0859 | Dots at 55, 57, 59 mins. past hour. |
| Indo-China .. | Kien-An .. .. | **FKA** | 600 | — | Special code. |
| Japan .. .. | Funabashi .. .. | **JJC** | 4,000 | 1159–1204 | Dashes begin at 59–00 01–02–03 04. |
| ,, .. .. | Choshi .. .. | **JCS** | 600 | 1159–1204 | ,, ,, ,, |
| Germany .. | Nauen .. .. | **POZ** | 3,100 | 1157–1200<br>2357–2400 | International. |
| France .. .. | Eiffel Tower .. | **FL** | 2,600 spk. | — | Times and codes given in previous article. |
| ,, .. .. | Lyons .. .. | **YN** | 15,500 | 0850 | Rythmic signals. |
| ,, .. .. | ,, .. .. | **YN** | 15,500 | 0859–0904 | Time signals. French system. |
| ,, .. .. | Bordeaux .. .. | **LY** | 23,450 | 1950 | Rythmic signals. |
| Indian Ocean .. | Mauritius .. .. | **BZG** | 2,000 | 0859–0901<br>2059–2101 | Dash operated from ob. at 0901 and 2101. |
| Mexico .. .. | Chapultepec .. | **XDA** | 2,000 | — | Special code. |
| Java .. .. | Malabang .. .. | **PKX** | 8,800 | 0057–0100 | ,, ,, |
| Russia .. .. | Petrograd .. .. | **TSR** | — | 1900–1905 | Dots at –03–04–05. |
| ,, .. .. | ,, .. .. | **TSR** | — | 1906–1914 | Rythmic signals. |
| ,, .. .. | Moscow .. .. | **MSK** | — | 2155–2200 | Dots at –58–59–00. |
| ,, .. .. | ,, .. .. | **MSK** | — | 2202 | Rythmic signals. |

### (2) The Reception of Wireless Time Signals.

The present time services are of two different types:—

i. Ordinary time signals transmitted either automatically or semi-automatically.

ii. Rythmic-scientific signals which are entirely automatic.

Ordinary time signals such as those sent out by **FL** (see Fig. 3, p. 429*) give G.M.T. with an accuracy of ¼ second for a practised observer, but under the most favourable conditions and by employing a self-registering system of reception, a

* *Wireless World and Radio Review*, 1st July, 1922.

maximum accuracy of 1/100th second is attainable. As previously mentioned, these signals are intended to enable navigators to set their chronometers while at sea at least once a day to standard G.M.T. (or prime meridian time), thus either entirely eliminating errors of rate in the chronometers or reducing such errors to a minimum. If in addition the local mean time of the ship is determined by observing the sun or one of the other celestial bodies, and the observations are timed by the chronometer, the difference between the Greenwich and local mean times will be found and this is the ship's longitude measured from Greenwich. In effect the reception of accurately transmitted time signals is equivalent to establishing a transit circle on board ship. Consequently these signals are of great value when approaching shore or in danger of ice, while they are of sufficient accuracy for most of the ordinary time-keeping purposes of every-day life, such as regulating town and railway clocks.

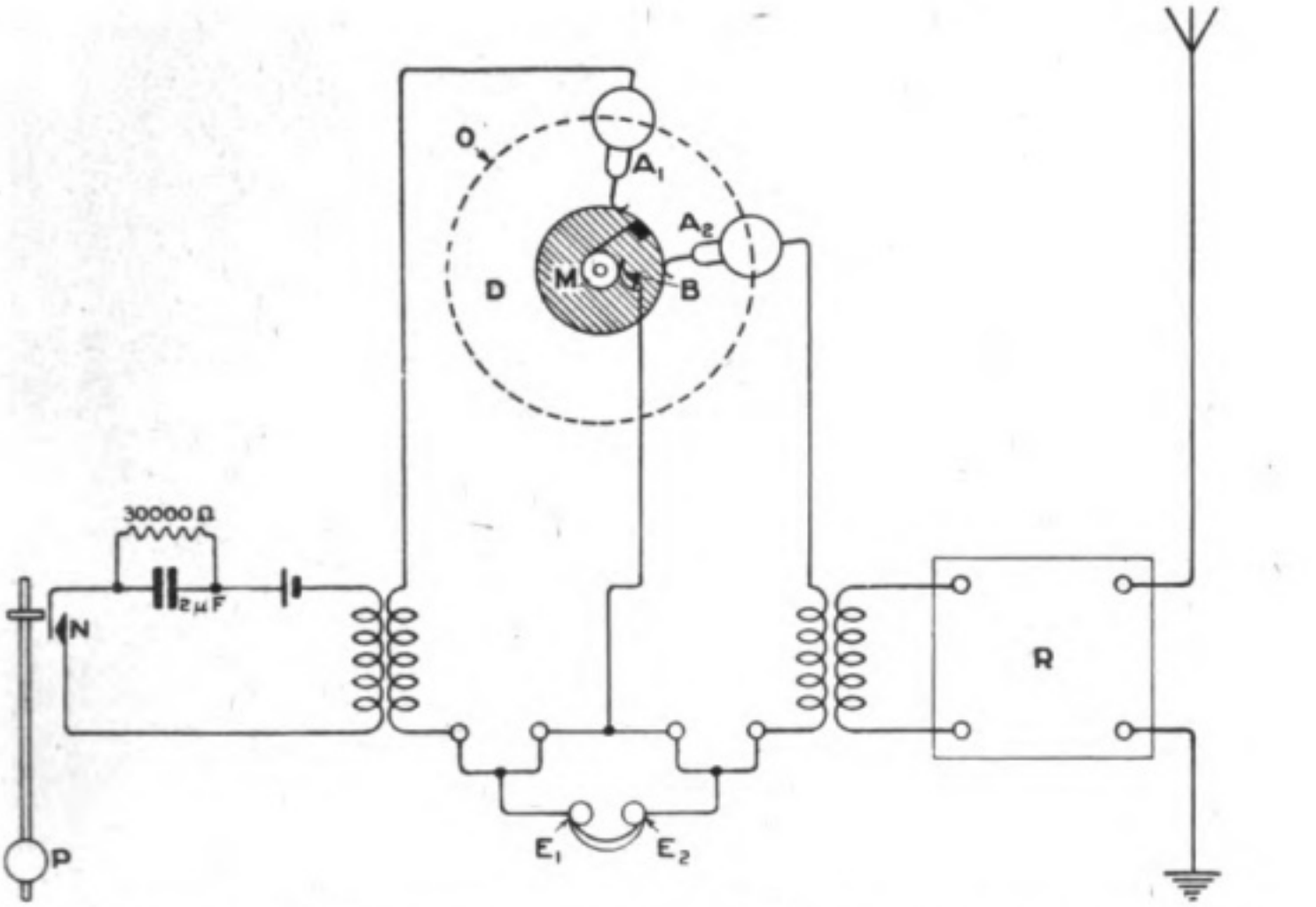



*Fig. 1. Apparatus used in the comparison of American Time Signals with the beats of a local clock for the purposes of the determination of longitude By this method, an accuracy of about 1/100 sec. is obtainable.*

We shall now indicate a method of recording time *as accurately as possible* without the use of any self-registering system. Essentially, the problem is to compare the beats of a local pendulum with

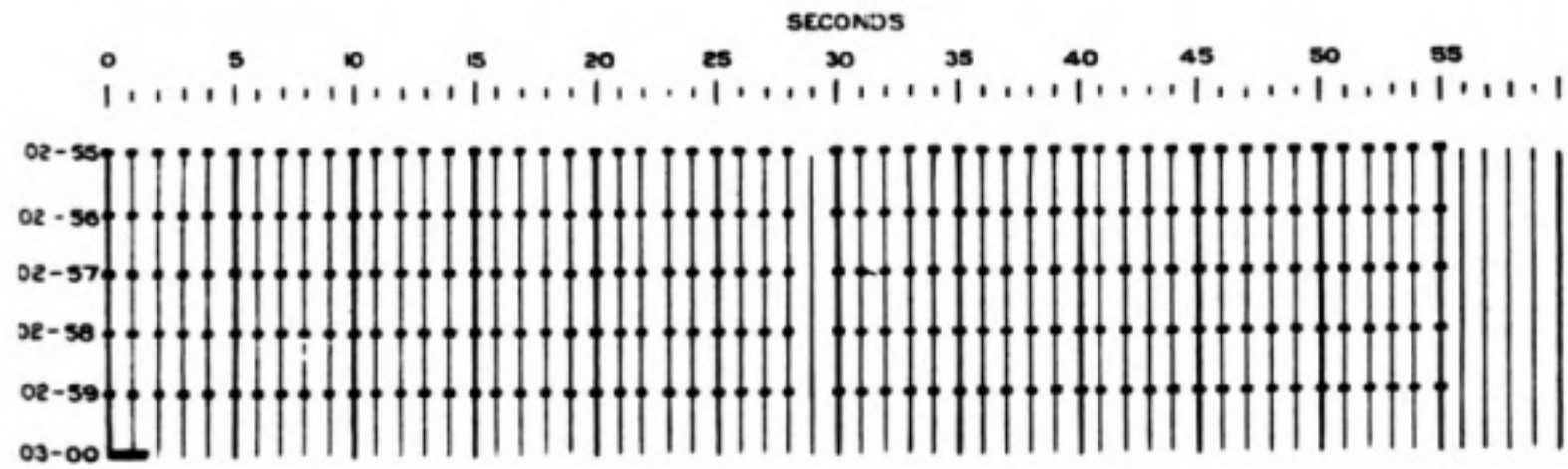



*Fig. 2. American Time Signal System.*

the transmitted T.S., *both* of which must be conveyed to the telephones for aural comparison if anything but the coarsest approximation to the real time is desired. In this connection it may be pointed out that the eye is far less accurate than the ear, and no reliance can be placed on the movements of a seconds-hand between consecutive intervals of one second on the dial of a clock. For conveying the local time to the telephones either a microphone may be suitably placed within the clock chamber or direct contact may be established with the pendulum at successive beats as indicated in the system described (see Fig. 1, circuit $PNE_1$). For convenience, let us imagine that the observer is receiving ordinary T.S. from **FL** (French system, see Fig. 3, page 429*). In this system the dots at 1045, 1047, 1049 are automatically transmitted by the closing of a pendulum circuit of a clock in the Paris Observatory, all the other signals being sent by hand. These dots are of duration ¼ second and are the only signals upon which reliance is to be placed. The observer has to place the position of the dots with respect to the beats of his own time apparatus. The actual reception may be represented more clearly graphically and the observer should proceed as follows :—

In the first place prepare a scale as shown in Fig. 3, the equidistant divisions in the scale marked 1-30 representing the beats of the local pendulum. Next note time of clock at beat 60 = 10h. 45m. Mark off beats as ticked out by the pendulum on the scale, and shown in the figure as dotted lines. By allowing the eye to travel along the scale at a uniform rate, place the ¼ second T.S. dot as accurately as possible between the one second intervals of the pendulum. A practised observer should be able to do this to within a ¼ second.

Calculation : T.S. = 10h. 45m.
Pendulum = 10h. 45m. 10·5s.
Correction = T.S. − (pendulum) = (10h. 45m.) − (10h. 45m. 10·5s.).
= − 10·5s.
∴ Local clock is 10·5s. fast.

The following conditions are necessary for the highest accuracy :—

i. It is essential that the room where observations are made should be quiet and the observer free from disturbance so that his whole attention can be concentrated upon counting the beats of his local pendulum and placing the T.S.

ii. The preliminary signals enable him to tune in his T.S. circuit or adjust his local pendulum circuit until the ticks of the pendulum are just slightly louder than the T.S.

Continuing in the same manner with the 1047, 1049 signals the final result should be the arithmetic mean of the three.

*Installation at the Paris Observatory for the comparison of Time Signals received from Eiffel Tower, Lyons, Bordeaux, Annapolis, Nauen and other stations with the pendulum of the Observatory clock. Signals received on the frame aerial shown in the photograph are thus compared by aural methods and by self-registering apparatus shown near the window.*

ii. Rythmic signals are sent out regularly by Paris, Lyons and Bordeaux and consist of a series of 300 dots, each formed of a single spark, the 60th, 120th, 180th and 240th dot being suppressed in order to establish the indication for counting purposes. They are automatically transmitted by a pendulum so adjusted that it beats 49/50 second intervals. When brought together for comparison with a local time apparatus using the aural method, they serve the purpose of a time vernier, a

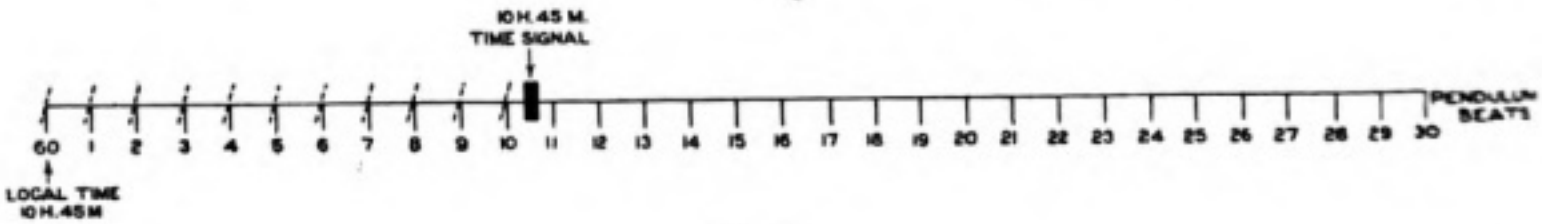



*Fig.* 3.

* *Wireless World and Radio Review*, 1st July, 1922.

reading being made on beats which are coincident (or as nearly so as possible) in the two circuits. This series is heard at the Paris Observatory and compared by the same coincidence method with the tickings of the Observatory clock.

The exact tunes of the 1st and 300th beats are calculated at the Observatory to the 1/100th second and are sent out in the form of a group of 8 figures by **FL** at 1038 and 2236. The first two figures give the sidereal hour, the 3rd and 4th figures the minutes, 5th and 6th seconds, and the last two figures the hundredths of a second, all in sidereal time. The accuracy of the method depends upon the spacing and the number of the coincidences. The limit of accuracy is reached where it becomes difficult to judge the coincidences. With the present system (*i.e.*, dots spaced 49/50 sidereal second) an accuracy of 1/100th second is attainable, and with self-registering apparatus 1/1,000th second.

These signals are of great importance in the determination of longitude. Before the introduction of W/T, longitude determinations have been made by observing the transit of a star across the meridian at one observatory and automatically transmitting this instant by land-land to another observatory, the differences in the times of transit being compared. Experiments have also been made of the degree of accuracy obtainable by carrying chronometers by aeroplane between two different observatories whose difference in longitude is required. Neither method approaches the degree of accuracy obtained by the method of vernier beats.

Fig. 2 shows the code used by American stations. For comparing these dots with a local pendulum beating seconds, the coincidence method is unsatisfactory, but by employing other means a precision of the order of 1/100th second is attainable for longitude determinations. In these cases the following apparatus may be employed. An electrically driven motor is regulated so that its speed is constant as far as possible. The axle of the motor carries a disc M (see Fig. 1) of insulating material, which completes a revolution in one second. The edge of the metallic sector S is 1/100th of the circumference of the disc M. Brush contacts A and B complete the local pendulum circuit $PNE_1$ through S, while $A_2$ B complete the T.S. circuit R $A_2$ B $E_2$. $A_1$ and $A_2$ are movable contacts. The observer listens simultaneously in the telephone ear-piece $E_1$ to the series of beats produced by the making and breaking of the arm of the motor and the movable contact A, as well as to the series of beats of the pendulum. Thus by altering the position of $A_1$, the beats of the two series may be exactly superimposed so that they appear as one to the listener. Similarly, by altering the position of $A_2$, the two series (local pendulum and T.S.) may be superimposed. The angular separation of $A_1$ and $A_2$ then gives the interval separating the two series of signals.

# Welcome News Regarding Patents

## THE ATTITUDE OF MARCONI'S WIRELESS TELEGRAPH CO., LTD., TOWARDS THE ACTIVITIES OF AMATEURS

AS a result of recent actions brought by Marconi's Wireless Telegraph Company, Ltd., against certain manufacturers for infringements of patents owned by that Company, there exists considerable uncertainty amongst amateurs as to their position in relation to the patent situation.

This is made apparent by the numerous letters on the subject received by *The Wireless World and Radio Review*, and in the interests of all wireless amateurs we referred the question to the Marconi Company in an interview.

We found the attitude of that Company towards amateurs to be very encouraging, and we have been authorised to make the following announcement, which should remove completely the uncertainty to which we have referred above.

Far from wishing to take advantage of its patent rights to hamper and discourage amateurs, the Marconi Company expresses its desire to assist rather than hinder them in following their hobby.

The Company has no intention of taking any action against amateurs who construct for their own use wireless apparatus embodying any of the patents owned by the Marconi Company, provided that such apparatus is not offered for sale, and is used only for amateur purposes. In this particular connection "construct" is intended to signify the actual manufacture, wholly or in part, of a wireless set, and not the mere connecting up of purchased instruments.

On the other hand the Company intends to protect its rights when unauthorised use is made of its patents in the manufacture of apparatus for sale publicly or privately.

Any patent action the Company has taken hitherto has been confined to the protection of its rights in respect of apparatus manufactured for sale by firms or individuals in infringement of the Company's patents with the object of commercial profit.

We feel sure that this announcement, which is endorsed by the Marconi Company, will give full satisfaction to all amateurs, and we appreciate the opportunity which has been afforded us to be the means of conveying to our readers such a reassuring statement. The many amateurs and clubs who have received demonstrations, lectures, special transmitting programmes and loans of apparatus and lantern slides at the hands of the Company know its encouragement of amateur wireless is practical and by no means a new policy.

# The French Experimental Station 8 AB.

*Most British amateurs are now familiar with the capabilities of the French amateur station* **8 AB**, *and it will therefore interest our readers to have the following account, which has appeared in "L'Onde Electrique," from Mr. Léon Deloy, the constructor, describing the considerable experimental work done in the development of the station. The constructor wishes to point out that the station must not be taken as anything like a model example, as it has been put together with a minimum of time and apparatus.*

UNDOUBTEDLY there are numerous details which still remain to be improved and a more carefully planned installation would undoubtedly give better results. The principal ideas which have directed the installation have been to obtain in the minimum of time and with the minimum of material the best results possible. As these are the conditions which control the work of the majority of amateurs, and considering that signals have been heard as far as Aberdeen, Scotland, and within a radius of about 1,700 kilometres, we have reason to believe that the following description of the progress of the installation of **8 AB** may be helpful to many amateurs who contemplate the installation of C.W. transmitters, and perhaps these notes may be the means of saving them some loss of time.

The aerial which has been used in all our transmission experiments is an umbrella aerial consisting of three bronze wires of two millimetres diameter and 25 metres of effective length. They are extended by insulated cables and suspended from their point of connection by an ebonite insulator attached to the lightning conductor of the house where the station is situated. The mean height of this aerial from the ground is about 20 metres. The lead-in wire, which is taken from the top of the aerial, is about 10 metres long to the point where it reaches the instruments; this is also a bronze wire two millimetres in diameter. (*One must mention here that this aerial was constructed entirely for reception, and is far from ideal from the point of view of transmission, and its resistance in all probability would be largely diminished by replacing the single wires with stranded.*)

As soon as the necessary authority had been received for conducting experiments in transmission, we installed a valve station on the 24th November, 1921. The connections were those shown in the circuit diagram given in Fig. 1. The valve was an ordinary receiving valve type T.M. Alternating current was used for the filament, using a small tapped Ferrix transformer to step down the voltage.

*Fig. 2. Mr. Léon Deloy photographed with Mr. W. J. Crampton whilst the latter was at Nice.*

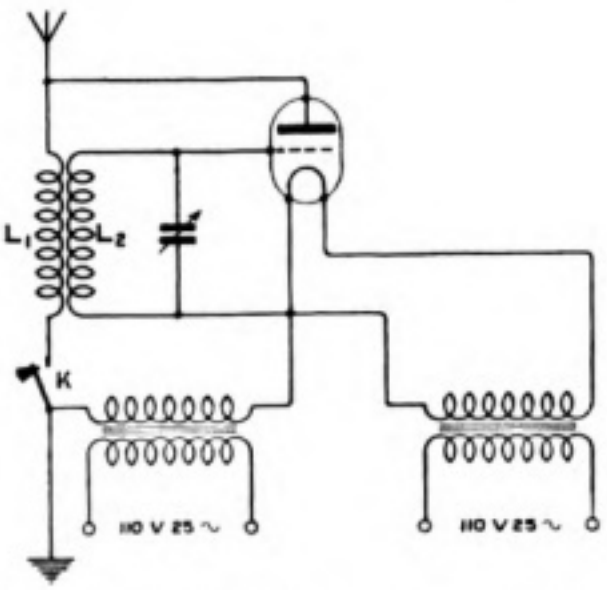



*Fig. 1. Connections of the first transmitter used.*

The coils used for the primary and secondary were coils which had served in the construction of a heterodyne. They consisted of 300 turns of No. 24 wire for the anode and aerial coil wound on a cardboard cylinder 15 centimetres in diameter, and for the grid coil 250 turns wound on a cylinder 12 centimetres in diameter The condenser of the grid coil was an ordinary receiving condenser of a capacity of 0·00075 microfarad. The plate voltage was supplied by a Ferrix transformer giving 250 volts at the secondary. Listening-in with a separate receiver and varying the positions of the inductances with respect to one another one could check the intensity of reception and so obtain the best adjustments for transmission.

This station was soon improved in the following manner. The key, instead of being placed in the

earth lead, was placed in the primary of the high tension transformer. In this way it was possible to avoid the shocks which might be obtained if two ends of the key were touched at the same time. The second improvement consisted in employing two valves in parallel in place of one, and the signals of the station were at once heard at Cros-de-Cagnes at a distance of about 11 kilometres. A high tension transformer was next installed which gave 500 volts at the secondary in place of 250. In these circumstances the plates of the valves heated quickly, but for telegraphic transmissions, where the signals are never of long duration, this did not constitute a serious difficulty. The valve filaments were supplied with 5 volts in order to obtain sufficient electronic emission, but it is obvious that this excess voltage was detrimental to the life of the filaments.

With this circuit completed, a 4-volt lamp with a carbon filament was put in series with the earth lead, in order to indicate by its brilliance approximately the best adjustment of the apparatus and to facilitate these adjustments. With this addition the station was rendered more powerful by employing four valves in place of two. The energy transferred to the aerial was then found to have been greatly augmented. Our signals were heard on the 24th of December, 1921, at Antives, a distance of about 18 kilometres. Up to this stage the earth connection had been simply to the water-pipe and now, with the assistance given by the lamp in the earth lead, we were able to ascertain that by connecting the earth lead in turn to water, gas and central heating connections, and to the lightning conductor, we increased the energy transferred to the aerial. Our first transmission had been made on a wavelength of 1,580 metres. Towards the end of December we came down to 960, then 725, and finally 525, employing other coils in the oscillating circuit. For 525 metres the same coils were employed which had been used for a long while in the receiving apparatus. The plate and aerial coil consisted of 120 turns of bell wire coiled on a cardboard cylinder 75 millimetres in diameter and the grid coil 100 turns of No. 24 wire coiled on a cardboard cylinder 55 millimetres in diameter.

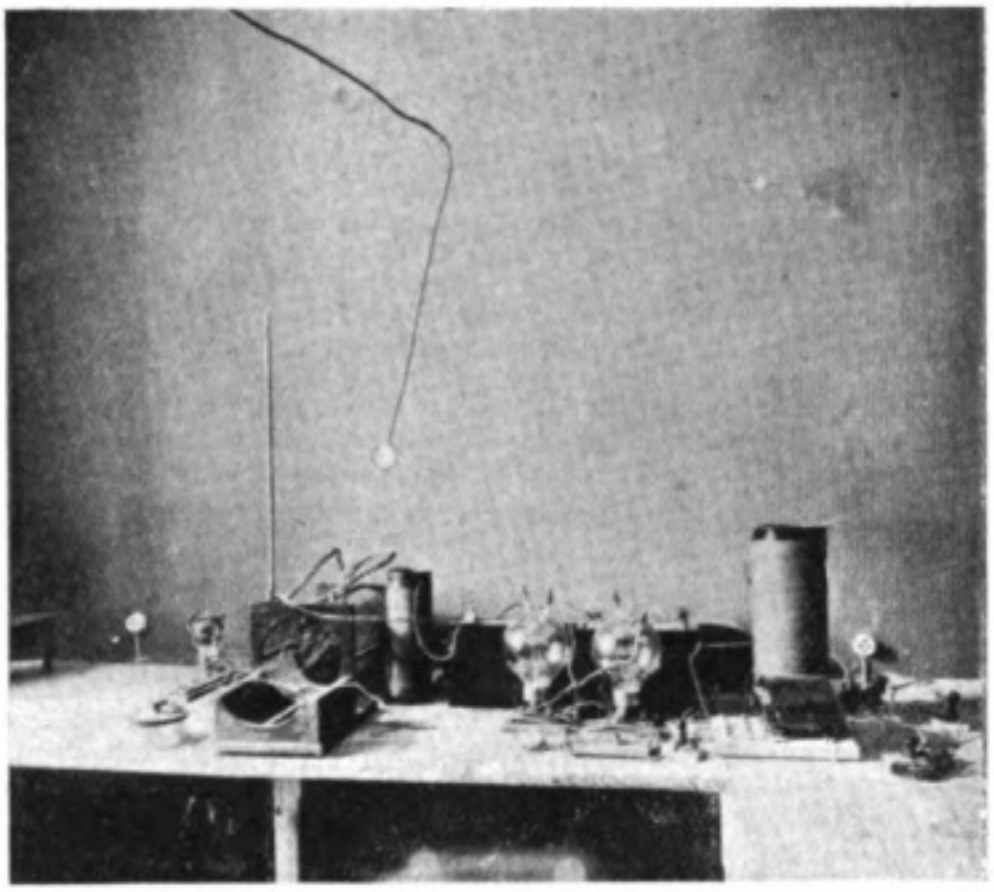


*Fig 3. The Experimental Set of* **8 AB.**

At this stage the four receiving valves were replaced by two 50-watt transmitting valves, the connections being modified in the following manner. The transformer of 500 volts was replaced by a transformer of 1,000 to 2,000 volts. A fixed condenser was put in the plate circuit to allow the passage of H.F. currents, whilst a choke coil

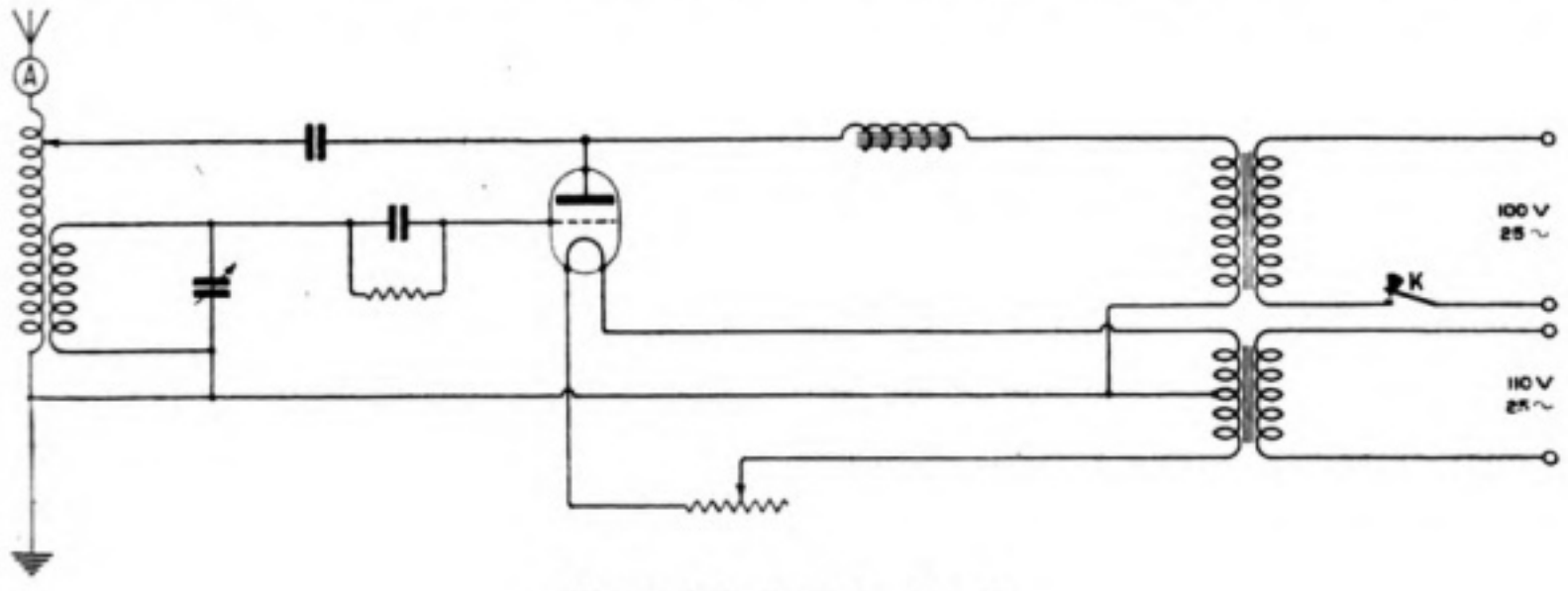



*Fig. 4. The final circuit used.*

inserted between the secondary of the high tension transformer and the plates prevented the transfer of high frequency currents into the secondary. A grid condenser shunted by a resistance was also inserted as shown in Fig. 4.

By earthing a receiving aerial which hitherto we had left insulated during transmission, a considerable increase in aerial current was obtained.

The aerial coil and the grid coil were later replaced by an oscillation transformer constructed in the following manner. The exterior coil was formed of a copper tube 7 millimetres in diameter, wound in a spiral of 20 centimetres diameter, and consisting of about 30 turns spaced 7 millimetres apart. With this coil two metallic clips were used which permitted connection to be made to the aerial and plate wherever desired. The amperes to be obtained. At the same time the wavelength was reduced to 360 metres in order to get away from interference caused by numerous stations working on 600 metres spark.

On the 1st of April, with 4 amperes in the aerial, our signals were received at Amiens, about 800 kilometres distant. At this time the two 50-watt valves were replaced by one 250-watt valve, the aerial current remaining at 4 amperes, but the valve was much less forced. At this stage we undertook tests with the experimental station of Mr. Burnham, **2 FQ**, at London. Mr. Burnham was putting 2½ amperes into his aerial, and we had every hopes of receiving him. Actually, after some days unsuccessful efforts, his signals were received very strongly by us on the 5th of April, at 2046 hours G.M.T. As to our own signals they had been

*Fig. 5. View from the site of French* **8 AB**.

grid coil was constructed of bronze wire three millimetres in diameter, and consisted of 25 turns on a diameter of 17 centimetres, a metallic clip allowing the required number of turns to be included in the circuit. An aerial ammeter was included and thereafter all adjustments were made following its indications and with the successive improvements which we have just described, the aerial current gradually rose from tenths of an ampere to three amperes.

On the 23rd of March, 1922, when the aerial current registered 2½ amperes, our signals were heard at Bonifacio about 300 kilometres distant.

The replacement of all the earth leads which went from the apparatus to water, gas and other connections, by strip, and the elimination of all unnecessary joints in the high frequency circuit, enabled an increase of aerial ampereage from 3 to 4 received since the 4th of April by another London amateur, at a distance of about 1,100 kilometres. On the 7th of April, **2 FQ** heard us and we were able to communicate very easily backwards and forwards several times in the evening as well as on subsequent evenings.

We have since learnt that we were received on the 8th of April by an amateur in Aberdeen, Scotland, at a distance of 1,700 kilometres. We have communicated with **2 OM**, another amateur station in London, and on the 16th of April received excellent signals from **2 CV**.

The arrangement of the circuit which we are at present using is shown in Fig. 4 with the only difference that we now use two 250-watt valves in parallel and the antenna current is normally from 4 to 5 amperes.

For the information of amateurs who may care

to construct a similar station, the following dimensions of the principal pieces of apparatus which we have not already described above are given :— The plate condenser is composed of 40 photographic plates 18 × 24 centimetres to separate the foils.

The grid condenser is composed of 10 glass plates of 5 × 18 centimetres separating sheets of tinfoil. The grid resistance is of a special type not yet patented. The choke coil is composed of 250 turns of No. 24 wire on a cardboard cylinder 12 centimetres in diameter.

In concluding the description of this station which has effected the first communication by wireless between English and French amateurs, we wish to express our thanks on the one hand to the French Administration of Posts, Telegraphs and Telephones for having rendered it possible for amateurs to conduct such interesting experiments through having given authority for amateur transmissions, and on the other hand to French and English amateurs who have been good enough to notify us of the reception of our signals.

We express our most sincere wishes that the severe restrictions which at present hamper the work of our friends across the Channel will soon disappear, and that the future will realise numerous and regular communications between French and English amateurs. **8 AB.**

# Some Notes on the Construction of Small Shunt Switchboards

By MARCUS J. MARTIN.

THE shunt switchboard is a piece of apparatus little known or used by the amateur, although it is employed largely by electricians for purposes where a number of various pieces of apparatus are used, each working at a different voltage and taking different amounts of current.

To the wireless amateur engaged in experimental or other work where the need is constantly arising, for some purpose or other, for varying amounts of current at different voltages, the shunt switchboard should prove a useful piece of apparatus, as with it any voltage from zero to the full supply pressure, by as many intermediate steps as required, can be readily obtained.

This type of switchboard should appeal to a large number of readers, as it can be constructed by any worker of average ability, is simple in design, inexpensive, and when once set up and connected to the mains is always available for tapping off the required voltage.

In this article it is not proposed to fully describe the construction of such a board, but to only give sufficient data and information to enable anyone, who so desires, to design and build a board to his own individual requirements. As the output required by different workers will necessarily vary between very wide limits, it is not possible to give dimensioned details, but the worker will not find any great difficulty in proportioning the various parts to suit his own particular case.

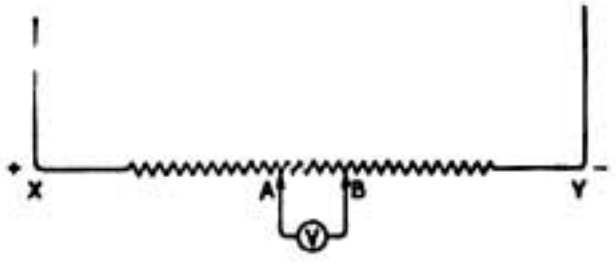



*Fig. 1. Showing Principle of a Shunt.*

To those who have no knowledge of the working of these boards, the principle of a shunt may be easily understood from a study of Fig. 1. Let X, Y, represent a fixed resistance connected between the supply terminals, and through which a current is flowing. If, now, another circuit is connected to two points along this resistance, a current will also flow in this second circuit, and the pressure will vary according to the position of the tapping points A, B. Let us suppose that the distance apart of the two points A, B, is one-fifth of the length of the resistance X, Y, then the voltage in the circuit A, V, B, assuming the supply pressure to be 250 volts, will be 250 ÷ 5 = 50 volts. If A, B = ½ X, Y, then the voltage in A, V, B, will be 250 ÷ 2 = 125 volts, and if ⅕ X, Y, the voltage will be 10, and so on, the voltage in the second circuit varying in direct proportion to the ratio of the lengths AB, XY. It is, therefore, obvious that if we provide X, Y, with a number of tapping points to which we can attach the circuit A, V, B, we can obtain any voltage we require from zero to the full supply pressure, and any current up to the maximum which can be carried by the resistance X, Y.

The general arrangement of a shunt switchboard is given in the diagram Fig. 2. The terminals E, F, are the main supply terminals, and connected

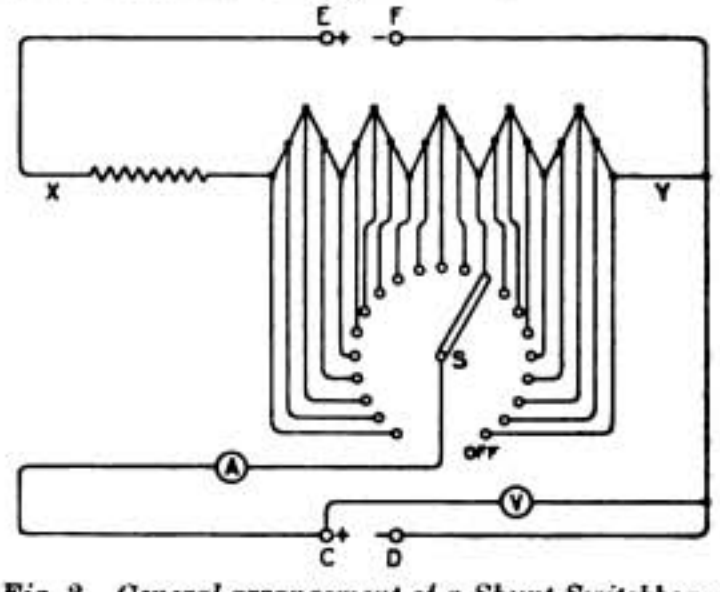



*Fig. 2. General arrangement of a Shunt Switchboard*

directly across these is the resistance X, Y. Tappings taken at various points along this resistance are connected to the studs of the radial switch S, the switch arm being connected to the positive board terminal C, through the amperemeter A. The negative board terminal D, and the off stud of the switch S, are both connected to the negative end of the resistance X, Y, as shown. The voltmeter V, is connected directly across the two board terminals C, D, the instruments indicating the pressure and current actually being used.

To more fully understand the calculations necessary for working out the values of a board, we will

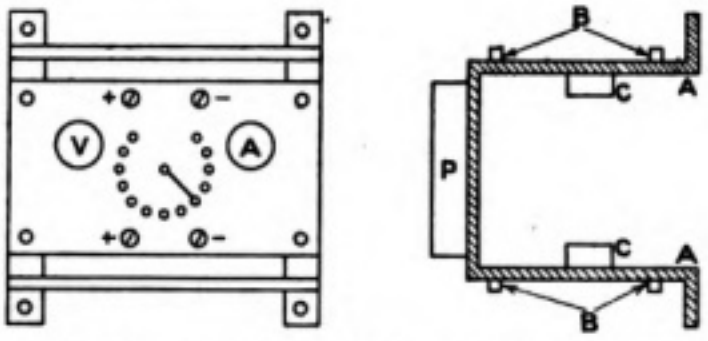



*Fig. 3. A simple arrangement of a Frame.*

suppose that a board is required capable of supplying 10 amperes at 100 volts, the voltage to increase from zero by multiples of 5, the supply pressure being 230 volts. The resistance of the coil X, Y, will be $230 \div 10 = 23$ ohms, and by referring to a resistance wire table we shall find that to carry 10 amperes safely 13 S.W.G. Eureka wire will be necessary, this wire carrying 11·25 amperes with a temperature rise of 200° F. Eureka wire 13 S.W.G. has a resistance of about 1·3 ohms per pound, so that the total amount required will be $23 \div 1{\cdot}3 = 17{\cdot}5$ lbs. (approx.). The length of 1 lb. of wire is roughly 43 ft., so that this length multiplied by 17·5 makes a total of 750 ft. for the complete resistance.

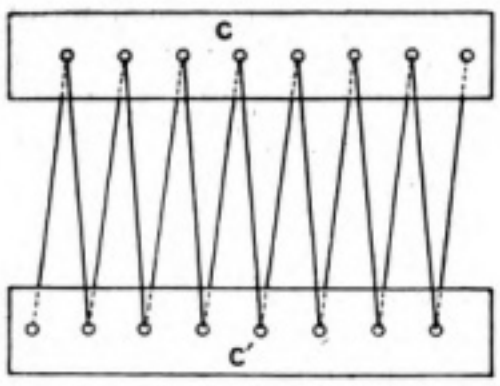



*Fig 4. Arrangement of the Coils.*

From what has already been explained, it will be understood that in order to obtain a pressure of 5 volts we must take our tapping from two points, which measure $230 \div 5 = 1/46$th of the total length of the resistance, and this will be $750 \div 46 = 16\frac{1}{2}$ ft. Therefore, to obtain the 100 volts required, 20 tapping points, 16 ft. 4 ins. apart will be necessary. In practice the resistance X, Y, would be made up of a number of coils of equal length, suspended in a frame, and so connected as to form a continuous length from which tappings would be taken at the correct points to the radial switch. In the example just given the resistance would be composed of 23 coils each 32 ft. 8 ins. long, the 20 tappings being taken from the first 10 coils, as shown in Fig. 2.

A few points concerning the actual construction of a board will now be considered. The size of the board will, of course, be determined by the length and number of the resistance coils, but these having been decided on, the dimensions of the frame can be easily obtained. A simple type of frame is shown in the diagram Fig. 3. It consists of two iron brackets A, of fairly stiff section, bent to the shape shown, and held in position by the four iron bars B. The resistance coils are suspended between the two slate bars C,C′, a compact method of fixing and arranging the coils being shown in Figs. 4 and 5. The distance apart of the bars C,C′,

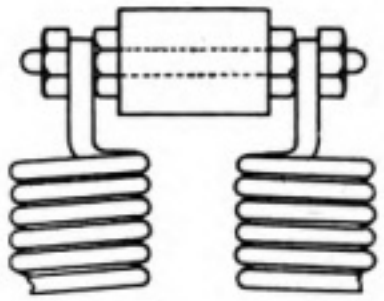


*Fig 5. Connections of Coils.*

should be such that the coils, when stretched between, form a fairly open spiral. If tappings are required at other points on the coils than at the various junctions, a good method is to divide the coil and bolt together, the connections being taken from these joints. A divided coil is shown in Fig. 6.

The front panel P, should be of slate, and is fitted with a suitably calibrated voltmeter and amperemeter, radial switch and two pairs of terminals. The general arrangement of the panel is given in Fig. 3. The connections from the resistance to the radial switch, etc., must be heavy enough to carry the maximum current safely, and care taken that all coils and connections are perfectly free and tight.

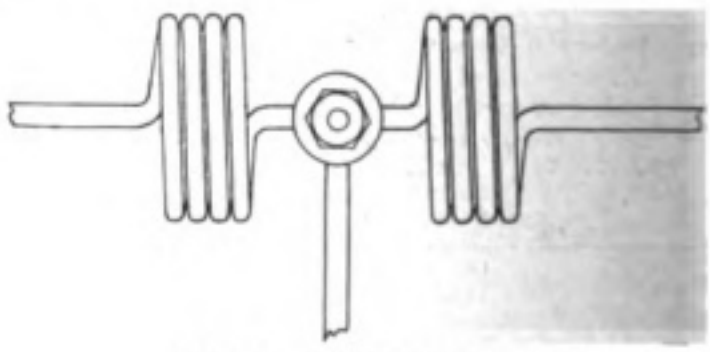


*Fig. 6. A Divided Coil.*

It is essential to insert a main switch in the supply circuit to completely isolate the board when not in use as, all the time the circuit is closed the total amount of current for which the resistance is designed is being consumed, however much or little you are actually taking from it.

# Amplification of Telephony

## DEMONSTRATION AT A LONDON CINEMA

A very interesting demonstration was given by Mr. Basil Davis (**2 BZ**) in the hall of the Pavilion Cinema, Marble Arch, W., on Friday, July 7th, using an arrangement which he has devised for rendering low power telephony transmission audible to a large number of persons.

The demonstration was preceded by a series of very attractive films, shown by means of moving diagrams. The production of oscillations by valve circuits, their modulation, and the reception of the modulated waves were represented in such a way that anyone could immediately grasp the general principles of wireless telephony.

By arrangement with Lieut. H. S. Walker (**2 ON**), music was transmitted from his station, which included two songs by Mr. Gilwyn Evans, the well-known tenor. The reception in the Cinema was remarkably good, and Mr. Davis is to be complimented in developing an arrangement capable of giving such great amplification, the music being easily heard by all those present, who were mostly seated at the far end of the hall. The modulation was particularly good, and the combination of voice and piano, especially the maintaining of their relative strengths, being exceptionally well carried out. It was unfortunate that a little jamming occurred near the end of the transmission, due, no doubt, to the use of reradiating receivers by other experimenters who were tuned in to the transmission.

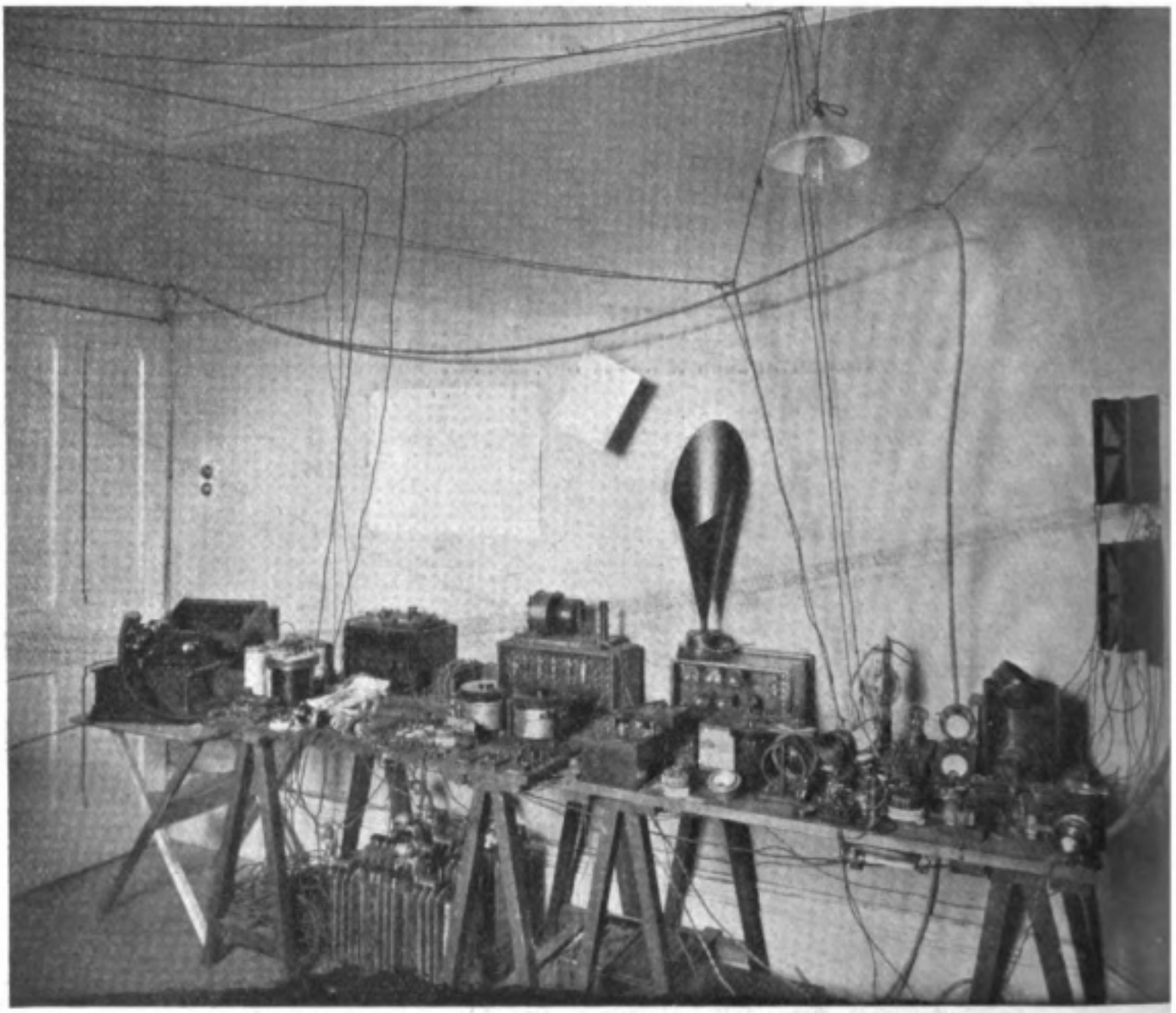
Below is a description of the apparatus at Mr. Davis's station.

For the sake of compactness, safety, etc., it is contained in a roll-top desk. This was gutted out, and standard receiving and transmitting sets installed inside, including H.T. and L.T. batteries. The whole can be locked up, to protect it from any curious folk that may use the room.

The aerial is a perpendicular twin wire about 60 ft. long with a very short lead-in. It is suspended from a steel cable stretched between tall buildings on either side of the theatre.

The receiver consists of one H.F. amplifier, detector and three L.F. valves for magnification. Any of these may be switched in separately. Tuning is done by Burndept coils and condensers. Either single circuit or secondary and aerial circuits may be used, controlled by switches. A Brown's

**2 BZ.** *Mr. Basil Davis's Station at the Pavilion Cinema, Marble Arch.*



*The Transmitting and Receiving Equipment of* **2OM**, *at Brentford.*

loud speaker is installed, but reception is usually done on the "Magnavox," the American loud speaker, to be seen on top of the desk in the photograph.

For transmitting the well-known choke control method is used, and sometimes the patent circuit of Lieut. Walker (**2OM**). For high tension a Mackie generator is employed, direct coupled to a high-speed ¼ h.p. D.C. motor (seen above the desk on wall brackets). This supply is effectively smoothed by a 2 microfarad waxed paper condense which is taken from an old 12-in. spark co A certain clarity of modulation in speech an music is obtained owing to the special micr phones used. Mr. Davis usually transmits mo week-day evenings after 8.30 p.m.

A photograph of the transmitting equipment shown above, and it is hoped in the near futur to give more information concerning th station.

## LIST OF EXPERIMENTAL STATIONS.

There has been a ready response to our request for additions and corrections to the List of Transmitting Stations published in our issue of July 1st. Will those who have not yet forwarded particulars kindly do so.

# Receiving Circuits

By CRISPIN C. REDSHAW, Assoc.I.R.E.

SINCE recently reading a paper entitled "Receiving Circuits" before the King's College Wireless Society, and its subsequent publication in the pages of the *Wireless World*,* I have had quite a number of enquiries for further information on various points in connection with the circuits I described. Hence I am of the opinion that the following few notes will be of assistance to amateurs generally, especially as the majority of the information to be given has not yet appeared in print.

To begin with, in Fig. 1, the function of the 10,000 ohms resistance, which is the resistance not lettered in Fig. 1 (Fig. 13 in my previous article), a non-inductive one, of the type usually employed for anode resistances in the resistance-capacity coupled circuits, seems to be obscure. It is inserted to aid reaction on short wavelengths. Its insertion causes greater potential variation at the anode of the second valve, the point from which reaction is obtained, in the same manner as the resistance in the anode circuit of the first valve causes large potential variations at point A for impression on to the grid of the second valve *via* the intervalve capacity C. The exact value of this resistance

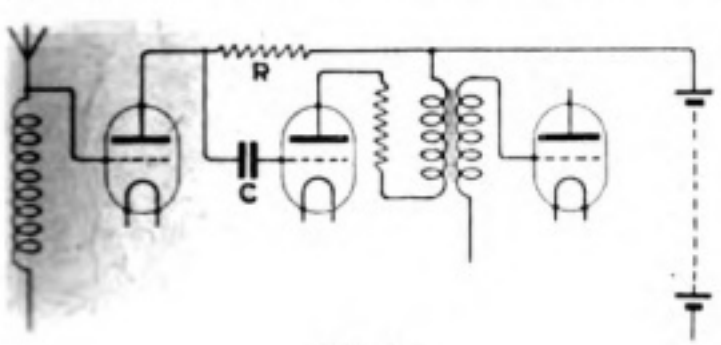



*Fig.* 1.

will be decided by the type of valve employed as No. 2, H.T. volts, impedance of primary and secondary of note magnifier transformer, etc.

The next thing I wish to point out is that the two curves (Fig. 3 in my previous article) have been accidentally interchanged, *i.e.*, that labelled "auto-transformer" should be "coupled," and *vice versa*.

I will now deal with another circuit—quite a standard circuit, certainly, but one which can be made to give very excellent results on all waves and for all purposes. It is outlined in Fig. 3. The circuit is well known, so I will leave out the general principles underlying its action and confine myself to those particulars which are usually neglected by the average writer. In particular, I wish to deal with coil L. This is an auto-transformer, and is shunted (optionally) by condenser S. The design of this coil plays an important part in the satisfactory working of the set as a whole. It should be made as small as possible and placed so that it has little capacity to other parts of the set, especially to wires and apparatus conveying or dealing with audio-frequency impulses. I have made up coils for this purpose wound "in air." This needs explanation. The usual method of winding these coils is either (i) ordinary single-layer solenoid; (ii) pile wound, basket wound or

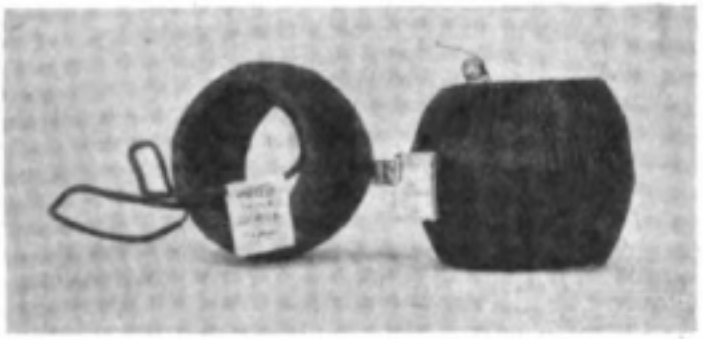


*Fig.* 2.—*H.F. Auto-transformers. Left*: 2,000 *turns* 28 *S.W.G. enamelled copper. Right*: 2,000 *turns* 26 *S.W.G. enamelled copper. Internal diameter* $2\frac{1}{4}''$.

honeycomb wound on an insulating former of wood, ebonite or other material; (iii) pile wound, basket wound or honeycomb wound, but without former. I favour the latter—the pile wound coils in air—as I have found them better than all those classed in group (ii). Group (i) coil is suitable only for short waves, while group (iii) coils are usually difficult or tedious to manufacture, with that one exception.

My method of winding these coils is as follows. Procure a former of any material, circular cross section, diameter about 2" or $2\frac{1}{2}''$. The wire is pile wound on to the required number of turns,

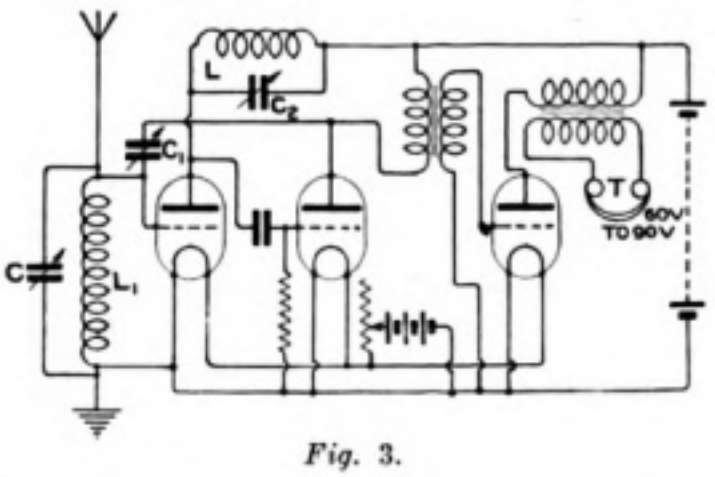



*Fig.* 3.

the whole slipped off the former and taped up with ordinary white tape in a manner similar to that employed for armature winding, shellaced and baked. The cross section of the resulting coil should be somewhat as shown in sketch (Fig. 4).

### ELECTRICAL PARTICULARS.

Gauge of wire anything between 26 S.W.G. and 36 S.W.G. No. 28 S.W.G. is a very convenient size.

* Vol. IX, page 724.

Flexible ends should be well soldered on for connections outside the coil. Increasing gauge of wire from 28 S.W.G. to 26 S.W.G. gives unnoticeable increase of strength of signals; decreasing gauge from 28 S.W.G. to 36 S.W.G. weakens signals about one strength.

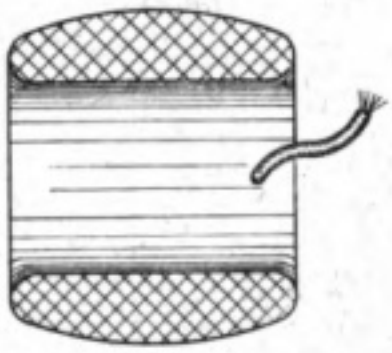


*Fig.* 4.

CALIBRATING.

Having made up the coil it must be calibrated. This is quite easy to do in the following manner. We will start with assuming that the set as a whole is not calibrated for wavelength. This must be done first. Curves are given showing the form the calibration will take, and are obtained as follows. Insert an 85,000 ohms (approximately) resistance in place of L. Set condenser C at zero value and inductance M at shortest wave, *i.e.*, stud 1. Listen-in for C.W. and adjust C till generated oscillations are equal in frequency to the wave being received, when no sound will be heard in telephones. Note position of pointer of C, and determine origin of and consequently wavelength of the signal by listening for call sign. Do this for as many stations as are available, using stud 1 and various settings of condenser, at all times being *just on the oscillation point*. Repeat for studs 2, 3 . . . and plot curve for each stud as shown in Fig. 5. There will be an "overlap" *a* between consecutive studs. This overlap should not exceed, say, 30 degrees of condenser. If it does, your tuning apparatus is not functioning at the height of its efficiency unless the capacity C is very small. However, the set as a whole being calibrated, we turn our attention to the auto-transformer in question. Take out resistance and connect in the transformer. Set aerial circuit to any wave and couple up with condenser K till oscillations commence. Decrease value of K till they just cease. Re-tune aerial till they again start and cut out more of K till they stop. Again

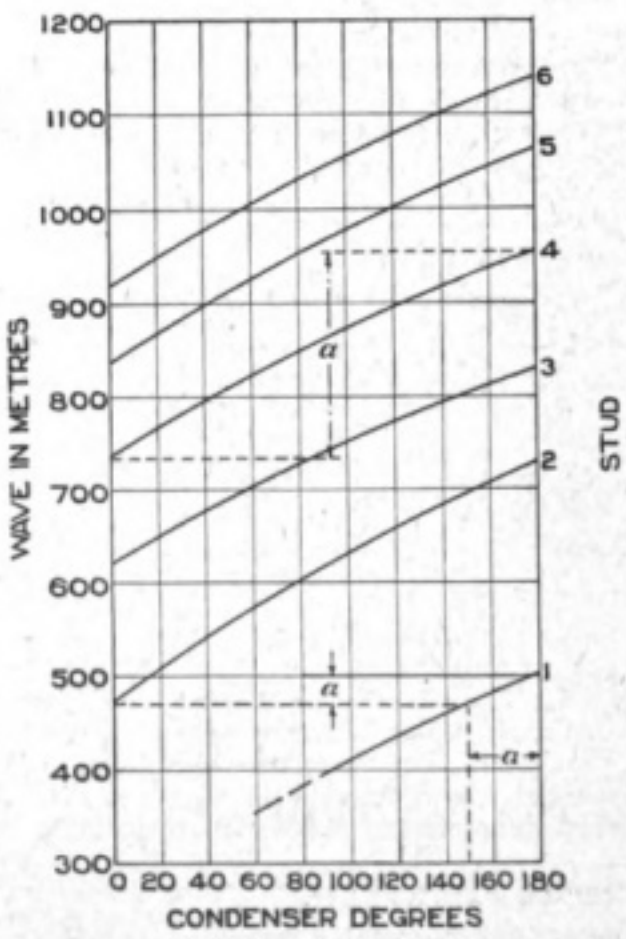



*Fig.* 5.

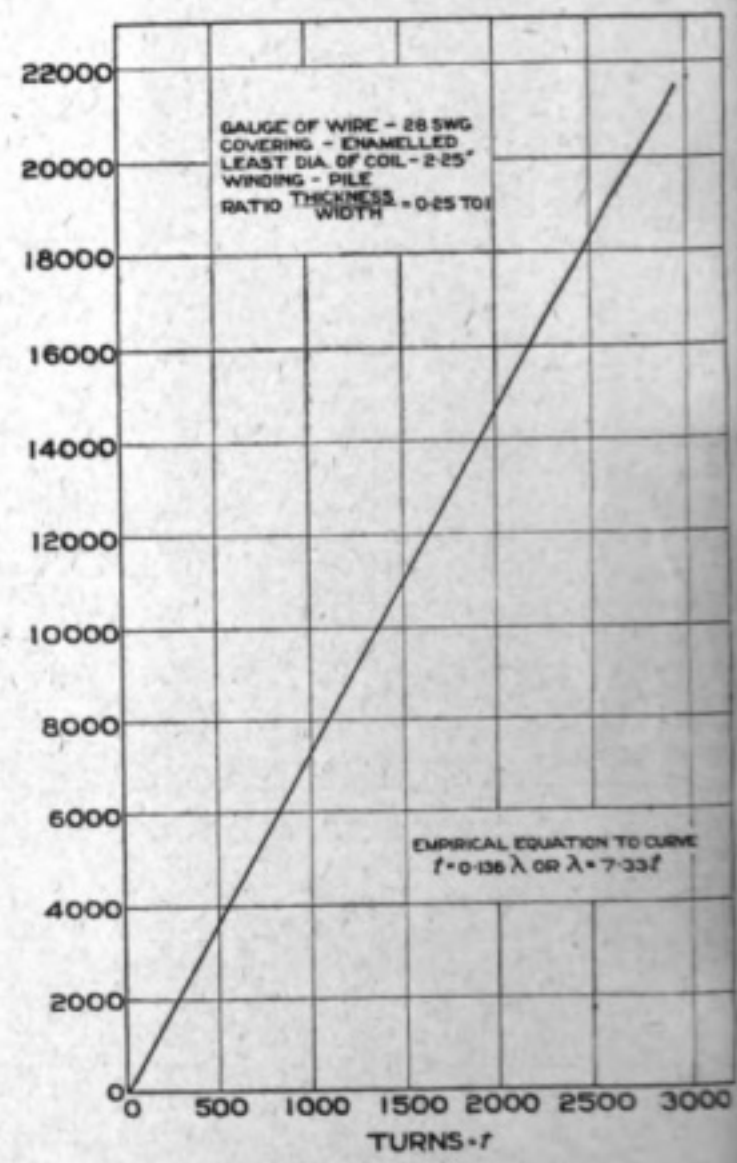



*Fig.* 6.

re-tune and cut out K, and by repeating this process a point will be found when a minimum value of K is obtained which will *just* cause oscillations on a particular valve, and by either increasing or decreasing this wave the oscillations will stop. Refer this adjustment to calibration curves of set and determine wavelength. This will be the most efficient wavelength of the auto-transformer. Do this with several different transformers and plot a curve, as in Fig. 6, showing the relation existing between *number of turns* and *wavelength*. Verify that it follows a *straight line law* for all ranges of wavelength between 400 metres and 25,000 metres.

One of these calibration curves is given herewith, where the diameter of former used was 2¼" and 28 S.W.G. enamelled wire. One can now wind a coil for any desired wavelength by reference to the curve, which is a point of great importance to the serious-minded amateur. A table is appended, giving further details of these transformers, which may be of assistance :—

HIGH-FREQUENCY AUTO-TRANSFORMERS.
No. 26 S.W.G. Enamelled Copper.

| Turns. | Depth over-all (inches) | Average thickness over-all (inches) | Wave-length (metres) | Weight complete (ounces) |
|---|---|---|---|---|
| 85 | 0·31 | 0·31 | 580 | 1 |
| 150 | 0·5 | 0·31 | 1,100 | 1·75 |
| 400 | 0·88 | 0·25 | 2,900 | 4·5 |
| 500 | 1·0 | 0·25 | 3,600 | 5·5 |
| 800 | 1·13 | 0·38 | 5,800 | 8·75 |
| 1,000 | 1·38 | 0·5 | 7,200 | 11·25 |
| 2,000 | 2·75 | 0·5 | 14,600 | 22·5 |

These transformers may also be wound in sections if desired, though this is not such an economical proposition as that already described. For instance, a certain coil was wound in two sections, taped up separately and taped together concentrically in two ways : (i) both windings in the same direction (compounded), and (ii) windings in opposite directions (differential). Both coils were the same size. The effect of the arrangement (i) was to increase the wavelength by about 10 per cent. of that of the two coils taken separately, and of arrangement (ii) to decrease it by the same amount. The only advantage gained is in ease of winding.

It will be noticed that coils calibrated on one valve panel will not necessarily give the same wavelength results on another. The capacity of the valve panel due to its mechanical construction and the disposition of its component parts is the deciding factor. The calibration curve given refers to a 3-valve panel having a standard R.A.F. 0·0004 mfd. intervalve capacity between "1" and "2" valves, the valve-holders being 3½" apart (centre to centre) and leads being perfectly straight short wires.

# Valves, and the Juice to give Them

By G. P. KENDALL, B.Sc.

THE first thing that the purchaser of a valve requires to know is what voltage to apply to filament and plate. The experienced valve fancier, of course, obtains this information for himself by experiment ; but the novice is in a different position, and often has disheartening experiences trying to run a six-volt valve from a four-volt accumulator, or striving to pacify a low-plate voltage valve which will do nothing but howl (he having given it the provocation of a 60-volt H.T. battery).

To assist such beginners some good working values for the commoner types of valves are given below. They may require a little modification to suit particular circuits and individual valves, but may be taken as satisfactory starting-points to be improved upon when experience has been gained :—

| Valve. | Filament Volts. | Plate Volts. R. | H.F. (a) | L.F. | H.F. (b) |
|---|---|---|---|---|---|
| French R | 4 | 40 | 50 | 70 | 80 |
| ES2 - | 6 | 30 | 35 | 40 | 50 |
| ES4 - | 4 | 50 | 60 | 70 | 90 |
| ORA - | 4 | 30 | 30 | 50 | 50 |
| V24 - | 6 | — | 30 | 40 | 50 |
| Marconi-Osram R | 6 | 60 | 70 | 80 | 100 |
| R4B - | 4 | 50 | — | — | — |

R. denotes voltage when the valve is to rectify.
H.F.(a) denotes voltage when the valve is to amplify at high frequency with transformer coupling.
L.F. denotes voltage when valve is to amplify at low frequency.
H.F.(b) denotes voltage when valve is to amplify at high frequency with resistance-capacity coupling.

# A Method of Increasing the Life of a Valve

The circuit diagrams (Figs. 1 and 2) relate to the article which appeared on page 448 of our last issue, and it is regretted that they were omitted, owing to a delay in their preparation.

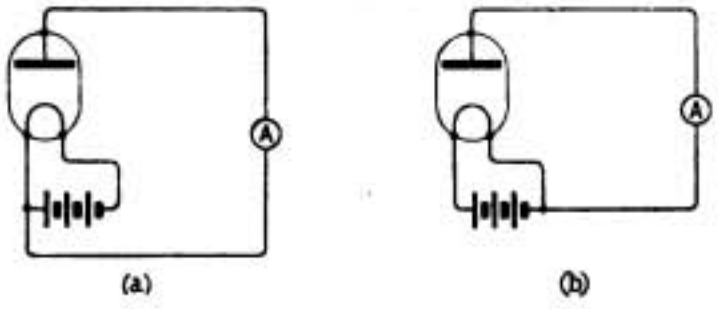



*Fig. 1.*

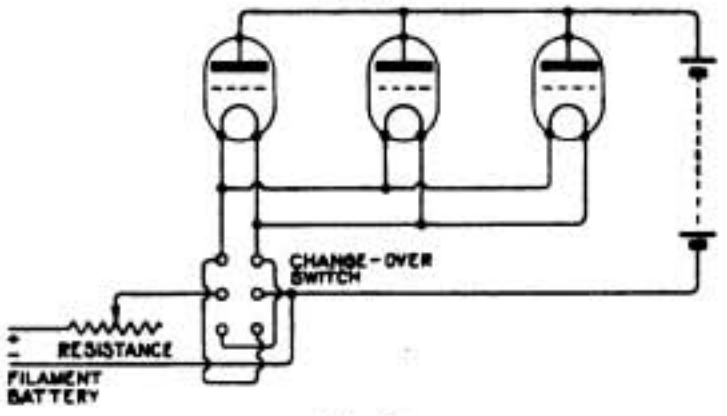



*Fig. 2.*

# Notes

### Transmitters: Official Figures.

In the House of Commons it was stated by the Assistant Postmaster-General that up to June 3rd approximately 11,000 receiving and 450 transmitting licences had been granted. He hoped to make a statement shortly on the question of a complete scheme for broadcasting, but as yet the matter was still under discussion.

### Air Ministry Demonstration at Agricultural Show.

At the Royal Agricultural Show held at Cambridge, which is of world importance, the Air Ministry, in conjunction with the Cambridge School of Agriculture, demonstrated the distribution of meteorological reports. The importance of keeping farmers and others informed of the anticipated weather was emphasised. Reports were received on the ground three times a day, and the data exhibited on a large chart. Deductions were made by an expert forecaster for the benefit of those attending the show.

### Wireless in Education.

That education in future must include early training in wireless is evidently recognised by education authorities. We learn that the Lowestoft Education Committee have granted permission to the headmaster of the Central School in that town to erect an aerial. Furthermore, the school managers have recommended that the apparatus be purchased out of the amount of money allowed by the committee for scientific teaching. The boys at the school under the science master, Mr. C. C. Culf, have made a complete set.

Many schools have given recognition to the place which wireless study should take in the everyday life of the pupils, but when the governing bodies in the educational world make a move toward including this phase of science in the school curriculum there is hope that the time is not far distant when the universal understanding of the fundamental principles will be prevalent. What is now a popular hobby will then be looked upon as child's-play, and the student will seek experiment not in fields now only traversed by a few highly qualified scientists, but in a general realm of science from which still higher platitudes will be sought.

### P.M.G.'s Power to Prescribe Licence Fees.

Sir Douglas Newton in the House of Commons, referring to the Wireless Telegraph and Signalling Bill, said the Postmaster-General indicated that the Bill is generally one to make permanent the powers he has hitherto possessed. "In one or two important details the Bill breaks new ground," he said. "One is that power is taken by the Postmaster-General to prescribe, subject to the consent of the Treasury, the fees to be paid in respect of the grant or renewal of any licence or certificate. That, presumably, governs the licences now required, for which a fee of 10s. is chargeable, in respect of all the wireless receiving sets. Would it not be possible to add to the clause a provision that any regulations which increase the fees chargeable are to be laid on the table of the House? It is most important that the receiving stations should not be hampered in any way."

### Sainte Assise (UFT).

A correspondent notifies us that Sainte Assise, with call **UFT**, has commenced transatlantic working on a wavelength of approximately 1,500 metres. H.F. alternators are used; the signals are very strong.

### Wireless to Entertain St. Dunstan's.

On Friday and Saturday, July 7th and 8th, some excellent telephony was transmitted by the Marconi Company to St. Dunstan's, Regent's Park. A large number of prominent artists gave their services, with the result that a splendid entertainment was provided for those assembled at St. Dunstan's, as well as all those who listened-in to the transmission.

### Bedford Physical and Radio Society.

Mr. C. W. Clarabut, Hon. Secretary of the above Society, informs us that during the last two months considerable success has attended their efforts. They now have over 80 members, and Mr. Rupert S. Allen is the President.

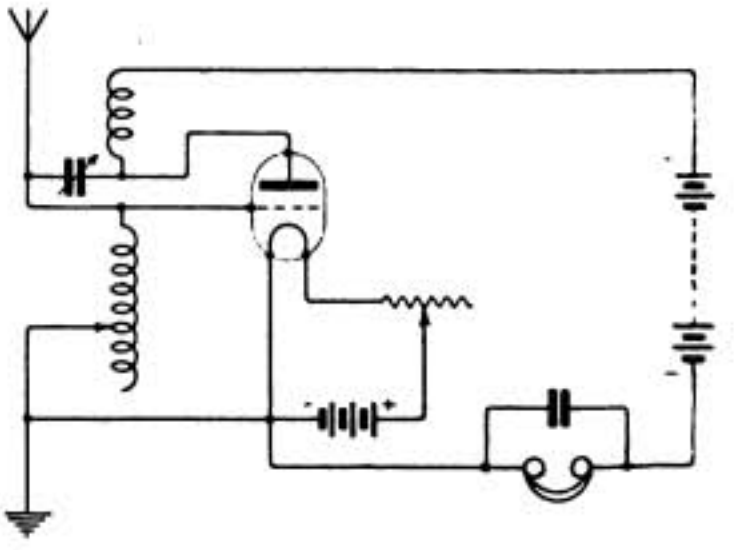
# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I read with considerable interest the article in the June 17th issue entitled "Some Effects of Capacity on Mutual Induction," by J. H. Reeves, M.B.E., as for the past six weeks I have been using a somewhat similar circuit for short waves.

Rough tuning is done quickly with the reaction condenser, fine tuning with magnetic reaction, then finally the set is stopped from oscillating by reducing the filament current of the detector valve.

The performance of the set is very good—very easy to operate, very stable, and very easy to bring to position of just not oscillating and therefore greatest magnification of speech and music without distortion. **2 FQ** and **2 ON** are very loud and clear using two valves—1 rect., 1 L.F.—and can easily be heard 25 ft. from 'phones. (Station, Wimbledon



Park; aerial, temporary, 40 ft. double wire, 40 ft. high lead-in end, 20 ft. high free end, badly screened by house.)

The method of tuning by alteration of filament current is, in my experience, badly neglected by amateurs.

The two inductance coils are two Mark III short wave coils, *not* rewound. The capacity reaction is a small Mark III condenser of 0·00055 mfd. capacity (max.).

It is possible to receive Croydon and the Hague on this short wave set by increasing the capacity reaction, the Hague being reasonably loud on one valve.

By using the Mark III condenser (0·00055 mfds.) as capacity reaction instead of for tuning the reaction coil, much better results are obtained and the set is more stable.

The following might be of interest:—

No A.T.C. is used.

| Wavelength. | 300 | 320 | 400 | 600 | 900 | 1050 | Metres. |
|---|---|---|---|---|---|---|---|
| Capacity - | 0 | 10 | 18 | 44 | 148 | 180 | Degrees of Condenser of 0·00055 mfd. |

The above with magnetic reaction at right angles to A.T.I.

A. CASTELLAIN,
*Treasurer and Asst. Hon. Secretary,*
City and Guilds Wireless Society.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—The question of the use of fine wire coils in reacting valve circuits has been dealt with in a recent paper by Mr. J. H. Reeves, but their use in crystal reception is of course quite different. Coils wound with No. 22 to No. 26 S.W.G. are usually recommended for use in the aerial circuit when using a crystal detector, to eliminate undue damping.

I have been experimenting in this connection recently, and find no appreciable difference in range or strength of signals when using No. 36 wire instead of No. 24 in a direct coupled tuner. I have now wound a basket coil for 600 metres with No. 47 S.S.C., and while signal strength has decreased slightly, my receiving range is still quite good. With a 70 ft. twin wire aerial of an average height of 30 ft. in open country, using this coil and a zincite-copper pyrites detector, it is possible at night to read most 600 metre stations as far south as Las Palmas (EAL), also several of the Mediterranean stations, signals being of a very fair strength.

I must apologise for trespassing on your space, but the use of these coils being contrary to normal practice, I thought the above details might possibly be of some interest to your readers.

C. H. AITKEN.

# Book Review

DIRECTIVE WIRELESS TELEGRAPHY. By L. H. Walter. (London: *Sir Isaac Pitman & Sons, Ltd.*)

This book forms a valuable addition to Pitman's well-known technical primers. The book assumes on the part of the reader a general acquaintance with the theory of Wireless telegraphy, and the special branch of the subject under consideration is therefore treated without any preliminaries of introduction.

In the opening chapter the author sets forth some of the principal advantages of directive transmission and reception, and later proceeds to describe different types of aerials suitable for the purpose of both transmission and reception. The relative merits of these are considered and formulæ for different types of aerials are given.

Commercial types of direction finders are illustrated and described. In a concluding chapter some miscellaneous applications of directive wireless telegraphy are considered.

The book is well written and illustrated, and provides a complete guide to what has already been accomplished in directive wireless telegraphy, whilst giving very full references to sources from whence more detailed accounts of various systems and methods may be obtained. H.S.P.

# Calendar of Current Events

**Sunday, July 16th.**

PADDINGTON WIRELESS AND SCIENTIFIC SOCIETY.

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

**Monday, July 17th.**

LEICESTERSHIRE RADIO AND SCIENTIFIC SOCIETY.
General Meeting, Vaughan College, Leicester. Lecture on "Continuous Wave Transmission," by Mr. J. W. Pallett.

**Tuesday, July 18th.**

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

**Thursday, July 20th.**

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Detecting Devices," by Mr. E. V. R. Martin.

**Sunday, July 23rd.**

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

**Tuesday, July 25th.**

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

**Thursday, July 27th.**

RADIO EXPERIMENTAL ASSOCIATION.
(NOTTINGHAM AND DISTRICT).

Meeting.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

# Wireless Club Reports

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

### The Wireless and Experimental Association.*

A most successful public demonstration was given on June 22nd at the Central Hall, Peckham. Over 400 were present and greatly enjoyed music broadcasted for the Association's benefit by Marconi House, as well as the usual lot of amateur experimenters. Short lectures were given by various members, many of whom brought along their instruments for exhibition. Public queries were invited and fully answered by those on the Committee. Popular books on wireless were sold for the benefit of the visitors. One item worthy of comment was the appearance of a complete class from a near-by school who are studying wireless, and to whom the association look for future support and information. The whole evening from 7 till 10.30 was fully occupied and enjoyed by all present. Over 50 new members were enrolled as a sequel to the Association's broadcast appeal.

The meeting of the Association held the following Wednesday was spent giving valuable information to the large proportion of new members who turned up hungry for information. Although they did not go away satisfied, as it was impossible to impart all the necessary information in one evening, they eagerly looked forward to the next week. Although the membership has been so greatly augmented there is room to enrol and educate new members, be they novices or experienced.

### The Wallasey Wireless and Experimental Society.*

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

At the meeting of the Society held on June 22nd, Mr. J. C. Mason lectured on "Radio Frequency Amplification." He first dealt with the theory of H.F. amplification and its advantages and disadvantages as opposed to L.F. The lecturer drew a few transformer coupled circuits, treating each one in detail, also one or two resistance capacity circuits. During the discussion many interesting points were raised.

It has been arranged to hold the club meetings fortnightly until further notice, owing to so many members being away from home.

The first field meeting of the present session was held at Thurstaston Hill on Saturday, July 1st.

### Paddington Wireless and Scientific Society.*

Hon. Secretary, Mr. L. Bland Flagg, 61, Burlington Road, Bayswater, W.2.

The third general meeting of the above Society was held in the lecture room of the Electrical Department, Paddington Technical Institute, on Thursday, June 22nd, at 7.15 p.m. It was gratifying to see the great majority of members in attendance.

After the Minutes of the last meeting and the monthly accounts had been disposed of, the Chairman announced that the Society had been fortunate in securing two papers for the evening.

The Chairman then called upon Mr. Marley, B.Sc., to read his paper on "Receiving Circuits." Mr. Marley commenced with the simple crystal circuit and gradually enlarged upon the subject, taking his audience through every known method of rectifying and amplifying wireless waves.

The paper was illustrated throughout, no less than 30 diagrams being used, and one could not help feeling that the lecturer had struck an original idea, for he handed round papers on which were drawn each one of the numerous diagrams, making the lecture easy to follow and at the same time giving a means of obtaining a great number of diagrams which must prove of great use for reference.

A discussion was opened in which further items were discussed, the most important of these being intervalve transformer ratios and magnitude of anode resistances.

Mr. A. L. Beak, A.M.I.E.E., then followed with his paper entitled "Oscillatory Circuits." This paper was also profusely illustrated and a number of experiments were shown, the whole being dealt with in a way that shows that the lecturer was more than familiar with the subject.

The Chairman pointed out that owing to the lateness of the hour it would be impossible to open the discussion but that would be done at the next meeting.

A hearty vote of thanks was proposed to the speakers of the evening, to which the members responded.

It is proposed to hold two field days during the summer, the first to take place on Sunday, July 16th, and the other to take place on Sunday, August 20th, 1922. Permission has been applied for and it is hoped that some gentleman will be good enough to transmit us a short programme.

The Society is now possessed of a receiving licence and the aerial is making good progress.

The affiliation to the Wireless Society of London is now complete.

The Secretary will be pleased to hear from any amateur who has not yet connected himself with any society, and will assist him in any way that lies within his power.

The date of the next general meeting will be announced later.

### Wireless Society of Highgate.*

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

Mr. J. Stanley, B.Sc., A.C.G.I., gave the third of series of lectures on the elementary theory of his wireless telegraphy and telephony on Friday, 23rd June, when there was again a large attendance of visitors.

After briefly alluding to the different types of aerials and indicating the functions of the earth connection, Mr. Stanley went on to deal with tuned circuits. He showed how, by coupling a

coil in an oscillatory circuit with a coil in another circuit, oscillations could be induced in the second circuit, and that these oscillations would have maximum strength when the natural frequency of the second circuit was the same as the natural frequency of the first circuit. He pointed out that by this means energy could be transferred from one circuit to another, the amount of energy transferred being largely governed by the tightness of the coupling between the coils.

Mr. Stanley went on to show that the closed circuit coupled to an aerial circuit is such an arrangement, and since in this case it is desired to radiate as much energy as possible from the aerial, he dealt with various methods employed in practice to prevent the energy transferred from the closed circuit to the aerial circuit being re-transferred back to the closed circuit, mentioning in particular the rotary and quenched spark gaps.

He then passed on to consider the receiving station, and showed how electro-magnetic waves impinging on the receiving aerial produced oscillations in the aerial circuit, and that these oscillations would be of maximum strength when the receiving aerial was tuned to the same frequency as the transmitting station. He pointed out the various methods of increasing or decreasing the natural frequency of an aerial by suitable combinations of inductance coils and condensers.

At the conclusion of the lecture, the whole of which was followed with great interest by the audience, a cordial vote of thanks was given to Mr. Stanley, and after seven new members had been elected—including two ladies—the meeting was adjourned.

On Friday, 30th June, Mr. F. L. Hogg gave the first of his series of lectures on "The Construction of Wireless Apparatus" at a meeting of the Society at their headquarters at the Highgate Literary and Scientific Institution.

Mr. Hogg dealt very carefully and lucidly with the construction of tuning coils and contrasted the relative merits of cylindrical, basket and honeycomb coils for various wavelengths. He showed how a simple one-valve circuit should be connected up and then dealt in detail with the assembling of the various components which go to make up such a set.

Mr. Hogg's lecture was followed with great interest by those present, and after a few questions had been put and answered, a hearty vote of thanks was proposed and carried with acclamation.

The lectures on the theory of wireless and the construction of apparatus are being continued each Friday until the middle of August, and the Hon. Secretary will be pleased to receive enquiries from anyone interested and to furnish full particulars of the Society.

### The Greenwich Wireless Society.*

A meeting of the above Society was held on June 9th, 1922, at the Rangers House, Blackheath.

In the absence of the President, Mr. Fergusson was invited to take the chair for the evening, who, after the usual business of the evening, gave the members present a very interesting account of the development of wireless in America by reading several extracts from letters received from his son, who is staying there. Mr. A. Bartle then gave an address on broadcasting, giving some very useful diagrams of suitable receiving circuits which were very much appreciated.

A letter was then read from Mr. Bartle tendering his resignation as Hon. Secretary owing to the pressure of business, which, after some discussion, he agreed to withdraw until the end of the session, Mr. W. G. Kimber being provisionally appointed to act as Joint Hon. Secretary in the meantime.

Two new members were elected and the meeting was adjourned until the first Tuesday in October, 1922, at 7-45 p.m.

Hon. Secretaries, Messrs. A. Bartle and W. G. Kimber. All communications to be addressed to Mr. W. G. Kimber, 39, Bargery Road, Catford, S.E.6.

### Woolwich Radio Society.*

Hon. Secretary, Mr. H. J. South, 42, Greenvale Road, Eltham, S.E.9.

The monthly meeting of the above Society took place at the Woolwich Polytechnic Institute at 8 p.m. on Friday, June 30th, 1922.

Mr. W. T. James, who was to have given a paper, was unable to be present, being unwell in health and the Secretary therefore arranged a concert.

Promptly at 8 o'clock **2 AQ** opened the concert by calling up and sending some fine music. He was followed at 8·10 by **2 OM**, at 8·20 by **2 KT**, at 8.40 by **2 ON**, at 9 p.m. by **2 BZ**, and at 9.20 by **2 LT**. Thus from 8 o'clock to 9.30 the Society was entertained with music and telephony, which was received very successfully To all the gentlemen concerned the Society tenders its best thanks. Considerable interference was experienced, particularly from "howling" valves. Evidently other amateurs in S.E. London were trying to get the music as well.

### Dartford and District Wireless Society.*

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

The activities of the above Society for the month of June are reported as follows:—On Friday, June 2nd, the usual fortnightly meeting was held with the Vice-President, Mr. J. R. Smith, M.I.E.E., in the chair. A general discussion on wireless matters took place and members had an opportunity of seeing crystal and valve sets in operation.

A wireless demonstration was given on Wednesday, June 14th, at a garden party at Dartford, which was held from 3 to 9 p.m. A three-valve experimental L.F. set and five-valve sets were made use of on this occasion. Telephony was clearly received and made audible by means of a loud speaker. The demonstration was very successful and aroused considerable interest.

The usual meeting was held at Dartford Grammar School on Friday, June 16th, Mr. J. R. Smith, M.I.E.E., in the chair. Seven new members were enrolled. There was a demonstration of violet ray apparatus, given by Mr. Phillips, and also a Trench transmitting and receiving set and a coil winder were shown by Mr. Pernett.

A wireless demonstration was conducted at a garden party in aid of "Waifs and Strays," given on Wednesday, June 21st, at Wilmington Hall, the residence of Lord and Lady Dudley Gordon.

This demonstration was even a greater success than the previous one. A regulation twin aerial

had been erected and the apparatus used was a two-valve reactance set with a two-valve L.F. amplifier, a five-valve set, a three-valve L.F. and one H.F. amplification. By means of loud speakers telephony was not only heard in the demonstration room but also in the garden, a loud speaker being suspended from a tree.

Mr. Burnham, of Blackheath, very kindly gave a special transmission of music, which was received splendidly. The Society's best thanks are due to him for his kind assistance. Telephony from Marconi House, also from Eiffel Tower, was clearly received.

A high frequency coil with fluorescent tubes was demonstrated as an additional interest.

On Sunday, June 25th, by arrangement with the Air Ministry, a visit was made to Croydon Aerodrome. After a splendid charabanc journey the aerodrome was reached at 3 p.m., where plenty of interest was soon found. The wireless installation was very kindly explained by the officials in charge. A very interesting and instructive time was spent.

The usual fortnightly meeting was held on Friday, June 30th, at which Dr. L. J. Miskin, M.D., F.R.C.S., presided. A demonstration set, as used at Wilmington Hall, was placed in operation, also a two-valve set made by Dr. Miskin. Very good telephony and signals were received. New members continue to be enrolled and local interest is improving.

**Birmingham Experimental Wireless Club.***

At a meeting held on Friday, June 16th, at Digbeth Institute, Birmingham, a lecture was given by Mr. S. H. V. Abbott, on "Wireless at Sea." Mr. L. J. Dore, Vice-President, took the chair at 7.45 p.m.

Mr. Abbott, in the course of a most interesting and instructive lecture, described wireless systems and methods since the earliest days of marine wireless. He was accorded a hearty vote of thanks.

The monthly "General Discussions" was held at Digbeth Institute on Friday, June 30th. Thirty-two members were present.

The Hon. Secretary, having read the Minutes of the previous meeting, these were confirmed, and the discussion was opened by Mr. B. A. Matthews.

Mr. Matthews' valve receiver was discussed and criticised at length. Several other members then mentioned difficulties which they had met, and these were discussed by the meeting. Several interesting and original ideas were described by members.

Meetings are held at Digbeth Institute fortnightly at 7.30 p.m. on Fridays. The Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, will be pleased to hear from intending members.

**Bradford Wireless Society.***

A meeting was held at Headquarters at 7.45 p.m. on June 30th, Mr. W. C. Ramshaw in the chair. The minutes of the previous meeting were read and passed, following which a few new members were elected.

The Chairman called upon Mr. H. G. Evans, of the Bradford Technical College, to give a lecture on "Electricity and Matter." This subject, as everyone knows, is an exceedingly difficult one to deal with in a simple manner, but Mr. Evans certainly succeeded in presenting his subject in a most attractive way.

The lecture was admirably illustrated by experiments—including Faraday's well-known one of passing electricity through solutions—and also by means of lantern slides.

At the conclusion a hearty vote of thanks was accorded the lecturer and the proceedings terminated.

This meeting ended the session, but the rooms are open every fortnight as usual for informal meetings, elementary lectures and Morse practice.

The Committee wish it to be known that persons interested in wireless work and under the age of 18 will be welcomed as Associate Members of the Society. Names of such should be proposed by a member in the usual way, or application made to the Secretary.

**Middlesbrough and District Wireless Society.***

At the 32nd meeting of the above Society, held at its meeting room in Borough Road East on Monday, June 26th, at 7.30, Mr. W. B. Ward gave a very interesting lecture on "High Frequency Currents."

He fully explained some elaborate experiments which he has recently carried out, and pointed out some curious phenomena which he has found when working his apparatus. One very extraordinary effect which he pointed out was that the frequency of alternation produced by his apparatus was such that he was able to pass sparks 18 inches in length from the apparatus to his bare hand without pain, the only sensation being that of warmth at the hand. Another of the curious effects which Mr. Ward explained was that in a reasonably shaded room the top of his apparatus gives off a magnificent display in the form of an extensive blue glow, known technically as the "silent discharge," which is seen on rare occasions on ships' masts and at the points of lightning conductors during a storm.

Mr. Ward further explained the principal theories with regard to high frequency currents and the instruments now in use for producing them, many of which instruments are in regular use for the purpose of wireless telgraphy and telephony. At the conclusion of the lecture, Mr. Ward was accorded a very hearty vote of thanks.

A meeting of the Wireless Committee was then held whilst the other members listened-in on the wireless set of Mr. C. E. Thewlis, connection being made to the aerial which was raised to a new mast, 55 feet high. This new mast is to form part of the Society's permanent aerial, on which it is hoped to receive the broadcasting messages at a high standard of perfection.

Hon. Secretary, Mr. Cleveland Hood, Nunthorpe, S.O., Yorks.

**Cardiff and South Wales Wireless Society.***

Hon. Secretary, Mr. P. O'Sullivan, 16, Adamsdown Square, Cardiff.

One of the most successful of wireless demonstrations held this year was that inaugurated by the Cardiff and South Wales Wireless Society at the Cory Hall on Wednesday, June 21st. It is interesting to note that this demonstration was the first public one of its kind to be held in South Wales.

To a large and highly attentive audience (numbering over a thousand people) Mr. E. Ogden A.M.I.E.E., a Post Office Engineer, lectured in a simple, non-technical manner on the principles of wireless telephony.

Mr. R. O. Sanderson (ex-President of the Cardiff Chamber of Commerce) was in the chair, supported by Capt. C. Crompton (Post Office Superintendent Engineer), Mr. F. Jones, and many other notable South Wales personalities.

The Chairman, upon introducing the lecturer, enlarged upon the value of the new science to commerce, and mentioned various new possibilities arising in that and other directions. He asked the support of the public for the Society which had done so much for the furtherance of wireless studies in the principality.

Mr. Ogden dealt in a light and concise manner with the first principles, and pointed out many of the difficulties arising during amateur experience, showing how they could be overcome. He invited the questions of the audience; and from the large number that were asked, it was clearly indicated what interest was being taken, and how successful the lecturer was.

For the purposes of the demonstration that followed, the Marconi Company very kindly provided apparatus and demonstrators, the Wireless College, St. Mary Street, being used as the transmitting station.

At the Cory Hall an amateur receiving set, the property of Mr. H. F. A. Sanderson, was also in use, and musical items contributed by prominent local artistes were rendered audible over the spacious auditorium.

During the demonstration Sir William Diamond, K.B.E., by means of wireless telephony, strongly appealed for the public support of the forthcoming Alexandra Rose Day.

The Chairman, at the conclusion of a very successful evening, and amid much applause, moved a vote of thanks to Mr. Ogden for the very able manner in which he had given his lecture. The motion, before being carried unanimously, was seconded by Mr. F. Jones.

The thanks of the Society were extended to the local Y.M.C.A. officials for the valuable assistance rendered by them.

### Leeds and District Amateur Wireless Society.*

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

A general meeting was held on Friday, June 23rd, at the Leeds University, Mr. A. M. Bage (Vice-President) taking the chair at 8.0 p.m. The Chairman informed the meeting that it had been found impossible to arrange a discussion on "Direction Finding" as scheduled in the syllabus, but Mr. G. P. Kendall, B.Sc. (Vice-President), had very kindly come forward and the Chairman had great pleasure in calling upon Mr. Kendall to describe "A Four-Valve Receiver."

This set, as Mr. Kendall explained, was still in the experimental stage, being assembled in the well-known 50-watt trench set cabinet, and utilising some of this set's components. The first valve functions at radio frequency, having potentiometer grid control, and is directly coupled by means of reactance-capacity or resistance-capacity methods to the grid of the rectifier, which functions on the grid condenser system. The set is provided with magnetic regeneration taken from the plate side of the rectifier to the aerial circuit, which will provide for the reception of continuous waves if the coupling be tight enough to set up self-oscillation or autodyning. Two stages of low-frequency magnification follow, and by means of a plug and jack combination, the telephones or loud speaker may be placed in the plate circuit of either the rectifier, the first L.F. or the second L.F. valves. The receiver uses "R" valves and will function on all wavelengths, being very useful for telephony reception. Theoretical and practical diagrams of the scheme of connections were explained briefly, but clearly, by the lecturer.

A short discussion followed, at the close of which Mr. Kendall was heartily thanked for his very interesting and instructive lecture. The meeting then broke up and adjourned at 10 p.m., after the apparatus on view had been closely examined by all present.

### The Ilford and District Radio Society.

On Thursday, June 29th, Mr. J. E. Nickless, A.M.I.E.E., assisted by Mr. F. Grover, gave a lecture and demonstration on "Wireless Workshop Hints."

Both these gentlemen are of the pre-war school of amateurs, accustomed to making things themselves instead of purchasing them, and after giving much useful information on the correct method of using tools and explaining many makeshifts by which considerable expense could be saved, proceeded to show, with explanations as to the method of manufacture, wireless instruments made by themselves from odds and ends usually regarded as of no value.

Mr. Grover's description of a crystal set capable of receiving ship traffic and meteorological reports from the Eiffel Tower made at an inclusive cost of less than 10s. was greatly enjoyed. The telephones, which invariably defeat the efforts of amateurs endeavouring to produce cheap sets, did not conquer Mr. Grover, for he produced a single high resistance earpiece which had cost him 2s. to make. When tested by the audience it proved to be quite an efficient article.

The Society's programme for the coming session has now been completed and includes many useful lectures. As before, the meetings are alternately "formal" and "informal," definite lectures being arranged for the formal nights, while the others are devoted to buzzer practice and junior constructional classes.

Hon. Secretary, A. E. Gregory, 77, Khedive Road, E.7.

### Birmingham Y.M.C.A. Wireless Club.

Hon. Secretary, Mr. R. Jenkinson, Y.M.C.A., Dale End, Birmingham.

A wireless club, as above, has now been formed and appears to be progressing well, the membership numbering about fifteen.

The equipment at present consists of a two-valve receiving set, but it is hoped to improve on this in the near future, and during the winter months arrangements are being made for a series of lectures appertaining to wireless and general electrical apparatus to be given.

There are still vacancies in the Club for a few more members, and enthusiasts residing in the vicinity are invited. Applications to be made to the Secretary, who will be pleased to furnish full particulars.

# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor,* THE WIRELESS WORLD AND RADIO REVIEW, *12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"INEXPERIENCED" (East Sussex)** *encloses a sketch of circuit and asks* (1) *If it would receive the Hague Concerts with a 50′ double wire aerial.* (2) *With what wire and how many turns should the coils be wound.* (3) *What should the capacity of the condenser be.*

(1) No; another valve with H.F. amplification would be almost essential at such a distance. (2) The A.T.I. should be wound with about 6″×4″ of No. 24. The reaction 4″×3″ of No. 28. (3) The A.T.C. should be 0·0005 mfd. Use as small settings as possible. Blocking condenser 0·002 mfd.

**"WIRELESS FIEND" (Oundle)** *encloses particulars of a Reinartz tuner and asks* (1) *With regard to an aerial sketched would it be better to take the lead in from the middle or the end and bring it in over the rain gutter in an insulated tube.* (2) *Would the Reinartz Tuner and single valve detector described in the May issue receive* **LAW** *and* **2 KD** *and* **LQK** *at Huddersfield.*

(1) Take the down lead from the middle point of the level portion. (2) We have no information of the transmitting stations referred to.

**"S.J.C." (Wolverhampton)** *encloses a sketch of a circuit and asks* (1) *For criticism.* (2) *The wavelength range of set.* (3) *The capacity of condenser C.* (4) *For particulars of a telephone transformer, and if* 0·0087 *D.C.C. can be used for same.*

(1) The circuit is O.K. except that a condenser is needed across the primary of the telephone transformer. Also the reaction coil is unnecessarily large. (2) and (3) If C is 0·001 mfd. the range will be up to 6,000 metres. (4) The core should be ½″ diameter. You can use 0·0087 D.C.C. for the L.R. winding. About 4 ozs. will be sufficient. The H.R. winding can be 2 ozs. of No. 42.

**"R.C.G." (Rogate)** *encloses a sketch of a wireless panel and asks* (1) *If the design is correct and the condenser values the best possible.* (2) *If the potentiometer is correctly connected.* (3) *Can a heterodyne be made to oscillate on all wavelengths by using different coils for tuning and reaction, and a tuning condenser of about* 0·001 *mfds., or if there should be a separate heterodyne for short and another for long waves.*

(1) The design is O.K. except that when, for instance, the closed circuit is plugged direct to the third valve, the grid winding of the H.F. transformer between the second and third valves should be broken or lost through this winding will be considerable. The same applies to the second valve. The grid condenser of the rectifying valve should not exceed 0·0003 mfds. except for very long waves. (2) Correct. (3) One heterodyne will do for all waves provided that a suitable collection of pairs of coils is made.

**"G.R. SHORT WAVE" (Annersley Woodhouse)** *asks how many tappings and how many turns between each tap will be needed on an inductance tube* 4″×4″ *primary, and* 4″×3″ *secondary, wound with No.* 22 *and No.* 26 *respectively.*

With good variable condensers in each circuit hardly any tappings will be required, while if no condensers, or only fixed value condensers are used, as many tappings as could be arranged would be needed. We should, of course, recommend the use of condensers, and you might then find it convenient to have about three equally spaced taps on each coil.

**"W.J.A." (Tottenham)** *asks questions about a single valve receiver.*

The coils will be quite suitable. Wind the primary of the loose coupler with No. 20 and the secondary with No. 22. If a secondary condenser of 0·0005 mfd. is used, the maximum wavelength will be about 6,000 metres. This value can be considerably increased by using a larger capacity with a parallel A.T.C. The reaction coil might be 8″×6″ of No. 22.

**"T.J.W." (Palmer's Green)** *asks how to design an inductance to give a required wavelength.*

The method is briefly as follows :—The formula $\lambda = 1885 \sqrt{LC}$ gives the relation between $LC$ for the wavelength required. In almost all detector circuits $C$ should be kept small, say 0·0005 mfds. Assuming this value $L$ can be worked out from the formula. When $L$ is found, suitable dimensions for the coil can be found by consulting the table on page 123 of Nottage's book, making allowance for the gauge of wire used, if necessary. Alternatively a guess at suitable windings can be made, and the inductance of the proposed coil worked out by a Nagoakas formula. The proposed dimensions can then be adjusted by trial until the computed value agrees with the value required.

**"R.F.F." (Oundle)** *asks* (1) *For a diagram of a tuner for a four-valve H.F. amplifier.* (2)

*Could* **PCGG** *be received on a small indoor aerial stretched across the roof of a room with the same amplifier.*

(1) In Fig. 7, page 276, May 27th, you will find a combined tuner and amplifier. The tuning circuits alone may be used if you already possess the amplifier. (2) We think it is somewhat unlikely that very good results will be obtained, but it is worth trying.

**"SHORTY" (Portsmouth)** *asks for information regarding a proposed crystal set, range* 300/2,700 *metres.*

Wind the primary and the A.T.I. full of No. 20, and the closed circuit full of No. 28. The quantities required will be approximately, No. 20, 2 lbs, and No. 28, ½ lb.

**"NEW READER" (Streatham)** *asks* (1) *If* **2 MT** *could be received on a crystal set with an eight-wire aerial, and a range of* 500/3,500 *metres.* (2) *When a Broadcasting Concert begins, if call signs are sent out in Morse or verbally.* (3) *When do the official Broadcasting Concerts begin.*

If you can tune Marconi House your maximum must be less than 500 metres, as this station uses a wavelength of 360 metres. (1) No; you are unlikely to hear **2 MT**. (2) Service information in this case is given verbally. (3) No date is yet fixed.

**"MICRON" (South Shields)** *encloses a diagram of a set and asks* (1) *If L.F. transformers are likely to cause howling on long wavelengths.* (2) *With regard to certain figures concerning the construction of the A.T.I., if these are excessive.* (3) *If the H.T. and L.T. batteries should be joined in series or opposition.* (4) *If a grid condenser and leak are necessary for the H.F. amplifying valve, and what should be the value of blocking condenser across the transformer primary.*

(1) No, but the suggested circuit is O.K. It would be better to put the condenser on the aerial side of the A.T.I. (2) The suggested A.T.I. is O.K. Reaction coil is probably excessive. 25 millihys. should be sufficient. (3) It is almost immaterial provided that the positive of the H.T. goes to the plate of the valve. (4) It is not necessary with this arrangement. The blocking condenser may be 0·002 mfds.

**"G.H.B." (Warwick)** *encloses a sketch of his circuit and asks* (1) *If suitable for reception of concerts on an aerial* 45′ *long.* (2) *If* 0·00025 *mfds. is correct for the variable condenser C.1 and C.2.* (3) *If a tuning inductance of* 12″ × 3″ *wound with No.* 20 *D.C.C. and a reactance of* 10″ × 2¾″ *wound with No.* 20 *is suitable.*

(1) Yes: you will get Birmingham Broadcasting Station when it starts, but the set is not sensitive enough for the stations at present working. (2) The values are O.K., but C.2 need not be variable. (3) Yes, for short waves.

**"MORSE" (Hoylake)** *asks* (1) *With reference to a circuit described in the issue of April 1st page* 15, *why is the H.T. taken through the reaction coil before going through the primary of the L.F. transformer.* (2) *The advantage of putting a grid condenser and leak between the H.F. transformer and the grid of the second valve. Which are the better for short and medium wavelengths, H.F. transformers or reactance capacity couplings.* (3) *How to cut out the H.F. valve of a three-valve circuit by means of a double pole change-over switch.* (4) *Who are* **2 KW, 2 GC** *and* **2 CV.**

(1) It is better to go straight to the reaction coil from the valve. (2) The use of a grid condenser and leak gives a somewhat more sensitive detector, but is liable to be a little more tricky in operation. Transformer amplification is the better for short waves, but is not adaptable to big ranges of wavelength without interchangeable transformers. (3) See diagram Fig. 1. (4) With regard to **2 KW**, see list of amateur transmitting stations published in our issue of July 1st. We have no knowledge of the other two stations mentioned.

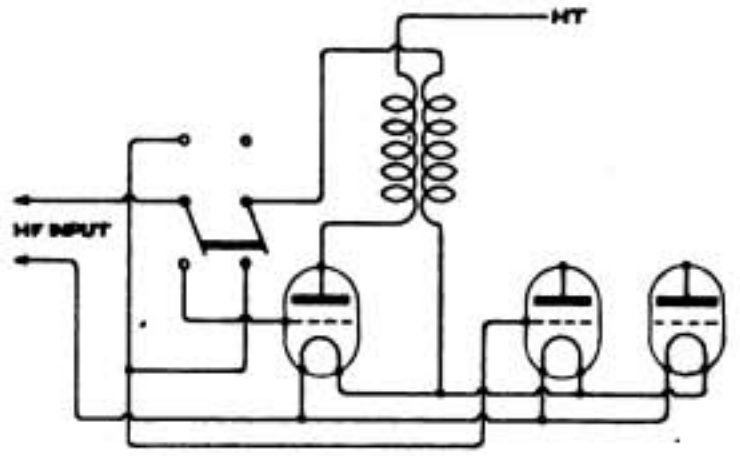



*Fig.* 1.

**"J.D." (S.E.18)** *asks for the formulæ which govern the capacities of the condensers described in the answers to* **"D.G.B." (Putney)** *and* **"G.G.F." (Newcastle).**

The correct formula is:—

$$C \text{ mfds} = \frac{1}{900{,}000} \times \frac{KAn}{4\pi d}$$

*K* being taken as approximately 8 for mica. This leads to the approximately correct results for **"D.G.B."** The value given to **"G.C.F."** is incorrect. The mistake, which we regret, is probably a printing error of 7 for 3, which would be approximately correct. It is impossible to predict such condensers accurately owing to the uncertainty of the di-electric constant of the mica used.

**"———" (Sutton Coldfield)** *asks* (1) *For particulars of set of basket coils to tune from* 150 *up to* 3,000 *metres.* (2) *For improvements to a circuit shown.* (3) *Gauge of a sample of wire.* (4) *If the auto-telephone transformer described on February 5th,* 1921, *will be suitable for* 300 *ohm telephones.*

(1) Wind about half a dozen coils for each circuit with a mean diameter of 3″, and from 40 to 350 turns. (2) Condensers should be used in series with the A.T.I. for short waves. (3) No. 40. (4) Yes.

**"W.L.B." (Walsall)** *asks* (1) *For windings for a set to tune from* 150 *to* 3,000 *metres with a* 0·001 *mfd. A.T.C.* (2) *Ditto for* 2,000/10,000 *metres.* (3) *Data for a L.F. transformer.*

(1) A parallel A.T.C. is very inefficient on short waves. Use it in series. A.T.I. might be 9″ × 6″ of No. 22 and reaction coil 5″ × 4″ of No. 28. (2) A.T.I. 9″ × 6″ of No. 28 with a parallel condenser. Reaction coil 7″ × 5″ of No. 32. (3) Core ½″ diameter by 4″ long. Primary and secondary 1 oz. and 4 ozs. of No. 42.

**"MAINDO" (Farnborough)** *asks* (1) *Whether a Reinartz Tuner or the tuner shown on page 281, June 7th issue, would be better for broadcasting reception.* (2) *If much modification would be necessary for the Dutch Concerts.* (3) *If any trouble would be experienced with re radiation with these sets.* (4) *For a winding for telephone transformer.*

(1) Either should be suitable, but we prefer the Reinartz. (2) The Reinartz could be brought up to this range with additional coils as described in the article. The exact dimensions for these coils should be found by experiment. Rumford's Tuner could also be brought up by increasing the size of the variometers. (3) Both these sets are liable to re-radiate. (4) H.R. winding 3 ozs. of No. 44, L.R. winding nearest the core 6 ozs of No. 30.

**"W.E." (Godalming)** *asks* (1) *Dimensions for a loose coupler with a range of from* 300 *to* 10,000 *metres.* (2) *If he should get* **2 MT** *and* **FL** *telephony on a single valve set.* (3) *Which is the nearest broadcasting station to him.* (4) *If he is allowed to use an aerial more than* 100 *ft. long.*

(1) One loose coupler would not be sufficient over so big a range. Use two, up to and above, say 2,000 metres. The latter might have primary 10"×6" of No. 26, with a 0·001 mfd. parallel condenser and secondary 8"×4½" of No. 30, also with a 0·001 mfd. condenser. Many figures for short wave couplers have been given recently. (2) Possible for a good set skilfully used, but results from **2 MT** will not be very strong. (3) London. (4) No.

**"W.E." (Newcastle)** *encloses sketch of circuit and asks* (1) *Will it receive telephony from European stations.* (2) *Consumption in watts of* 4*-volt Mullard valve filament.* (3) *Will a telephone induction coil function as a telephone transformer.* (4) *Does the H.T. negative come on to the positive or negative side of the filament of the valve.*

(1) From such stations as Eiffel Tower, yes. (2) If of normal receiving type, about 3 watts. (3) The resistance of the windings would probably make it quite unsuitable. (4) Generally immaterial.

**"SENNOCKE" (Sevenoaks)** *asks* (1) *Would an A.C. main lighting circuit interfere with the use of a single valve set.* (2) *Would a variable condenser as sketched be sufficiently variable.* (3) *Would the length of in-lead as sketch have any bad effect on reception.*

(1) No. (2) Yes, if you have a variometer or vernier condenser for fine tuning, but you will probably have considerable trouble with the contacts. (3) Yes.

**"B.V.W." (Sevenoaks)** *wishes to make a two-valve receiving set, diagram enclosed, and asks* (1) *If it will receive* **PCGG.** (2) *Winding data for the A.T.I. and reaction.* (3) *Can he use an "Ora" valve and a "V.24," or two "Ora" valves.* (4) *Number of plates required for a variable condenser for set of* 0·001 *mfd. capacity.*

(1) O.K., except that a blocking condenser should be used across the telephones, and a potentiometer for the first grid. (2) For such a large range a series of coils would be almost essential. We should recommend basket or honeycomb coils as advertised in this magazine. (3) Either arrangement is O.K. (4) You will require 105 plates in all.

**"REACTION" (Swansea)** *encloses particulars of set and asks* (1) *If connections are correct.* (2) *Why the telephones produce a high-pitched note when the slider of A.T.I. does not make contact with the A.T.I.* (3) *Can a valve be heard oscillating on the telephones.* (4) *Shortest and longest wavelength which can be received with set.*

(1) The connections and dimensions appear to be correct. We see no reason why you should not get good results. The A.T.C. should be variable. (2) Probably due to intermittent discharges across the bare contact or A.T.C. (3) Oscillation is not generally audible in your own telephones. If the set is oscillating a click will generally be heard on touching the aerial side of the A.T.C. (4) About 300 to 3,000 metres.

**"NOVICE" (Wellington)** *wishes to add a two-valve amplifier to his set, and asks for a diagram showing arrangement.*

See Fig. 7, page 216, May 13th issue, for an illustration showing how a combination of these two instruments could be effected.

**"G.V.F." (Beckenham)** *asks* (1) *Could he work a loud speaker on a single valve set.* (2) *Would results be good on an indoor aerial as sketched.* (3) *Lowest satisfactory capacities for two variable condensers as sketched.* (4) *Winding data for a tuning inductance.*

(1) Not satisfactory. (2) The results will be about the same as with a straight wire 12 ft. long. *i.e.*, not very good. (3) It depends on the wavelength range required. If not above 5,000 metres, not more than 0·0005 mfds. in either case. These condensers can be omitted if desired. (4) Wind full of No. 26. Reaction coil 5"×3" of No. 30.

**"E.C." (Streatham)** *asks* (1) *Is the U.S.A. wire gauge the same as the British.* (2) *What sort of a valve panel can be used with a Mark III.* (3) *Would a Mark III with a valve panel be suitable for the proposed short wave broadcasting.*

(1) There is not a great deal of difference between the American and British gauges. The use of British No. 24 instead of American will not appreciably alter your wave ranges. (2) Any kind of valve panel can be attached thereto. The valve terminals go to the grid and filament of the valve. (3) This is not a particularly efficient arrangement as the valve is used merely as a detector and not as an amplifier. Various rearrangements of this tuner for more effective valve operation have been given in back numbers.

**"LAIREA" (Thorne)** *asks* (1) *If the tuner described in the issue of June* 3*rd, page* 281, *could be used with an indoor frame aerial.* (2) *If a frame aerial* 4 *ft. square could be used for broadcast reception.* (3) *If it is possible to add a note mag. valve to the circuit mentioned above.* (4) *Approximate broadcast range.*

(1) Yes, but efficiency would be considerably reduced. (2) Yes, if only a few turns were used. (3) Yes, in the ordinary way. (4) Probably about 50 miles with one valve.

**"N.W." (Swansea)** *has a single valve receiving set and asks* (1) *How he can remedy howling.* (2) *Particulars of windings.* (3) *Should the grid potential be positive or negative in his circuit.* (4) *Why his set does not function.*

(1) There appears to be too much reaction. Weaken this. Also try removing the grid condenser

and using a potentiometer. (2) Using A.T.C. in series arrangement will require about 75 turns, and for the reaction coil about 60 turns on 2½" former. (N.B.—This circuit will give serious re-radiation.) (3) It depends on the type of valve, H.T. volts, etc. With the arrangement shown the potential required will generally be positive. (4) As you give no details as to the dimensions of your apparatus we cannot help you much, but try putting a variable condenser across the secondary. This will give you some chance of tuning the circuit. Do not use a grid condenser without a leak.

**"H.J.B." (Everton)** *asks* (1) *Winding to put on a solid wooden former of given dimensions for use as A.T.I.* (2) *If* 2,000 *ohm telephones could be converted to* 4,000 *ohms or higher.* (3) *If he could receive telephony in Liverpool on a crystal.* (4) *If his aerial is O.K.*

(1) A solid wood former will be very inefficient, wood being a very poor di-electric. As regards size, if you wind with No. 24, range would be up to about 2,000 metres. (2) This could be done by rewinding with finer wire, but we do not recommend it, as, unless you are very careful, you are not likely to improve the sensitivity. (3) Yes. Manchester broadcasting station and local amateurs. (4) O.K.

**"P.D.A." (Uppingham)** *asks* (1) *For criticism of circuit.* (2) *Dimensions for loading for his circuit.* (3) *Can "Ora" valves be used for this circuit.* (4) *What is the capacity of a condenser A in diagram, and should it be variable.*

(1) The circuit is O.K., except that amplification will be poor below about 1,000 metres. (2) 8" × 6" of No. 20 will probably be sufficient. (3) "Ora" valves will be suitable. (4) About 0·001 mfd. maximum capacity. It should certainly be variable.

**"S.B.X." (Liverpool)** *asks for three-valve and crystal circuit with loud speaker for reception of Manchester broadcasting.*

See diagram Fig. 2.

**"H.B." (Blackpool)** *asks* (1) *For a diagram of a three-valve circuit.* (2) *How many fixed and moving vanes would be required for a variable condenser to tune all wavelengths.* (3) *Voltage of H.T. and L.T. batteries.* (4) *Most suitable valves to use.*

(1) See Fig. 7, page 276, May 27th issue. (2) 21 fixed and 20 moving vanes, 3½" diameter, with a spacing of 1 mm. between fixed and moving vanes. (3) and (4) Any hard valve, for instance "V.24" or "R" type. L.T. voltage generally 6, H.T. 24 to 40 volts for "V.24" and "Ora" and 40 to 75 for "R" types.

**"R.A.J." (Woodside Park).**—Yes. Take the down lead from the middle of horizontal portion; also, if possible, stay away from the wall instead of leading it through a tube close to the wall.

**"NOR-RADIO" (Stavanger)** *asks* (1) *If he should receive* **LP, FL, 2 MT** *and* **PCGG** *on a four-valve set with an indoor aerial.* (2) *Why it is possible to obtain* **FL's** *carrier wave when his speech is inaudible with the reaction weakened.* (3) *What is the value of the modulation co-efficient.*

(1) **FL** and **LP**, possible; **PCGG**, possible; **2 MT** very unlikely. (2) Set is working in a more sensitive condition on the carrier wave, which is also intrinsically stronger. (3) We do not know the value employed in this station. Probably of the order of 50 per cent.

**"C.E.H." (Dewsbury)** *asks* (1) *What type of set to use to receive* **PCGG, 2 MT, FL** *and the proposed broadcasting stations.* (2) *What advantage* 8,000 *ohm telephones have over the* 4,000 *ohm type.*

(1) A four-valve set, with two H.F., one detector and one L.F. valve. The former are slightly more sensitive than the latter.

**"J.L." (Newcastle-on-Tyne)** *asks* (1) *For criticism of a set.* (2) *If suitable for telephony, including* **PCGG.** (3) *How to fit another valve as L.F. magnifier.* (4) *If slab coil or a loose coupler (presumably solenoid) would give better results.*

(1) O.K. if a fixed condenser is put across the winding of the first L.F. inter-valve transformer, which is in series with the reaction coil. (2) Yes. (3) Fit exactly as your present third valve, the input side of your additional L.F. transformer being inserted in place of the telephones. (4) This depends mainly on the wavelength, slab coils being more convenient for long waves and solenoids more efficient on the short to medium waves.

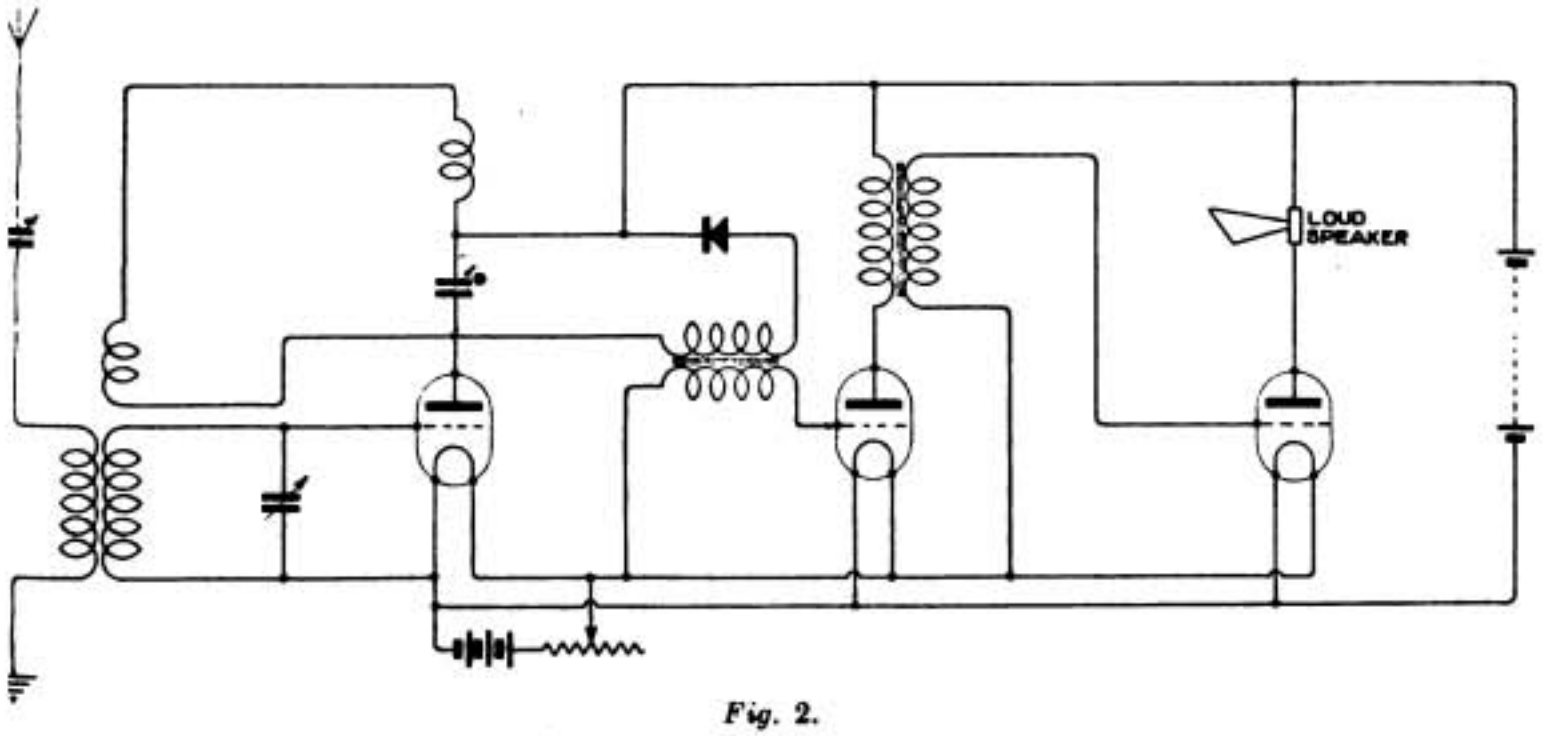



*Fig. 2.*

**"E.A.F.B." (Westcliff-on-Sea)** *asks* (1) *For a diagram of a three-valve set to receive amateur broadcasting,* **PCGG** *and other telephony.* (2) *How he can get* **PCGG** *on the set described.* (3) *Would pin type H.F. transformers be a great improvement over resistance coupling.* (4) *Is a fourth valve as note magnifier necessary to get* **PCGG.**

(1) and (2) Your present set should meet the case. The only fault appears to be the absence of a condenser across the anode winding of the L.F. transformer. You might add a potentiometer to the first grid. (3) Transformer coupling would be better for the broadcasting band. (4) It certainly should not be.

**"A.G." (Hanley)** *asks* (1) *For details of minimum apparatus necessary to receive broadcasting and other telephony from a distance of* 150 *miles.* (2) *Details of minimum apparatus for receiving broadcasting telephony from Birmingham and Manchester.* (3) *How to connect up the instruments.* (4) *Would the P.M.G. grant a licence for home-made wireless set.*

(1) and (2) Seeing that the Birmingham and Manchester Stations will be so much nearer to you and will give services almost identical with London, you will be well advised to try for them alone first, as really good results at 150 miles will need a good set skilfully used. For Birmingham and Manchester a single valve set will do. If you know nothing about the subject we should advise buying the complete set or else getting a text-book and studying the whole subject before making your own set. It is impossible in any case to state minimum apparatus required as the nature and locality will affect it as well as the quality of the results required. (3) One of many possible circuits is shown in Fig. 1, page 243, May 20th. (4) Yes, but the cost of the licence will be considerably more than for a special broadcast receiver of a type approved for the purpose by the G.P.O.

**"EXPERIMENTER" (Crouch End)** *asks for dimensions for an inductance unit to oscillate at* 600 *metres in a circuit sketched.*

The use of an inductance alone without a condenser for this purpose is practically impossible unless the coil is calibrated against standard wavelengths, as minute differences in the covering of the wire and the windings would create such serious differences in the resultant wavelength used in this way that it would be out of the question to attempt to predict the correct size for the coil.

**"E.V." (Wattsville)** *asks* (1) *Will a frame aerial as shown in diagram connected to a crystal receiving set, give any strength of signals.* (2) *To what apparatus is the aerial end of the frame aerial connected.* (3) *Would a simple silicon detector and inductance connected to this frame aerial receive spark signals of* 200 *miles radius.* (4) *Would the aerial wire, passing through the holes in the frame, require to be insulated.*

(1) No. (2) The ends of the frame winding should be connected across a variable condenser, which should itself be across the grid and filament of the valve. The aerial will practically be of no use with a crystal set however arranged. (3) No. (4) Preferably—with any normal wireless insulating material, e.g., ebonite.

**"N.B." (Sowerby Bridge)** *encloses diagram of his four-valve circuit from which he gets very poor results, and asks* (1) *Is it correctly wound.* (2) *Would transformer coupled be better than impedance coil for the H.F. valves.* (3) *Are the 2 megohm leaks and Mullard "Ora" valves satisfactory.* (4) *Will the set be efficient on short waves.*

(1) Your aerial circuit is all wrong, as it shows the set with nothing connected to earth when on tune side and with the grid of the first valve earthed when on stand-bi. Moreover, 300 megohms is far too high for a potentiometer resistance. You probably mean 300 ohms. (2) There should be very little difference at 1,000 metres. (3) They should be O.K. Your condenser or valve panel seems to be very leaky. (4) The set will not be very efficient below 100 metres.

**"RADIO" (Salford)** *refers to the crystal set, Fig.* 2, *page* 120, *April* 22*nd issue, and asks* (1) *Is it suitable for local broadcasting.* (2) *Size of coil and wire required and capacity of condenser for wavelengths from* 200/3,000 *metres.*

(1) Certainly, within a distance of about 12 miles from a broadcasting station. (2) A.T.I. 9″×6″ wound with No. 22. Coupling coil. 3″×3″ of No. 22, with one or two tappings. Closed circuit inductance, 6″×4″ of No. 26, with about six tappings. Variable condenser 0·0005 mfds.

**"HENRY" (Hampstead)** *asks re the tuner of a single valve circuit. Range about* 300 *to* 5,000 *metres.* (1) *The dimensions of solenoidal A.T.I. and number of tappings, and range of small suitable variable condenser to be used in parallel.* (2) *Dimensions of solenoidal reactance.* (3) *Stations likely to be received by the set.*

(1) 9″×6″ wound with No. 24, tapped at 1″, 1½″, 2½″, 3½″, 5″ and 7″. The condenser should be about 0·0005 mfds. approximately, and should be in series at the shorter wavelength. (2) Reactance 5″×4″, wound with No. 28 or 30, and tapped at every inch. (3) London Broadcasting Stations, 2 MT, Air Stations, Ships and Continental Stations such as Norddeich, Eiffel Tower, etc.

**"L.O." (Hampstead),** *with reference to the short wave set described in the "Work" book by E. Redpath, Esq., asks* (1) *What difference, if any, will it make if formers of 3½″×4½″ are used instead of those given.* (2) *Should the leads from secondary tappings be kept inside the secondary former and led out through one of the end plugs to the panel studs.* (3) *Will it be possible to hear the London Broadcasting Stations on a crystal set.*

(1) The set will tune to higher wavelengths, but not to as low a wavelength as the original. (2) It will be best to take the leads along the inside of the secondary to the end plug. This can easily be done while the coil is being wound, but not afterwards. (3) Certainly.

**"VICTORIA" (Stranraer)** *asks* (1) *If the telephone set described in Fig.* 1, *page* 316, *in the issue of July* 24*th,* 1920, *would have a range of* 5 *or* 6 *miles.* (2) *If the set in question* (1) *is not suitable, for a diagram of suitable set.* (3) *If it is better to use set as sketched or with aerial and earth inductively coupled.*

(1) Quite suitable. The microphone may be shunted across part of the A.T.I. or connected in series with it. (3) There is no necessity to couple inductively a set of this type.

**"SAILOR" (Dover)** *asks* (1) *How to add a valve to a circuit sketched.* (2) *Could he use slab inductances in place of a loose coupler.* (3) *Wave-length range of a certain coil.* (4) *Could a 6-volt accumulator be used for "Ora" valve.*

(1) See diagram Fig. 3. (2) Slab coils could

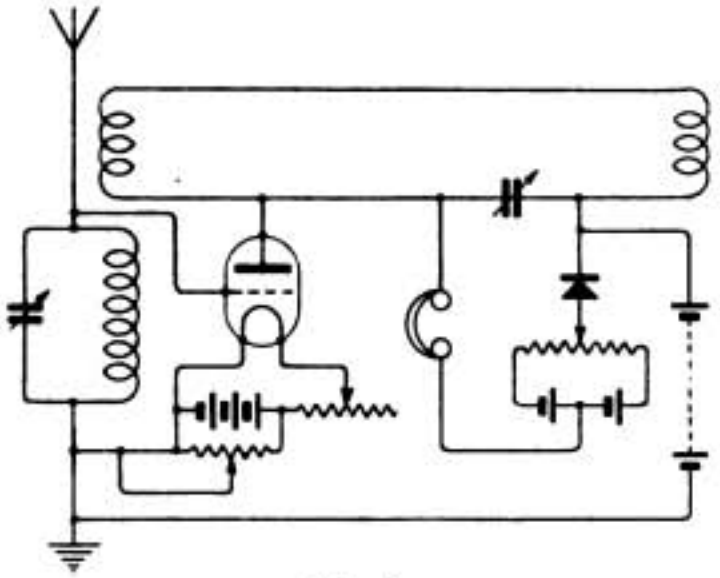


*Fig. 3.*

be used. Except for very short wavelengths the reaction coil should be smaller than the A.T.I. (3) About 2,800 metres. (4) O.K.

**"X.B.S." (Yorkshire)** *asks* (1) *If the Reinartz tuner described in the issue of May 31st is suitable for S.W. telephony.* (2) *If tubular condensers would be efficient for telephony.* (3) *What size of condensers to use with Reinartz tuner.* (4) *If a separate licence is required for a portable set, and if the area over which it may be used is limited.*

(1) Yes, if carefully used to prevent re-radiation. (2) Quite satisfactory. (3) Both 0·0005 mfd. (4) Separate licence is usually required, but why not write to the Secretary of the Post Office?

**"———" (Widnes).**—Range of your set will be up to about 3,000 metres. A variable condenser for series use and short wavelengths would be an improvement. A potentiometer is not necessary.

**"J.W.K." (Stanmore)** *encloses diagram of three-valve transformer circuit and asks* (1) *If it would be suitable for all telephony.* (2) *Data for constructing transformers, inductances and condensers.* (3) *Data for the construction of fixed condensers of* 0·00025 *mfd. and* 0·0004 *mfd.* (3) *Would the set described on page* 280 *of the May issue be suitable for telephony; if not, what additions would be required, and would it interfere with other people.*

(1) The circuit is O.K. A.T.I., 9"×6" of No. 22; Secondary inductance, 6"×4" of No. 28; A.T.C., 0·001 mfd.; C.2, 0·0005 mfd.; C.3, 0·0002 mfd.; C.4, 0·001 mfd. (2) Condenser should be 0·00025 mfd., mica 4 mils thick, four foils overlapping 2 cms. × ½ cm. For second condenser 0·0004 mfd., as above, but six foils. (3) We do not think so.

**"RAFAT" (Hull)** *asks for a diagram of a three-valve circuit for all wavelengths between* 400 *and* 24,000 *metres.*

See Fig. 3, page 340, issue June 10th. In order to cover such a large range of wavelengths it will, however, be necessary to use a series of H.F. interchangeable transformers, about six being needed for each pair of valves.

**"A.H." (Sheffield)** *asks* (1) *Would* **PCGG, 2MT** *and* **FL** *telephony be audible at Sheffield on a three-valve receiver with a frame aerial.* (2) *If some wires* 10 *ft. long, stretched across a room, would be better.* (3) *How many and what distance apart would the wires require to be.* (4) *Suggestions for a better arrangement of aerial.*

(1) No, you should use at least two stages of H.F. amplification. (2) This is somewhat better than the suggested frame. (3) Only two or three, say 2 ft. apart, would be required. Make the down-lead as long as possible. (4) An indoor aerial with four or five valves, including two H.F., should give the required results.

**"E.D." (Kennington)** *asks* (1) *For diagram of a panel to be connected to one already in use.* (2) *If necessary to have separate H.T. batteries for soft and hard valves.* (3) *If it is necessary to use L.R. telephones with a transformer.*

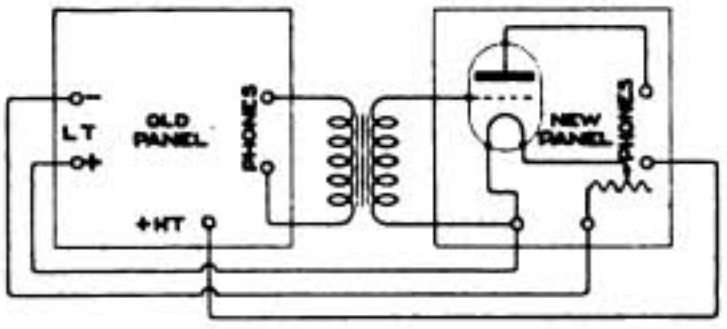



*Fig. 4.*

(1) See diagram Fig. 4. (2) If the valves are of such widely different types we should recommend separate H.T. batteries and filament resistance, although the second H.T. battery could very likely be dispensed with. (3) The H.R. telephones will be quite suitable.

**"K.B." (Hucknall)** *sends diagram of a set and asks* (1) *If the connections are correct.* (2) *Winding data for the inductance.* (3) *If it will be possible to receive telephony from a distance of* 150 *miles.* (4) *Would a two-valve set be better.*

(1) The connections are O.K. if the negatives of the two batteries are connected together as well as to the earth. (2) For British broadcasting, 80 ft. of No. 22 for the A.T.I., and 50 ft. of No. 26 for the reaction. (3) You are unlikely to get such a range—50 ft. is more like it. (4) Certainly; see Fig. 2, page 272, May 27th, and many others.

**"CRYSTAL" (Elland)** *has a set which works well except on telephony. He asks* (1) *How to improve it.* (2) *If variable H.F. transformers would be better than resistance capacity coupling.* (3) *If* **PCGG** *should be heard with four valves.* (4) *Causes of noises in telephones if the L.F. valves are too bright.*

(1) If a set works well on everything else it must be suitable for telephony. Failure is probably due to unskilful handling. For good results very careful reaction adjustment is required. A potentiometer is not required. (2) Very little difference at 1,000 metres. Transformer coupling better on short waves. (3) Yes, but more H.F. amplification instead of L.F. would be better. (4) Due either to

an uneven discharge of the battery at the high rate or to accentuation of noises already there owing to a steepening up of the characteristic.

**"LABURNUM" (Bethnal Green)** *asks* (1) *The wavelength range of a certain circuit.* (2) *If* 0·0003 *mfd. is too small a condenser for a closed circuit.* (3) *If a certain winding will be suitable for a spherical reaction coil.* (4) *What times are indicated by* 15.50 *and* 23.30 *G.M.T., and if there is a code book for deciphering these times.*

(1) Approximately 3,500 metres. (2) No. The parallel vernier condenser you suggest would not greatly affect the wavelength. (3) No. Wind it with the same wire as the coil in (1). (4) 3.50 p.m. and 11.30 p.m., G.M.T., *i.e.*, 4.50 p.m. and 12.30 a.m., B.S.M. No code book is necessary. The last two figures give the minutes and the first one or two the hours, reckoning 24 from midnight to midnight.

**"R.G.W." (Stockton-on-Tees).**—(1) If you are using reaction you should hear **PCGG, 2 MT** and **FL**, all weak. Without reaction we doubt if you will get much except local amateurs. (2) We should prefer the new H.F. panel, but the alternative scheme should give quite good results if properly designed. (3) A.T.I., 9″×6″ of No. 22, with slider. Coupler primary, 3″×3″ of No. 22, two taps. Coupler secondary, 6″×5″ of No. 26, six taps. Reaction coil, 4″×3″ of No. 28, three taps. (4) Use the same gauges as in (3), and try the following numbers of turns; the cams used do not matter much :—

| Metres | A.T.I. | Closed circuit | Reaction |
|---|---|---|---|
| 200 - 600 | 120 | 100 | 50 |
| 600 - 1,200 | 200 | 200 | 120 |
| 1,000 - 4,000 | 350 | 350 | 200 |

Final adjustment should be made by experiment.

**"M.E.M." (Clayton)** *asks* (1) *For criticism of a set.* (2) *For criticism of a suggested intervalve transformer.* (3) *If fine tissue paper may be introduced between the layers of the windings.* (4) *How to make honeycomb coils.*

(1) Circuit O.K., but grid condenser should be about 0·0002 mfd. With vanes 4″ diameter and spacing 1 mm. between fixed and moving, 16 plates will be required of 0·0005 mfd. and 31 for 0·001 mfd. (2) Probably O.K., although 4/1 is rather a high ration of turns. (3) Yes. (4) These coils need some form of winder, such as the "Lokap," or the winder described in the issue of July 3rd, 1921. The use of such coils will enable a range to be brought up to any desired value.

**"E.O." (Leyton)** *wishes to transmit about* 50 *yards and asks if it would be possible to do this with, for instance, a coherer set without the necessity of a transmitting licence. Also, if reception on a crystal would be possible.*

Transmission without licence is only allowed in the case of what may be called toy sets. We do not know of any ruling as to the exact range which may be covered. We should advise application to the P.M.G. for a ruling in regard to your case. Crystal reception could be employed, but not very easily, with the type of set generally used for these transmitters, which operate on a very low wavelength.

**"L.J.R." (St. John's Wood)** *asks* (1) *Question about certain aerials.* (2) *For dimensions for a* 0·0005 *mfd. condenser.* (3) *Dimensions for a* 0·002 *mfd. variable condenser.* (4) *If* 120 *ohm. telephones can be used with a crystal set without a transformer.*

(1) The aerial across the road would give better results, and would not affect the other stations, but it would be necessary to obtain a permit from the authority responsible for the road. This might be somewhat difficult to obtain. (2) About 30 plates, with a space between fixed and moving of 1 mm., diameter of plates 3″. (3) 45 plates, 5″ diameter, also with a spacing of 1 mm. (4) A transformer must be used.

**"H.R." (York).**—(1) and (2) Set should give **PCGG** if the parallel A.T.C. is removed, or only used at approximate minimum value. Also, grid condenser should be about 0·0002 mfd. and not 0·004 mfd. (3) The H.R. telephones will be somewhat more sensitive than the L.R. and transformer

**"L.H.C." (Cambridge)** *asks which of the formulae* (*a*) $\lambda = 1885\sqrt{LC}$ (*b*) $\lambda = 597\sqrt{LC}$ *is correct where* $\lambda$ = *wavelength in metres, L is inductance in mhys., and C capacity in mfds.* (2) *If a combined crystal and valve set is suitable for* **PCGG.**

(1) Formula (*a*) is correct formula; (*b*) is correct if inductance is measured in mhys., and capacity in millimicrofarads.

**"S.W.R." (London)** (1) Wind primary with No. 26, and reaction coil with No. 30. (2) About two equally spaced taps on each coil. (3) No. 26. (4) See diagram Fig. 6, page 94, April 15th issue.

**"C.G." (Lowestoft).**—(1) Your present set is of very inefficient type. Revised set should be as in Fig. 5, page 92, April 15th issue. (2) An iron-cored L.F. with a valve transformer is required. This should have a core ½″ in diameter, with windings of 1 oz. and 3 ozs. of No. 42. (3) Not essential, but generally desirable.

**"INTERESTED" (Eastbourne).**—(1) Yes. (2) Yes, about 0·002 mfd. (3) 0·0005 mfds. (4) Yes. Certain extra parts would be required, but all the old apparatus could still be employed.

**"TRIER" (Manchester)** *wishes to use a two-valve set with an indoor aerial, and asks what resistance telephones to use, and if a suitable telephone transformer has been described.*

The suggested aerial is very poor. You will get as good result from about 25′ of wire in a straight line somewhere in the house. Telephones may be 4,000 ohms, or 120 ohms with transformer. For transformer see article on page 782, February 5th, 1921, issue.

## SHARE MARKET REPORT

Prices as we go to press on June 30th, are :—

| | | £ | s | d |
|---|---|---|---|---|
| Marconi Ordinary .. .. | | £2 | 4 | 6 |
| ,, Preference .. .. | | 2 | 0 | 6 |
| ,, Inter. Marine.. .. | | 1 | 7 | 3 |
| ,, Canadian .. .. | | | 9 | 3 |
| Radio Corporation of America :— | | | | |
| Ordinary .. .. .. | | | 19 | 6 |
| Preference .. .. .. | | | 14 | 0 |

2nd JULY, 1922. THE PRICE 6D. NET.

# WIRELESS WORLD AND RADIO REVIEW

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THE
# WIRELESS WORLD
## AND RADIO REVIEW

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. X. No. 17. JULY 22ND, 1922 WEEKLY

# A Further Development of the Armstrong Circuit.

### HOW TO APPLY THE PRINCIPLE TO EXISTING APPARATUS.

By EDGAR H. FELIX, Associate I.R.E.

SUPER-REGENERATION is the term used in description of the new circuit recently described by E. H. Armstrong. In utility it overshadows previous achievements of its discoverer.

Armstrong is responsible for the development of the regenerative principle in its application to heterodyning by means of which we amplify short wave signals at radio frequencies to an extraordinary degree.

The super-heterodyne was used last December by the American observer in receiving amateur signals from the United States. Two hundred feet from his head-phones he could easily hear the signals from one of the American amateur stations.*

Now, if the super-regenerative circuit is used, such results are possible with but *two* vacuum tubes instead of ten. With its use the radio frequency transformer becomes unnecessary. With this circuit it is claimed that the only limit to the amplification obtainable for any signals is the tube's current carrying capacity.

LIMITATIONS OF THE REGENERATIVE CIRCUIT.

If you operate a regenerative receiver, you have noticed that there is a definite limit to the amplification of music by means of regeneration. Too much reaction coupling causes the receiver to generate continuous oscillations. When it does this, the good tone quality of the music received is lost.

Armstrong's new discovery is a method by which we can make full use of reaction without causing the receiver to generate oscillations.

The reaction may be considered as the insertion of "negative resistance" in the vacuum tube circuits. Such resistance wipes out the positive resistance of the tube and its associated circuits or tends to do so. When the negative resistance applied by reaction approaches a certain relation to the positive resistance—let us say when the negative and positive resistances are approximately equal—the receiver generates continuous oscillations.

Immediately before this point of approximate equality is reached there is, however, considerable amplification of music without distortion. For five or six years, many have exclaimed to themselves: "If only the negative resistance could be made greater than the positive without having the undesirable oscillations set up, what tremendous amplification would be possible!"

It seems obvious that the theoretical limit of amplification is reached when the positive resistance approaches and approximately equals the negative resistance. Certainly, it was

* *This refers to the station* **1BCG**.—Ed.

argued, the system will oscillate if the negative resistance becomes greater than the positive.

Armstrong set out to solve the seemingly impossible problem—and he has succeeded.

Armstrong's home station uses a small loop antenna and two vacuum tubes connected up with his super-regenerative system. **WJZ** is twenty miles away. Yet, 1,500 feet from his phones, Armstrong can hear the music sent by **WJZ**.

For illustration, imagine first an alternator generating a current of fifty thousand cycles or more—in fact any frequency beyond audibility. Next, imagine such an alternator coupled with the plate circuit of an ordinary regenerative receiver. If the apparatus could be adjusted so (1) that the maximum regeneration would take place when the alternator is positive and (2) so that regeneration would be prevented when the alternator is negative, you would

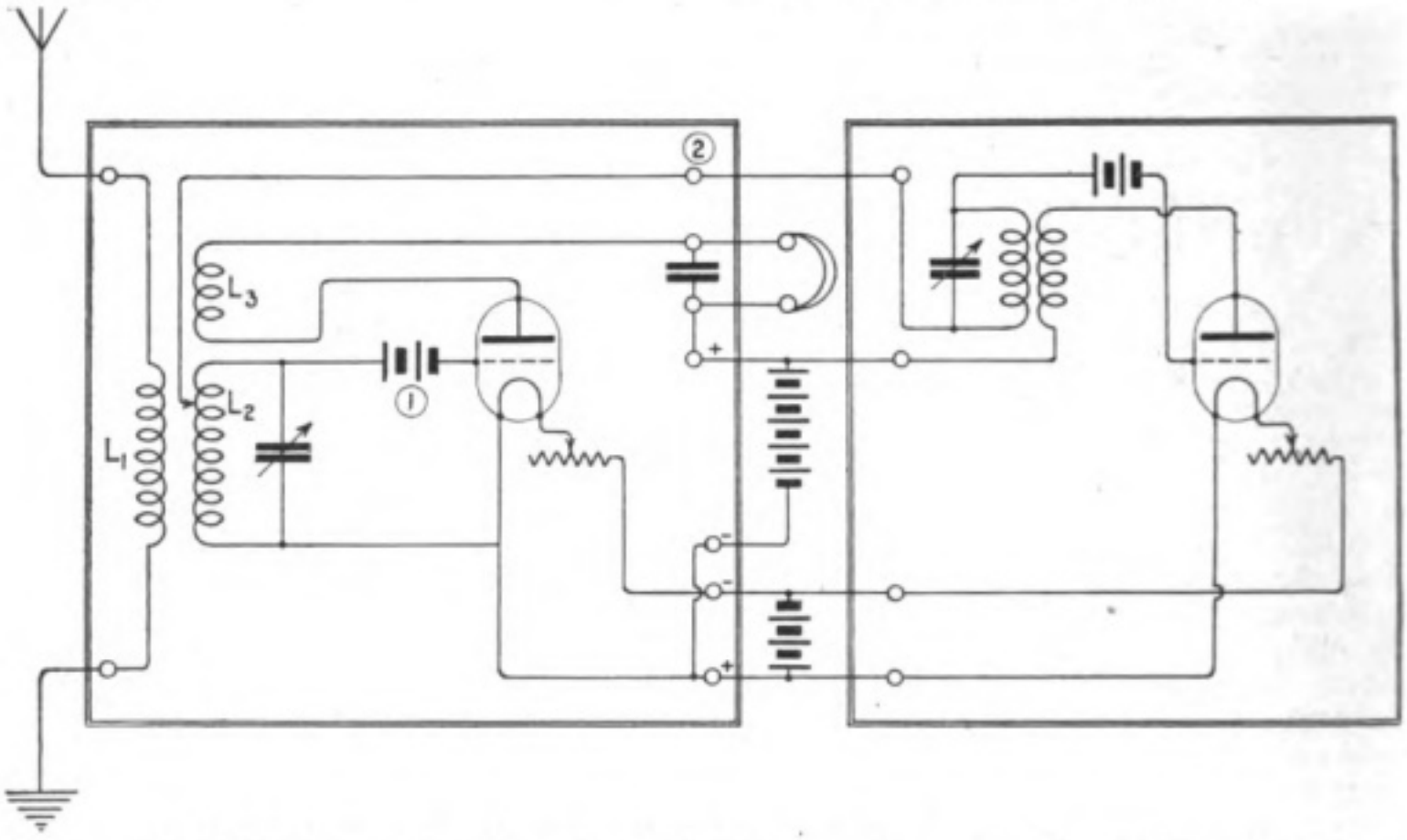


*Fig* 1. *The Super-Regenerative Circuit, adapted to a reaction receiver for reception of telephony. Changes required in the receiver are :* (1) *Substitution of battery to give a negative potential in the grid for grid condenser and grid leak ; and* (2) *tap connected to top of secondary inductance.*

At a recent meeting of the Institute of Radio Engineers, at which Armstrong first publicly described his invention, a small loop receiver was set up. With a regenerative circuit and two steps of audio-frequency amplification, music from **WJZ** could barely be heard even when the phones were but a few inches from our ears. This is due to the fact that the Engineering building is a steel structure and so well shielded that it is almost impervious to radio signals.

But with Armstrong's three-tube super-generative circuit, we could easily hear the music in every part of the lecture hall !

HOW SUPER-REGENERATION WORKS

The basic principle of super-regeneration is very simple.

have something that would meet the case. In such a case regeneration would not destroy the quality of music, for it would be choked so frequently and so rapidly by the alternator that the musical qualities would be retained; and in addition, full advantage would be obtained from the regenerative effect which would build up during the positive period of the alternator's cycle.

The same result would be obtained were the alternator coupled with the grid circuit or with the secondary circuit.

The most satisfactory generator of continuous waves of high frequency is of course the vacuum tube associated with the proper circuits. Armstrong therefore evolved circuits employing the vacuum tube as the generator of the

high frequency oscillations. One tube serves the ordinary function of detector and regenerator; the other serves as oscillator, producing high frequency current which is impressed upon one of the circuits of the first tube in such a way that the negative resistance exceeds the positive resistance at intervals of 1 50,000 of a second or less.

### SUPER-REGENERATION FOR RADIO-TELEPHONY.

Figure 1 shows the circuit best adapted to reception of radio-telephony. The section enclosed in the box on the left shows an ordinary reaction receiver, modified only by the substitution of a grid battery and a tap at the top of the secondary of the vario-coupler. $L_1$ and $L_2$ are the primary and secondary of the tuning circuits ; $L_3$ is the reaction coil.

The second tube and its circuits comprise the oscillator. The grid and plate circuits are coupled by inductances $L_4$ and $L_5$. The grid inductance is shunted by the variable condenser which determines the frequency of the oscillations generated. The output of the oscillator tube is impressed on the secondary of the receiving transformer or vario-coupler.

When the oscillator tube is conductive, it short circuits the secondary, stopping for the moment the generation of oscillations. When the charge on the grid of the oscillator tube reverses, the first tube oscillates. The oscillator tube therefore acts as a switch, short circuiting the secondary 50,000 times per second or more.

### HOW TO ADAPT SUPER-REGENERATION TO A REACTION RECEIVER.

This circuit is drawn so that from it you can make a super-regenerative unit to add to your regenerative set, thus converting it into a super-regenerative receiver.

Figure 2 shows a circuit particularly adapted to C.W. reception. It employs a third tube which acts as detector. A separate inductance coupled to the secondary is used to transfer the output of the oscillator tubes to the detector tube. The heterodyned frequency is controlled by the variable condenser across the inductance in the plate circuit of the first tube and by the variable condenser across the grid inductance of the second tube. In this circuit the oscillator tube acts upon the positive resistance of the plate circuit.

The third circuit acts upon both the grid and plate circuits of the first tube, reducing the negative resistance while increasing the positive, and vice versa. This circuit gives the greatest amplification possible with two tubes. It will appeal to amateurs wishing to make the most of their equipment, even at the expense of greatly increased number and difficulty of adjustments.

### ADJUSTING THE SUPER-REGENERATIVE CIRCUIT.

The process of adjusting these circuits after they are set up is as follows.

First, the coupling of the oscillator tube is reduced to a minimum, so that no oscillations are generated by the oscillator tube.

Second, the antenna and secondary circuits are tuned in the usual manner.

Third, the reaction is adjusted until maximum amplification without distortion takes place.

Fourth, the coupling of the oscillator tube

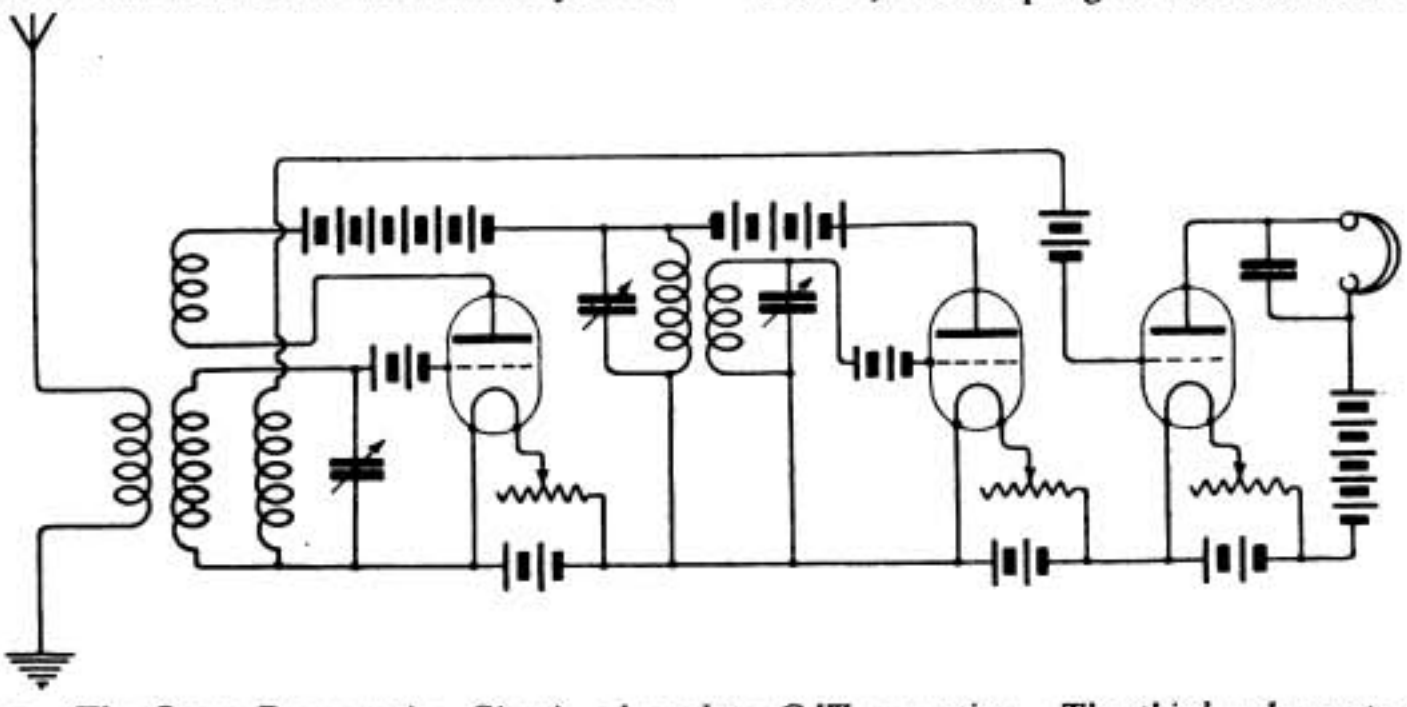

*Fig. 2. The Super-Regenerative Circuit adapted to C.W. reception. The third valve acts as a detector of the combined outputs of the oscillator and amplifier valves.*

circuits is increased until one hears the familiar click which indicates that continuous oscillations are passing through the phones.

Fifth, the reaction coupling of the first tube is increased

Sixth, the variable condensers of the oscillator tube circuits are readjusted until the quality of the music is restored.

REDUCTION OF SPARK STATION INTERFERENCE.

In addition to possessing extraordinary amplification properties, the super-regenerative system greatly reduces interference from

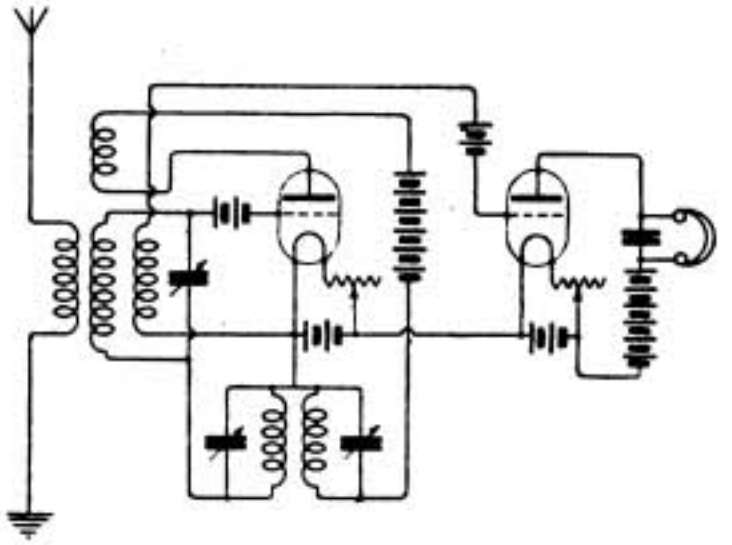

*Fig. 3. The Super-Regenerative Circuit, by means of which both negative and positive resistance is acted upon. The second valve acts merely as a detector.*

spark stations. With ordinary reaction, the trouble from spark stations is much increased because their interfering signals are maintained after the incoming energy from the spark station has ceased.

With the super-regenerative circuit, regenerative action is periodically damped out tens of thousands of times per second, so that the interfering spark signal is stopped as soon as it ceases affecting the receiving antenna.

The super-regenerative system requires "hard" valves.

A remarkable feature of the super-regenerative circuit is that its amplifying power increases inversely as the square of the wavelength. This means that the shorter the wavelength the greater the amplification. In this way the problem of interference is greatly minimised, for the shorter the wavelength the smaller the band of wavelengths affected by one transmitter.

Cascade amplification is possible with the system, but with entirely new methods and circuits. Audio-frequency amplification, as we are familiar with it, sets up harmonics, rendering the system inoperative. This difficulty is overcome by applying audio-frequency amplification to the second harmonic of the station whose signals it is desired to amplify.

Within a short time many amateurs will have supergenerative sets in use, and no doubt simple variations and applications of the system will be evolved. This article attempts merely to make sufficient information available to enable the amateur to begin his experiments. Much interesting information is left for the future.

# A Four-Valve Station Suitable for Short Wavelengths *(continued)*.

By PERCY W. HARRIS.

2.—THE HIGH-FREQUENCY AMPLIFIER AND DETECTOR UNIT.

IN the last article the tuner for this station was described. This, as mentioned, is the first of three units. The second is a two-valve high-frequency and detector unit which can be used by itself or in combination with a two-valve low-frequency amplifier to be described in a further article.

For short wavelengths the resistance-capacity method of high-frequency amplification is ruled out, and one must have recourse to either transformer or reactance-capacity coupling. When it is not desired to receive wavelengths much below 600 metres, tapped transformers and reactance coils prove very satisfactory, one method of using such having been described by the present writer in *The Wireless World and Radio Review.**

The particular receiver described in this article has been tested down to 140 metres and has been found very efficient. The circuit used is that described before the Wireless

* *Wireless World and Radio Review*, April 1 & 8, 1922

Society of London by Mr. Frank Phillips.† This uses reactance-capacity coupling, the reactance coils being interchangeable. One set of coils can be used for both tuner and amplifier, as the coil used in the amplifier is always larger than that used in the tuner. The chief feature of this particular circuit apart from its efficiency is its stability, which is obtained by connecting the grid of the H.F. valve to the *positive* filament terminal, thereby maintaining the grid at positive potential and stopping all tendency to self-oscillation. The loss of efficiency due to positive grid potential is made up by the reaction coil which supplies from the H.T. battery the energy otherwise lost. Unless the grid is so connected it is necessary to use a potentiometer to control grid potential, and this introduces a complication and further adjustment (although in some cases a slightly higher efficiency may be obtained).

In considering the construction of such a receiver, the writer thought it advisable not to incorporate the reactance tuning condenser in the instrument, as condensers are very useful in experimental work, and few experimenters wish to reserve a good variable condenser for one purpose alone. Terminals are therefore fitted for the connection of an external condenser, which may be of a value to suit the particular range of waves being received. In most cases a maximum of 0·0001 mfd. is the largest advisable.

Fig. 1 shows the general appearance of the

*Fig. 1. General appearance of the H.F. amplifier and detector unit.*

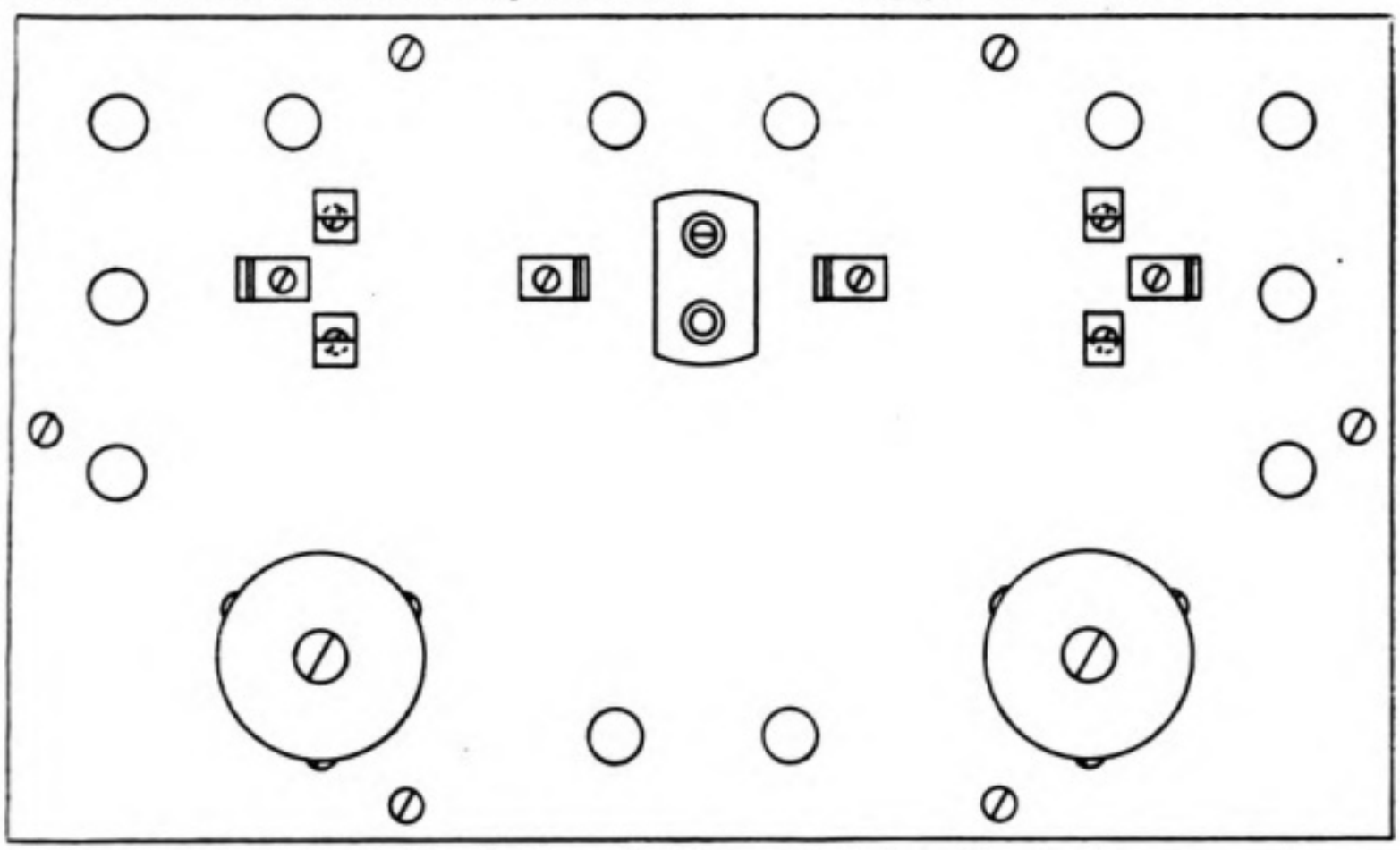

*Fig. 2. Layout of Panel. Terminals on the left are for "Input." On the top row they are for reaction, reactance condenser, and H.T. respectively; the pair on the right side being for L.T., and those at the front for telephones or note magnifier unit.*

†*Wireless World and Radio Review*, April 8, 1922.

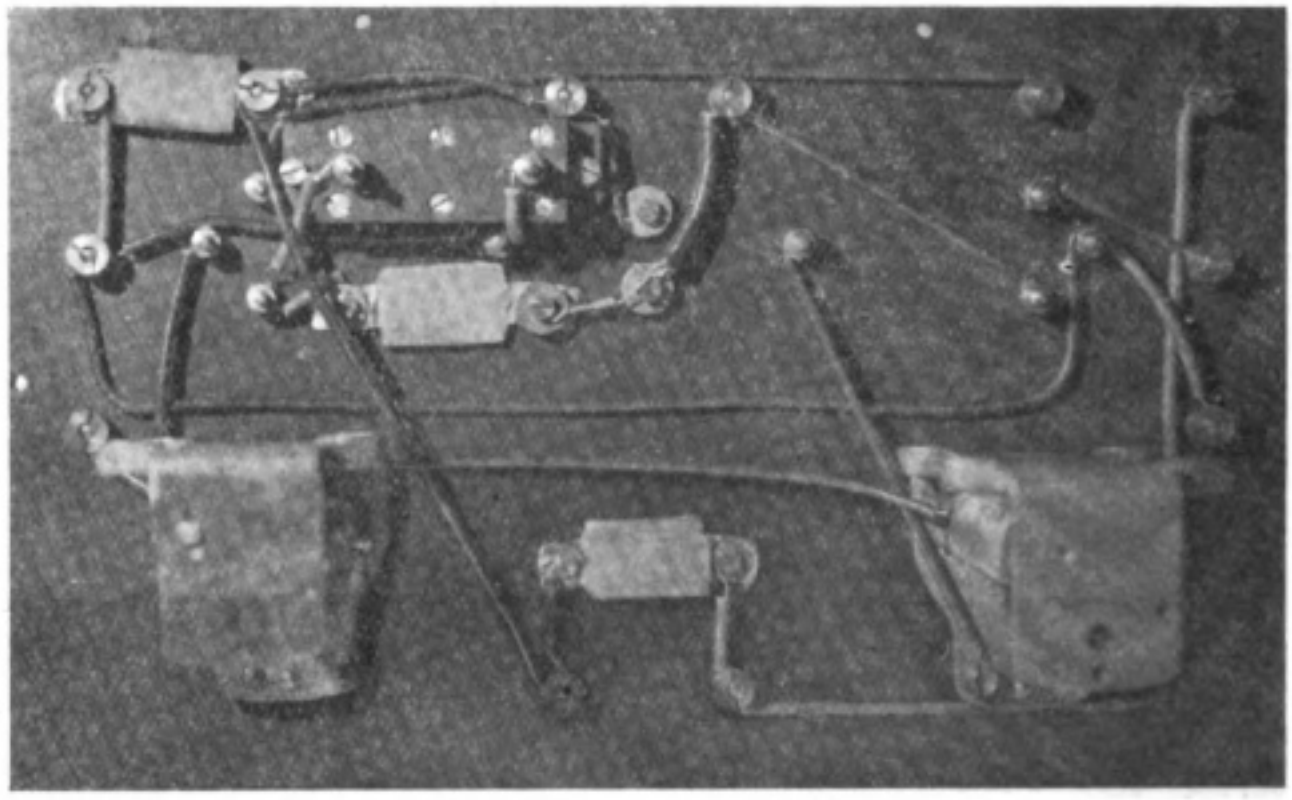

*Fig. 3. The underside of the panel, showing the wiring connections.*

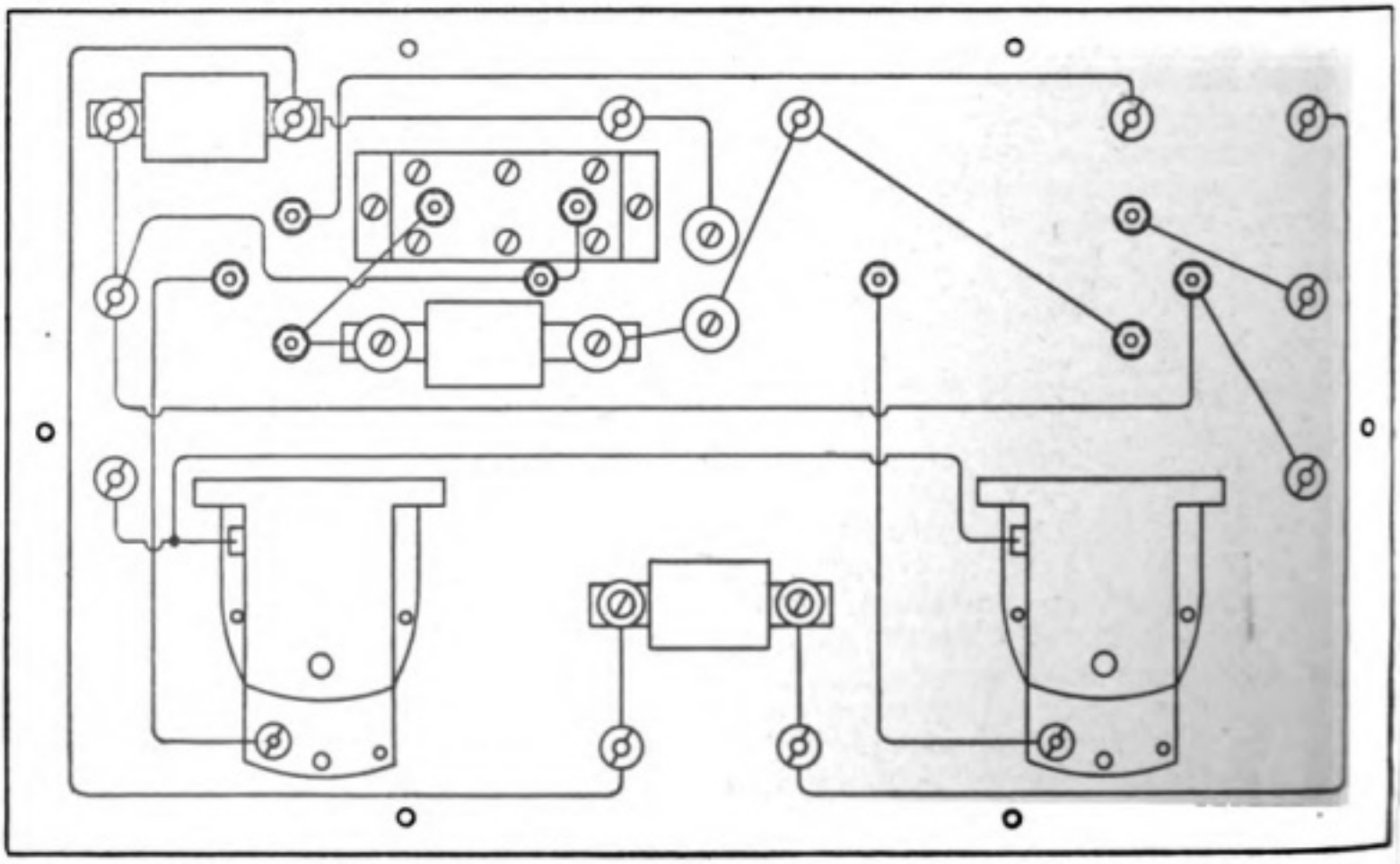

*Fig. 4. Layout of underside. The ordinary type of filament resistance can be substituted for the special type shown here.*

instrument. It is designed to use V24 or QX valves, as these are particularly efficient on short wavelengths, owing to their small internal capacity. Obviously the four-pin type of valve could be used with slight modification of the design.

A separate filament rheostat is fitted for each valve, as the purpose of the two valves is different, and separate adjustment is necessary to obtain best results. There are twelve terminals on the instrument, for "Input," "Reaction," "Tuning Condenser," "H.T.," "L.T." and "Output" respectively. The plug-socket for the interchangable coils is placed between the two sets of valve clips, and immediately adjacent are the terminals for the reactance tuning condenser. In this way the leads to the condenser are kept short.

CONSTRUCTIONAL DETAILS.

The box is made as described in the last article, and measures 10 ins. by 6 ins. by 5 ins. deep. As the box for the two-valve note magnifier is of the same dimensions, both may be made at the same time. They can be finished with two coats of mahogany varnish stain, if made of ordinary deal, or French-polished if constructed of better wood. The top is of ebonite, and should be drilled with clearance holes for the terminals and valve-clip screws, as shown in the drawing. Holes must also be drilled for the filament resistance fittings and for the plug-socket screws. In this instrument the writer has used for the first time a form of filament resistance in which contact is made with the resistance wire by means of a long spiral. This gives a smoother action than the better-known type.

The plug-socket is one sold for fitting to coils, and in order to adapt it to this instrument the curved portion on which the coil rests has to be cut off. Nr. 6 B.A. screws pass through clearance holes in the ebonite, and hold the plug from the back. These also afford the necessary connections with the coil above.

Figures 3 and 4 show the underside of the panel. Three fixed condensers are used, one for the grid (0·0002 mfd.), one across the H.T. battery (0·01 mfd.) and one across the output terminals (0·001 mfd.). The first and third are secured by means of 6 B.A. screws in blind holes tapped into the ebonite (washers gripping the lugs), and the second is held by the locking screws of the two H.T. terminals. The grid leak is of the lead-pencil type on bakelite, of a valve of 1½ megohms. This is also secured by 6 B.A. screws tapped into the ebonite.

In the layout of this instrument care has been taken to keep all the leads as short as possible. An external telephone transformer is used with L.R. telephones.

OPERATION.

The operation of this instrument is rather tricky at first as simultaneous tuning of two condensers is generally required. In his paper* Mr. Phillips gave useful tables of coils for various wavelengths. For short wave work the tuning condenser for the reactance coil should be of not more than 0·0001 mfd. maximum capacity, although larger condensers can be used on long waves.

A good method of beginning work with this set is to take a buzzing wavemeter (the "Townsend" type serves admirably) and hold it near the reactance coil. If the wavemeter is set to, say, 360 metres, the correct reactance coil being in its plug-socket, vary the tuning condenser until maximum strength is obtained in the telephones. The wavemeter, still buzzing, should then be set near the tuner and this adjusted until maximum strength is once more obtained, the reactance tuning condenser being left as previously adjusted. After a little practice with a wavemeter, signals can be tuned in with comparative ease, particularly when notes have been made of the best adjustments.

VALVES.

Good results are obtained with V24 valves in both clips, using 30 volts on the plates. A little better results are found by using a "QX" as the detecting valve. Best of all are two QX valves with 60 volts on the plates.

CONVERSION TO LONG WAVES.

For long wave work the large multilayer coils can be used, but it is far simpler to connect a resistance of about 80,000 ohms across the two condenser terminals in place of the condenser. The amplifier is then of the ordinary resistance-capacity coupled type. Another method is to fit the resistance to a plug, and to substitute it for the coils, the condenser being of course removed.

RESULTS.

On the aerial described in *The Wireless World and Radio Review* for April 1st, page 13 (50 ft. long by 20 ft. high, and using reactance capacity coupling), the Hague Concerts come in on the two valves without difficulty, tuning being sharp and selective. On long waves American stations can frequently be heard.

**Wireless World and Radio Review*, April 8, 1922.

# Experimental Station Design

(*Continued from page 454, July 8th, 1922.*)

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

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

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

## VIII. A SIMPLE VALVE RECEIVING SET.

HAVING completed the construction of the single valve panel described in the previous article under this heading, it now remains to explain the method for connecting up and operating the panel for the reception of signals and in particular the telephony that is transmitted on wavelengths between 300 and 450 metres.

There are many designs for the construction of tuning coils, but in order that the reader may not be delayed further by the necessity for making other instruments, the tuning coils described in an earlier issue* can be made use of. These should be wound exactly as described, two such coils being required, one for connection in the aerial circuit and marked "A" on the panel, and the other which is necessary to produce reaction effects is connected to the terminals "R."

An accumulator is necessary for providing the current for heating the filament of the valve. Most valve filaments need only 4 volts for this purpose, and consequently a 4 volt 20 ampere hour accumulator will suffice. It is inadvisable to select a battery with less capacity than that suggested, as it will need to be in use for several hours at a time. Moreover the ambitious experimenter will not be content with a single valve set for very long, the addition of amplifying valves increasing the current consumption.

The high tension battery may be of any well-known make, and those made up in 15 volt units can be specially recommended. Three 15 volt units providing 45 volts will operate most of the receiving valves at present on the British market. These batteries must be connected in series, that is, the negative, end of the first battery is taken to the negative H.T. terminal of the panel, its positive end being connected to the negative end of a second battery, the positive end of which is taken to the negative end of a third battery, which has its positive end ready for connecting to the H.T. positive terminal of the panel when the remainder of the apparatus has been connected up. It is always advisable when connecting up a valve circuit to leave the joining up of the H.T. terminal until last, for should an error in connection have been made whilst the H.T. battery is connected, it will probably be found to have become completely discharged, even if only left erroneously connected for a brief interval. It is a good plan before finally joining up the positive lead of the H.T. battery to make a test between this lead and the terminal to which it is to be joined, by moistening the fingers and touching them on to the points to be connected. If a slight shock is felt a faulty connection must be looked for. By moistening the fingers and applying them across the main terminals of the H.T. battery a test is afforded as to its condition, as most individuals are susceptible to a slight shock when making contact with a potential as low as 45 volts.

Telephone receivers of high grade manufacture as referred to in a previous article are required, and should have a total resistance of not less than 4,000 ohms. To minimise distortion in the reception of telephony, it is not necessary that they should be of the type having adjustable pole pieces. The reader should acquaint himself with the many types at present on the market before purchasing, in order that he may be satisfied that he has secured receivers of the most reliable make. It is false economy to save a few shillings by purchasing inferior telephone receivers. The use of a telephone transformer is not advocated here. In the course of these articles, the construction of such a piece of apparatus suitable for use with high resistance telephones as mentioned above will be described.

In procuring a valve, one having fairly good rectifying properties should be asked for, and that known as the "R" type is particularly suitable. Other types which give good or perhaps slightly better results are the "R4B," "Q," and "QX," the latter two requiring adapters for fitting to the standard valve holder. All of these valves have a cylindrical plate and spiral grid totally surrounding the filament. There are many small tubular types of valves with four-pin sockets having electrodes arranged in this manner, and these, although admirably suitable for operation in special circuits cannot be recommended for use with this outfit.

For telephony reception a variable condenser is practically indispensable. Although it is intended to describe the construction of one of these instruments subsequently, the reader, unless possessed of a lathe, is advised to buy one. Variable condensers for use in valve circuits should be of the air dielectric type, that is, the space between the

**Wireless World and Radio Review*, p. 327, June 10th, 1922.

fixed and moving plates should be occupied by no other insulator than air. One of specially large capacity need not be selected. It would be more expensive, and owing to its large dimensions would not be capable of giving fine adjustment. A condenser having a maximum capacity of not more than 0·001 microfarads should be obtained if the chief aim of the reader is the reception of short wave signals, and in any case a cheap low capacity variable condenser is always useful. This instrument will probably have an ebonite knob for revolving the moving plates, and it is advisable not to put it into use without providing an extension arm so that adjustments can be made without bringing the hands near to the plates, which is apt to cause small variations of tuning. A small hole drilled into the side of the knob and tapered by means of the tag of a file can be made to firmly hold the tapering point of a 5 in. piece of ¼ in. ebonite rod.

In connecting up the outfit, the aerial is taken to one terminal of the aerial tuning condenser, the other terminal of which is connected to one end of one of the inductances. This end is also taken to the terminal marked "A1." The other end of this inductance is connected to the terminal marked "A2," and also to the earth wire. In the diagrams of the valve panel, terminals were shown marked "aerial" and "earth." These were provided for subsequent use should the experimenter decide to convert the detector panel into a complete receiving tuner, in which case these terminals would be needed. To obviate the connecting of two wires under each of the terminals "A1" and A2" internal connections may be made across between "A" and A1," and "E" and "A2" (Fig. 1, page 455). The inductance will then remain connected on the "A1" and "A2" terminals, whilst the lead from the variable condenser will pass to terminal "A" and the earth wire will be connected to terminal "E." A similar inductance has its ends connected to the terminals marked "R1" and "R2." The H.T. and L.T. batteries, the telephones, and the insertion of the valve complete the connecting up of the set.

The method of operation is first to adjust the brightness of the filament to nearly maximum. There is little danger of burning the filament out when working from an accumulator of only four volts. The aerial tuning condenser is set to a mid-position adjustment and the aerial and reaction coils are placed almost completely over one another. If a shrill whistling noise is heard the top coil should be slowly pushed away from the other with a small piece of ebonite until the noise just ceases. If no whistling is heard a click should be obtainable in the telephones as the two coils are moved apart. If this is not obtained, one of the coils should be turned over and the test repeated. The turning of the aerial tuning condenser should now bring in signals. The overlap of the coils should be kept at a minimum during reception, and they should only be sufficiently close to bring in the signal. Too much overlap will reduce the signal strength, but, moreover, and this is very important, excessive overlap will give rise to the production of oscillating current in the aerial circuit of sufficient intensity to cause interference with other receiving stations which may be near by.

It is probable that the experimenter will receive, first of all, ship and coast stations on wavelengths of about 600 metres and in searching for telephony the aerial tuning condenser must be turned to a smaller value than is required to bring in 600 metre transmissions which can be recognised by their buzzing note. These stations use transmitters of the spark, or damped wave type, which can be identified by the fact that no variation is obtained in the pitch of the note as the tuning is altered. Telephony reception, particularly from amateur stations, is usually attended by a shrill note which fluctuates with movements of the aerial tuning condenser, and it is frequently very difficult to tune in speech transmitted on low power, away from noise of this kind, generally referred to as the "carrier wave." With moderately high power transmission, however, there is no difficulty in tuning into the telephony by critically adjusting the variable condenser by means of its extension handle. A refinement that facilitates critical adjustment is the connection of a small value (0·0005 microfarads )variable condenser across the reaction coil.

F. H. H.

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## Sir Oliver Lodge's Address to the Wireless Society of London

The following is the text of a letter received from Sir Oliver Lodge, F.R.S., regarding his address to the Wireless Society of London, published in our issue of July 1st. Sir Oliver Lodge suggests that the letter should be published as a means of drawing attention to one or two corrections to be made to the report of his address.

10*th July*, 1922.

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I regret that I had not time to correct and amplify the report of my lecture to the Wireless Society, published in your July issue. But the report is very well done, and someone has kindly corrected it for me. There remain only a few errata, of which I need only mention the following:—

Middle of first column, p. 409:—"The ether being the light" should be "the ether being treated as an elastic solid."

In the first equation on p. 409, p should be $2\pi$.

The first paragraph on p. 412 should be in quotation marks, because it was the footnote with which I concluded my Paper on Electric Waves in the *Phil. Mag.* for August, 1888; the preceding paragraph being also a virtual, though rough, quotation from the conclusion of that same Paper.

Near end of second column on p. 415, 1889 should be 1899.

Yours faithfully,

(Signed) OLIVER LODGE.

# Some Effects of Capacity on Mutual Induction

*The following is a reply to the discussion on the paper read by Mr. J. H. Reeves on the above subject.*

**Mr. J. H. Reeves** (*in reply communicated*).

Prof. G. W. O. Howe has brought to my notice a paper by himself written in 1912 (*Electrician*, Vol. 68, p. 1,017) in which he showed that the effect of electrostatic coupling helps or opposes that of electromagnetic according to the direction of winding of the respective coils. Mr. Coursey gives a qualitative explanation of the same phenomenon. Interesting though this is, I do not see how to use it for improving the design of reception coils unless numerical values can be calculated for coils of stated dimensions, and he gives no hint how these calculations can be made as regards the co-efficient of electrostatic coupling. Mr. Carpenter gives precise direction as to where to seek for the necessary expressions, but Washington, U.S.A., is rather far for the amateur. I will try to get a copy but wish it could be bought in this country.

I draw so much distinction between the two types of electrostatic coupling because I found in practice there is a great difference in action as regards passing through jamming signals, and I will state in greater detail the experiments which made me abandon the variable condenser coupling. I used my No. 40 coils very loosely coupled, fully one foot apart, so that the coupling should be almost entirely static. I arranged the variable condenser and the static coupler circuits so that each could be coupled up instantaneously through one of two plugs. Using the latter coupling first I tuned into 400 metres by a buzzer wavemetre and then, bringing in the other, I adjusted the condenser till the strength of the signals was as nearly as I could judge the same. Hence I concluded I had reached Mr. Coursey's criterion of equally effective capacity couplings. With the circuits left in this adjustment I listened in for the **FL** 9.30 G.M.T. time signals. These were easily readable on the condenser coupling, quite inaudiable on the static coupler connection. I changed over to single circuit working. **FL** continued to come through with some variation in strength. I turned back to coupled circuit working (a single switch makes these changes) and disconnected the earth connection of the A.T.I. **FL** came through the secondary with appreciable, but small, alteration of strength, but was again inaudible on the static couplers.

My theory is that when the **FL** wave effect reaches the junction of the end of the A.T.I. and the lead to the secondary *via* the coupling variable condenser it has two paths in parallel direct to earth, and the oscillations forced on either of these is independent of that on the other, or nearly so, while in the case of the static couplers the **FL** wave effect sets up forced oscillations in the A.T.I., altered possibly, but very slightly, by back action, from the encircling strip. The forced oscillations, greatly diminished in strength, are passed on to the second strip, and by it, with still further diminution, are passed on to the secondary. This may also explain my observations on atmospherics. I was unable to listen in for some days preceding the reading of the paper as I was in bed by medical orders. The fact that atmospherics were exceptionally bad during those days makes me regret still more my enforced abstinence from wireless work. I hope, however, to be able one day to take my set of No. 40's over to Mr. Blake on a really bad day and we will have a comparison between these and the Reinartz set he so interestingly described.

In reply to Mr. Blake's enquiry as regards signal strength I will include an allusion to Mr. Child's suggestion that I use extra high amplification. The 55D was designed more for simplified working over a large range than for high efficiency on any one; further, its minimum range is 1,500 metres and most of my later work has been done on 600 and 400, with only four V.24's instead of the full number of six. Hence the H.F. amplification is certainly not extra high, and indeed on a friend's circuit with one H.F., tuned transformer coupled, I have heard better than with my four. As regards long distance 600 metres work, the best I have got, with No. 26 coils, magnetic coupling only has been Alexandria, **SUH**. With the same amplification, using my No. 40's feet apart and relying on the static coupling only, Mr. Murchie and I have read a ship answering Ajaccio, **FUI**. Hence as regards reception, provided reaction just short of oscillation is used, there would seem to be little difference. There has been marked difference as regards elimination of jamming by the alternative methods of (*a*) very loose magnetic coupling; (*b*) balancing magnetic against electrostatic, whether by means of the inherent self-capacity of No. 26 coils, wound with the turns touching, or by the No. 40 coils using static couplers. I refer Mr. Blake to my early remarks *re* eliminating **GFA** from Croydon and Mr. Child's telephony. I am not expert enough to be able to recognise with certainty the harmonics of **GBL**. There is a frequent harmonic in the neighbourhood of 600 metres. With the No. 40's this is reduced to a restricted band on either side of which ships come through on their natural note.

From Mr. Child's remarks about the way my coils and apparatus generally are well spaced, it would seem that my reception unit is of unwieldy dimensions, so I have had the curiosity to make a few measurements. The base is a cupboard, floor area 23 ins. by 18 ins; in this are the batteries and spares. On the top back of this is a series of panels 18½ ins. by 11 ins. mounted vertically over one another. This leaves a shelf 23 ins. by 7 ins. on which can rest any set of coils with which I am experimenting. The base area of my No. 40 set is 17 ins. by 4 ins., and the 17 ins. could be made 14 ins. by altering the reaction adjustment. Surely these dimensions are smaller as regards "room-occupying" space than those of many of which photographs have appeared in *The Wireless World*. I would willingly double all if by so doing I could get nearer to perfection in the elimination of jamming and distortion.

The close agreement of the estimates of Mr. Phillips and Mr. Child as to capacity values is interesting. I can only regard as a lucky chance the fact that the first pair of laminated couplers came so closely to about the right order of things. I have not yet had time to try the effect of making them smaller or larger, but as soon as I get H.F. amplification more suitable for 400 metres and under I will try varying their magnitude.

# The Elementary Theory of the Thermionic Valve*

By GORDON FRYER, L.D.S., R.C.S.Eng.

*Vice-Chairman of the Hounslow and District Wireless Society.*

THE subject of my paper is the elementary theory of the thermionic tube or valve as we are in the habit of calling it, and after the interesting lectures and demonstrations that we have had in the recent past, I fear the subject may appear somewhat tedious.

I do not claim anything original in what I may say, but I am only trying to explain in a simple manner the present accepted theory which you may read much more fully in any text-book dealing with the subject.

From this you may gather that I am addressing primarily those among you who have but recently entered upon this fascinating branch of science.

Roughly, we may divide those interested in wireless into three classes.

There are first, those whose chief interest is in making wireless sets and tuners and in turning out beautifully polished panels and cabinets; in other words, their bent is to be wireless instrument makers. Secondly, we have the men who, having obtained or made a set of some kind or other, devote their time to reading the Morse messages, their ambition being to become more or less efficient operators. And, thirdly, we have the class to which we amateurs chiefly belong, who, without neglecting the constructional and operating side, are far more interested in experimental work, in trying new circuits and instruments, always with the idea and hope of bettering our present one and with ever the possibility of discovering something new that may advance the science.

But before we can reach this stage of amateur research work, we must obviously know exactly what our instruments are doing, how they do it, and why.

There must be no gadget on our bench whose use we do not know, and we must be able to picture in our minds what is actually taking place at any point of our circuit. And if this evening I am able to assist any of you over the first fence of the difficult course of wireless theory, my object will have been accomplished.

If I crush a piece of chalk into a very fine powder and take the smallest particle of it which is hardly visible to the eye, it would still appear quite large under a microscope. If this were further divided into innumerable smaller particles, we should at length reach a stage where it could no longer be divided without destroying its character as chalk.

This smallest particle of any element or compound that can exist of itself is called a molecule.

Each molecule consists of one or more atoms, which may be defined as the smallest part of an element which can enter into combination with another atom. (See Fig. 1.)

Now, let us consider the structure of one of these atoms.

According to what is now known as the electron theory, an atom consists essentially of a central nucleus or core around which revolves at varying distances one or more corpuscles which are called electrons.

Of the central nucleus we know very little, except that its mass is very much greater than the electrons that revolve around it, and that it is supposed to consist essentially of positive electricity.

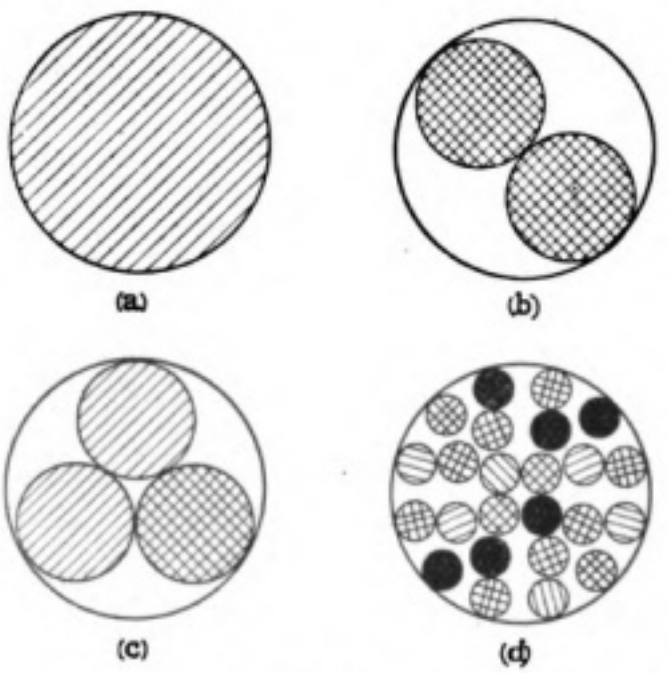


*Fig.* 1. *Diagrammatical representation of* (a) *A molecule of Hydrogen consisting of one atom.* (b) *A molecule of Oxygen consisting of two atoms.* (c) *A molecule of Water consisting of two atoms of Hydrogen and one of Oxygen.* (d) *A molecule of Sugar consisting of six atoms of Carbon, twelve atoms of Hydrogen and six atoms of Oxygen.*

However, it is not so much the central core in which we are interested this evening as in the revolving electrons.

Each electron is of infinitely small size, and is supposed to consist of negative electricity.

The number of these electrons, their distance from the centre and their relative positions, are different in every element, and it is these electrons which are supposed to give to an element its chemical properties. Thus, the difference between lead and gold may be that the atoms of the one possess a greater number of electrons than the other (Fig. 2), and so if we were able to vary the number of electrons in an atom we should be able to change lead into gold, which would be most unfortunate. However, no physical forces at our disposal have so far been able to alter in the slightest degree the structure of the atom, although we have in what are known as radio-active substances, *e.g.*, radium and uranium, examples of atoms emitting some of their electrons. This process, however, takes place very

* A paper read before the Hounslow and District Wireless Society on May 18th, 1922.

slowly, in fact it would take 50,000 years for a piece of radium to change into an element of slightly different characteristics.

The size of the atom may be likened to the dome of St. Paul's Cathedral; an orange suspended by a thread would represent the central nucleus and several flies circling round relatively show the size of the electrons.

The atom with its nucleus and revolving electrons may be likened to our solar system; the size of the atom to the Solar system is as $1 : 10^{22}$. Now, although you can see at a glance what a tremendous size this figure is, you will gain a better idea of its

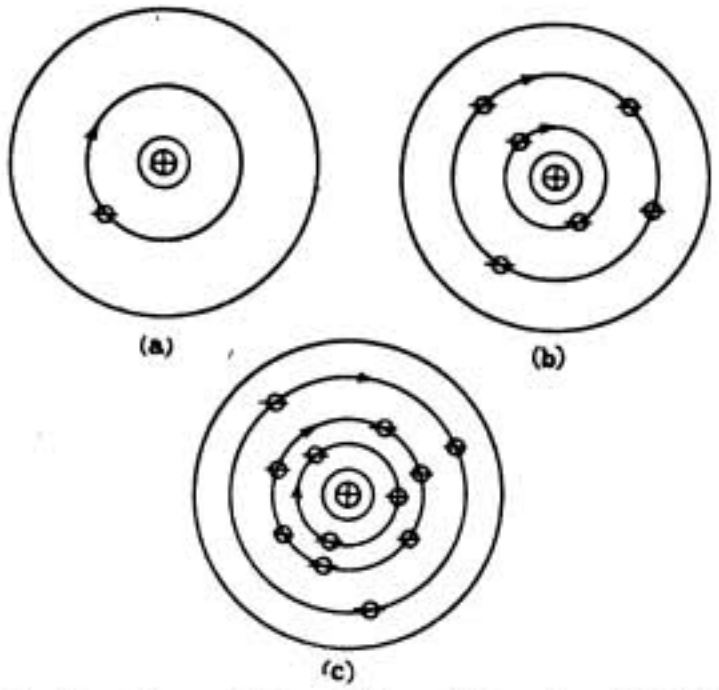


*Fig. 2. Atoms of three different elements.* (a) *With one electron revolving round the positive core.* (b) *With six electrons in two orbits.* (c) *With twelve electrons in three orbits.*

size if you will try and imagine that an atom with its electrons and nucleus is actually a sun with its revolving planets, and let us imagine that one of these electronic planets be peopled as the earth is. Now, even as their size is $10^{22}$ times smaller than ours, so is their time. In other words, one of our seconds is equal to $10^{22}$ of their seconds.

This time is so short that hundreds of thousands of years of their time pass during a second of ours. It is thus quite impossible for us to destroy one of the worlds.

A book written by Prof. Fournier d'Albe, called "The Infra and Supra Worlds," deals with this fascinating theory, and I should recommend any of you sufficiently interested to read it.

Now besides these fixed numbers of revolving electrons in an atom, there are other electrons which are called free electrons because they are able to move freely between atom and atom, and under suitable conditions are able to leave the atom altogether. They, also, consist of negative electricity and their number varies in every element, and they are supposed to give to an element its physical properties. It is these free electrons which take part in electrical phenomena. A substance that contains many of these free electrons, which are easily movable from atom to atom, is a good conductor of electricity such as the metals, as a current of electricity, as we shall see later, is simply a flow of these free electrons from molecule to molecule.

Now, under normal conditions, all the electrons which, as I have said, consist of negative electricity, neutralise the positive core in an atom, which thus possesses no electrical charge. If, however, we take a number of these free electrons away from the atom, the positive charge in the case will preponderate, and the atom will possess a positive charge, and the more electrons we take away the more positive it becomes; thus, by withdrawing electrons from an uncharged or neutral piece of matter we may be said to give it a positive charge.

Similarly, if we add electrons to an atom it will become negatively charged. A positively charged atom is called a positive ion, and a negatively charged atom is called a negative ion.

According to the well-known law, like repels like and attracts unlike. Thus two bodies negatively charged will repel one another, but would attract an uncharged or positively charged body, and if we have two bodies, one of which possesses a greater number of free electrons than the other, it is said to be at a higher negative potential than the other, and if these two bodies be brought together until they touch, the electrons will flow from the one with the higher negative charge to the other until they are both of the same potential.

If, however, the difference in potential between the two bodies is very great and they are brought towards each other without touching, the electrons will fly across from the one to the other, producing in their passage through the air an electric spark (Fig. 3), which is simply the heated molecules of air caused by the friction of the electrons as they pass through it at terrific speed.

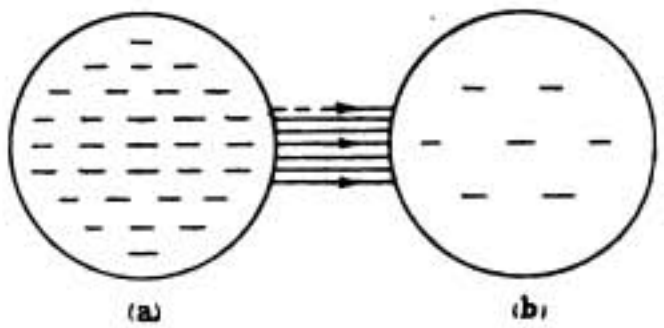


*Fig. 3. Represents two atoms* (a) *possessing a negative charge or surplus of electrons.* (b) *possessing a positive charge or deficiency of electrons; if brought near together, electrons fly across to the atom with the positive charge.*

The free electrons are in continual motion in the atom, and their speed increases with the temperature.

If we heat some water in a kettle the molecules of the water increase their speed until at last they are able to overcome the pressure of the atmosphere and leave the water issuing from it as steam. Now exactly the same thing occurs with electrons.

If we heat a piece of wire, say, by means of an electric current flowing through it, the movements of the electrons will increase in speed as the temperature is raised, and if we take away the pressure of the atmosphere their speed will increase much more rapidly.

I have gradually, step by step, been leading up to the point where we are in a position to understand what takes place in a wireless valve.

*Fig. 4.*

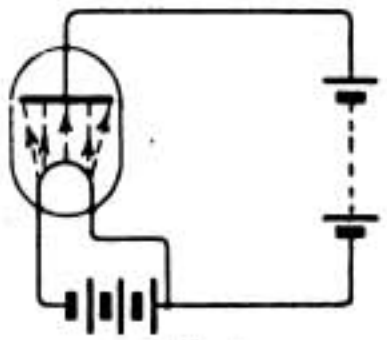

*Fig. 5.*

*Fig. 4. Showing electrons leaving and returning to heated filament.*

*Fig. 5. A plate with a positive charge inserted, showing a regular flow of electrons from the heated filament to the plate.*

In an assembly such as the present, there is no need for me to describe the valve in great detail, but essentially it consists of a glass bulb, highly exhausted of air in which is first a filament of tungsten, of which we can raise the temperature by means of a 4 to 6 volt accumulator. Secondly, there is sheet of nickel, which is generally of cylindrical form, and surrounds the filament, it is called the plate; and, thirdly, we have between these two and somewhat nearer the filament what is known as the grid. This takes various forms according to the make of valve, but usually it consists of a spiral of fine molybdenum wire. Two of the legs of the valve belong to the filament, one goes to the plate and the other to the grid.

Let us see what takes place when we heat the filament, ignoring for the present the plate and grid.

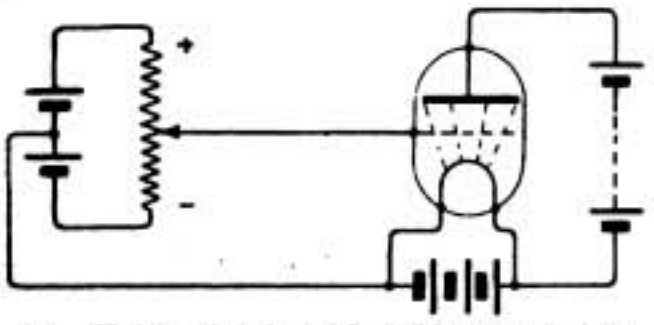


*Fig. 6. Valve circuit with grid connected to the centre of the potentiometer and so having no charge on it. The grid here does not interfere with the normal flow of electrons.*

As the temperature of the filament is raised, the free electrons vibrate at a rapidly increasing rate. At length their speed is so great that they are able to leave the filament altogether (Fig. 4.) Here they meet the resistance caused by the molecules of gas still left in the bulb. Their energy is rapidly exhausted and they return to the filament in exactly the same way that a stone thrown in the air returns to the ground.

We thus have a cloud of electrons surrounding the filament, and this is called the space charge as it really constitutes a negative charge in space.

Now any electrons leaving the filament have to overcome three things:—

First the attractions of the positive core.

Second, the resistance caused by friction between the molecules of gas in the bulb.

Third, the repulsion caused by cloud of electrons.

But as the electron travels further from the filament the number of electrons of the space charge in front decrease and those behind increase until at last the space charge would be helping the electron on its way from the filament.

Now let us introduce a thin unconnected metallic plate some distance from the filament. This plate has no charge and is therefore at a higher positive potential than the rest of the bulb. Electrons which always tend to flow from a point of low positive potential to one of high potential will therefore accumulate on the plate and charge it negatively. This will continue until the plate is so negative that it begins to repel electrons which were going to it.

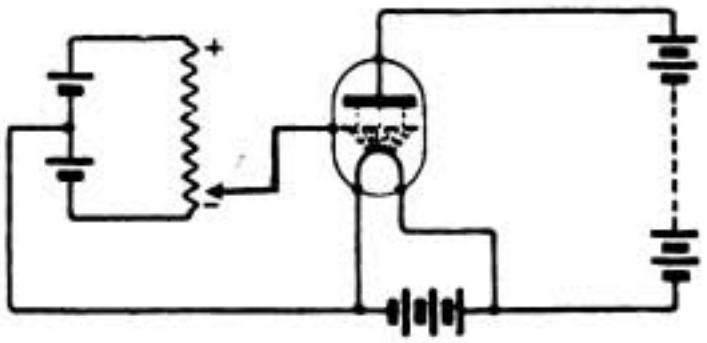


*Fig. 7. The same circuit with a negative charge upon the grid, which lessens the flow of electrons to the plate.*

Now having considered an isolated plate, let us suppose we give the plate an electrostatic positive charge. Since the plate is positive it has had electrons taken away from it, and it makes good the deficiency by attracting to itself the electrons which are being emitted by the filament. I may mention here that the attraction of the plate causes a strain on the filament itself, so that sometimes it may even break the filament. This is the reason that the plate is usually in the form of a cylinder around the filament.

Now by connecting the positive of the battery to the plate, and the negative to the filament, as in Fig. 5, we shall maintain a constant positive potential on the plate and maintain a constant flow of electrons from filament to plate. This is called the plate or anode current.

This constitutes the two-electrode valve or Fleming valve.

The essential feature of the three-electrode valve is the grid.

The function of the grid is to control the flow of electrons that we have just been considering, and it is sometimes called the "control electrode."

Now let us connect up a circuit as in Fig. 6, by which means we are able to place a varying potential upon the grid.

Starting with no charge upon the grid, the flow of electrons to the plate circuit is normal (Fig. 6), but if we put a negative charge upon the grid, it will now repel many of the electrons that would have

gone to the plate. This means less plate current, and as we increase the negative potential upon the grid, we shall at length reach a point where the charge upon the grid is so great that it will turn

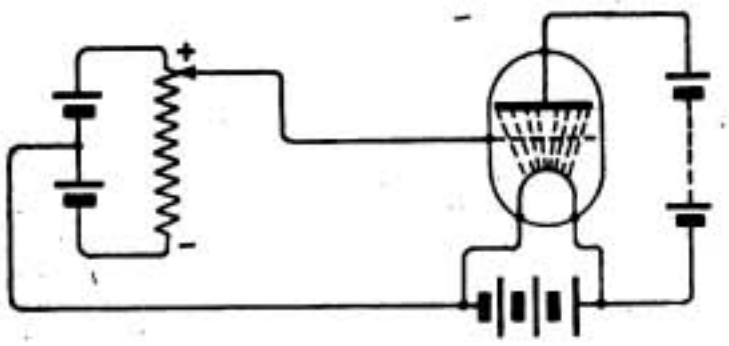

*Fig. 8. The same circuit as in 6, but with a strong positive charge on the grid, causing a greatly increased flow of electrons to the plate.*

back all the electrons that would have gone to the plate. The plate current would now be zero. (Fig. 7.)

Conversely, if we put a positive potential on the grid the plate current is increased, and if we keep increasing the positive potential on the grid a point will at length be reached when all the available electrons are going to the plate, after which any further increase of positive potential would have no further effect. This is called saturation point, and is illustrated in Fig. 8.

So you may see that by altering the potential of the grid we can vary the plate current from zero to saturation value

I have given in Fig. 9 a curve to show the value of plate current for different values of grid potential.

You will see there are two bends to the curve. The one A is due to the space charge which decreases as the potential of the grid rises and the one at B is due to the effect of saturation.

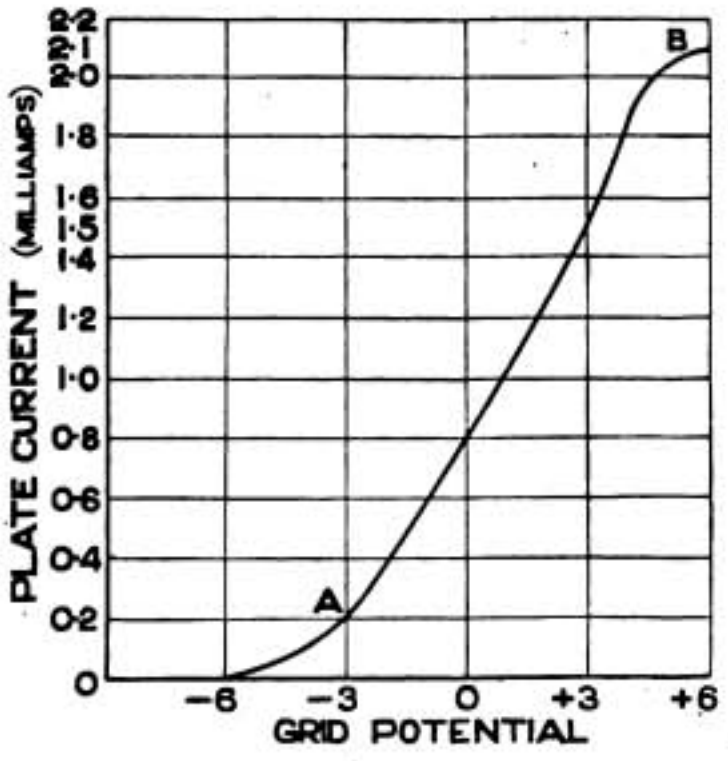


*Fig. 9. Curve showing effect of varying the grid voltage upon the plate current.*

The portion between A and B is fairly steep; this means that small variations of grid potential will cause large variations of plate current.

Now without going into any further details I conclude with a diagram (Fig. 10) which shows how we use the valve in a simple wireless circuit.

Electrons are emitted from the heated filament; these are attracted to the plate, which is kept at

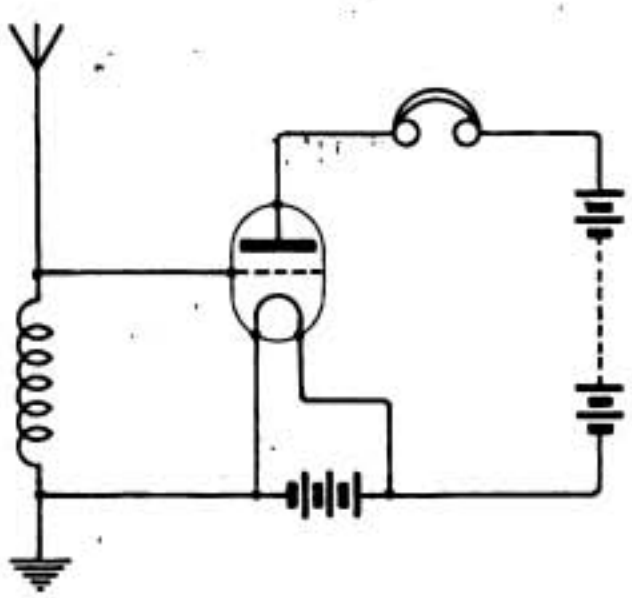

*Fig. 10. Simple valve circuit to show how a varying potential is put upon the grid by the incoming oscillations in the aerial circuit.*

a positive potential by the H.T. battery, so that we have a continuous regular plate current. The telephone is inserted in the plate circuit, but, of course, while the current in the plate circuit is steady it has no effect upon the telephones. The grid is connected to the aerial, and the oscillations sent out by the transmitting station cause a varying potential of the grid, which in its turn varies the plate current. These variations affect the telephones and we get signals.

# The Wireless Society of London.

**The new session of the above Society will commence in September next. Application for membership or for affiliation of Provincial Wireless Societies should be made to:**

**The Hon. Secretary,**
**(Mr. L. H. McMichael)**
**32, Quex Road,**
**London, N.W.6.**

# Amplitude of Electrical Oscillations Generated by Electron Tubes.*

By G. BREIT.

THE calculation of the amplitude of electrical oscillations generated by electron tubes has been treated by Van der Pol and by Moeller by different methods.† In this paper a still different method of discussing the question is indicated.

This method is based on the geometrical fact that a curve may be approximated by a polygon (inscribed or circumscribed). It thus substitutes a polygon for the characteristic curve of the tube. It is clear that the general method may be also used in other problems in which the connection between two of the variable quantities is not linear provided the problem can be solved for the case in which this connection is linear.

The fact that the polygon is never an exact substitute for the curve offers no difficulty because the graphical solution of the transcendental equations involved can be carried out with practically as much ease for a polygon with many sides as for a polygon with few sides. Thus, the approximation can be always made as close as is desired.

## Notation and Assumptions.

The symbols and quantities used are illustrated in Fig. 1.

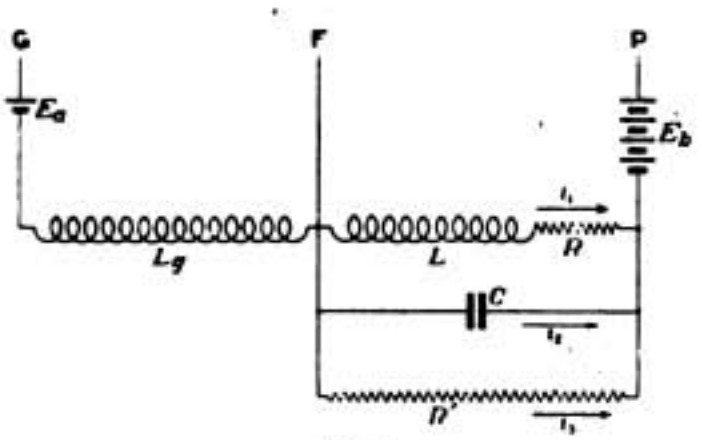


*Fig 1.*

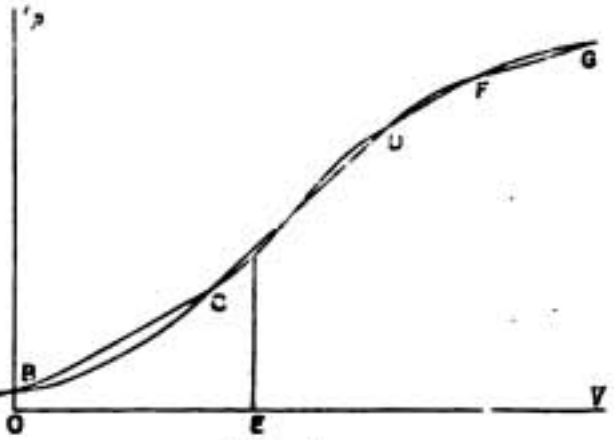


*Fig. 2.*

G denotes grid terminal of valve.
F denotes filament terminal of valve.
P denotes plate terminal of valve.
$E_a$ = Voltage of grid battery reckoned positive when + terminal faces grid.
$E_b$ = Voltage of plate battery reckoned positive when + terminal faces plate.
$L$ = Inductance of plate coil.
$R$ = Resistance of plate coil.
$C$ = Capacity of plate circuit condenser.
$R'$ = Leakage resistance of plate circuit condenser.
$M'$ = Mutual inductance between plate and grid coil, reckoned positive when the mutually induced e.m.f. is of same sign on G and P with reference to F.
$V_P$ = Excess of potential of P over that of F.
$V_g$ = Excess of potential of G over that of F.
$i_p$ = Plate current reckoned positive when flowing from plate to filament inside tube.
$i_1$ = Current through plate circuit inductance from F to P.
$i_2$ = Current through plate circuit capacity from F to P.
$i_3$ = Current through leakage resistance of plate circuit capacity from F to P.

The current $i_p$ is composed of the three currents $i_1$, $i_2$, $i_3$, shown on the figure, i.e.,

$$i_p = i_1 + i_2 + i_3 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

It will be assumed that $i_p$ is a function only of $V_G$, $V_P$ and that this function is of the form

$$i_p = f(V_P + \mu V_g) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1')$$

where $\mu$ is a constant called the amplification constant of the tube. The grid current will be neglected throughout.

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* Received December 22nd, 1921.

† BALTH. VAN DER POL, Jun. *Radio Review*, 1, pp. 701-710, November; and pp. 754-762 December, 1920. HANS GEORG MOELLER. "Die Elektronenröhren." (Published by Vieweg & Sohn.) P. 79.

**Derivation of the Fundamental Equation.**

Since the potential differences across the coil ($R$, $L$), across the capacity $C$, and across the leakage resistance $R'$ are equal we have

$$\left(L\frac{d}{dt} + R\right) i_1 = \int_0^t \frac{i_2}{C}\,dt = R'i_3$$

or

$$i_2 = \left(LC\frac{d^2}{dt^2} + RC\frac{d}{dt}\right) i_1$$

$$i_3 = \left(\frac{L}{R'}\frac{d}{dt} + \frac{R}{R'}\right) i_1$$

Hence by (1)

$$i_P = \left[LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}\right] i_1 \quad \ldots\ldots\ldots \quad (2)$$

Further

$$\left\{\begin{aligned} V_P &= E_b - \left(L\frac{d}{dt} + R\right) i_1 \\ V_g &= E_a - M\frac{di_1}{dt} \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots \quad (2')$$

so that

$$V_P + \mu V_g = E_b + \mu E_a - \left[(L + \mu M)\frac{d}{dt} + R\right] i_1$$

or letting

$$\left.\begin{aligned} V_P + \mu V_g &= V \\ E_b + \mu E_a &= E \end{aligned}\right\} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2'')$$

We have

$$V - E + \left[(L + \mu M)\frac{d}{dt} + R\right] i_1 = 0 \quad \ldots\ldots\ldots \quad (2''')$$

Operating on this with $LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}$ and using (2) we obtain

$$\left[LC\frac{d^2}{dt^2} + \left(RC + \frac{L}{R'}\right)\frac{d}{dt} + 1 + \frac{R}{R'}\right] V + \left[(L + \mu M)\frac{d}{dt} + R\right] i_P = \left(1 + \frac{R}{R'}\right) E \quad \ldots \quad (3)$$

This is the fundamental equation of the problem.

**Method of Solution.**

It was assumed that

$$i_P = f(V) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Thus it is required to find a solution of (3) for which (4) is satisfied. The relation (4) may be represented graphically as in Fig. 2.

The method of approximation consists in inscribing polygons in the curve representing the relation (4) as *e.g.*, the polygon A B C D F G. For any side of the polygon we have

$$f(V) = a + bV$$

Thus substituting into (3) a new variable $v$ defined by

$$v = V - \frac{E - \dfrac{aR}{1 + R/R'}}{1 + \dfrac{bR}{1 + R/R'}} \quad \ldots\ldots\ldots\ldots\ldots \quad (4')$$

and replacing the differential operator $\frac{d}{dt}$ by a variable $\xi$ in the usual way we obtain the quadratic

equation

$$LC\xi^2 + \left(RC + \frac{L}{R'} + b\,(L+\mu M)\right)\xi + 1 + \frac{R}{R'} + bR = 0$$

The two roots of the equation we denote by $a$ and $\bar{a}$.

In terms of these

$$v = A\,\epsilon^{at} + \bar{A}\,\epsilon^{\bar{a}t} \quad \ldots\ldots\ldots\ldots\ldots \text{(I)}$$

where $A$, $A$ are arbitrary constants. Differentiating (I) we have

$$\dot{v} = Aa\,\epsilon^{at} + \bar{A}\bar{a}\,\epsilon^{\bar{a}t} \quad \ldots\ldots\ldots\ldots\ldots \text{(II)}$$

Multiplying (I) by $a$ and subtracting * from (II).

$$\dot{v} - av = \bar{A}\left(\bar{a} - a\right)\epsilon^{\bar{a}t}$$

Writing the above equation for $t = t_1$ and for $t = t_0$ and taking the ratio of the two we get

$$\frac{\dot{v}_1 - av_1}{\dot{v}_0 - av_0} = \epsilon^{\bar{a}(t_1 - t_0)} \quad \ldots\ldots\ldots\ldots\ldots \text{(III)}$$

Similarly, on multiplying (I) by $\bar{a}$, subtracting from (II) and taking the ratio of the results for $t = t_1$ and $t = t_0$ we get

$$\frac{\dot{v}_1 - \bar{a}v_1}{\dot{v}_0 - \bar{a}v_0} = \epsilon^{a(t_1 - t_0)} \quad \ldots\ldots\ldots\ldots\ldots \text{(IV)}$$

and eliminating $t_1 - t_0$ between (III) and (IV).

$$\frac{(\dot{v}_1 - av_1)^{\bar{a}}}{(\dot{v}_1 - \bar{a}v_1)^{\bar{a}}} = \frac{(\dot{v}_0 - av_0)^{\bar{a}}}{(\dot{v}_0 - \bar{a}v_0)^{\bar{a}}} \quad \ldots\ldots\ldots\ldots\ldots \text{(V)}$$

THIS MEANS THAT $\dfrac{(\dot{v} - av)^{\bar{a}}}{(\dot{v} - \bar{a}v)^{a}}$ REMAINS CONSTANT WHILE ONE OF THE SIDES OF THE POLYGON IS FOLLOWED.

This fact will enable us later to follow the changes in the system while it remains on one side of the polygon.

Further, if the system passes from one side of the polygon to the next $V$ *changes continuously*. This, as we shall show presently, implies also that $\dot{V}$ changes continuously.

In fact, since $V$ is continuous $i_1$ is also continuous because $L$ is an inductance. Consequently, by (2''') $\frac{di_1}{dt}$ is continuous and by (4) the same is true for $i_p$. Hence, from (2) we infer the continuity of $\frac{d^2i_1}{dt^2}$ and differentiating (2'') we find that $\dot{V}$ is continuous.

In most practical cases $a$ and $\bar{a}$ are conjugate complex numbers. Only these cases will be considered at present.

Since $v$, $\dot{v}$ are real

$$\frac{(\dot{v} - av)^{a}}{(\dot{v} - \bar{a}v)^{\bar{a}}} = \epsilon^{2j\theta}$$

where $\theta$ is real.

Writing $a = \alpha + j\beta$ we have for positive $v$

$$\epsilon^{2j\theta} = v^{2j\beta}\,\frac{(\rho\,\epsilon^{-i\phi})^{\alpha + j\beta}}{(\rho\,\epsilon^{i\phi})^{\alpha - j\beta}}$$

where $$\rho = \sqrt{\left(\frac{\dot{v}}{v} - \alpha\right)^2 + \beta^2}\,, \quad \tan\phi = \frac{\beta}{\frac{\dot{v}}{v} - \alpha}$$

*The procedure here employed is shorter than that originally used and has been suggested by Prof. H. A. Lorentz.

Hence, for positive $v$ the quantity

$$\theta = \beta \log v - \alpha \phi + \beta \log \rho$$

$$= \beta \log v - \alpha \tan^{-1} \frac{\beta}{\frac{\dot{v}}{v} - \alpha} + \beta \log \sqrt{\left(\frac{\dot{v}}{v} - \alpha\right)^2 + \beta^2} \quad \ldots\ldots\ldots (5)$$

remains constant during the motion.

Similarly, for negative $v$ the quantity

$$\theta' = \beta \log (-v) - \alpha \tan^{-1} \frac{\beta}{\frac{\dot{v}}{v} - \alpha} + \beta \log \sqrt{\left(\frac{\dot{v}}{v} - \alpha\right)^2 + \beta^2} \quad \ldots\ldots\ldots (6)$$

remains constant.

Theoretically the problem is thus solved because on any side of the polygon either (5) or (6) establishes a connection between $v$ and $\dot{v}$. It is most convenient to express this connection graphically.

## Graphical Methods.

The motion of the system can be studied by means of the curves

$$y = Y(x) = -\alpha \tan^{-1} \frac{\beta}{x - \alpha} + \beta \log \sqrt{(x - \alpha)^2 + \beta^2}$$

drawn for each of the sides of the polygon. The curve will be always supposed to be plotted for positive $\beta$ and has the general shape shown in Fig. 3.

*Case of* $v > 0$.

Let us consider the case of $v > 0$ in more detail. Let us denote $\frac{\dot{v}}{v}$ by $x$. Then in virtue of (5), changes in $y$ are equal and opposite to changes in $\beta \log v$. If now $\dot{v}$ is also positive then $\frac{\dot{v}}{v}$ is positive and corresponds therefore to a point $\overline{A}$ (see Fig. 3) on the right branch of the curve. Since $\dot{v} > 0$, $v$ is increasing, and, hence, by (5) $y$ is decreasing so that the point corresponding to $\frac{\dot{v}}{v}$ slides down the curve. If its

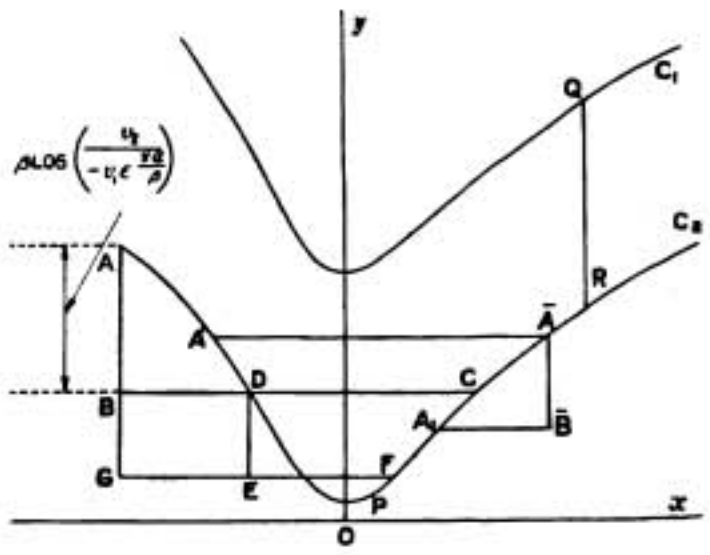



*Fig. 3.*

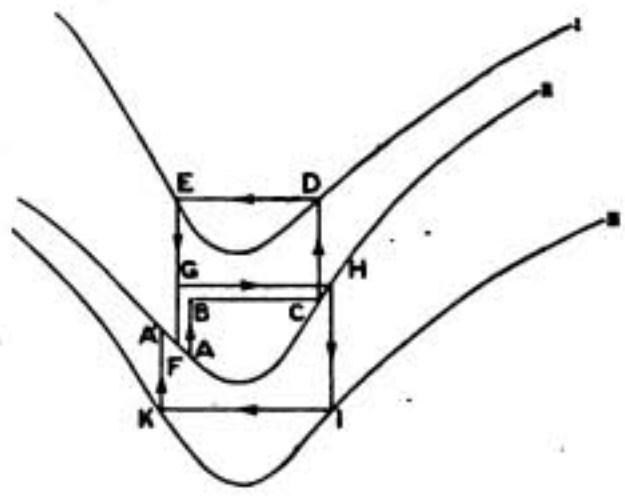



*Fig. 4.*

new position is $A_1$ and if $v_{A_1}$ is the value of $v$ in that position, then by (5)

$$y_A - y_{A_1} = \beta \log \frac{v_{A_1}}{v_{\overline{A}}} \quad \ldots\ldots\ldots$$

In particular if P is the lowest point of the curve

$$y_{\overline{A}} - y_P = \beta \log \frac{v_P}{v_{\overline{A}}}$$

But at P $\dot{v} = 0$, because $v \neq \infty$ at P.

THEREFORE, IF $v_p = v_{\overline{A}}\, \epsilon^{(y_{\overline{A}} - y_p)/\beta}$ IS ON THE SIDE OF THE POLYGON THE SYSTEM TURNS BACK AT P AND DOES NOT REACH THE NEXT SIDE.

On the contrary if $v_p = v_{\overline{A}}\, \epsilon^{(y_{\overline{A}} - y_p)/\beta}$ IS NOT ON THE SIDE OF THE POLYGON THEN THE SYSTEM PASSES ON THE NEXT SIDE.

If the system reaches P and turns back $\dot{v}$ and $\frac{\dot{v}}{v}$ become negative. The value of $\frac{\dot{v}}{v}$ corresponds then to a point on the left branch of the curve; $\dot{v}$ being negative $v$ decreases and hence by (5) $y$ increases. Thus the point moves up the curve. When it reaches a point A′ for which $y$ has the same value as $\overline{A}$ it has by (5) the same value of $v$ as at $\overline{A}$. If this value is one common to two adjacent sides the system passes to the next side at A′.

Thus we found that IF THE SYSTEM TURNS BACK ON THE SIDE OF THE POLYGON AND IF THE VALUE OF $\frac{\dot{v}}{v}$ WHEN IT ENTERS THE SIDE IS THE VALUE OF $x$ AT $\overline{A}$, THEN THE VALUE OF $\frac{\dot{v}}{v}$ WHEN IT LEAVES THE SIDE IS THE VALUE OF $x$ AT A′ WHERE THE LINE $\overline{A}$A′ IS PARALLEL TO OX. (See Fig. 3.)

This presupposes that $v$ does not change sign on the side considered.

If the system passes on the next side and if $v = 0$ is not on the side considered formula (7) suggests a construction for $\frac{\dot{v}}{v}$ at the end of the side opposite to A. If $v_{A_1}$ be the value of $v$ at that opposite end and if $v_{\overline{A}}$ the value of $v$ at $\overline{A}$ then THE STEP $\overline{A}$ B $A_1$ IN WHICH A B $= \log \frac{v_{A_1}}{v_{\overline{A}}}$ GIVES THE POINT $A_1$ AT WHICH $x$ IS THE VALUE OF $\frac{\dot{v}}{v}$ AT THE END OF THE SIDE OPPOSITE TO $\overline{A}$.

*Case of $v = 0$ on the side considered.*

Let us refer to one end of the side by the suffix 1 and to the other by the suffix 2. Let $v_1$ be negative and let $v_2$ be positive and suppose that the system enters the side at 1 with $\dot{v}_1$ positive. Then in the vicinity of 1, $\log(-v)$ is decreasing and therefore by (6) $y$ is increasing. Thus the representative point moves up the left branch of the curve. It moves off to infinity when $v = 0$. When $v$ changes sign $\frac{\dot{v}}{v}$ changes sign and the point reappears on the right branch. Here $\log v$ increases and hence in virtue of (5) $y$ decreases so that the point moves down the right branch of the curve. For some proper value of $y$ on this branch the value $v = v_2$ is obtained. In order to ascertain this value of $y$ it is necessary to ascertain the relation between $\theta$ and $\theta'$.

This may be obtained from the fact that $\dot{v}$ is continuous at $v = 0$. Now clearly for an infinitive $\frac{\dot{v}}{v}$ and for a finite positive $\dot{v} = \dot{v}_0$ at $v = 0$

$$\theta = \beta \log \dot{v}_0 \quad , \quad \theta' = \beta \log \dot{v}_0 - \pi\alpha$$

because $\tan^{-1}(-0)$ in this case is $\pi$ since $\tan^{-1}$ passed through $\frac{\pi}{2}$ for $x = \alpha$ and after that went into the second quadrant.

Thus

$$\theta = \theta' + \pi\alpha$$

Hence, since

$$\theta' = \beta \log(-v_1) + y_1, \quad \text{and} \quad \theta = \beta \log v_2 + y_2$$

we have

$$y_1 - y_2 = -\pi\alpha + \beta \log\left(\frac{v_2}{-v_1}\right) = \beta \log\left(\frac{v_2}{-v_1\, \epsilon^{\pi\alpha/\beta}}\right)$$

Thus if $v_1 < 0$ and $v_2$, $\dot{v}_1$ are $> 0$ WE STEP DOWN BY THE AMOUNT $\beta \log \frac{v_2}{-v_1\, \epsilon^{\pi\alpha/\beta}}$ AND PASS TO THE OPPOSITE BRANCH OF THE CURVE as is shown by passing from A to C in Fig. 3.

The point C so obtained gives by its abscissa the value of $\frac{\dot{v}}{v}$ at $v_2$.

If the side is entered with a negative $\dot{v}$ the same construction applies. In fact the side must then be traversed from 2 to 1. Thus the start has a negative $\frac{\dot{v}}{v}$; $v$ decreases and by (6) $y$ decreases. The point moves down and thus the two cases are alike if 1 and 2 are reversed.

The step down in this case is $\beta \log\left(\frac{-v_1}{v_2\, \epsilon^{\pi\alpha/\beta}}\right)$.

*Combination of turning point and $v = 0$ on same side.*

We are now ready to treat the case in which the system enters a side, passes the point $v = 0$, comes to its turning point, passes the point $v = 0$ again, and finally leaves the side. It is clear that at the beginning $\frac{\dot{v}}{v}$ is negative. The values of $v$ and $\dot{v}$ at the beginning we call $\dot{v}$, $v_1$. We choose a value $v_2$ between 0 and the turning point. The diagram then proceeds along A B C D E F (Fig. 3), where

$$A\,B = \beta \log \frac{|\,v_2\,|}{|\,v_1\,|\,e^{\pi\alpha/\beta}}$$

$$D\,E = \beta \log \frac{|\,v_1\,|}{|\,v_2\,|\,e^{\pi\alpha/\beta}}$$

or simply along A G F where $A\,G = -2\pi\alpha$

Thus a step down A G F of amount $AG = -2\pi\alpha$ must be made if $v = 0$ is passed twice on a side. It then gives a point F whose abscissa is equal to the value of $\frac{\dot{v}}{v}$ on leaving the side if $\frac{\dot{v}}{v}$ on entering the side is equal to the abscissa of A.

*Case of $v < 0$.*

A comparison of equations (5) and (6) shows that this case is the same as that of $v > 0$ provided the $|\,v\,|$ is used instead of $v$.

We have thus made a complete study of the motion along a side of the polygon. The advantages of the graphical method, however, become most marked when the transition from side to side is discussed.

*Transition from side to side.*

Let us first consider the special case in which $R = 0$. This case contains the most essential features of the problem.

By (4') $v = V - E$ for this case. Thus, since $V$ and $\dot{V}$ are continuous $v$ and $\dot{v}$ are also continuous, and consequently $\frac{\dot{v}}{v}$ is continuous. Therefore, if the representative curves of two adjacent sides of the polygon are $C_1$ and $C_2$ (Fig. 3), and if on leaving the first side the representative point is at P then on starting on the second side the representative point is Q where PQ is parallel to OY. Thus, in discussing the motion of the system we need not deal with the values of $\frac{\dot{v}}{v}$. It suffices to make the construction for the representative point on leaving a side and then to transfer the point in a direction parallel to OY to the curve of the next side. In such a way we shall follow the motion of the system and we shall find how the steady oscillation is established.

If $R \neq 0$ the construction is a little more complicated. In this case (see (4')

$$v = V - \frac{E - \frac{a\delta}{b}}{1 + \delta}$$

where

$$\delta = \frac{\frac{bR}{R'}}{1 + \frac{R}{R'}}$$

Hence, the boundary condition at the passage between two sides is

$$\left(\frac{\dot{v}}{v}\right)_2 = \left(\frac{\dot{v}}{v}\right)_1 \frac{1 - \frac{E}{V}\,\frac{1 - \frac{a_2\delta_2}{Eb_2}}{1 + \delta_2}}{1 - \frac{E}{V}\,\frac{1 - \frac{a_1\delta_1}{Eb_1}}{1 + \delta_1}} \qquad \ldots\ldots\ldots\ldots \quad (8)$$

where the suffix 1 refers to side 1 and suffix 2 refers to side 2. If $\delta$ is small one can also write

$$\left(\frac{\dot{v}}{v}\right)_2 = \left\{1 + \frac{E}{V - E}\left[\delta_2\left(\frac{a_2}{Eb_2} + 1\right) - \delta_1\left(\frac{a_1}{Eb_1} + 1\right)\right]\right\}\left(\frac{\dot{v}}{v}\right)_1 \quad \ldots\ldots \quad (8')$$

The equations (8), (8') mean that if $R \neq 0$ the transition between $C_1$ and $C_2$ is made by changing the abscissa of the representative point in the proper ratio and then moving the point down to $C_2$ parallel to OY.

For convenience of reference in the following illustration the graphical rules are here recapitulated, the three important rules being (b), (d), (e).

(a) Curve is always plotted for positive $\beta$.

(b) Pass from right branch to left branch along horizontal in case the turning point is on the side and $v = 0$ is not on the side. The turning point is on the side if the maximum step down possible is less than $\beta \log \left| \frac{v_2}{v_1} \right|$.

(c) Pass from left branch to right branch by step down of $(-2\pi\alpha)$ if turning point and $v = 0$ are on side.

(d) Remain on same branch of curve if the maximum possible step down is greater than $\beta \log \left| \frac{v_2}{v_1} \right|$; $v_1$, $v_2$ being the values of $v$ at the beginning and the end. It is assumed that $v = 0$ is not between them. Under these conditions step down by $\beta \log \left| \frac{v_2}{v_1} \right|$ in order to get

$$\left( \frac{\dot{v}}{v} \right)_2 \text{ from } \left( \frac{\dot{v}}{v} \right)_1 .$$

(e) If at entrance of side the representative point is on the left branch and if $v = 0$ is on the side, pass from left branch to right branch by step down of $\beta \log \left( \left| \frac{v_2}{v_1} \right| \cdot e^{-\pi\alpha/\beta} \right)$

The meaning of the symbols $\alpha$, $\beta$, $v$ is also restated. $\alpha \pm j\beta$ are the two roots of the quadratic in $\xi$:

$$C L_P \xi^2 + \left[ \frac{L_P}{R} + b (L_P + \mu M) \right] \xi + 1 = 0$$

where $C$, $R$, $L_P$, $M$ are as in Fig. 1, where $\mu$ is the amplification constant and where

$$b = \frac{di_P}{d(V_P + \mu V_g)} ;$$

$v$ is the excess of $V_P + \mu V_g$ over $E_b + \mu E_a$, i.e.,

$$v = V_P + \mu V_g - (E_b + \mu E_a)$$

**Illustration.**

Let the polygon have three sides (I), (II), (III) (see Fig. 4). The curves corresponding to these sides are numbered (I), (II), (III). It is supposed that the numbers are small so that $\frac{\dot{v}}{v}$ is continuous at the passage. Also the point $v = 0$ is placed on the side (II). On II $\alpha$ is positive and on (I) and (III) $\alpha$ is negative.

If the system is started on side (II) with a negative $\frac{\dot{v}}{v}$ given by A its value on leaving (II) is the abscissa of C where C is obtained from A by the step up A B C.. Then the system starts on (I) with a positive $\frac{\dot{v}}{v}$. On I the system suffers damping and the absolute value of $\frac{\dot{v}}{v}$ is already diminished at $E$. With this negative value of $\frac{\dot{v}}{v}$ the system traverses (II) again beginning at F, making a step up F G H (FG $\neq$ AB in general). From H the system passes on to (III) from which it emerges at K with the value of $\frac{\dot{v}}{v} = (x)_K$.

The path of the system from there on nearly coincides with the stationary path.

The introduction of a few more sides does not involve any complications because the construction there is the simple one shown in Fig. 3 for the case $\bar{A}$ B $A_1$.

The maximum value of $v$ reached on the sides (I) and (III) is obtained from the location of the points P and Q because the difference in the ordinates of P and D gives directly $\beta \log \left( \frac{v_m}{v_{I,II}} \right)$ where $v_m$ is the maximum $v$ and $v_{I,II}$ is the $v$ of the intersection of (I) and (II).

One can design mechanical devices which will facilitate the constructions here discussed. It must be also remarked that instead of plotting $\frac{\dot{v}}{v}$ as abscissae a function of $\frac{\dot{v}}{v}$ could be plotted as long as this will keep the two branches distinguishable.

The author is very grateful to Prof. H. A. Lorentz, Prof. P. Ehrenfest and Dr. Balth. van der Pol for reading the manuscript.

His thanks are also due to the National Research Council of the United States of America, of which he was Fellow while writing the paper.

# Experimental Wireless Station 2 KU.

By A. J. S.

THE receiving set shown in Fig. 1 is the result of about 18 months' experimenting with various methods of amplification, both high and low frequency. This set now consists of two radio-frequency amplifying valves, with tapped transformers for wavelengths of 200 to 20,000 metres, a rectifying valve, and two audio-frequency magnifying valves, with iron-core transformers. The whole is made up into a panel set with tuning condensers, series-parallel switch, and plugs for high and low resistance telephones. By the aid of six single circuit plugs and sockets, and four switches to valve filaments on panel front, any of the following nine combinations may be used :—

1. One valve detector circuit.
2. One valve detector and one valve audio-frequency magnifier.
3. One valve detector, and two valve audio-frequency magnifiers.
4, 5 and 6. One valve radio-frequency amplifier, with any of above.
7, 8 and 9. Two valves, radio-frequency amplifying, with any of the above.

The tuning inductances consist of honeycomb coils, covering all wavelengths from 180 to 28,000 metres with 0·0015 variable condenser. In parallel with this condenser are two 0·00008 variable condensers for fine tuning. The series-parallel switch, when moved to series position, cuts out the large condenser, and puts the two small condensers (in parallel) in series with the aerial for short waves.

Provision is made by two terminals to use capacity reaction, for loop and frame aerial work, also for grid potential adjustment to rectifying and radio-frequency valves. A potentiometer can be connected to terminals on panel front. The whole set is self-contained, with the exception of batteries and tuning inductance, and not being over weighty it is easily transported, which makes it very useful for demonstrations at club meetings, field days and exhibitions. Good loud signals are received on a 3 ft. frame aerial.

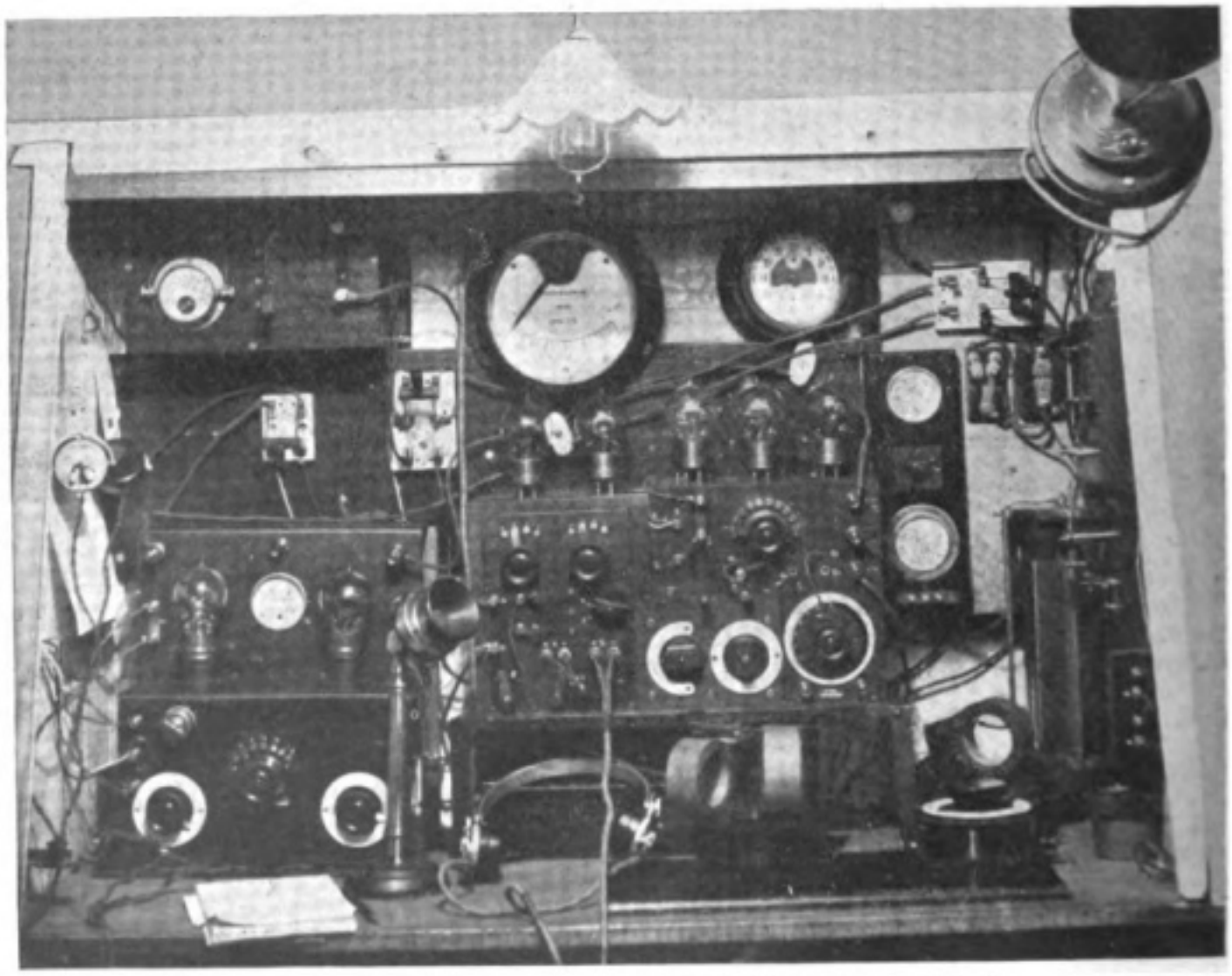


*Fig.* 1. *The Receiving and Transmitting set of* **2 KU**

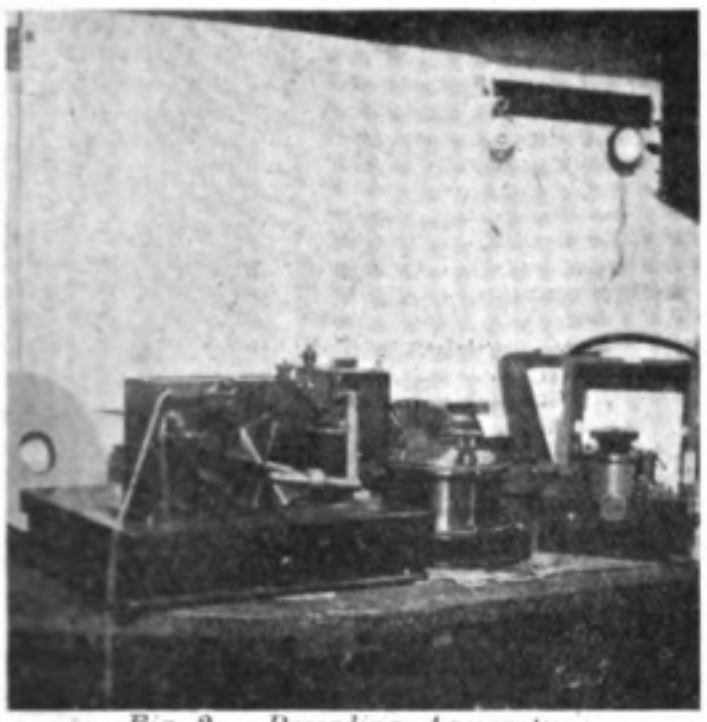


*Fig. 2. Recording Apparatus.*

The recording apparatus shown in Fig. 2 consists of a valve relay as described in *The Wireless World*, January 22nd, 1921, but since altered to the description in the proceedings of the Wireless Society of London in *The Wireless World* of November 12th, 1921, a Siemens relay and Morse inker. On the right will be seen an old Marconi wavemeter, which was reconditioned and its range increased. (The valve relay does not show very well in the photo, being behind the Morse inker.)

The C.W. and telephone transmitter shown on left of Fig. 1 is yet being experimented with, using various methods of microphone control, and on short waves 200 metres and less. The H.T. supply is at present from dry batteries, but an H.T. generator is being constructed from an old aeroplane generator to give about 500 volts D.C.; also it is intended to experiment with the A.C. transformed to 2,000 volts and rectified by valves. On the shelf above, in Fig. 1, will be seen the 180 metres spark transmitter, using an old motor ignition coil. In the right-hand top corner is a Brown's loud speaker; the large voltmeter in centre is for testing H.T. voltage of both transmitter and receiver. The aerial ammeter is in centre of C.W. and telephone transmitter, and the H.T. input ammeter on left.

The other ammeter is the aerial ammeter for spark transmitter. On the extreme right is an old crystal receiver, fixed to side of cabinet, still doing useful service for experimenting with crystal rectification for short waves. The cabinet has a spring roller-blind shutter, to exclude dust while constructional work is being carried on at the work bench. The whole of the apparatus is constructed of more or less junk, the accumulation of over 12 years' wireless and electrical experimenting

# Notes

## Conditions in Norway.

"Radio-activity in Norway seems now at last to have reached the steep part of its characteristic, both government and amateur," says Mr. Kaye Eystein Weedon, Hon. Secretary of the Norwegian Wireless Amateur Club which has a membership of approximately 40. Co-operation with the Petty-Officers' Society at Horten, the base of the Norwegian navy, and with the "Norsk Elektro-teknisk Forening," has been arranged. Amateur working-conditions in Norway differ in many respects from those of the British amateur. The British amateur may talk of bad screening from hill 100 feet high some distance away, but what of Kristiania, which is surrounded on all sides but one with what foreigners call mountains, some of which are more than 300 metres in height. And last, but not least, while it was stated somewhere "that but one in a hundred of the British amateurs is so lucky as to have 'juice' installed in his house," it is not too much to say that there will not be more than one in a thousand Norwegian enthusiasts (yet to be, of course), who will have to do without.

The "Telegrafdepartement" is continuing the great work of the late Mr. Ths. Heftye, Director of Telegraphs—the erection of a system of W/T stations throughout the country. **LCH**, Kristiania, is to be altered for duplex working, and to this end a separate receiving station is to be erected, as is the case with **LCM**. The few D/F stations that exist are very poor and out of date, bearings being sometimes given which differ up to 100 degrees from the true one. Therefore, when the Government announced that a big modern W/T station is to be erected at Mandal (on the south coast, between Kristiansand S. and Lindesnæs), the Kristiansand Shipmates Society sent the Government a petition, asking that an up-to-date D/F station be at the same time built there.

## Comparative Rates for Transmission.

The difference between the rates charged for transmission of messages by wireless and cable to Australia and India is worthy of note. Under an agreement between the Australian Commonwealth Government and the Amalgamated Wireless, Ltd., the proposed rates are two shillings a word for full rates, a shilling for deferred rates, sixpence for week-end rates, fivepence for press rates and threepence for deferred press rates. These costs are two-thirds of those for cables between Britain and Australia.

C

### New Station at Honduras.

About £70,000 is being spent on a contract for the construction of a station near Tegucigalpa, in the Republic of Honduras. Operations will not commence before October, by which time it is expected the station will be in working order, with two towers 458 ft. in height.

### Ocean Depth Sounding.

It is announced by Colonel Theodore Roosevelt, the United States Assistant Secretary of the Navy, that successful tests have been made of a new wireless sounding device, which instantaneously registers ocean depths by measuring the time which a sound takes to travel from the ship to the bed of the ocean and back. The device is an invention of Dr. Harvey C. Hayes, physicist at the Naval Engineering Station, Annapolis. It has just been tested on board the U.S. destroyer "Stewart," during a voyage from Newport to Gibraltar. Over 900 soundings were made, ranging from 2,400 to 28,000 ft.

### Closing of Poldhu.

Operations hitherto conducted from Poldhu, Cornwall, are now being carried out at Radio House, London. Direct transmission to Madrid and Central Spain is now established by the Marconi Company. The new transmission station at Ongar, Essex, transmits to Canada, U.S.A., Central and South America, West Indies, Australasia, etc.

### British Association Meeting.

September 6th has been fixed as the date for the opening of the British Association meeting at Hull. At that meeting exhibitions will be given daily by the Air Ministry of synoptic weather charts and forecasts. Weather data employed will be received from the broadcasting stations in this and other countries, and demonstrations of the reception and of the decoding and charting of the reports will be given by representatives of the Meteorological Office and of the Controllerate of Communications of the Ministry.

The Association is making a great effort this year to secure a fuller attendance of the younger scientific students at the meeting.

### Time and Distance Differences.

Long distance transmitters have to bear in mind the difference in time in various geographical localities. Listening-in messages timed by transmitting stations at great distances must be conducted according to the time at those stations, and not at the time at the receiving stations. As an illustration of this point, a case occurred in which bookmakers in Vienna were discovered to have been accepting bets upon horses run in Paris after the races had taken place. The difference in time between Vienna and Paris was sufficient to allow the arrangement to work successfully.

### Communication with Road Transport.

From the information received from America, which clearly indicates that considerable advance has been made along the lines of adapting apparatus to moving trains for the purpose of telephonic communication, there appears another phase of the same idea upon the horizon. Recently a big

*The apparatus used in ocean depth sounding described on this page.*

effort was made to so organise road transport that lorries and cars conveying loads on an outward journey might not return empty. It was thought that if some means could be devised of informing the man in charge as to where he could pick up a load for the return journey a tremendous saving would be effected. This scheme, for some reason, has not become very prominent, and the reason is probably that communication is not properly organised. Here is a new field for experiment. While our American friends are perfecting their railway scheme, which is fairly certain, we believe, to mature very shortly with far-reaching results, some enterprising people in this country might be fortunate enough to establish communication with moving transport on the road with equal success.

**Safety Rules and Avoidance of Risk.**

New safety rules to the National Electric Code in America have been adopted. The proposal was made by the National Fire Protection Association, and provide for the protection of receiving and transmitting equipment against lightning effects, avoidance of risk of contact with neighbouring electric light and power circuits, and protection from effects of high potential surges in the lines supplying power to the equipment, as well as the ordinary requirements of sound construction. In the case of receiving equipments, a lightning arrester is required where the leading-in wire enters a building and, on account of the larger size of the ordinary transmitting aerial, which is more likely to be subject to damage from lightning, and the high voltages produced in the apparatus, the provision is recommended in transmitting stations of a double-throw switch for connecting the aerial either to the transmitting apparatus or to earth. The use of this switch is to disconnect the aerial entirely from the transmitting apparatus. On account also of the difficulty which has been experienced by the induction of voltages in the supply lines of a transmitting station, it is advised to use a protective device across the power line near its point of entrance. Copper-clad steel wire is recommended throughout as an alternative to copper wire.

**Suggested Sale of Apparatus by Methodists.**

A suggestion is made in the *Methodist Recorder* that the Sunday School Department of that body should sell apparatus for the installation in Mission Halls and for use in Methodist meetings. The need for broadcasting the principal discussions at conferences for the benefit of Methodists who cannot attend was expressed.

**Cardiff Technical College Apparatus.**

At a recent meeting of the Cardiff Technical Institute Committee, Mr. Charles Coles said in regard to the question of the disposal of the wireless apparatus at the Technical College of which he was Principal, that he recommended its retention for the existing departments of the college. He said it should be placed in charge of the head of the engineering department. The apparatus, in view of the decided impetus given to the study of wireless by the proposal to make Cardiff one of the provincial broadcasting stations, would be available for popular lectures.

**Wireless Broadcasting.**

It is reported that the Cabinet has approved a recommendation of the Postmaster-General that for a period of two years licences for wireless broadcasting should contain a provision that only British instruments should be used.

# Calendar of Current Events

**Saturday, July 22nd.**

MANCHESTER WIRELESS SOCIETY.

2 *to* 3 *p.m.*, also 7 *to* 9 *p.m.*—At Rusholme Public Hall, Manchester. Two lectures on "Broadcasting." Open to the public.

**Sunday, July 23rd.**

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

**Tuesday, July 25th.**

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

**Thursday, July 27th.**

RADIO EXPERIMENTAL ASSOCIATION (NOTTINGHAM AND DISTRICT).

Meeting.

DERBY WIRELESS CLUB.

7.30 *p.m.*—At "The Court," Alvaston, Derby, Lecture on "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

LIVERPOOL WIRELESS SOCIETY.

Meeting.

HACKNEY AND DISTRICT RADIO CLUB.

8 *p.m.*—At 111, Chatsworth Road, E.5., Meeting.

WEST LONDON WIRELESS AND EXPERIMENTAL ASSOCIATION.

"Three Circuit Variometer Tuner," by F. E. Studt.

**Sunday, July 30th.**

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

**Tuesday, August 1st.**

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

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I would be much obliged if you could enlighten me as to who **5 HD** is. He was calling **5 CO** and sent out some music, and read several passages out of a book. **5 CO** did not answer. This was about 10.30-11.30 one morning just lately. His call letters are not in your latest list, and his wavelength was about 370-400 metres.

G. V. PRIESTLEY.

*3rd July*, 1922.

# Books Received

NATIONAL PHYSICAL LABORATORY REPORT FOR THE YEAR 1921 (London: H.M. Stationery Office. Pp. 207. Illustrated. Price 6s. 6d. net).

RADIO ENTERS THE HOME. A Descriptive Catalogue. (Radio Corporation of America, Woolworth Buildings, New York. Pp. 128. 11" × 8")

# Wireless Club Reports

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

### Brighton Radio Society.*

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

At a recent meeting of this Society an interesting discussion ensued, during the course of which the methods of short wave reception were considered. Various useful suggestions were offered by different members who were present, and it was ultimately suggested and decided upon that at the next meeting all members who so desired should bring their short wave sets along for trial with a view to comparing results.

As a means of assisting the beginner as far as possible in the construction of a set capable of attaining the best possible results at the minimum cost, Mr. Magnus Volk, Vice-President of the Society, very kindly offered to provide the funds for the construction of a set upon these lines, which should be used solely for the assistance of members on the lines indicated.

Everything possible is being done to meet the needs of the amateur in this Society and it is sincerely hoped that gentlemen wishing to obtain a knowledge of the science will avail themselves of the facilities which are now being offered by the Society.

Any gentlemen interested are invited to communicate with the Hon. Secretary.

### North Middlesex Wireless Club.*

The 94th meeting of the Club was held on Wednesday, June 28th, at Shafteebury Hall, Bowes Park. In spite of the inclement weather, there was an excellent attendance. The chair was taken by the President, and after a few preliminary remarks, he called on Mr. W. Gartland to deliver his paper entitled "The Miscellaneous Applications of the Thermionic Valve."

Those of the members who have heard Mr. Gartland on previous occasions were anticipating something interesting, but all were surprised to hear the very good and consistent results obtained by Mr. Gartland on apparatus which he had just brought to the Hall, and had had very little time to adjust. Anyone who has had the unpleasant experience of bringing a lot of instruments for a lecture, and has failed to produce the results intended will the more readily understand how gratifying it is to be able to record that Mr. Gartland's experiments did *not* fail, but were a great success.

The chief instrument was an altered Mark III receiver, and by means of an ingenious barrel contact switch either one, two, or three valves could be used as desired. This enabled the lecturer to show the valve being used for detecting and amplifying. Speech and music was received, from several stations, and by means of a simple loud speaker was rendered audible to all present.

Unfortunately the time passed so quickly that Mr. Gartland was unable to go fully into the many other uses of the valve, but the brief outlines which he gave were sufficient to show that the applications of the thermionic valve were only just beginning to be realised. The members will look forward to hearing Mr. Gartland again at an early date.

Particulars of the Club may be obtained from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, N.21.

### Croydon Wireless and Physical Society.*

A meeting of the Croydon Wireless and Physical Society was held on Saturday evening, July 1st, 1922, at the Central Polytechnic, Croydon.

Although the attendance was not so large as usual, this was more than compensated for by the enthusiasm of the members present. Mr. A. H. Peakman, a member of the Society, very kindly provided two buzzer sets for Morse practice, and the members divided into two groups, one consisting of the more advanced Morse readers who practised high speed work, and the other of the less experienced gentlemen who were desirous of improving their Morse reading.

After spending a profitable hour, the members had an informal talk on innumerable radio subjects, ranging from the harmonics of GBL to the date on which broadcasting would commence, these subjects in particular calling forth some forcible remarks. The meeting terminated with a vote of thanks to Mr. Peakman for the loan of his instruments.

The Secretary, Mr. B. Clapp, "Meadmoor," Brighton Road, Purley, wishes to announce that there will not be a meeting of the Society in August, the next meeting being held on Saturday, September 2nd. He will be glad to hear from any lady or gentleman who may be desirous of joining the Society.

### Stoke-on-Trent Wireless and Experimental Society.*

Hon. Secretary, Mr. F. T. Jones, 360, Cobridge Road, Hanley.

At a meeting of the Stoke-on-Trent Wireless and Experimental Society on Thursday, July 6th, some buzzer practice for the benefit of the new members was followed by a lecture on "A Short Wave Tuner," by Mr. A. H. Wilson.

The lecturer, after outlining points concerning wireless receiving sets as a whole, which, if neglected, would greatly reduce the efficiency of any tuner, dealt with the construction of a short wave tuner, on which telephony from local amateur stations and the wireless concert sent out from the Marconi station in Essex could be received with excellent results.

A home-made tuner of the variometer type, constructed by the lecturer, other tuners and a large number of tuning coils, were exhibited and handed round for inspectoin.

Mr. Wilson was heartily applauded, and the lecture greatly appreciated by the members, who showed their keenness by plying the lecturer with a large number of questions.

### Newcastle and District Amateur Wireless Association.*

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

At the Annual General Meeting, held on July 3rd, the following officers were elected for the ensuing year:—President, Dr. Smallwood, Gateshead; Chairman, Mr. G. Dixon, Rowlands Gill; Secretary, Mr. C. Bain, Newcastle; Librarian, Mr. Fabian, Newcastle; Technical Committee, Mr. White, Radio Communication Co., Newcastle; Captain Stevens, Newcastle, Mr. Douthwaite, Newcastle.

The financial statement for the last year showed a balance in hand of £2 1s. 3½d. This is satisfactory, when an expenditure of £17 for new instruments is allowed for. A voluntary subscription collection box yielded £4 11s. 1d. for the twelve months.

The list of members showed 56 up to June 30th. A number of fresh applications have since been received.

A lively debate on the question of entrance fee resulted in the following agreement:—Entrance fee, 5s.; subscription, 7s. 6d. per annum; junior members' subscription, 3s. 6d.; country members, 5s.; junior country members, 2s. 6d.

A number of elementary and advanced lectures for the winter months are now being arranged.

Those desirous of joining the Society should write to the Hon. Secretary.

*Listening-in on Mr. R. Carlisle's amateur set at Glasgow. The owner is a member of the Glasgow and District Radio Society.*

### Plymouth Wireless and Scientific Society.

Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

On Saturday, July 1st, the Society gave a demonstration and exhibition of wireless apparatus at a fête and carnival held at Torpoint. With an improvised aerial and a six-valve set belonging to the Hon. Secretary, quite good signals were obtained, and with apparatus brought by Mr. Graves, an interesting and instructive exhibition was arranged. Very inclement weather was responsible for the non-arrival of much apparatus that would otherwise have been on show, but nevertheless the demonstration was in every way a success and added a substantial sum to the total receipts of the fête.

Although membership has increased considerably during the last few weeks, there is still plenty of room for more members, and particulars of the Society will be gladly furnished by the Hon. Secretary.

### Newport and District Radio Association.

Hon. Secretary, Mr. E. R. Brown, M.S.A., A.T.P.I., 92, Corporation Road, Newport, Mon.

A public meeting was held at the Technical Institute on Thursday, June 29th, 1922, for the purpose of reviving the pre-war activity of the local Association. The meeting was exceedingly well attended and much enthusiasm shown. The following officers were chosen:—*President*: Rt. Hon. Lord Tredegar. *Vice-Presidents*: Sir Garrod Thomas, M.D., Sir Frederick Mills, Bart., Captain C. H. Bailey, Alderman Dr. J. McGinn, Mr. D. W. Roberts. *Hon. Secretary*: Mr. E. R. Brown, M.S.A., A.T.P.I.

Alderman Dr. J. McGinn gave a very interesting and witty address, which, being non-technical but covering useful ground, was very much appreciated by all present.

The membership even now is over 100 and only one meeting has been held. It is hoped to make it the largest Association in Wales.

### Bishop's Stortford and District Amateur Wireless Association.

A meeting of the above Society was held on Friday evening, June 23rd, at 2, Half Acres, Bishop's Stortford, the Vice-President, Councillor E. F. Cooper, in the chair. The President, Mr. W. A. Field, delivered an address entitled "Wireless During the War." This was based chiefly upon his own experiences and observations as a naval wireless officer and a pre-war amateur. His address was full of technical and historic interest and threw an entirely new light upon many of the well-remembered incidents of the war, in which wireless played such an important part.

The lecture was followed by questions and an informal discussion, after which a hearty vote of thanks terminated the proceedings.

Buzzer practice is held every Monday at 8 p.m. and an elementary class for beginners half an hour earlier.

Prospective members should communicate with the Secretary, Mr. J. Cooper, 2, Half Acres, Bishop's Stortford.

### Derby Wireless Club.

The usual weekly meetings will be held at "The Court," Alvaston, on Thursday evenings at 7.30 p.m.

In order to assist the large number of new members recently elected, the following programme, specially suitable for beginners, was arranged:—July 6th, lectures on "The Aerial and its Construction," by Mr. J. Lowe; July 13th, "Aerial Oscillatory Circuits," by Mr. S. J. R. Allwood; July 20th, "Detecting Devices," by Mr. E. V. R. Martin; July 27th, "Practical Construction of Single Valve Receiver Set," by Mr. A. T. Lee.

This series will be extended, and additional papers arranged week by week.

Annual subscriptions due are requested by the end of this month.

The bye-law passed at the Extraordinary General Meeting held on June 22nd last, fixing an entrance fee of half-a-crown for all new members, operates from July 1st, 1922.

Hon. Secretary, Mr. R. Osborne, The Limes, Chellaston, Derby.

### Stockton-on-Tees and District Amateur Wireless Society.

Hon. Secretary, Mr. W. F. Wood, 4, Birkley Square, Norton, Stockton-on-Tees.

A general meeting of this Society was held in the Jubilee Hall, Stockton-on-Tees, on Thursday, June 22nd, which was attended by a large number of members. This Society, which is only a month old, is one of the largest in the district, having close upon eighty members.

Permanent rooms have been taken in the Malleable Workmen's Institute, Norton Road, together with the monthly use of the large concert hall, in which it is proposed to hold lectures, etc. An aerial is being arranged for and considerable apparatus has been placed at the disposal of the members.

The Committee have arranged that some official shall be in attendance in the rooms every evening to cater as much as possible for the wants of the members and also their comforts. The fees have been fixed as low as possible and can easily be met by any working man. The membership is open to persons of both sexes and any age.

The general meetings of the Society are fixed for the second Thursday in every month.

### Dublin Wireless Club.

A general meeting of the Dublin Wireless Club was held at the Central Hotel, Dublin, on Tuesday, June 6th, when a large number of members and prospective members were present.

The Club, which was founded in 1913, did good work previous to the war, but owing to Post Office restrictions on experimental wireless, has been in a more or less dormant state since August, 1914.

In view of the removal of these restrictions, it is now being reconstructed and gives promise of great success. The Committee is engaged in redrafting the Rules, arranging a programme and other necessary preliminary duties.

Another general meeting will shortly be held, when the recommendations of the Commmittee will be submitted and officers elected for the coming session.

It is hoped soon to obtain more suitable headquarters, where up-to-date instruments may be installed, meetings held, etc.

Persons desirous of becoming members should make early application to Mr. A. C. Bridle, the Hon. Secretary, 29, South Anne Street, Dublin.

### Ipswich and District Wireless Club.

Hon. Secretary, Mr. F. T. G. Townsend, 46, Grove Lane, Ipswich.

A successful field day was carried through on Saturday, June 24th, when by kind permission of Mr. Taylor, of Messrs. Crane Bennett, Ltd., a party of about twenty erected two sets in the field belonging to that firm at Nacton Road. The Club set was tacked on to an aerial attached to a high flag-mast and another set, kindly loaned by Messrs. Boddey, Keeble and Page, gave excellent results on a wire supported by a kite. Mr. Barbrook superintended the arrangements in the unavoidable absence of the Secretary and Assistant Secretary. Transport of the apparatus was effected by means of cars belonging to Mr. Kersey and Mr. Barbrook, to whom the Club is much indebted. The winter programme is now being arranged and any members willing to give lecturettes during the winter are requested to communicate with the Secretary. Also a night is being set aside in the near future for an exchange and mart of members' spare apparatus. All particulars are obtainable from the Secretary.

*Ipswich and District Club's portable set used during a field day.*

The Club now musters nearly 60 members and is looking forward to a first class winter programme. A fair number of experimenters in the surrounding districts have enrolled but are very quiet. However, there are several stations under observation and the owners can be sure of a hearty welcome at headquarters any meeting night.

### Liverpool Wireless Society.

A meeting of the Society was held on Thursday, June 22nd, when an informal exhibition of apparatus was held. Mr. Balmer continued his elementary lectures for beginners.

Mr. A. L. Lyon exhibited a German valve panel and explained its peculiarities. Mr. Vere-Smyth exhibited a single valve home-made set, which was very well made considering that Mr. Smyth is new to the science. Mr. J. H. Swift then brought his home-made three-valve set into action. The results were remarkably good; in fact they were probably the best the Society had ever had at any of its meetings. The set is wired up to Mr. Swift's own diagram and he uses special transformers and not the usual ex-Army type. Music from local stations was audible in the corridors outside and the clearness was remarkable.

A vote of thanks to Mr. Swift and the other exhibitors concluded the meeting.

At a Committee meeting it was decided that Mrs. Skelden, being the first lady candidate for admission, be admitted as a hon. member.

There will be a meeting of the Society on July 27th.

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

### Cardiff Y.M.C.A. Boys' Radio Club.

The Boys' Department Radio Club at the Cardiff Y.M.C.A. has now a membership of nearly thirty. This Club is open to boys between the ages of 13 and 18 years. Lectures, classes and special training courses are run during the winter months, and the usual activities during the summer.

Secretary for the department, Mr. N. Craven, Whitehead Club. Call letters, 2 UN.

### The Hornsey and District Wireless and Model Engineering Society.

A meeting of the above was held on Tuesday, July 4th. Although this Society is now only a few weeks old and no proper apparatus has been installed, a set was "rigged up" and the concert from Chelmsford clearly heard.

Mr. H. J. Pugh demonstrated a two-valve resistance capacity set, the only aerial used being one of the members standing on an insulated pedestal with one finger on aerial terminal. Messages were clearly heard and readable, many stations being heard.

In future meetings will be held at 29, Felix Avenue, Western Park, Crouch End.

Many interesting features are promised, including elementary lectures for beginners. New members will be heartily welcomed. All particulars from the Secretary, Mr. H. Davy, 134, Inderwick Road, Hornsey, N.8.

### Streatham and Norbury Radio Club.

Monday, July 3rd, was the opening day of this Club. For the time being the headquarters will be the premises of Messrs. R. Woodruff & Co., 550, Streatham High Road, S.W.16. It is hoped that in the near future a hall or other suitable club-house will be found.

Several first-class telegraphists have already joined and it is hoped that amateurs, experimenters and other enthusiasts perhaps more advanced, will bring their respective experiences to the Club for mutual enlightenment. The sole idea of the Club will be to fit out a laboratory where members can experiment and construct a complete station.

Application for membership should be addressed to Mr. F. J. Lock, 548, High Road, Streatham.

### Stratford Radio Society.

Hon. Secretary, Mr. R. Singleton, 159, Plaistow Road, West Ham, E.15.

The Society was formed on June 11th with temporary headquarters at the address given above. Prospective members living in the district are invited to communicate with the Secretary, who will furnish all particulars. The area from which the Society hopes to recruit its membership is the Eastern suburbs of London. Experts and novices will both be welcomed.

Gentlemen who might serve as Vice-Presidents are being asked to make themselves known and the Secretary will be glad to receive names as early as possible.

### Ilkley and District Wireless Society.

Hon. Secretary, Mr. E. Stanley Dobson, "Lorne House," Richmond Place, Ilkley.

A meeting was held at the Regent Café, Cowpasture Road, at 7.30 p.m. on Wednesday, July 5th, with Dr. J. B. Whitfield, President, in the chair.

Following the reading of the minutes of the previous meeting, the Committee were elected. It was decided to hold future meetings on the second Thursday in the month, and to arrange a series of practices in Morse.

The Chairman then called upon Mr. H. G. Evans, B.Sc., to give his lecture on "Radio-Telegraphy and Telephony."

The lecturer dealt briefly with the properties of the thermionic valves, and its application to simple wireless circuits. The lecture was illustrated with lantern slides, among which were representations of some of the British high power stations.

After the lecture Carnarvon, Leafield, etc., were tuned in on a very fine set which the lecturer had brought with him.

Unfortunately, the telephony which was expected did not come through, on account of a slight misunderstanding as regards the time.

At the conclusion, a hearty vote of thanks was accorded to Mr. Evans, and the audience, which comprised a large number of visitors, including several ladies, adjourned to inspect the apparatus used by the lecturer.

Twelve new members were enrolled. The Hon. Secretary will be pleased to hear from anyone interested, and will furnish particulars of membership, together with the objects of the Society, on application to the above address.

### Heckmondwike and District Wireless Society.

Hon. Secretary, Mr. F. Townsend, Secondary School, Heckmondwike, Yorks.

A meeting of the above Society was held on Friday, June 30th, when Mr. Dennison, of Halifax, gave a lecture on "Short Wave Reception." Mr. H. Rayner presided over a large attendance.

The lecturer gave a large number of diagrams, showing the connections for different circuits, and also gave a number of valuable hints to amateurs in the construction and manipulation of their own sets.

During an interesting discussion, the lecturer showed a wide knowledge of both the theoretical and practical sides of the subject.

The lecture was illustrated by a fine series of lantern slides, showing the different sets used by Mr. Dennison during the war and since. A hearty vote of thanks was accorded the lecturer.

### Brondesbury and Cricklewood Radio Club.

Hon. Secretary, Mr. J. F. Stevens, 119, Fordwych Road, Brondesbury, N.W.2.

The above Club has been misnamed the "Cricklewood and Brondesbury Radio Club." This is likely to cause confusion unless the title is correctly noted. In all communications the title Brondesbury and Cricklewood Radio Club should be used.

### Central London Wireless Society.

Hon. Secretary (pro tem.), Mr. Horace E. Hobbs, 15, Rydon Crescent, E.C.1.

Inner London enthusiasts are informed of the formation of this new Society in Central London. The Secretary will be glad to hear from anyone interested as early as possible. There is to be a preliminary meeting and the date is not yet fixed. It is hoped that as many as possible will attach themselves in time to attend in order to discuss proposed rules, etc., and to decide upon the organisation.

**Southampton and District Wireless Society.**

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

A general meeting of the above Society was held on Wednesday, June 28th, at the Kingsland Assembly Rooms. A good attendance was recorded. Mr. W. H. Stockdale was the lecturer for the evening. He devoted the whole evening to the Armstrong regenerator short-wave tuner. He also stated the result he himself had obtained from an Armstrong short-wave set amateur-constructed. The lecturer used the blackboard a great deal, much to the liking of the members. At the conclusion of the lecture questions were asked and answered to the satisfaction of the members and a hearty vote of thanks was accorded Mr. Stockdale.

Owing to the large number applying for membership and not yet having obtained licences, the Society now welcomes Associate Members, and particulars can be obtained from the Hon. Secretary. Anyone in the district intending to adopt wireless as a hobby should join the Society and obtain information before buying sets (such as crystal sets for telephony). By so doing they may save themselves from much labour in vain and unnecessary expense by consulting with fellow experimenters.

A general meeting of the above Society was held on Wednesday, July 5th. It was reported by the Secretary that all the amateurs in the Southampton district (with the exception of a few) are members.

The Society will shortly be announcing a further public demonstration, and a pleasant evening is being looked forward to. This demonstration will be given for the benefit of the future wireless enthusiast.

The members are getting very keen on making and constructing their own sets, and not only assembling. Members have been complaining of late of the inability of the local tradesmen to supply them with component parts, and it is now stated that satisfactory arrangements have been made whereby members can obtain all their requirements from their Society. This will avoid further disappointments.

Any one in Southampton interested in wireless and who has not yet purchased or made his set, and would care to have a demonstration of an amateur set, is invited to make arrangements with the Secretary. His station is the most powerful one in the Southampton district, being converted so as to employ 3, 5. 7, 8 or 9 valves at discretion. Mr. Freeman, the Chairman, has also a very powerful receiving station, using 7 valves, and he also will oblige any amateur interested.

**The Hackney and District Radio Society.**

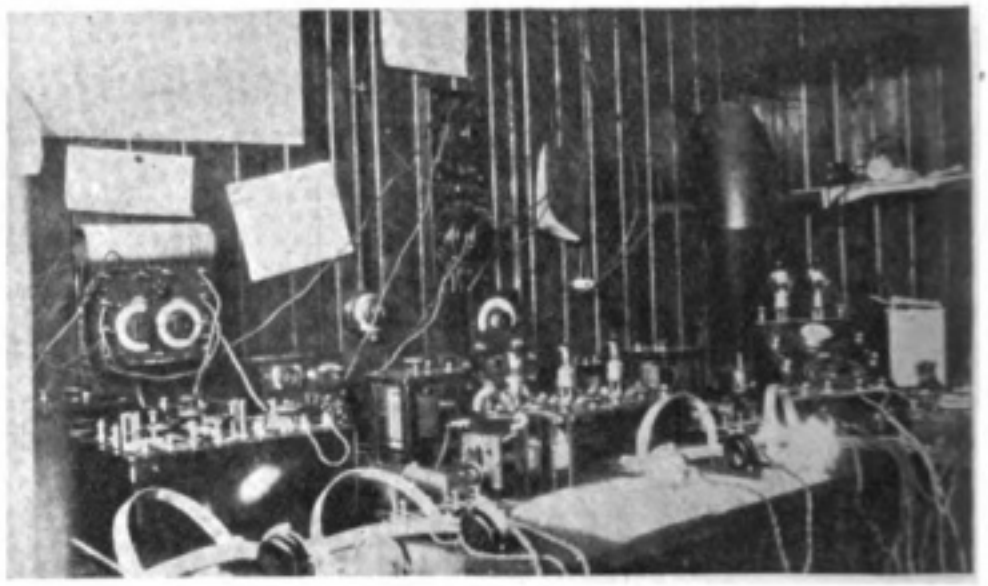
The third meeting of the above Society took place on June 22nd at 111, Chatsworth Road, Clapton, at 8 p.m. There was again a good attendance. New members continue to come in.

After the minutes of the previous meeting had been read, the Rules and Regulations were again read and confirmed. Now that the Society is well established, an endeavour is being made to build up an interesting programme for the quarter.

Public meetings were held on the 6th and 7th of July. The lecture given at the opening by Mr. E. R. Walker was on the "First Principles in Wireless Telegraphy," showing the audience how the aerial became charged so that it produced waves, and so opened up the present-day means of long-distance communication. After seeing that the audience had more or less grasped the situation, the second lecturer, Mr. D. R. Ison, gave an explicit explanation of reception of these waves, with the aid of a Marconi 31 A tuner. This was followed by a great number of questions being asked by a greatly interested audience and many points were touched upon, including construction of many portions of apparatus. During the evening various items of telephony were received. Many thanks were given for the loan of a Brown loud speaker.

By these means the Society hopes to increase the numbers of its members and make itself popular throughout the Hackney district.

**Loughborough College Wireless Society.**



*The Society's Receiving Apparatus.*

The apparatus which was used consisted chiefly of units made by members, who have gained excellent results with amateur-made apparatus.

Membership has greatly increased, being now over 40, and the Society will soon be looking for a more convenient meeting hall for permanent headquarters. Meetings are held every Thursday.

All enquiries as to membership, etc., should be made to the Secretary, Mr. E. R. Walker, 48, Dagmor Road, South Hackney, E.9.

**Barnoldswick Wireless and Technical Society.**

A Society bearing the above name has been formed in Barnoldswick (Yorkshire) and there is every promise of rapid development. The prime object of this Society will be the study of wireless as a science.

The Society is commencing work with a course of progressive lectures in theory and practical construction. These lectures will be augmented by a special class in practical physics and applied science.

# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—*(1) *Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, The Wireless World and Radio Review, 12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise.* (2) *Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before.* (3) *Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions.* (4) *The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* (5) *In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.* (6) *Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions.* (7) *Four questions is the maximum which may be sent in at one time.*

**"J.D." (Lancaster)** *asks* (1) *If he can receive* **PCGG** *and* **2 MT** *on a Mark III long wave tuner and three-valve amplifier. His aerial is* 138 *ft. long and highest point* 48 *ft. high.* (2) *For windings for a telephone transformer for use with* 120 *ohm telephones.* (3) *Wavelength of Mark III long wave tuner.* (4) *Windings and former for reaction coil for Mark III long wave tuner.*

(1) Yes, you should be able to get both these stations, presuming of course that you can tune down to 400 metres. (2) See page 343, June 17th issue, winding to a diameter of 11/16" with No. 46 S.S.C. for the primary, and up to a diameter of ¾" with No. 40 S.S.C. for the secondary, spacing the cheeks 1¾" apart instead of 1" as given in the diagram. (3) Probably about 7,000 metres. (4) It is difficult to incorporate a reaction coil in this tuner, but owing to the special design of the inductances it is quite easy with a few minor alterations to use the tuned closed circuit to give reaction effects.

**"J.D." (Liverpool).**—(1) and (2) The circuit you show and the dimensions you give of the various components are quite satisfactory. It would be better, perhaps, to arrange a small condenser across the telephones of 0·002 mfd. and a separate condenser of bigger capacity across the high tension battery. Your aerial consisting of six wires each 11 ft. long is not a very good arrangement. (3) You can easily convert your set into one embodying H.F., detector and L.F., and for circuit see page 37, April 8th issue.

**"S.M." (Forest Gate).**—(1) The specimen of the asbestos material cannot be recommended as suitable for the mounting of the components of a valve circuit. (2) You would require about 22 movable and 23 fixed plates to give a capacity of 0·001 mfd. (The delay in answering your queries, occasioned by making tests on the material you submitted, is regretted.)

**"ANATKH" (Southerick-on-Weir).**—(1), (2), (3) and (4) The circuit you show is incorrect, and we would advise you to consult the pages of this journal in which are given scores of reliable circuits. It is doubtful how the valve would function in your circuit, and we cannot see how the set could work at all unless perhaps you have made some mistake in drawing out the circuit.

**"C.P." (Hartly Witney)** *sends a specimen of wire and wishes to know* (1) *Its gauge and covering, and* (2) *If it is suitable for the construction of H.F. transformers.*

(1) 38 S.S.C. (2) Yes, though double silk covering would be better if you have in mind winding primary and secondary simultaneously.

**"———" (Sittingbourne).**—(1) Your aerial would appear to be quite satisfactory, though read carefully article on aerial construction in May 27th issue. (2) and (3) Your cardboard tubes will be very useful for the construction of aerial and reaction coils, and you would be well advised to saw them up into three portions, each 4" long, and making three tuners for short, medium and long wave tuning. The 6" diameter tube for the aerial coils may be wound with No. 20 D.C.C. for reception up to 650 metres, No. 26 D.C.C. up to 1,200 with parallel condenser and two or four-pile winding of No. 30 D.C.C. for longer wavelengths. The reaction coils, 5½" in diameter, may have windings of No. 22 D.C.C., No. 28 D.C.C. and No. 34 D.C.C. respectively. (4) We consider that it is improbable that you will be able to receive **2 MT** on a crystal in Kent.

**"AERO" (Doncaster).**—It is very difficult to say why you only receive signals when touching certain parts of your circuit. The usual effect of making contact with your receiving circuit is to cause some slight change in tuning and so bring in a particular signal. In your case, however, as the high tension circuit only appears to be concerned, we should imagine that fault is either in the transformer primary or its bridging condenser, which should have a value of 0·002 mfd., and not 0·0002 as marked in your diagram.

**"W.F." (Johnstone).**—It is not possible to advise you as to whether your telephone receivers are suitable for conversion for use with wireless receiving apparatus. High resistance telephones are wound with wire from 46 to 50 S.W.G., according to the dimensions of the pole pieces and the number of turns required. Thinner diaphragms may be required, but without knowing the type at present fitted it is impossible to advise you. Thin diaphragms are not always an advantage, as the stiffness of thicker ones sometimes gives a desirable damping effect, making them operative over a wide range of note frequencies.

**"EMMERESSES" (Dundee)** *asks* (1) *For dimensions of aerial tuning inductances to tune to* 150-800 *metres on a* 4" *former.* (2) *Reaction coil*

*for same.* (3) *Dimensions for A.T.I. and reaction coils for* 1,500-5,000 *metres.* (4) *Whether a variable condenser of* 0·0015 *mfd. can be used in parallel with these coils.*

(1) Depends on the size of your aerial, but 4 ins. of winding of No. 22 D.C.C. would no doubt be suitable. (2) 3 ins. of winding of No. 26 D.C.C. on a 3" former. (3) A.T.I. 5½" diameter by 7" long, wound with No. 28 D.C.C. Reaction coil 4½" diameter by 5" long, wound with No. 32 S.S.C. (4) Yes; air dielectric recommended.

"**F.T.**" **(Bradford)** *wishes to know* (1) *If fixed condensers may be mounted one over the other in order to economise in space.* (2) *Dimensions and number of plates for building a variable condenser.* (3) *Whether waxed teak can be used instead of ebonite for tuner construction.* (4) *To what purpose he can put* 25/40 *D.S.C. wire.*

(1) Not recommended, as the condensers are bound to have capacity one to another, which, in a valve circuit, may cause trouble. (2) If the plates have an overlap diameter of 2½", and are stamped on No. 20 S.W.G. sheet and spaced with washers 5/64" thick, then 30 moved and 31 fixed plates will give a capacity of approximately 0·0015 mfd. (3) We do not advise this unless the room in which your receiving apparatus is installed is a very dry one. (4) Quite useful for constructing inductances for crystal or non-reactive tuners, but little would be gained by the use of this special wire, which is essentially designed to minimise damping, if reaction is to be made use of.

"**ALPHA**" **(Huntley)** *sends circuit similar to that shown on page* 372, *June* 17*th issue, and asks* (1) *If we consider it a good one.* (2) *For values of grid condenser and leak.* (3) *The tuning range of his loose coupler.*

(1) and (2) The circuit is one which gives quite good results, and the values asked for are given in the diagram referred to above. Arrange to connect aerial tuning condenser, which may have a value of 0·001 mfd., in series or parallel with the aerial inductance. (3) Approximately 800 to 4,500 metres, depending upon the dimensions of your aerial.

"**A.W.S.**" **(Mt. Kennedy)** *asks* (1) *If a flat inductance wound on a "spider" is called a slab or a pancake coil.* (2) *Dimensions of intervalve transformers for* 450-4,000 *metres, consisting of such coils of* 100 *turns of No.* 40 *wire.* (3) *Whether lightning discharge would destroy an aerial wire of thinner gauge than No.* 18, *and what precautions should be taken to prevent damage from this cause.* (4) *Whether* 1 *H.F. amplification will give much better results on distant telephony than one stage L.F. amplification.*

(1) Inductances of the flat type are called slab or pancake coils. Those wound on a "spider" are called basket coils. (2) It is difficult to say, but very good intervalve transformers can be made by placing basket coils together, or better still, by winding two wires on the "spider" simultaneously. Do not use transformers for wavelengths above 2,000 metres, as the comparatively large capacity given by the many turns would make their action equivalent to capacity reaction intervalve coupling. (3) The gauge of the aerial wire is controlled by the mechanical strength required. With small amateur aerials there is very little danger of damage by lightning, but a switch should be arranged to earth the aerial when not in use. (4) Yes, H.F. amplification does not increase signal strength to the same extent as L.F. amplification, but H.F. will bring in weak signals which any amount of L.F. would never render audible.

"**T.H.D.**" **(Cardiff)** *asks* (1) *For the name of a publication, if not too technical in character, dealing with wireless telephony.* (2) *Whether any manufacturer of wireless telephony receiving sets rents them out on some such basis as the ordinary telephone.*

(1) There is no publication which deals exclusively with the action of wireless telephony. There are many simple theory books, such as "Wireless Telegraphy," Parts I and II, by Bangay, "Wireless Telegraphy," by Stanley, and for practical constructional details you might read "The Construction of the Amateur Valve Station," by Douglas, or "The Radio Experimenter's Handbook," by Coursey. An introductory booklet to the properties and applications of wireless telegraphy and telephony is "The A.B.C. of Wireless," by Harris (*Wireless Press, Ltd.*). (2) We are not aware of any manufacturer offering sets on these terms.

"**W.B.**" **(Yeovil)** *wishes to make a two-valve receiver, and asks for information as to how to do this.*

A set of this type could be constructed, but would not be very efficient on the low powers and wavelengths used for telephone transmissions. It would give very poor results on long distance telephony, which is only, perhaps, 1/20th of the effective strength of spark signals coming from the same stations. For satisfactory results for 50 miles on a loud speaker from a broadcasting station with an indoor aerial, five or six valves would be required. The life of a good type valve, carefully used, runs from 1,000 upwards to 5,000 hours. Carelessly used it may only last a few hours.

"**RADIO**" **(Hornsea)** *asks* (1) *How to connect a variable condenser with a reaction coil.* (2) *Is a reaction coil of good proportion to the A.T.I., if it has* 4/5*ths of the amount of wire on it.* (3) *If the capacity of a condenser is increased or reduced by enlarged spacing between the plates.* (4) *If* 30 *volts is sufficient for a Mullard "Ora" valve.*

(1) A variable condenser is not essential with a reaction coil, but often quite useful if connected across the coil and having a maximum value of 0·0005 mfd. (2) This figure is often about right, but no hard and fast rule can be given. (3) Large spacing reduces capacity, which is inversely proportional to the width of space. (4) Yes.

"**L.L.**" **(Rainham)** *asks* (1) *For a diagram of connections for a certain set.* (2) *Winding data for set.* (3) *What should be the values of the resistances of the L.F. transformer.* (4) *For criticism of set.*

(1) The combination suggested is not suitable. We should recommend complete connection as in Fig. 5, page 15, April 1st issue, with series parallel switching for A.T.C. if desired. The number of turns might be as follows:—90, 100, 190, 300, 490, 950, 1,800, 2,500, and the total weight of wire approximately 1 lb. (3) Resistances might be 2,000 and 5,000 ohms, with considerable latitude. (4) The set, as we have arranged it, should be quite satisfactory.

**"R.H.W." (Little Sutton).**—If your receiver is connected as in your diagram we are surprised you have even heard crackling noises, which are due to atmospherics. We cannot say the capacities of your condensers as you tell us nothing about them. Similarly, we cannot say much about your wavelength, but with connections as in Fig. 2, page 120, April 22nd, you should tune in broadcasting stations all right. The loose coupler might be 6″×5″ of No. 22, and 4″×3″ of No. 28.

**"C.M.B." (Marlborough)** *asks which of three types of aerials would be most satisfactory, and how he could receive* **PCGG** *at Nice.*

An aerial length of 300 ft. is not allowed in this country. Even if you propose to erect the aerial abroad, we think that the second or third scheme would be better, the choice between them lying with the one having the greater height above the roof or earth as the case may be. Reception of **PCGG** at Nice would probably give very severe difficulties, and require at least a six-valve set for any results at all. If you succeed, we should be interested to receive an account of your methods.

**"R.H." (Stoke Newington)** *encloses diagram of his set and asks* (1) *What is its wavelength.* (2) *What stations transmit between 7 and 9 p.m.* (3) *If 100 ft. of No. 16 copper wire would be all right for an aerial.* (4) *The cause of loud whistling in his telephones.*

(1) 2,000 metres without a parallel condenser, and about 4,000 metres with a parallel condenser of 0·001 mfds. (2) See list in issue of August 6th, 1921. It is hoped to publish an amended list early in August. (3) Yes. (4) We could help you more if you told us the circumstances under which the whistling occurred. It is most probably due to too tight reaction coupling.

**"TANKS" (Newcastle-on-Tyne)** *asks* (1) *If a four-valve diagram will fulfil certain specialised requirements.* (2) *Length of aerial required to hear Dutch Concerts and English broadcast stations.* (3) *If cutting out one or two valves will alter the range and strength of signals.* (4) *If it is possible to cut out Cullercoats at a distance of 10 miles.*

(1) See Fig. 5, page 62, April 8th issue, a fourth valve being added exactly as the last valve there shown. (2) Anything between 50 and 100 ft. should be satisfactory. (3) Certainly, otherwise there would be no point in using these valves at all. (4) You are unlikely to cut out Cullercoats on wavelengths close to his own, but at other wavelengths you should be able to do so by sufficiently weakening the coupling.

**"T.R.S." (Stoke-on-Trent)** *gives particulars of his set and asks why he cannot receive telephony.*

The probable cause of failure to receive telephony is the distance from any telephone transmitting station. You would have a better chance with a series A.T.C. rather than a parallel, but we doubt if you will get any success without one or two more H.F. valves.

**"INSULATION" (Winchester)** *asks* (1) *How does an electrolytic detector compare with a carborundum in sensitiveness.* (2) *Could he hear* **FL, 2 MT** *and Croydon telephony on a crystal set with aerial 25 ft. high.* (3) *Who is* **GKB.** (4) *If 110 volt H.T. should be used with an R.5 valve.*

(1) More sensitive, but less reliable. It is difficult to give a numerical estimate of the relative sensitivity. (2) **FL** possibly; **2 MT** very doubtful. (3) Regret we have no information. (4) Yes.

**"S.B.X." (Liverpool)** *asks for a diagram of a two-valve and crystal, or three-valve and crystal circuit, with loud speaker suitable for broadcasting telephony.*

See Fig. 6, page 215, May 13th issue, with the loud speaker in place of the telephones.

**"G.N.N." (London)** *describes his set and asks* (1) *If the reaction coil described will make it suitable for valve reception.* (2) *Wavelength range of the coil.* (3) *Capacity of a certain variable condenser.* (4) *If a single wire aerial 70 ft. long and 25 ft. high, will be suitable for a single valve set.*

(1) No, it will probably be necessary for the reaction coil to slide inside the A.T.I. unless considerably more turns are used. (2) The aerial circuit will tune to about 2,000 metres. The closed circuit probably very considerably higher. (3) 0·00065 mfds. (4) Yes.

**"FOGGED" (Croydon)** *asks for a three-valve set to give best results on all wavelengths.*

Neither of the resistance capacity coupled sets you suggest will be of much use below 1,000 metres. The circuit of Fig. 5, page 62, April 8th issue, would fill your requirements, but the necessity for a larger number of transformers could be avoided by using resistance capacity coupling above 1,000 metres. This can easily be made to plug-in in place of, and be substituted for the normal transformer.

**"PLUS ONE" (Tonbridge)** *encloses diagram of circuit and asks* (1) *How to add one more valve.* (2) *What voltage should the L.T. be for use with "Ora" valves.* (3) *What stations should be heard with basket coils, range 300 to 5,000 metres.*

(1) See the diagram given to **"TRIODE" (West Bridgford).** (2) 6 volts with a 6 ohm resistance. (3) Broadcasting, some ships, air stations and Continental stations, such as **FL.**

**"TRIODE" (West Bridgford)** *wishes to construct a set described in the issue of March 4th, and asks* (1) *Dimensions of a variometer to tune from 450 to 12,000 metres; gauge and amount of wire required for this.* (2) *If a valve panel can be used to connect with set, or the short wave receiver described in the issue of June 3rd.* (3) *If Paris sends out Greenwich time, or must correction be made for the longitude of Paris.*

(1) For a range of this extent you would need a set of interchangeable honeycomb coils with turns ranging from about 50 to 5,000. The mean diameter of coil is about 2½″, and the wire used might be No. 26. (2) The most suitable arrangement for this purpose would be as a note magnifier as in diagram (Fig. 1). (3) No correction is necessary for the longitude of Paris.

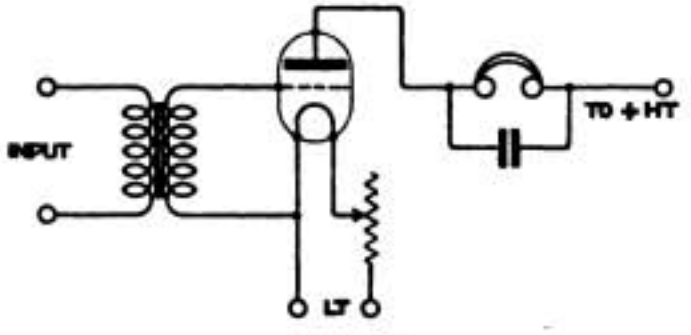



*Fig.* 1.

**"A.V.B." (Ostend)** *asks for a formula to calculate the self-inductance of a duo-lateral winding such as published in the issue of December 11th.*

There is no accurate formula. That given to **"V. 526" (Australia)**, on page 64 of the April 8th issue gives results which are generally within 10 to 15 per cent. of truth.

**"D.H.B.McC" (Leicester)** *asks* (1) *The number of turns and tappings on a* $2\frac{1}{2}'' \times \frac{1}{2}''$ *former to tune to* 25,000λ. (2) *Best values for grid condenser and leak for "Ora" valves in the same circuit.* (3) *For criticism of two methods of connecting the L.T.*

(1) We have no data. Suitable windings would have to be determined by experiment, as the self-capacity of the coils would prevent accurate calculation. (2) Try about 0·002 mfds. and 2 megohms. (3) Almost immaterial. Method 2 is somewhat less liable to lead to cross connections and short circuits in connecting up more than one set to a single pair of batteries.

**"AERIAL" (Reigate)** *sends a diagram of his set and asks* (1) *Which would be the better wire to use for the aerial,* 7/22 *or* 3/18 *copper.* (2) *If the circuit sketched is correct.* (3) *What should be the H.T. voltage for two Mullard "Ora" valves.* (4) *Would a condenser across the primary of the H.F. transformer improve results.*

(1) Either will do; 7/22 preferable. (2) Yes, except that the earth end of the A.T.I. should go to the negative of the L.T. instead of to the positive. (3) About 40 volts. (4) Yes, it would increase the effective wavelength of each transformer.

**"T.Q." (Sutton)** *sends diagram of his circuit and asks* (1) *For criticism.* (2) *The most suitable type of tuner to use.* (3) *How to connect the tuner between X and Y.* (4) *If* **PCGG** *will be received on the loud speaker.*

(1) Circuit is O.K. (2) and (3) Arrangement as shown is O.K., or any two-circuit tuner may be used with secondary condenser across X and Y. (4) It should be, with careful tuning.

**"W.D.O'G." (Harrogate)** *asks* (1) *Whether down lead should be taken from the lower or higher end of an aerial.* (2) *Whether down leads may be lashed together round the insulator from which they fall or should pass freely through it.* (3) *If not convenient to get down leads to a suitable room, if loud speaker leads may be run from the receiving room to that in which signals are to be heard.*

(1) Very little difference. It is generally best to take it from the end nearest to the instruments. (2) Leads should be fastened round the insulators. (3) Yes.

**"J.S." (Slaithwaite)** *asks* (1) *For winding data for a H.F. transformer for a range of* 440 *metres.* (2) *Winding data for transformer for* 2,600 *metres.* (3) *If the aerial sketched is suitable for telephony.* (4) *Are four "Ora" valves connected by H.F. transformers sufficient to give good signals with* **PCGG**.

(1) This will need experimental adjustment, but try about 70 turns per winding to commence with. (2) Try 200 turns. (3) Quite suitable. (4) Better to use the last stage as L.F. amplifier.

**"SPARKS" (Harrow)** *asks* (1) *If he could increase the wavelength of a set described in the issue of June 10th, and for winding and connecting details.* (2) *Dimensions of coil described in the issue of June 3rd.* (3) *If enamel can be used for insulating the cardboard formers for inductances.* (4) *If the aerial sketched is correct.*

(1) Try about 90 turns for each coil. The connection is quite simple. Put one end of coil 1 to the aerial and the other end to one end of coil 2, and the other end of coil 2 to earth. (2) A spherical coil of 3" diameter wound full of No. 20 or 22. (3) Enamel might be O.K., well stoved on, but it would not be easy to do, and we do not recommend it. (4) O.K., but why not just bind the wires with a thinner wire and then solder the whole up.

**"C.A.S." (Reigate)** *sends sketch of his circuit and asks* (1) *The simplest way of altering it to work on lower wavelengths.* (2) *Would this circuit work on lower wavelengths if duo-lateral coils were used.* (3) *Would a separate heterodyne give the required results.*

(1) Put the A.T.C. in series with the A.T.I. (2) No, unless smaller coils were used, but you could make smaller coils yourself. (3) A separate heterodyne will not affect the wavelength range of the set.

**"B.E.P." (Woking)** *asks* (1) *With reference to the article on heterodynes in the issue of May 6th, if the value of C.2 is correct.* (2) *What is the capacity of the telephone blocking condensers on Mark III tuners.* (3) *How to clean an ebonite panel where discoloured by light.*

(1) No; in this case a value as high as this is desirable. (2) Usually about 0·0025 mfd. (3) Rub it up with emery cloth, finishing up with a very fine grade, then polish with a little oil on a rag.

**"E.D." (Bristol)** *asks* (1) *For a diagram of a switching arrangement for a five-valve receiver, so that any combination of valves may be used at once.* (2) *How can he obtain a list of stations transmitting telephony, and if any afternoon concerts are run on weekdays.*

(1) Detailed design of a set of this type is outside the scope of these columns. However, a set of this kind is shown in Fig. 3, page 31, April 1st issue, in which transformers may be used for H.F. coupling if preferred. If transformers are used the switching arrangement may be as in the diagram.

**"STAR" (Romford)** *asks* (1) *What is the best size grid leak and condenser to use with a Mullard "Ora" valve.* (2) *If a Britwire coil is used as a tuner, will another Britwire coil do as a reaction coil.* (3) *What size coil will act as reaction for the* 180/450 *metres coil, a smaller or a larger one.* (4) *If a single valve circuit sketched is suitable.*

(1) About 0·0002 mfds. and 1 megohm. (2) Yes. (3) The best value to use should be found by experiment. Either is suitable at this wavelength. (4) O.K. if you put a condenser across the telephones, but a loose coupled circuit will give much less re-radiation.

**"MICA" (Broadstone).**—(1) Thickness of copper is 1·5 mils., and mica 3 mils. For 0·002 mfds. use five metal foils with an overlap of 5 sq. centimetres. For 0·004, use nine foils with the same overlap. (2) Neither of these cells are recommended, but the Edison type may be used if desired. The disadvantage is change of voltage on discharge. The price comes out somewhat higher than for normal cells. (3) Coil of this type is not suitable for use in this way, except possibly by removing

the break, exciting the primary by a buzzer, and introducing secondary in the grid circuit of the valve.

**"H.A.W." (Elmhurst Park)** *asks* (1) *For suitable reactance coil 5" × 9" of No. 28.* (2) *Wavelength of the above coil.* (3) *Gauge of enclosed wire.* (4) *If a car ignition coil would be any use as a transformer.*

(1) Try 4" × 6" of No. 32. (2) Inductance is 14,000 mhys. This will tune a P.M.G. aerial to about 4,000 metres. (3) No. 37. (4) Possibly it could be used as a microphone transformer, but winding is unsuitable for anything else.

**"R.V.S." (Manchester)** *submits diagram of a crystal set and asks* (1) *Values for the variable condensers.* (2) *A question about the connecting up.* (3) *If certain formers will be suitable.* (4) *For criticism of set.*

(1) A.T.C. enclosed circuit condenser 0·0005 mfd. each. Blocking condenser 0·0002 mfds. (2) Preferably to Y. (3) The suggested values should be all right. If you cannot tune down to 325 metres, remove a few turns from the fixed portion of the coil. (4) O.K.

**"J.R.C." (Kilburn)** *asks for a diagram of a single valve set with dimensions for tuning from 180 to 1,100 metres.*

See diagram. Fig. 2.

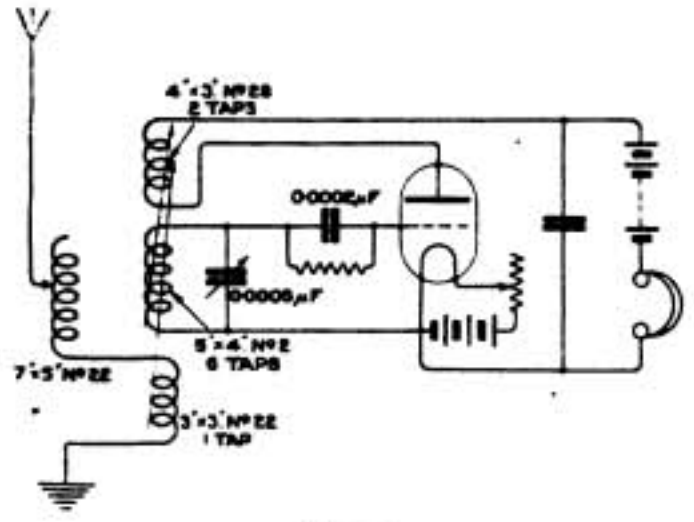



*Fig. 2.*

**"CAT" (Dartford)** *asks whether the fact that a crystal passes current as indicated by a click in the telephones, or the fact that a cat-whisker adjustment behaves as a microphone indicates that the detector is functioning properly.*

No, neither of the tests in any way prove that the crystal is capable of rectifying H.F. currents.

**"RADIO-TRAIN" (Brixton)** *asks what Government licences are necessary to carry out experiments in radio-control of mechanical transport.* (2) *What wavelength he would be allowed to use.*

(1) We think that the ordinary regulations governing transmission would probably apply, but you should apply to the Post Office for detailed information. (2) This would have to be settled with the Post Office. They might agree to the normal amateur wavelength, or more probably a lower value, say 20 to 50 metres.

**"G.H.I." (Highgate).**—Coils suggested could be used. Reaction coil might be 6" × 3½" of No. 28, introduced into the closed circuit coil of the end farthest from the A.T.I.

**"J.F.S." (Hoylake)** *describes a proposed aerial, and asks* (1) *Which of two arrangements is the better.* (2) *What is a suitable earth.* (3) *If an iron tube mast is as good as a wooden one.* (4) *If the length of the supporting rope affects the aerial.*

(1) Impossible to say without tests or detailed sketch of the two arrangements, but the higher aerial would probably be somewhat the better of the two. Try the aerial to the dormer window to start with. (2) A buried plate, 3 ft. square, or fine mesh netting on the ground, not less than 12 square yards. (3) O.K. (4) No, except for liability to tighten up in wet weather.

**"D.C.M." (Dublin)** *has a set which works on a crystal but not on a valve, and asks why this is.*

Impossible to say. Possibly the valve is defective. However, some of the circuits referred to are of doubtful utility. See Fig. 3.

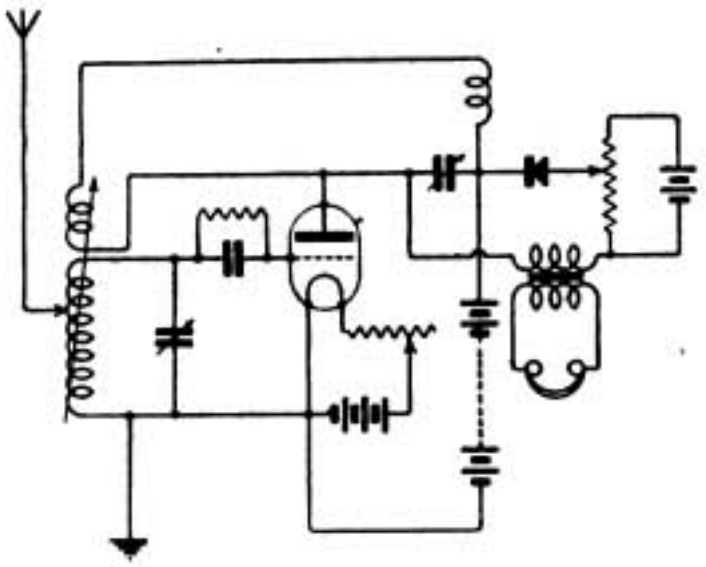


*Fig. 3.*

**"CAREFUL" (Derby)** *asks* (1) *For criticism of a circuit sketched.* (2) *If a set of slab inductances 300/30,000 metres would be suitable for the A.T.I. of his set.* (3) *Would the circuit be suitable for short-wave telephony, using the aerial sketched.*

(1) Circuit O.K., but interchangeable H.F. transformers will be required to cover a wide range. (2) Yes. (3) Yes, with A.T.C. used in series.

**"POMPONIAN" (Portsmouth)** *gives a diagram of his circuit and asks if it is correct, and various details about it.*

Circuit is O.K. For the A.T.I., 8" × 6" of No. 22; Coupler, 3" × 2" of No. 22; closed circuit coil, 6" × 4" of No. 28; closed circuit condenser, 0·0005 mfds.; grid condenser, 0·0002 mfds.: anode blocking condenser, 0·001 mfds.

**"SHAFTESBURY" (London)** *sends a sketch of a three-valve amplifier, and asks* (1) *If the wiring diagram is correct.* (2) *If a list of components for an amplifier are correct.* (3) *Particulars of suitable aerial, A.T.I. and reactance coil.* (4) *If this set will receive telephony and broadcasting concerts.*

(1) Yes. (2) The grid condenser is too big. Two pieces should be enough. The plates of your condenser are probably too big. (3) The A.T.I., 8" × 6" of No. 22. Reaction coil, 5" × 3" of No. 28. (4) Yes, from stations in the London district.

D

**"FRAME" (Halifax)** *asks* (1) *Formula for calculating the inductance of Lokap wound coils*; (2) *If the P.M.G. has officially allowed experimenters any length of aerial.* (3) *Size of condenser across telephones.* (4) *Particulars of a French wireless magazine, and if it would help an experimenter in this country.*

(1) There is no very good formula. That given to **"V. 526" (Australia)** in the issue of April 8th, page 64, is about the best. (2) No increase of length is to be allowed, except in the case of a multi-wire aerial, where the length may now be brought up to 100 ft. as with a single wire. (3) About 0·001 mfds. is a very good value. The value suggested is probably lower. (4) It would probably be of interest, but it is doubtful if it would be of any very great help to you.

**"BEGINNER" (N.W.8).**—(1) and (2) There is no point in making a crystal set to tune above 3,500 metres, as there are no spark stations above this wavelength for it to work on. If you must have a greater wavelength, increase the closed circuit capacity and put the A.T.C. in parallel with the A.T.I. (3) Tappings or a slider may be used if good variable condensers are available. If the condensers are not continuously variable a slider must be used.

**"C.L." (Maldon)** *refers to the Reinartz Tuner, described in the issue of May 13th, and asks* (1) *What is the maximum and minimum wavelength on a P.M.G. aerial.* (2) *What would be the approximate cost to make.* (3) *If a certain loose coupler and reaction would be suitable for the broadcasting and amateur telephony.* (4) *The reason for humming noise when the hand is put near the valve.*

(1) Approximately 200/450 metres. (2) It depends on whether the variable condensers, switch knobs, terminals, etc., are made or bought. If every part is made, the set could possibly be made for 20s. or 30s. excluding the valve. If the parts were bought, and only the set assembled, the cost might be upwards of £5. (4) We cannot say without test.

**"JOB" (Manor Park).**—The gauges of the samples of wire are as follows:—1, No. 24; 2, No. 22; 3, No. 21; 4, No. 28.

**"B.E.J." (Copenhagen)** *encloses a diagram of his set and asks* (1) *How to make R oscillate regularly without altering the coils or H.T.* (2) *Which valve will generate most, and how many watts will each deliver to the aerial.* (3) *Wavelength range for telephony and telegraphy.* (4) *Would results be better with 220 volts H.T. with a 25 watt transmitting valve intended for 800 volts H.T.*

(1) Put the condensers across the key or microphone contacts, or put a static potential on the grid, or use a grid condenser and leak, or alter the size and position of the reaction coil. (2) Approximately the same. Probably not more than one watt. (3) Difficult to specify. Possibly five to ten miles with critical reaction. (4) Probably, although it may be somewhat difficult to induce it to oscillate on so greatly reduced voltage.

**"H.R." (The Hague)** *encloses a diagram of his set and asks for criticism and an improved diagram.*

The set is of quite good type, except that there is rather too little L.F. and too much H.F. amplification. Try the circuit of Fig. 3, page 467, July 8th issue.

**"R.W.C.J." (Newport)** *encloses a diagram of his five-valve receiver and asks* (1) *What would be the best tuner to use with the five-valve amplifier, honeycomb or single-layer coils.* (2) *If a variable condenser can be used with a set.* (3) *Will the set receive the Dutch concerts and Home concerts.* (4) *The capacities of the condensers* 1, 2, 3, 4, *and* 5.

(1) It depends on the wavelength required. Use solenoids for ranges up to 3,000 metres, and honeycombs if a wider range is required. Many examples of windings suitable for wavelengths of different ranges have been given recently. (2) Yes, in the closed circuit. Capacity 0·0005 mfd. for short waves, and 0·001 mfd. for long. (3) Yes. (4) Condensers 1, 2 and 3, 0·001 mfd.; No. 4, 0·0002 mfds.; and No. 5, 0·002 mfds. (N.B.—We should advise you to work with a simple set until you have obtained more experience.)

**"OHM SWEET OHM" (Lytham)** *asks* (1) *Which is the best circuit to use for a four-valve H.F. set.* (2) *Would this set receive* **PCGG, 2MT** *and the broadcasting stations.* (3) *If this set is powerful enough to work a Brown loud speaker.* (4) *Wavelength of the set.*

(1) See Fig. 4, page 437, July 1st, introducing a vernier condenser in parallel with a closed circuit condenser. (2) Yes, with a good aerial. (3) Yes, from fairly near stations, but we should prefer one or two stages of note magnification in place of the final H.F. magnification. (4) The closed circuit would tune to 4,500 metres. The primary will tune to this with a parallel condenser of 0·002 mfds., but it will be better to use a loading coil.

**"CHITTY-BANG-BANG," H.B. (Nottingham)** *wishes to construct a short wave receiver described in the issue of June 3rd, and asks* (1) *What is the capacity of the two variable condensers.* (2) *If a grid leak is necessary.* (3) *If the grid leak should be connected across the grid filament or shunted across the grid variable condenser.* (4) *If a L.F. transformer coupled amplifier can be connected in place of the telephones.*

(1) It is not necessary for these condensers to be variable, although the grid condenser might be, say, 0·0003 mfds. at maximum. The telephone condenser is about 0·001 mfds. (2) Yes, it should certainly be used. (3) Immaterial. (4) Yes.

## SHARE MARKET REPORT

Prices as we go to press on July 17th, are:—

| | | | | |
|---|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 7 | 0 |
| " Preference .. .. | 1 | 18 | 9 |
| " Inter. Marine .. .. | 1 | 8 | 9 |
| " Canadian .. .. | | 11 | 0 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 1 | 3 |
| Preference .. .. .. | | 15 | 0 |

29th JULY, 1922 THE PRICE 6D. NET.

# WIRELESS WORLD AND RADIO REVIEW

VOL. X. No. 18. 29th JULY, 1922. Registered at the G.P.O. as a Weekly Newspaper.

THE
# WIRELESS WORLD
AND RADIO REVIEW
THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON
VOL. X. No. 18. JULY 29TH, 1922. WEEKLY

# A Tuner for all Wavelengths

By W. FORBES BOYD.

IT has been said that an efficient tuner is as good as an extra valve, and although this naturally assumes that comparison is made with a badly designed tuner, there is undoubtedly a certain amount of truth in the statement.

Wireless literature for amateurs is redundant with improved methods of amplification, but tuner design is only infrequently given, and these thoughts have prompted the writer to give the following particulars of a tuner in which he has attempted to combine efficiency at all wavelengths with facilities for quickly changing the wavelengths. This means that the aerial tuning inductance must be built up in sections which can, as far as possible, be isolated from one another not only electrically, but also magnetically, to prevent the "dead-end" effect that so often worries the amateur at short wavelengths.

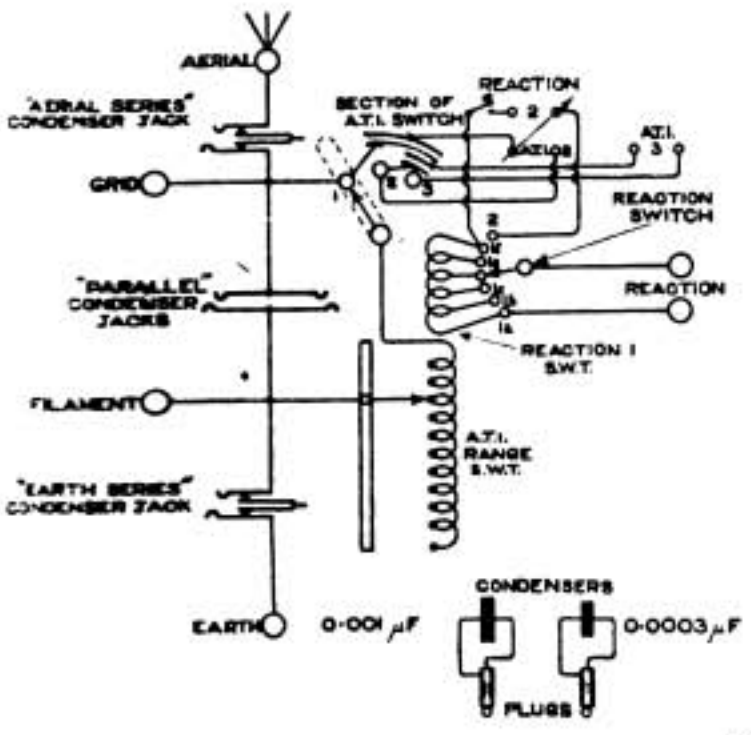
The writer has assumed that for efficiency, compactness and cheapness, the coils taken from the Mark III Short Wave Tuner are the most suitable for short wavelengths, and that the machine-wound duo-lateral type of loading coil, on account of its low equivalent or self capacity, combined with the space occupied, is the most efficient for the longer wavelengths, and for these reasons they are embodied in the design.

Two variable condensers of 0·001 and 0·0003 mfd. capacities are included in the tuner attached to concentric telephone plugs so that they may be connected :—

(*a*) In series with the aerial lead.
(*b*) In series with the earth lead.
(*c*) In parallel with the inductance.

These alternative positions for connecting up the condensers form an attractive feature of the design.

For short wavelengths the 0·001 mfd.



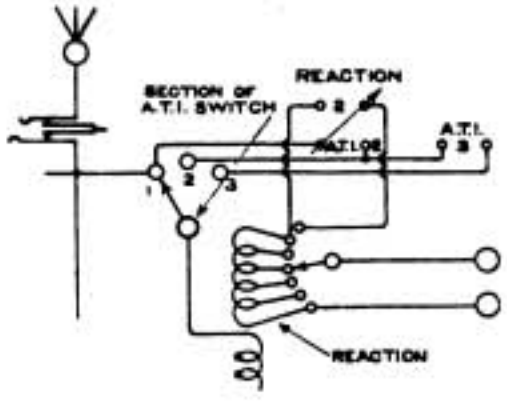




*Fig.* 1.

*eft figure shows diagram of connections and the right figure an alternative and simpler rrangement, but in order to "dead-end" the sections not in use, it is necessary to remove the idle coils.*

condenser is connected in series with the aerial lead, and the 0·0003 mfd. condenser in series with the earth lead.

This arrangement, more especially the small earth series condenser, facilitates reaction at short wavelengths, and whereas reaction with parallel condensers fails at about 300 metres, it is safe to say that with series condensers reaction can easily be obtained at 100 metres or even a smaller wavelength.

The series aerial and earth jacks must be so arranged that when the condenser plug is

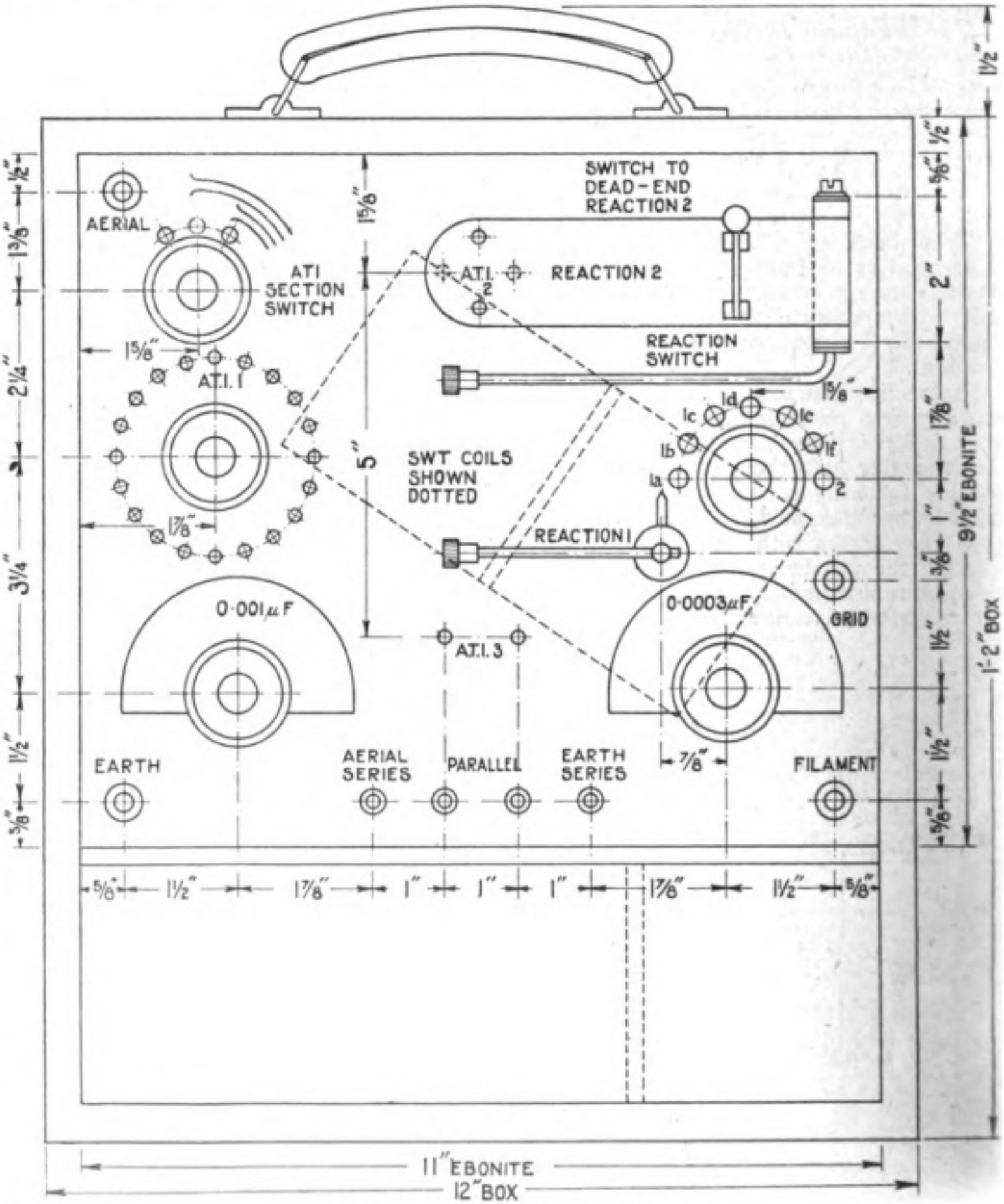



*Fig. 2. Showing the principal dimensions.*

withdrawn the two contact pieces are shorted through the two centre contacts. This is done by using 4 or 5-way contact jacks and permanently connecting the two centre contacts together as shown in Fig. 1.

Another advantage of using the " plug-in " method of connecting condensers to the open oscillatory circuit is the fact that there is no gap in the range of wavelengths, which is sometimes the result when only one condenser is used with the ordinary series parallel switch. For example, using a particular inductance, one condenser and series parallel switch, wavelength may be obtained as follows :—

Condenser in series with inductance. Range (say) 300-600 m.

Condenser in parallel with inductance. Range 750-1,500 m.

And from the above it is seen that there is a gap in the wavelength between the series and parallel connections.

When using two condensers and the " plug-in " method of connection this gap can easily be bridged as follows :—

0·001 mfd. and 0·0003 condensers in series. Range (say) 300-600 m.

0·001 mfd. in series and 0·0003 in parallel. Range 500-1,000 m.

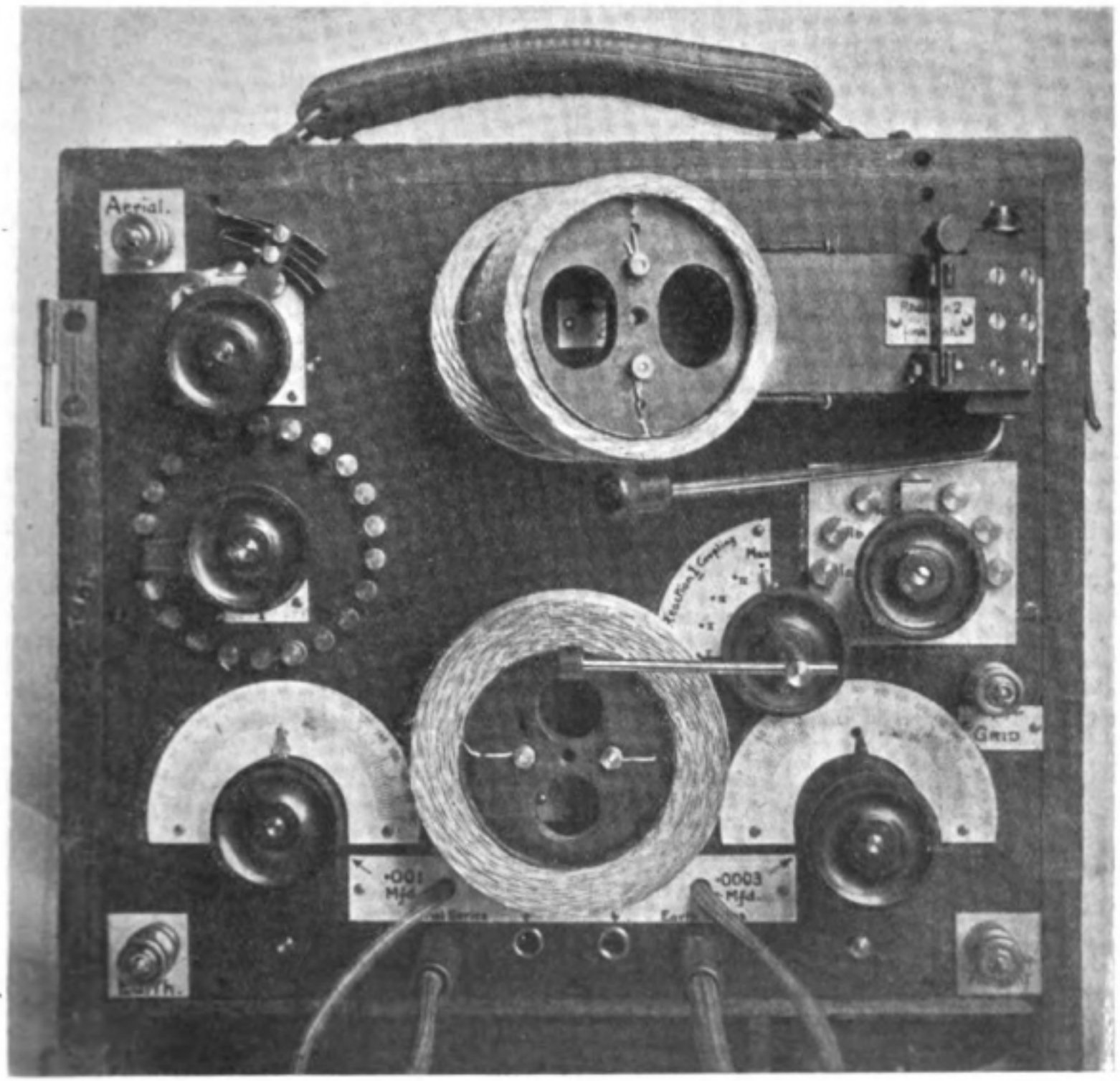



*Fig. 3. General Arrangement.*

0·001 mfd. and 0·0003 condensers in parallel. Range 750-1,500 m.

So much for the condensers. The aerial tuning inductance at first sight is perhaps a little more involved, but in actual practice it is easily manipulated, and the design is such that all unnecessary complications have been omitted.

Actually there are two circuits in the tuner, which are used as aerial tuning inductance and reaction. The reaction circuit can easily be adapted so that it can be used as a closed or tuned oscillatory circuit, but in this article it is described as a standard reaction circuit.

The aerial tuning inductance is arranged in three sections, each section being isolated by means of the section or A.T.I. switch as shown in Fig. 1.

The first section of the inductance is the well-known single layer inductance taken from a Mark III short wave tuner, and is connected to a 19 point switch as shown in Fig. 1, marked A.T.I. Range 1.

The reaction for this section is the closed circuit, or loose coupled inductance taken from the Mark III short wave tuner, and has five tapping points.

These two coils are mounted under the ebonite face plate as shown dotted in Fig. 2.

The second and third sections of the inductance are duo-lateral coils, which are plugged into sockets on the outside face of the ebonite base-board.

The reaction for the second section of the inductance is also plugged into a movable arm by means of which the coupling can be altered.

*Fig. 4.*

*The A.T.I. Section Switch, showing the "dead-ending" arrangement. The switch is moving from Range 1 to Range 2, and the wiper contact is on the point of bridging the two outer contact plates.*

In connecting up Range 1 of the inductance to Ranges 2 and 3, we could add 2 studs to the 10 point tapping switch and connect section 2 between studs 19 and 20 and section 3 between studs 20 and 21, but this arrangement, by adding the loading coils at the *end* of Range 1, would prevent the use of the 19 tapping points of Range 1 for fine tuning,

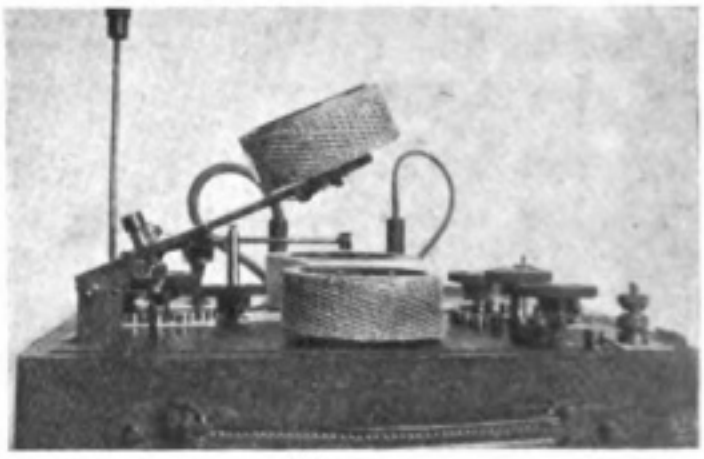


*Fig. 5.*

*View taken from top of tuner and showing the A.T.I. and Reaction Coils.*

and so Ranges 2 and 3 are connected by means of the section switch to the *beginning* of Range 1. This is a distinct advantage, especially when receiving telephony, when it is possible, by reducing the condenser valve to a minimum, and the inductance valve to a maximum, to increase the potential difference between the two ends of the inductance, and thus considerably improve the signal strength.

Coming now to the general lay-out of the various parts, it will be noticed that the ebonite face plate to which they are attached is designed to fit into the instrument section of a short wave tuner box. The smaller section, *i.e.*, the old telephone and battery compartments, are used to store the duo-lateral coils.

Fig. 2 is a sketch showing the principal dimensions and Fig. 3 is a photograph of the tuner. Ranges 1 of the A.T.I. and reaction are mounted on the underside of the ebonite, and as these coils are so well known, no details of them are necessary.

The following details of the other parts are given, as they depart to a certain extent from standard practice :—

A.T.I OR SECTION SWITCH.

This switch is shown in the top left-hand corner of the instrument, and not only adds sections 2 and 3 to the aerial tuning inductance,

but isolates the section not in use. For example, when the contact arm is on stud No. 1, ranges 2 and 3 are absolutely disconnected in order to eliminate dead-end effect. This is done by vertical and curved contact plates which are short-circuited by two wiper arms attached to, but insulated from the contact arm. The contact plates are held firmly in place by driving them into saw-cuts in the ebonite.

Fig. 4 shows a nearer view of the section switch, the contact plates and the two wiper arms.

It will be noted that the outer contact plates are short-circuited when the contact arm is on studs 2 and 3, and that the inner contact plates are shorted only at stud 3. Reference to the diagram (Fig. 1) shows how these studs and contact plates are connected.

### Reaction for Ranges 2 and 3.

This is shown in Fig. 3 and also a view taken from the top of the tuner is shown in Fig. 5.

The reaction coil is plugged into the end of a thin fibre arm which is strengthened at the bearing end. The bearings are phosphor bronze or brass strips, which project through the ebonite face plate a sufficient distance to allow the arm to be horizontal with the ebonite face plate when in the maximum coupling position.

This means that there is a space under the fibre arm, and this space is used for the reaction terminals which are hidden from view, being behind the bearing strips.

The reaction terminals consist of two sockets into which a 2-pin plug fits, the plug being connected to the reaction leads from the amplifier. This allows the reaction coils to be quickly reversed, an advantage which users of H.F. magnification will appreciate.

### Duo-lateral Coils.

These coils are a well-known make, but the writer, not being satisfied with the standard method of mounting with plug and socket attached to the outside of the wire, has brought out an alternative design which has the advantage that the wire need not be handled when in use.

The method of coil mounting is shown in the photographs, and it will be noticed that two large holes are cut in the ebonite centre-piece to facilitate handling. The inside of the coil is first lined with fibre paper, the centre-piece is pressed into position, and with the use of "Seccotine" or shellac is held firmly in position.

The ebonite centre-piece is $\frac{3}{8}$ in. thick, and the top of the ebonite is $\frac{1}{8}$ in. lower than the top of the coil, so that the nuts which hold the split pins are practically flush with the top of the coil.

### Application.

In using the tuner it will be found that reaction can be readily obtained on the shortest wavelengths if the condensers are connected in the aerial series and earth series positions, especially if the value of the earth series condenser be kept small.

When using the condensers in the parallel position always use the smallest value of condenser and the largest value of inductance. For example, 1,000 metre telephony can be received on Range 1 with the 0·001 mfd. condenser in the parallel position, but it can also be obtained by adding a 150 turn duo-lateral coil at Range 2, and connecting the 0·001 mfd. condenser in the aerial series position. This latter combination gives practically double the signal strength.

Then again it often happens that one wants to listen-in to 180 m. and 1,000 m. telephony, and at more or less the same time to keep in touch with stations which are transmitting at from 2,000 to, say, 5,000 metres.

For the purpose of tuning to short wavelengths such as the telephony which is transmitted on 280 to 450 metres, it may be found convenient to substitute ebonite control levers for the brass ones shown in the photograph (Fig. 3). Extension rods might also be fitted for critically revolving the condensers and making manipulation possible without bringing the hands too near to the coils and other parts of the receiver.

The A.T.I. section switch allows this to be done at maximum efficiency without changing any of the inductances.

In conclusion, it is not claimed that the above article involves any new principles or describes the simplest form of tuner, but at a time when everyone is working for better results it must be understood that a certain amount of complication is necessary, and when once mastered it will be found to be well worth the trouble, so that possibly the last valve in the amplifier will be scrapped after all.

# Wireless Exhibition & Convention

## September 30th—October 7th, 1922.

ARRANGEMENTS have been made for a Wireless Exhibition and Convention to be held at the Horticultural Hall, Westminster, from Saturday, September 30th, to Saturday, October 7th inclusive.

Hitherto the interest of the general public in wireless has not been sufficient to justify the holding of an all-wireless exhibition in London on any large scale. With the advent of Broadcasting, and the great increase in interest taken in wireless, and wireless telephony in particular, there is ample scope for a really comprehensive exhibition, which may be expected to draw huge crowds.

The present Exhibition and Convention is being held under the auspices of the Wireless Society of London, and with the support of the affiliated Societies. It is obvious that no exhibition of this nature could hope to be a complete success without the co-operation of the wireless societies, or at least their goodwill. It is therefore hoped that Secretaries of Societies will bring the Exhibition to the notice of their members, in order that the Societies may be represented by as large an attendance as possible.

The social side of the exhibition will be conducted by the officers of the Wireless Society of London, and the co-operation of the affiliated Societies is required in these arrangements.

The Managers of the Exhibition, Messrs. Bertram Day & Company of 9 & 10, Charing Cross, S.W.1, are arranging that special accommodation shall be given for demonstrations and lectures, to be open to all visitors to the Exhibition, and it is expected that it will be possible to organise something of this nature to be in progress at all times throughout the period of the Exhibition.

At the present time, when so much public attention is being paid to the question of the support of British industries, it is not surprising to learn that the Postmaster-General is proposing to give to British firms the monopoly of supplying apparatus for the Broadcasting for a period of two years. Such a start should enable the industry, which is largely a new field for manufacturers in this country, to lay for itself a foundation which will be able to withstand the force of later competition from abroad. In this connection it is most gratifying to learn that the managers of the present Exhibition have decided that this shall be an all-British event, and that only British manufacturers of wireless apparatus shall be invited to exhibit.

This is a point which the Committee of the Wireless Society of London had not been slow to appreciate, and no doubt the affiliated societies are all agreed as to the importance of supporting British industries in the wireless boom. Each individual can do his share in this direction by insisting that whatever apparatus he may purchase from time to time should bear the hall mark of British manufacture.

Taking into consideration the difficulty which many of those interested in wireless would find in attending the Exhibition during ordinary weekdays, it is interesting to note that the period during which the Exhibition will be open embraces two Saturdays, and this arrangement should appeal to those in the provinces who may only be able to come up to London at the week ends.

The price of tickets for the Exhibition will be 1s. 3d. (including tax). A Trade Day will be held on Monday, October 2nd. Tuesday, October 3rd, will be a Special Day for the public, when 5s. will be charged. On both these special days there will be admission at ordinary prices after 6 p.m.

The Managers of the Exhibition are arranging to supply to the Wireless Society of London a number of complimentary tickets for distribution amongst their members and affiliated Societies.

An orchestra is to be provided, and arrangements will be made with a good firm of caterers for refreshments to be available for the public.

# Time Signals

## THE TRANSMISSIONS FROM EIFFEL TOWER

By W. G. W. MITCHELL, B.Sc., F.R.A.S., F.R.Met.S.

THE most important routine work of an astronomical observatory is the determination of exact time. This is done every evening when weather and sky conditions permit, but it frequently occurs, and especially in winter, that it is not possible to make astronomical observations of the transits of stars every night. It is therefore necessary to be satisfied with the times registered by the chronometers kept at the observatory. When the "rates" of the separate chronometers are known and the chronometers themselves are sufficiently numerous and accurate, such a procedure causes no inconvenience so long as the cessation of transit observations does not exceed a few days at the most. If, on the other hand, the period of cloudy weather continues too long, it is no longer possible to answer for the accuracy of the chronometers. Wireless telegraphy in such cases furnishes a method which allows of the co-operation of other observatories more fortunately situated as regards climatic conditions in the determination of the state of the master control clock.

The time signals sent out by Eiffel Tower are controlled by apparatus situated at the Paris Observatory and under the direct supervision of the staff of that institution. For this purpose the Observatory is connected up by underground wires with the transmitting apparatus at **FL** (Figs. 1 and 2). The pendula which control the emission of the 300 rythmic beats or scientific signals are kept at the Eiffel Tower station and these are shown on the left of the terminus panel in Fig. 1.

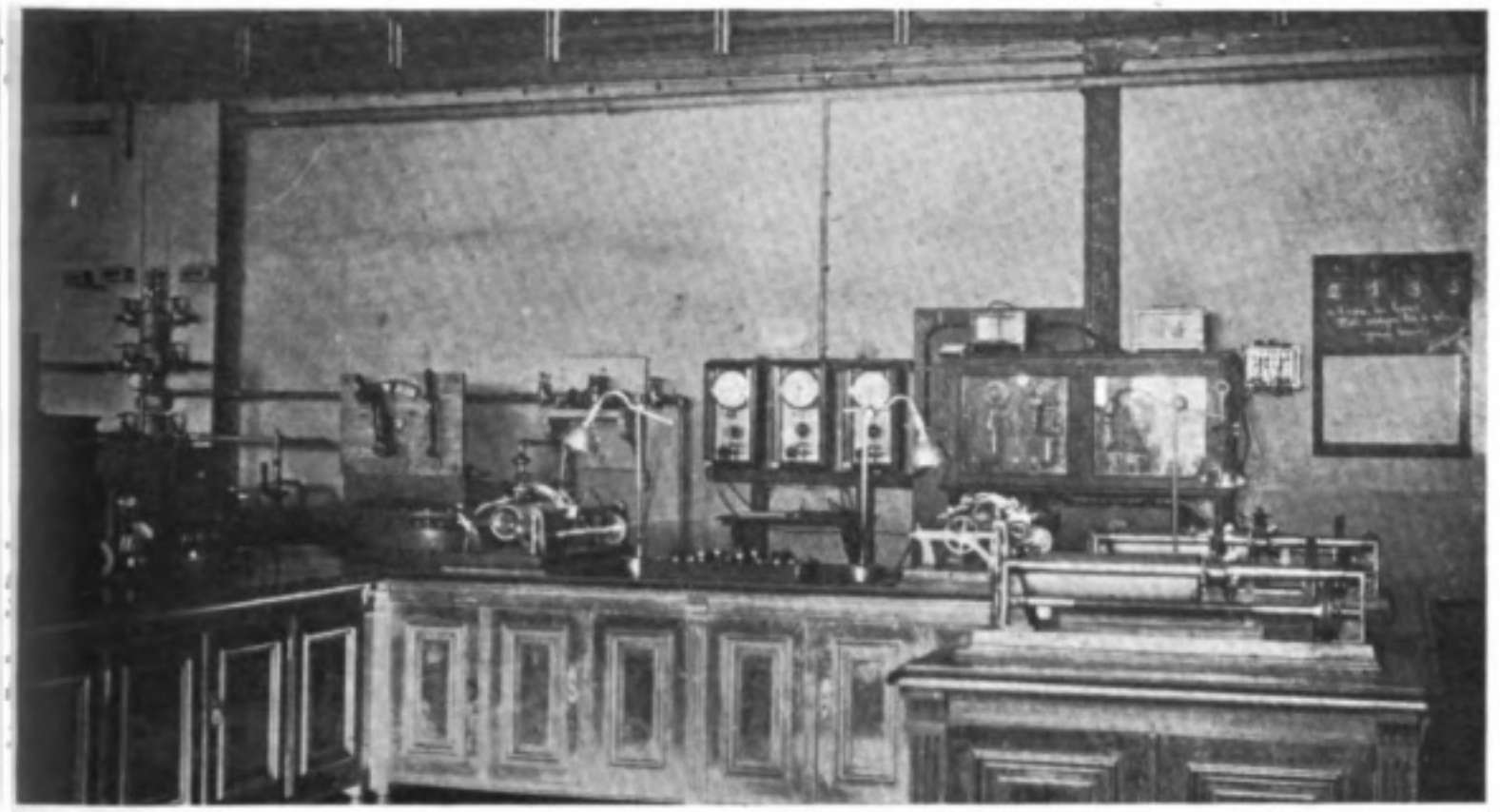


*Fig. 1. Interior of Eiffel Tower. The glass case against the wall is the terminus of the underground lines connecting the Paris Observatory with the transmission apparatus at* **FL**. *The pendula employed for transmitting the rythmic signals are shown on the left of the case.*

### ORDINARY TIME SIGNALS (FRENCH SYSTEM).

The ordinary time signals shown in Fig. 3, transmitted twice daily, at 1044 and 2244, are semi-automatic. The dots at 45, 47 and 49 minutes past the hour are the only signals sent automatically, all the other signals being sent by hand by an operator at the Observatory. A few minutes before the transmission takes place, connection

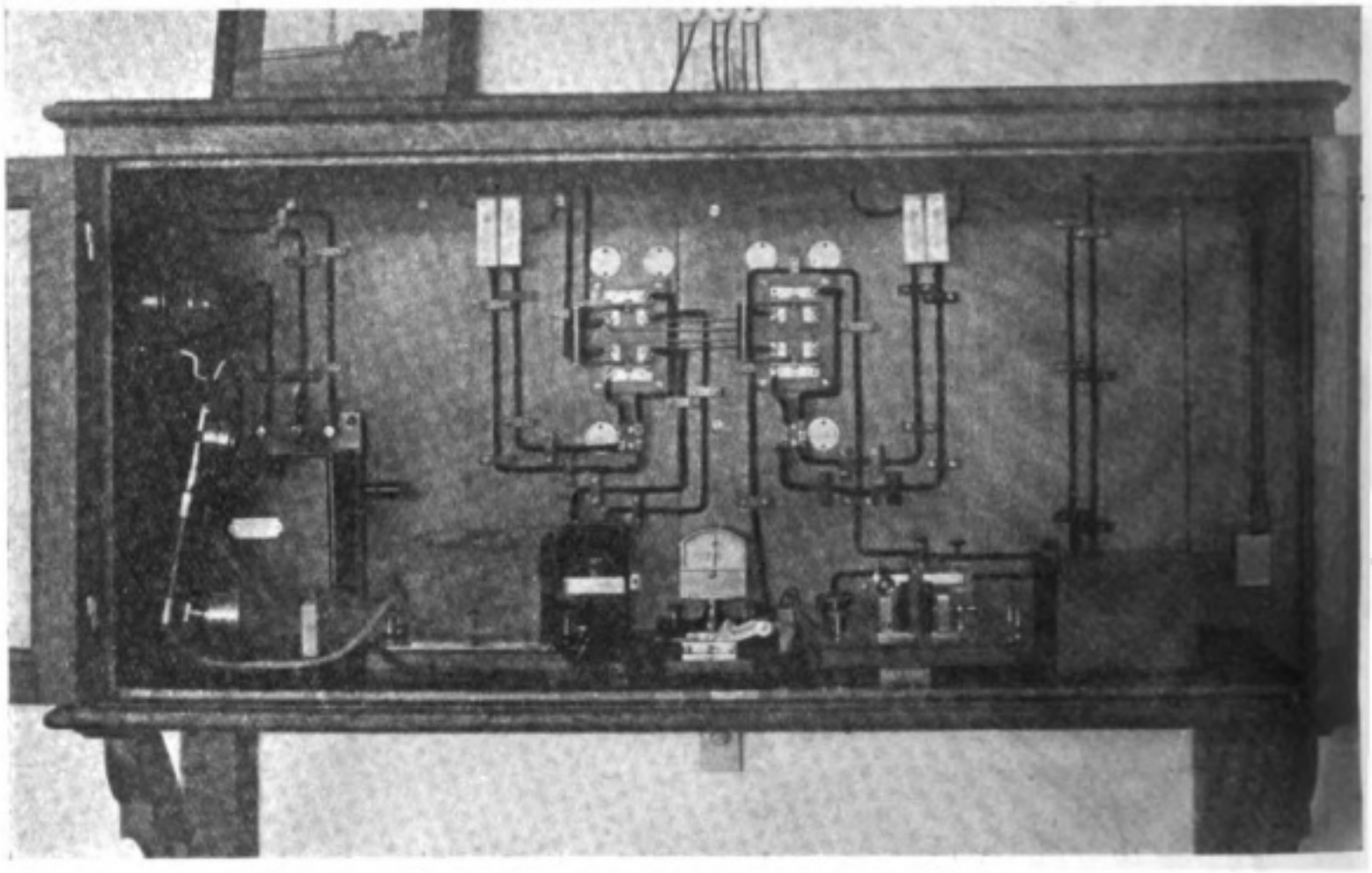


*Fig. 2. Details of terminus shown in Fig. 1.*

is established with the transmitting apparatus at **FL** through the underground lines referred to above. The automatic signals at 45, 47 and 49 minutes past the hour are given by a clock placed in the time-keeping room at the Paris Observatory. This clock operates the three cams *A*, *B* and *C* (Fig. 4). *A* makes one complete turn in 24 hours and has two notches, one corresponding to 10h. 44m. 30s., and the other to 22h. 44m. 30s.. The function of this cam is to permit of the closing of the contacts at the correct hour. The length of the notches corresponds to a duration of five minutes. *B* makes one complete turn in one hour and has three notches, corresponding respectively to 44m. 30s., 46m. 30s. and

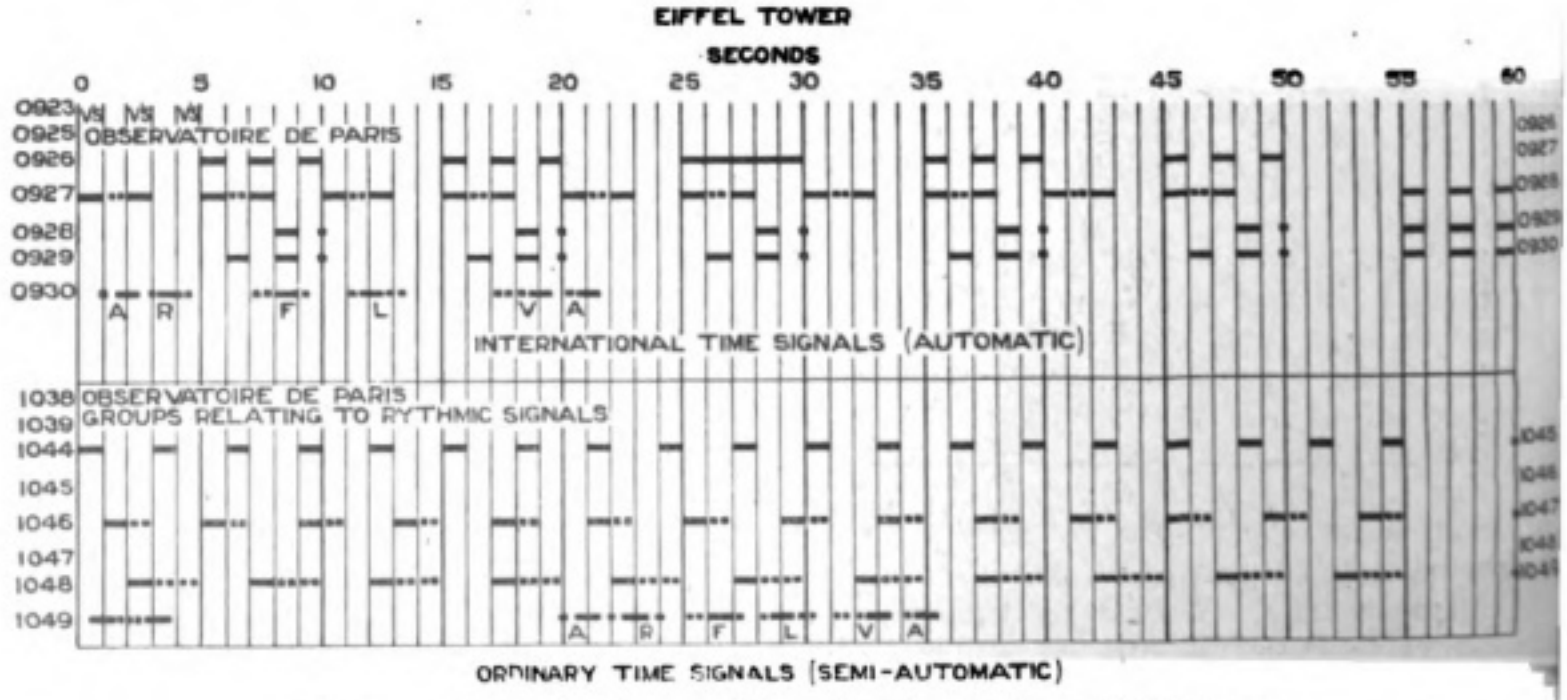



*Fig. 3. Method of transmitting time signals from Eiffel Tower.*

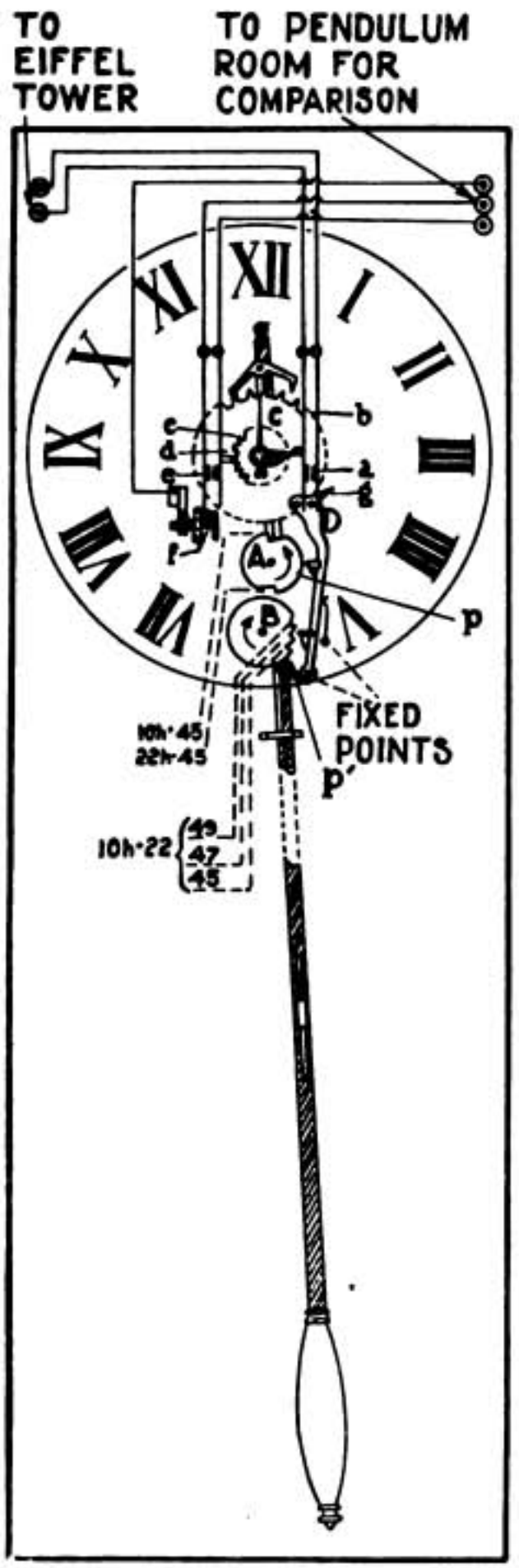



*Fig.* 4.

*Pendulum used for transmitting automatically the T.S. at* 1045–47–49 *and* 2245–47–49 *from the Paris Observatory.*
*a* = *sendin gcontact.* *b* = *seconds pointer.*
*c* = *toothed seconds wheel.*
*d* = *zero second.* *e* = *contact for synchronising time signal and pendulum.*
*f* = *listening-in contact.* *g* = *insulated studs*

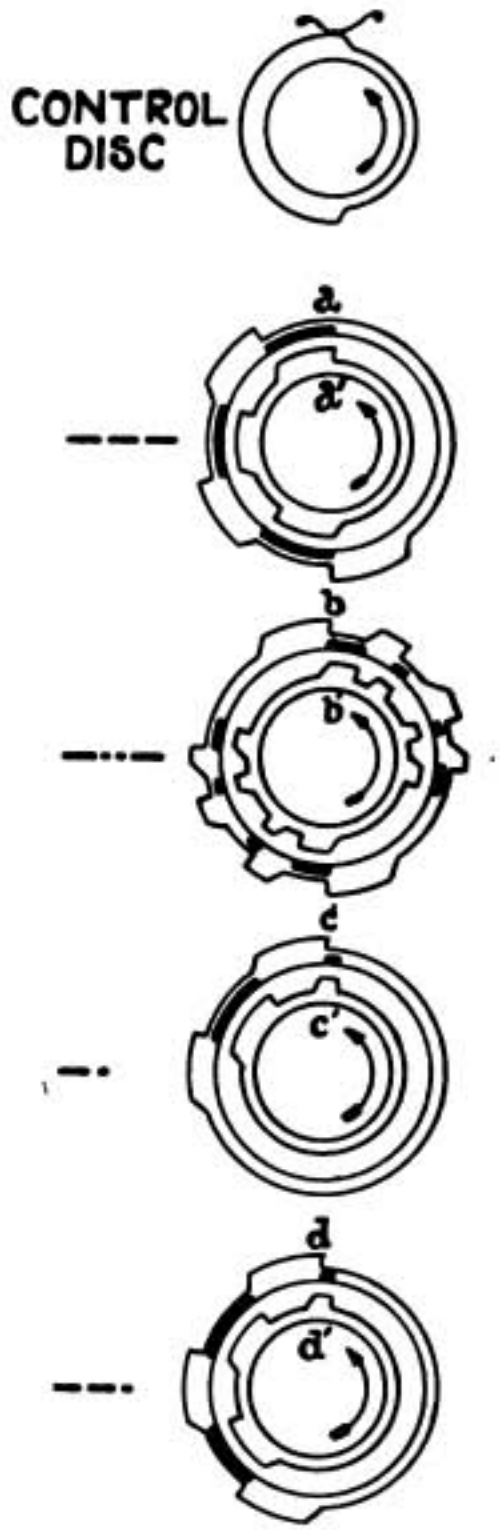



*Fig.* 5.

*Details of the Discs Mounted on O² O² (Fig.7). The discs have equal diameters; the outer circles represent the underneath discs, which function the closing of the circuits; the inner circles represent the upper discs which function the breaking of the circuits.*

48m. 30s. Similarly, this cam permits of the closing of the contacts at the correct minutes. Finally, *C* makes one complete turn every minute and controls the time signal.

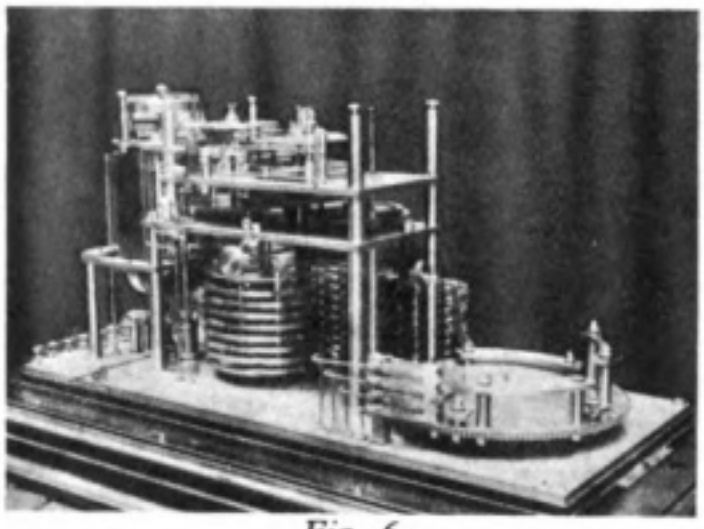


*Fig. 6.*

*The Brillié-Leroy apparatus which automatically transmits the International time signal from* **FL** *daily.*

When the gears $p$ and $p^1$, carrying with them the lever $D$, run into the notches of the cams $A$ and $B$, the lever $D$ is displaced towards the left and this sets free the springs of the transmission contact. This contact can then be closed by the cam $C$ at the zero second, *i.e.*, 45, 47 or 49 minutes exactly. But actually, in practice, $C$ does not function on the exact minute. The position of the cam $C$ with regard to the toothed seconds wheel is such that the transmission contact $a$ is closed 0·20 seconds before the "listening-in" contact $f$. This is to compensate for the self-induction and consequent lag in the instruments between the observatory and the aerial at **FL**.

AUTOMATIC DAILY TIME SIGNALS AT 0923.

The apparatus employed in automatically transmitting the International Signals is much more elaborate than that described above. Fig. 6 is a photograph of the Brillié-Leroy apparatus now employed for this purpose. Reference should now be made to the circuit-diagram in Fig. 7, in conjunction with the brief description which follows.

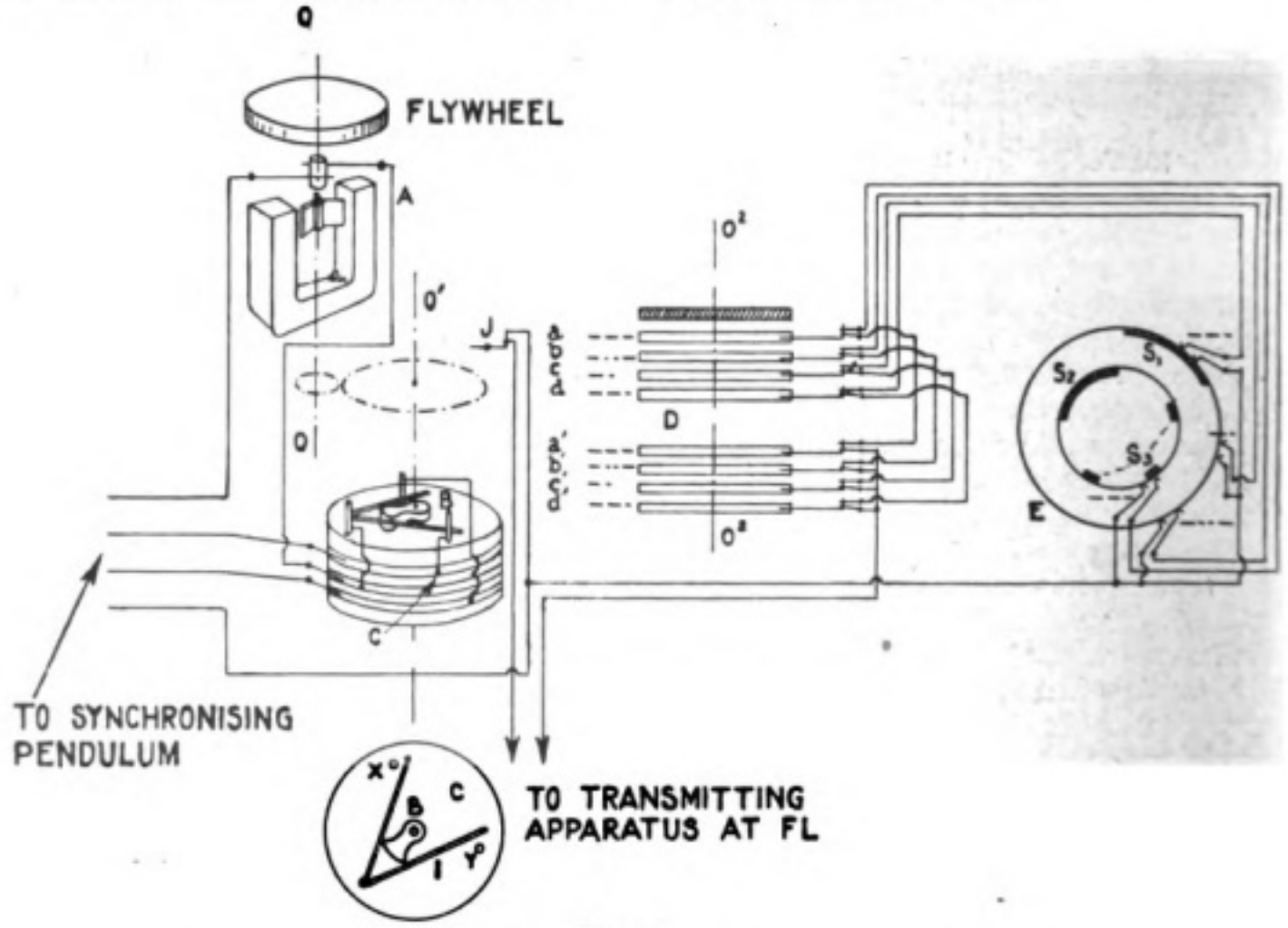



*Fig. 7.*

*Circuit diagram of the Billié-Leroy Automatic Time Signal Apparatus.*
*(A) Motor which drives the whole of the apparatus. (B) Cam secured to o'. (C) Insulated support carrying three rings. (D) Drum with cams setting in action the contact levers a, b, c, d, a', b', c', d'. $O^2$ $O^3$ axis of transmitting disc (one turn in ten seconds). (E) Wheel commutator closing the circuits. (I) Fork operated by the cam B, alternately closing circuits X and Y every half second. (J) Interrupter automatically closing the circuit at 9h. 26m.*

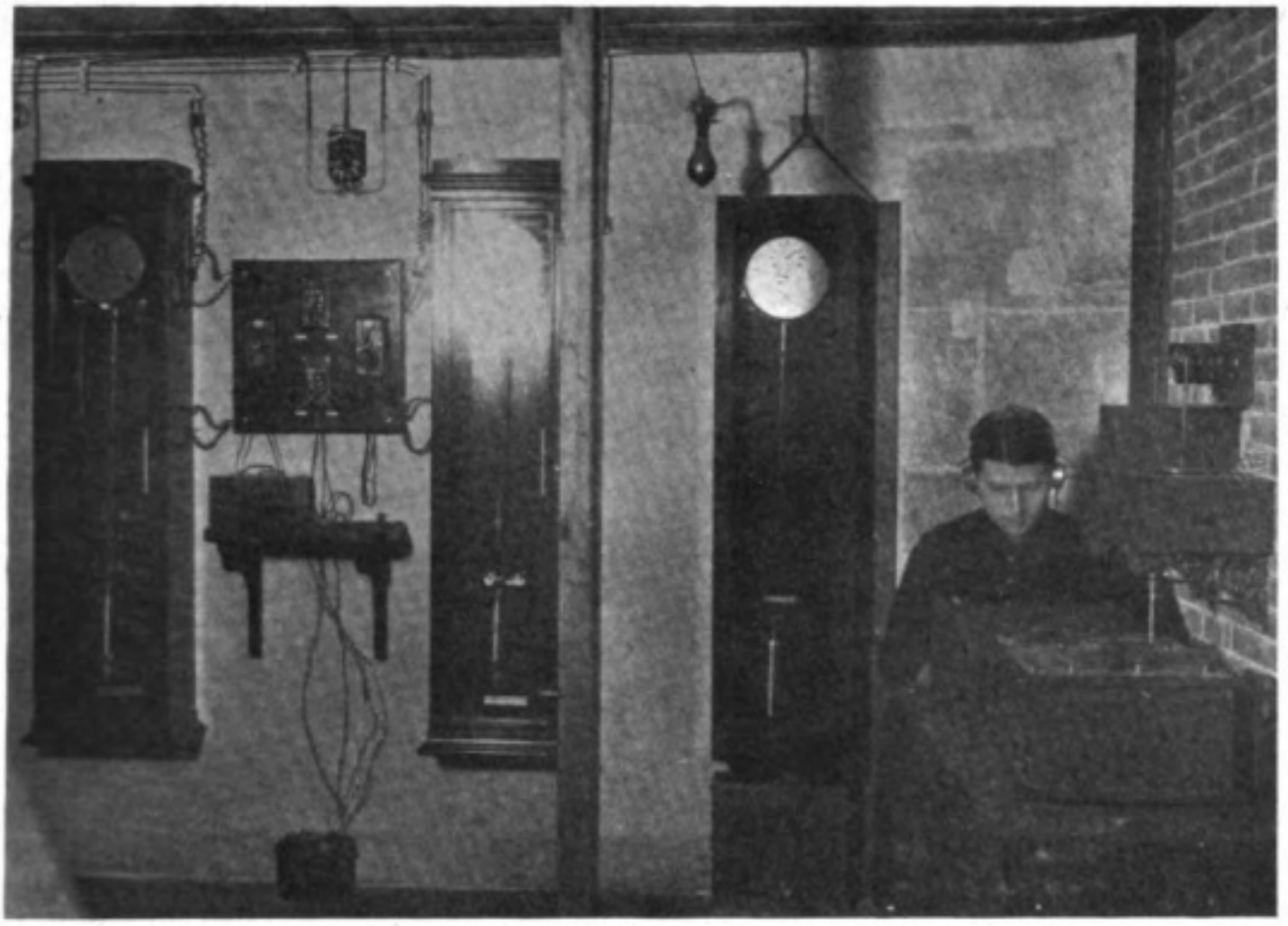


*Fig 8. After adjusting the pendula the lag due to the automatic transmission apparatus interposed between the pendulum and the aerial is measured before the time signal is sent out.*

*Fig. 9. Paris Observatory Pendulum Room.*

*Central telephone desk used for the comparison of all the pendula at the observatory by the method of coincidences by ear and also by aural comparison of the pendulum controlling the scientific time signal sent out by Paris, Lyons and Bordeaux.*

The pendulum of the master clock at the Observatory functions a small electrically-controlled pendulum. which in its turn synchronises the motor *A* of the signal transmission apparatus. The motor receives every second the emissions of current from the pendulum through the intermediary of a commutator. *O'* is the axis of the synchronising commutator, which completes one turn per second. The armature of the motor has three branches and turns between the two poles of an electro-magnet. It receives its current from a battery of four accumulators. The wheel commutator *E* is also functioned by the motor and makes one complete turn in five minutes. This wheel carries a sector $S_1$, whose length corresponds to 55 seconds approximately. This sector closes successively the three circuits —• • —, —•, ——•, each of 55 seconds duration, and forming the signals of the last three minutes. The sector $S_2$, whose length again corresponds to 55 seconds of time, closes the circuit — — —, forming the first minute of the signals. In the same way the sectors $S_3$, of length corresponding to five seconds of time, close the circuit — — —, which are the signals at the end of the last three minutes of the time signal.

Figures 8 and 9 illustrate other apparatus at the Paris Observatory.

The eight discs *a*, *b*, *c*, *d*, *a'*, *b'*, *c'*, *a'*, turn once every ten seconds and send out the signals shown against them. They are furnished with notches; one set establishes, the other cuts off the current which actions the relays of the sending apparatus. They are shown in detail in Fig. 7.

It is regretted that in the article on Time Signals which appeared in the issue of July 15th, an error has been made in the last paragraph. Instead of "Similarly, by altering the position of $A_2$, the two series (local pendulum and T.S.) may be superimposed," should be read "The operator then finds by trial a position for $A_2$ which enables him to hear a time signal between two beats, or inversely, a beat between two time signals."

[*We wish to acknowledge indebtedness to General Ferrié for the very kind assistance which he has given to the author in supplying information used in the preparation of the present article.*—ED.]

# The Capacity Unit.

By R. C. CLINKER, M.I.E.E.

IS it not high time that we dispensed with the decimal point, together with its row of noughts which are almost invariably used when designating the capacity of a radio-frequency condenser? If we want to tell a friend how much we put into a collection box we don't say "no pounds, no shillings and no-pence halfpenny." Why, then, should we write the capacity of a grid condenser as 0·0003, when "300 m.m.f." is so much more quickly grasped, once one is used to the smaller unit?

It is rather unfortunate that the practical unit of capacity is so large. I remember that, when first learning my units, I asked how large a thing a farad was, and I got for answer: "about the size of a haystack." Further enquiry as to the reason for this enormous bulk elicited the information that it is "co-mensurate with the greatness of the genius whose name it bears." However this might be, the farad had very soon to be divided into a million parts to make it convenient for laboratory use, and now it is surely time that all wireless men agreed to again divide by a million, and to use the micromicrofarad (MMF or $\mu\mu$F) as a more convenient unit.

Personally, for quick calculation, I prefer the centimetre unit, although it is related in size to the MMF by an awkward ratio, viz., 1:0·9. The reason I find it convenient is as follows:—If we measure capacity (*C*) in cm., and inductance (*L*) in millihenries, it is easy to find the wavelength by remembering that a product (*LC*) of 1,000 gives almost exactly 2,000 metres (1,985, to be exact). If, then, we have a certain product, the corresponding wavelength is quickly found on a slide-rule by setting the 1 on the top slider-scale opposite the product, and reading off the wavelength on the bottom fixed scale at the point where the 2 on the bottom slider-scale is found. If one prefers the microhenry as an inductance unit, one can use the "jar" (1,000 cm.) as the capacity unit, and get the same convenient product. No doubt this procedure makes use of a mixture of units, but it is a handy mixture. In any case, it is surely advantageous to eliminate those serried rows of 0's which worry the mind and eyesight, to say nothing of the exasperation to the compositor. What a stock of decimal points and zeros *The Wireless World and Radio Review* printing office must hold!

# Experimental Transmissions between Aberdeen and London

## AN ACCOUNT OF TESTS CONDUCTED BY 2 UV AND 2 JZ.

By W. E. F. CORSHAM.

GREAT interest has recently been aroused in the tests carried out by Mr. Spence of Aberdeen and myself at Willesden, London, and it has been suggested that an account of some of the most important transmissions should be "written up," together with a detailed description of the apparatus used at the respective stations. Unfortunately, however, Mr. Spence, or as he is better known to the amateur, **2 JZ**, is working on a special circuit and is not quite ready to give a complete description of his apparatus yet, but that will doubtless be forthcoming at a later date. He experiments with practically every system of telephony transmission, and we have had wonderful results at times. One night four different circuits were tried in succession, and each proved successful in bridging the distance. Details of his receiving circuit will be found in *The Wireless World* of February 4th, 1922. At the present, therefore, I am devoting this article to the chief features of the Aberdeen Tests and a description of **2 UV**. Since the result of the transatlantic tests, experiments between London and Aberdeen have been practically continuous night after night, my own part in these experiments taking place on Saturday and Sunday nights after 9 p.m., when I have had excellent results, speech and music from **2 JZ** being clearly read on my three-valve set through heavy jamming from ships and static. Time after time I have been able to report "your speech and music O.K., old man," when other stations have reported "carrier wave O.K., but no speech," and each report to **2 JZ** carried conviction in the shape of either the words used or the name of the gramophone record transmitted. But soon local amateurs began to get wind of what was happening and the chorus of howls from oscillating receivers began to swell the **QRM** very considerably, making reception terribly hard, the faint voice being heterodyned by numerous howls of various intensities, but reception was still possible, and it was only when spark jamming became really bad that I failed in getting the whole of **2 JZ**'s speech. On one occasion the s.s. *Brighton* commenced work with Dieppe at the exact hour the test was arranged for. We had made it 11 p.m. that night so as to clear most amateur jamming, and **MOV** kept up a series of messages until well after the time the test finished, and the arrival of a healthy harmonic from **GBL** completed the only actual failure I have had. By far the most successful transmissions took place on the 9th and 10th of April, 1922. At 10 p.m. on the 9th, **2 JZ** called **2 UV** and said, "Will send to you for five minutes on 180 metres at 9 p.m. to-morrow; please stand by for me," and then followed music, which I received very well, and he then gave me "K." At 10.30 I commenced calling **2 JZ** on the tonic train transmitter, acknowledging receipt of his message and music, and gave him "K." **2 JZ** replied at once, informing me that he was receiving me, and stated "Sigs quite readable at first, but very faint later, not harsh but characteristic." During the tonic train transmission the break on the spark coil failed and I repeated the wait signal continually, all of which was faithfully reported by **2 JZ** in his letter to me, and it was a most remarkable transmission, as **2 UV** was only radiating 0·09 at the time. It seems to be a most strange thing, but the note of the spark coil seems to have a very great effect upon the distance the tonic train will cover. I have had various adjustments from a low harsh note to a high-pitched whistle, and although in every case the ammeter readings were the same, yet there is one tone which seems twice as strong and seems to eat up distance. This is apparently what happened in the above case. When I altered the make and break I altered the tone as well, and signal strength fell off, hence **2 JZ**'s report that signals were O.K. at first, but got fainter after my alterations. On the evening of the 10th, **2 JZ** called me on 180 metres, radiating 0·45 from a single wire aerial 40 ft. long and 30 ft. high, directed due east and close up against a house at the south. This transmission was badly jammed by a **GFA** harmonic, but again **2 UV** reported "your signals O.K. on 180 metres," another excellent night's work, the 500 miles between **2 JZ** and **2 UV** being covered on extraordinarily low power. Good speech has been received from **2 JZ** when his input has been less than 50 watts. These are the most important tests carried out by **2 JZ** and myself, a very noticeable point being that during the best reception of **2 JZ** here I have noticed that the local weather has been cloudy and in some cases wet. It will be remembered that in the Transatlantic test the best nights of reception were when the weather over the Atlantic was very rough, so that apparently bad weather helps wireless transmissions very considerably. A very curious point was noticed during a transmission from **2 LG** of Birmingham to me a few weeks back. **2 LG**'s note was reported at Birmingham as being a very clear and intense C.W., but was received here in Willesden a scratchy hiss, sounding, in fact, like an arc harmonic with plenty of "hash," a very interesting note. The receiving side of **2 UV** consists of a three-valve low frequency detector amplifier; its connections will be found in the complete station wiring diagram, and will be seen to differ slightly from the usual. Its finest test was its reception of the American amateurs during the Transatlantic test, and it has proved a very efficient all-round receiver for distance work. Distortion in speech is not noticeable to the human ear on the fainter signals, and can be cleared on the louder signals by taking the circuit a little further off oscillation. Actually, the distortion noticed is ridiculously slight and not worth troubling about on a station that has to be prepared to pick up 'phone and Morse work at short notice. In my opinion the distortion complaints that the poor low frequency circuit has to put up with have been considerably overdone. I have used a low frequency circuit for nearly four years now, and in practice I find that distortion is very very

slight. The Dutch Concert has always been readable to me by its means, even on her very low power, and it would pay some experimenters to do a little more experimenting in low frequency work. 600 metre work is very good, the Italian shore stations being readable when they can be picked out of the QRM, and no difficulty is experienced in reading the American high power stations at any period of the 48 hours. The transmitter is slightly different to the usual, and is divided into two parts—tonic train and continuous wave. In the accompanying Fig. 1 it can be seen on the extreme left, and as can be seen from the diagram (Fig. 2), is very easily changed to either side. The feed for tonic train consists of a small ¼-inch spark coil, fed from a 4-volt battery, and the C.W. side consists of a high-tension battery of 150 volts made up from 4-volt flash lamp batteries. A

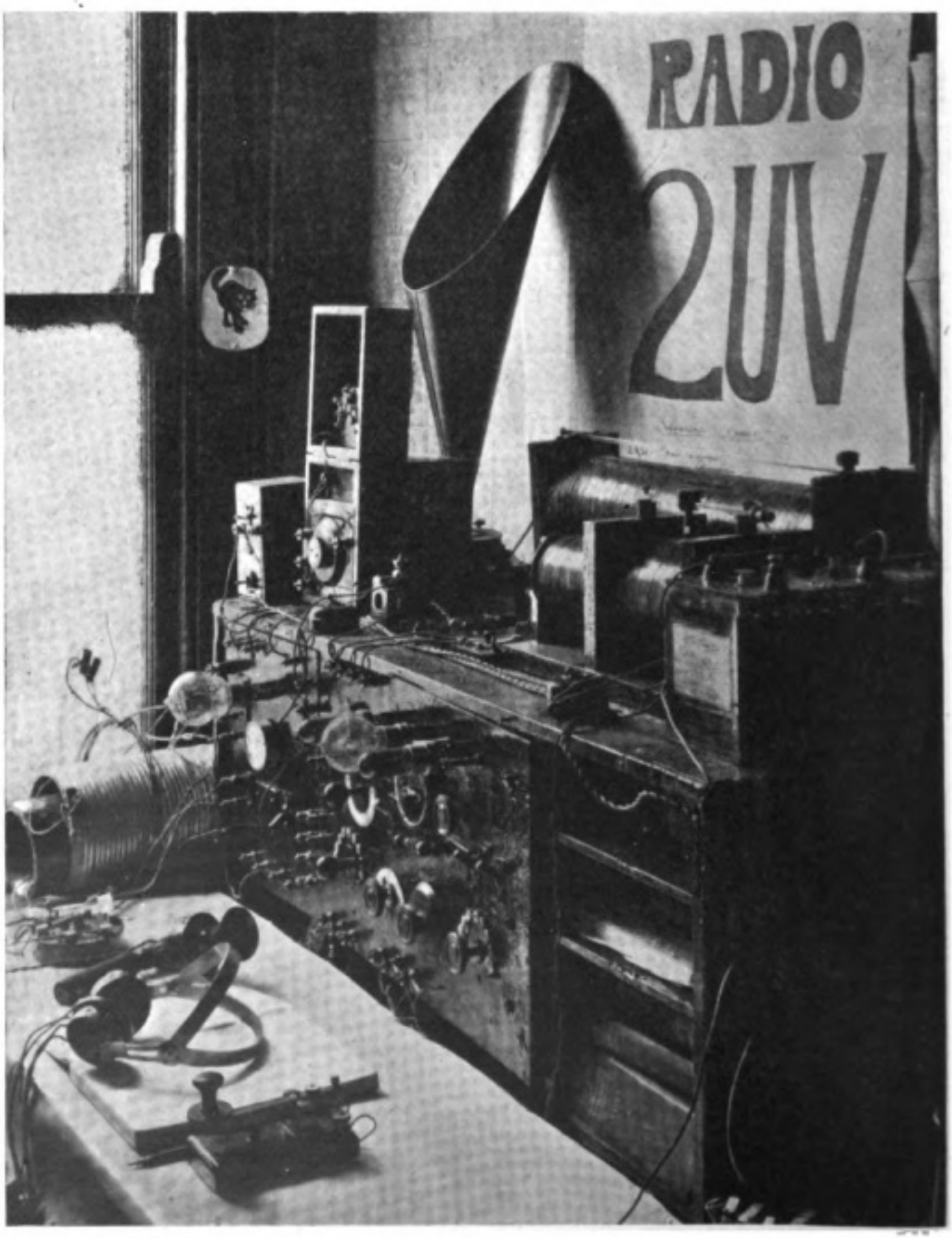



*Fig. 1. The Station of Mr. Corsham, showing the apparatus used in conducting the experiments described in this article.*

generator is on the station, but cannot be used until the Council lay the mains near to the house. Telephony is obtained by means of a coil coupled to the aerial circuit, a heavily damped microphone being essential for speech and a fairly sensitive one for music. The music is transmitted by means

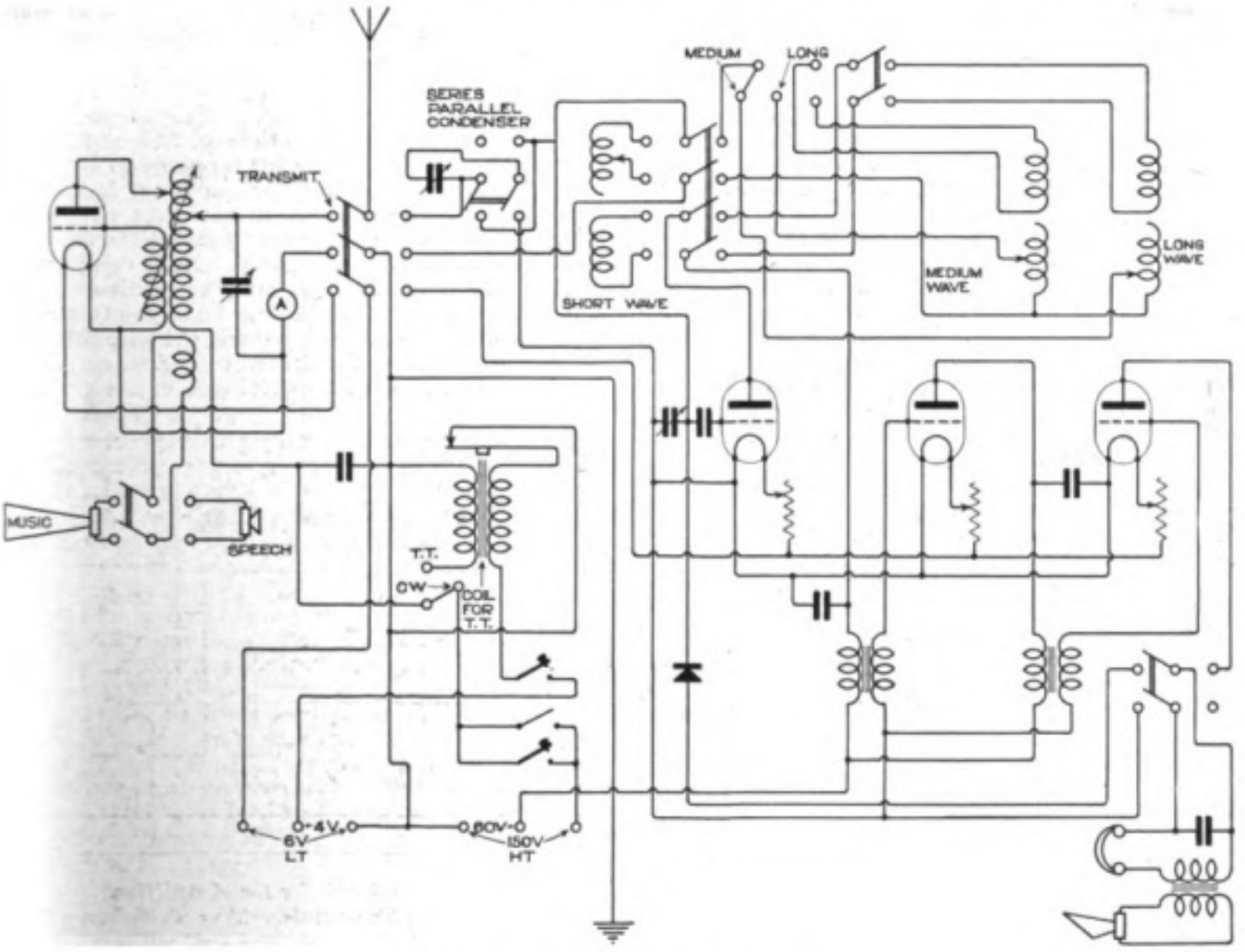



*Fig. 2. Circuit diagram of* **2 UV.**

of a large horn fixed over the opening of the gramophone, and when properly adjusted is quite satisfactory. Some very satisfactory low power tests have recently been carried out from this station, speech and music being successfully received by **2 OD**, Gerrard's Cross, receiving on four valves, the input to the power valve being only 14 volts, and **2 SX** of Putney and **2 VW** of Chalk Farm have both received C.W. signals from me when I was only using 8 volts on the plate of the transmission valve, **2 SX** using two valves for reception, and **2 VW** only one. In all cases signals were quite readable. The power valve is an AT.40, and the present valves for receiving are Mullard "Ora"; previous to this, French "R" type valves were in use. I hope in further tests to increase my tonic train transmitting range very considerably, and always welcome reports from amateurs receiving my signals. The whole of **2 UV** is home constructed, and most of the parts are home made.

**Will those who have not yet forwarded particulars of their Transmitting Stations kindly do so.**

# An Amplifier for the Broadcasting

By G. P. KENDALL, B.Sc.

THE instrument herein described is intended to meet the needs of those who wish to construct from standard components a simple but effective amplifier for picking up the programmes of the broadcasting stations. On a fair aerial it may be expected to give signals strong enough for a loud-speaker from several of the stations, except, of course, in very out-of-the-way localities.

Three valves are employed, one as H.F. amplifier, one as rectifier, and one to magnify at audio frequency. The circuit is shown in Fig. 1. As will be seen, a two-stud switch is included to enable either of two H.F. intervalve couplings to be used, the first being a semi-aperiodic reactance-capacity type, and the second the well-known "tuned anode" coupling, which is probably the most efficient known. It is intended that the untuned coupling shall be used when searching for a station, and when the signals have been picked up and the aerial circuit tuned to them the switch is to be placed on No. 2 stud and the plate circuit tuned to the wavelength of the aerial. (This generally involves a slight readjustment of aerial tuning, and also of reaction coupling.) The signals will then be heard more loudly and with less interference from other stations.

CONSTRUCTION.

The first requirement is an ebonite panel 12 × 14 × ¼ ins., which is best obtained cut to size and rubbed down matt. All the parts are to be mounted on this panel, which may desirably form the lid of a shallow box.

Fig. 2 indicates the general arrangement of the parts, but does not give exact dimensions, since these must depend to some extent upon the make of the various components. A list of components and materials required follows :—

Three valve sockets; three filament resistances; one grid leak of 2 megohms; one grid condenser of 0·0003 mfd.; one blocking condenser of 0·003 mfd. ($C_2$ in Fig. 1); ditto of 0·001 mfd. ($C_3$ in Fig. 1); one reservoir condenser ($C_4$) preferably a 0·3 mfd. Mansbridge. Any large fixed condenser will serve, provided the capacity is not less than 0·005 mfd.; one L.F. intervalve transformer; one 0·0002 mfd. variable condenser for panel mounting ($C_1$); ivorine scale for the above; two switch arms; one dozen switch studs; piece of ¼ in. ebonite 3 ins. square; 5 ins. of 3 in. diameter ebonite tube; ½ oz. of No. 40 d.s.c. resistance wire; 4 ozs. of No. 22 d.c.c. copper wire; 10 terminals.

The semi-aperiodic reactance coil is to be wound on a bobbin made by turning from the piece of ¼ in. ebonite a disc 2½ ins. in diameter, and then cutting a groove 1/16 in. wide and ¼ in. deep in its edge. (If you have no lathe any machinist will do it for you.) In the groove wind 70 turns of the resistance wire, bringing the ends either to two small terminals mounted on the ebonite disc, or else soldering them to two thicker wires which can be secured by passing them through holes in the bobbin as shown in Fig. 3. The completed coil is to be screwed to the under side of the panel in the position indicated in Fig. 2.

The plate circuit tuning coil ($L_2$ in Fig. 1) consists of 4 ins. of single layer winding on the 5 in. by 3 in. ebonite tube. Use the No. 22 wire for this coil, and make nine points for tappings to the ten-stud switch. Directions for winding follow:— First drill two ⅛ in. holes in the tube at points ¼ in. from each end; these are to enable the finished coil to be fastened to the panel. Next drill a pair of 1/16 in. holes at each end, at a distance of ¼ in. from the ends; these four holes are to secure the ends of the winding by passing the wire through them in the manner illustrated in Fig. 4, and they are best placed at the opposite side of the tube to

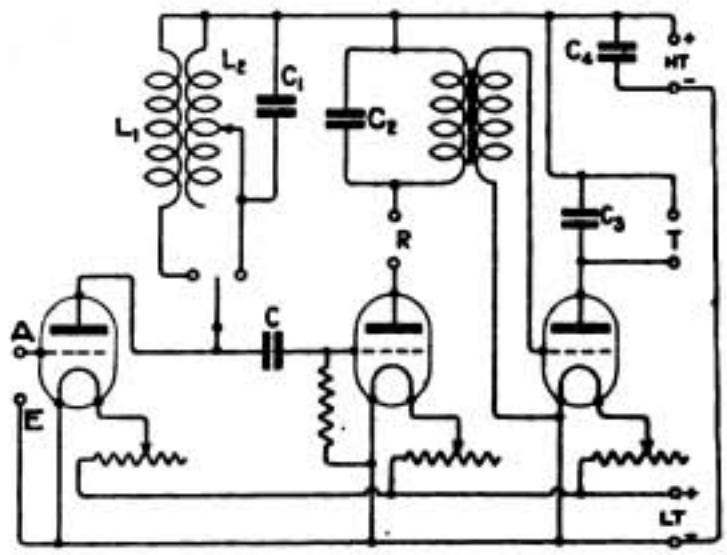



*Fig. 1. Circuit for the Amplifier.*
*R = Reaction Terminals. T = Telephones.*

the securing holes, in order that the ends of the wire may be in a convenient position when the coil is fastened in place. Having secured the end, proceed to wind on the wire in a single close layer winding by revolving the tube, and *not* by passing the wire round and round it. When about an inch of the former has been filled make a loop for the first tapping, then continue winding and making loops at intervals of ¼ in. until the ten sections have been wound on, the end of the last section being secured by passing the wire through the two 1/16 in. holes. The tapping points are made by twisting up a loop in the wire of about ¼ in. diameter at the required places; do not put in more twist than is necessary to maintain the loop, which will probably be one turn or thereabouts. It is, perhaps, a rather over-careful attention to details which prompts this warning, since the increase in the self-capacity of the coil which would be produced by a number of tightly twisted loops is probably very minute. However, the writer holds strongly that it is by attending to such little things throughout a receiver that the additional 5 per cent. of efficiency is obtained which makes your set better

than the other fellow's. This example shows the principle carried rather to excess, but serves to emphasise a point upon which most old hands agree. A better but more troublesome method of making loops which will appeal to those who think, like the writer, that no trouble is too great in the cause of efficiency, is shown in Fig. 5. As will be seen, the loop is secured by a small ebonite or fibre washer, which is quite a satisfactory method for the thicker

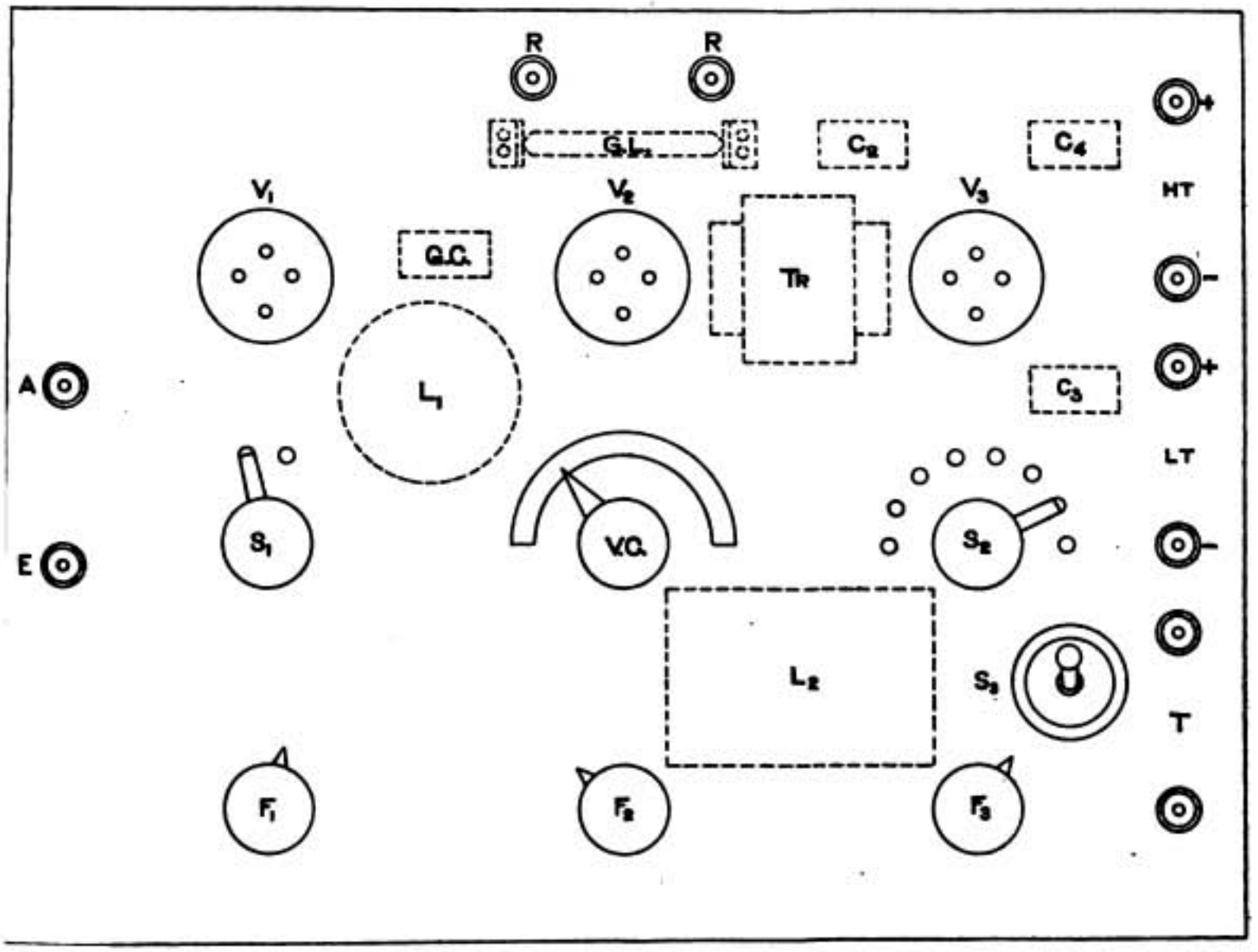



*Fig. 2. The lay out of the panel (not to scale).*

$V_1$, $V_2$, $V_3$ = Valve Sockets. $F_1$, $F_2$, $F_3$ = Filament Resistances. VC = Variable Condenser. $S_1$ = Two-way Switch. $S_2$ = Ten-way Switch. $S_3$ = Small Tumbler Switch for Filament Current Dotted lines indicate the position of components on the underside of the panel. G.L. = Grid Leak between Clips. G.C. = Grid Condenser. Tr. = L.F. Transformer. The other lettering corresponds to that of Fig. 1.

gauges of wire. If difficulty is experienced in obtaining the washers they may be easily cut from 1/32 or 1/16 in. sheet by means of a tool made by filing up a sharp edge to the end of a piece of ¼ in. brass tube. If this tool is heated it will be found quite easy to press it through the ebonite. Drill the centre hole of the washer first, of course.)

When the winding is completed the coil must be lamp-proofed, and this can be done with either paraffin wax or shellac varnish, according to preference. If wax is used it should be melted in some form of double boiler, such as a jam jar standing in a saucepan of boiling water. Dry the coil thoroughly in front of a fire, or (preferably) in an ounce of brown shellac in about half a cupful of methylated spirit. The lac takes some time to dissolve, so it should be put in a wide-necked bottle with the spirit and left for two or three days, with occasional shaking. Apply a thin coat to the coil, using sufficient varnish to thoroughly impregnate the cotton covering of the wire, but no more. It saves trouble later if one avoids varnishing the tapping loops, since these will later have to be scraped bare and soldered upon.

After varnishing, the coil must be thoroughly dried by baking in a moderately hot oven. (If it is a gas oven turn off the gas jets before you put in the coil, or you may have an explosion from the

alcohol vapour.) After cooling, the coil is to be fastened to the under side of the panel in the position indicated in Fig. 2, by means of two ¼ in. by 1 in. brass screws and nuts, passing through the two ¼ in. holes in the tube. It is better not to screw the coil up tightly against the panel but to arrange for it to be held about half-an-inch below it. This is easily done by the use of an ebonite bushing on each screw, which can be made by cutting a ½ in. length of ¼ in. diameter ebonite tube for each.

Fig. 6 shows one end of the tube in section and should make the use of the bushing quite clear. The commencing end of the winding (*i.e.*, that with the 1 in. section) is to be connected to the H.T. positive terminal, while the tapping points and the other end of the coil are to be connected up in order to the studs of the ten point switch. The moving arm of this switch is then to be connected to No. 2 stud of the two-way switch.

*Fig. 3.*

The completion of the amplifier is now only a matter of drilling the necessary holes in the panel and attaching the ready-made components in the positions indicated, and then connecting them up. This part of the work should not require any more detailed guidance than that given by the following hints on the wiring: use No. 16 or 18 wire, preferably bare tinned copper, and try to keep all connections as straight and direct as possible. At


*Fig. 4. Method of passing wires through the tube.*

the same time avoid running wires parallel with others which are indifferent circuits; sacrifice a certain amount of straightness and directness in order to space out the wiring and avoid parallelism of connections which come at all close to each other. Each wire should be sleeved with a piece of systoflex tubing (sometimes called spaghetti), preferably coloured green for filament circuits, red for plate circuits, and yellow for grid. Take care when ordering this tubing to specify the size of wire it is intended for, since one may lose much time trying to push No. 18 wire into systoflex intended for No. 20.

From the point of view of the reliability of the finished instrument it is well worth while to solder *all* connections, even those which might be screwed down under nuts or terminals on the various components. (If you are ignorant of the art of soldering, the first thing to do is to get rid of the idea that it is difficult, and the second is to get *The Wireless World* for January 21st, 1922, and read the article on it therein.) The extra trouble involved is more than repaid by the freedom from faults which results.

COST.

If all the components except the impedance coil and the tuning coil are purchased ready-made, the cost of the amplifier will be in the neighbourhood of £5 10s. This figure can be considerably reduced by making such components as the various fixed condensers and the filament resistances. An economy of about 15s. can be effected by the construction of the condensers, and this course can be recommended, since they are easily made, and their capacities are not at all critical. Suitable dimensions follow:—*Grid condenser*, two plates only, each of one square inch of copper foil, separated by mica and clamped between two pieces of ebonite, 1½ by 1½ ins. $C_2$—Five plates each side (*i.e.*, ten in all) of copper foil, 1 by 2 ins. clamped between ebonite as before. $C_3$—Three plates each side (six in all) same size as for $C_2$. $C_4$—Not less than ten plates each side (20 in all), 2 by 3 ins. of copper foil. For the other condensers mica of 0·002 in. thickness is specified, but it can hardly be used for $C_4$, because the large quantity required would make the con-

*Fig. 5. Showing formation of loop in stages, using a washer.*

denser unduly expensive. Instead, use waxed paper, which will be quite satisfactory and will only cost a few pence. (It is supplied by all electrical stores.)

MODIFICATIONS.

For the benefit of those who may wish to make the amplifier their main receiving unit for all purposes, it may be desirable to indicate the slight alteration necessary to adapt it to their requirements. First, the plate circuit tuning coil should be made large enough to cover waves up to and including 600 metres. This will require about 6 ins. of winding instead of 4 ins. on the 3 in. diameter ebonite tube, whose length should be increased to 7 ins. Two more studs should be added to the ten-point switch, to cover the increase in the size of the coil. For the longer waves a third stud can be added to the two-point switch and a resistance of 80,000 ohms connected to the H.T. positive terminal and the extra stud; this provides an untuned intervalve coupling for use on 1,000 metres and upwards. If a more selective system is desired the tuned anode coupling can be extended to the longer wavelengths by mounting a standard coil socket on the panel and connecting it between the arm of the twelve stud switch and the stud of the three-way switch to which the arm was previously connected. A set of coils can then be used to give long waves, or the short wave coil can be used

alone by inserting a shorting plug in the socket. The connections of the plate circuit of the H.F. valve will be understood more readily from Fig.7, in which S is the coil socket and R the anode resistance.

OPERATION OF THE AMPLIFIER.

The circuits embodied in the instrument are all of well-known types, and probably do not need any detailed instructions for use. The following hints, however, may be helpful :—First, as to valves. Much depends upon getting a suitable combination, especially in the case of the H.F. amplifier and the rectifier. The latter is the most important valve in the set, so try all the different ones you possess in this position until you are satisfied that you have found the one which gives the best results.

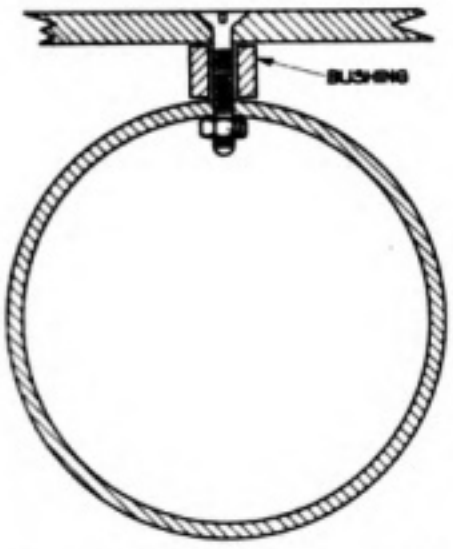



*Fig. 6. One end of the inductance former.*

Make sure that you are using a suitable valve of plate voltage, for if not you may get the condition known as over-lap, which makes satisfactory reception of telephony an impossibility.

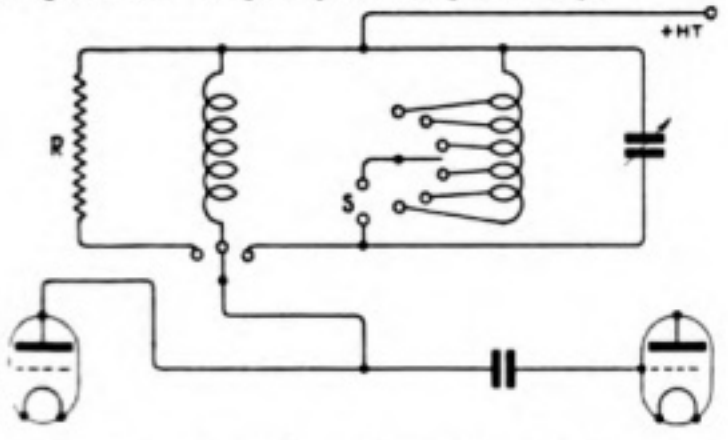



*Fig. 7. Connections of the plate circuit of the H.F. valve.*

The amplifier can, of course, be connected to any type of tuner, but a loose-coupled circuit is strongly recommended, in spite of the difficulty of searching for stations with this type of tuner. Its use will probably be well repaid by the relative immunity it confers from jamming by 450 metre D.F. stations, and should, moreover, be compulsory for the purpose of reducing interference by radiation from sets in the oscillating condition.

# The Wireless Society of London

THE undermentioned Members and Associates of the above Society are requested to communicate their present addresses to the Honorary Secretary, Mr. L. F. Fogarty, A.M.I.E.E., F.R.S.A., Dene Cottage, Manor Way, Ruislip, Middlesex.

It is desirable that this information should be supplied as early as possible, in order to ensure that the next list of members published with the book of rules of the Society should be as complete as possible.

| | |
|---|---|
| Anderson, Major D. B., T.D. | Cove, Dumbartonshire. |
| Beatie, A. S. .. .. | Broadhurst Gardens. |
| Bechtel, G. H. .. .. | Birmingham. |
| Close, C. J. .. .. | Kingsway. |
| Cogger,, H. T. .. .. | Maidstone. |
| Coombes, F. E. .. | Finsbury Park. |
| Dean, A. E. .. .. | Streatham. |
| Ewen, H. A. .. .. | Shenfield, Essex. |
| Fletcher, H. .. .. | Hounslow. |
| Green, G. W. .. .. | Feltham. |
| Henderson, H. W. .. | Portman Square. |
| Housden, H. .. .. | South Norwood. |
| Johnson, W. A. .. | Co. Cork. |
| Lewis, H. .. .. | Clapham. |
| Loten, H. S. .. .. | Hornsea, E. Yorks. |
| Lucy, R. M. H. .. | Anerley. |
| Murch, R. W. .. .. | St. Margarets-on-Thames |
| Nickerson .. .. | S. Norwood. |
| Osbon, F. J. .. .. | Dublin. |
| Page, H.B. .. .. | Stoke Newington. |
| Parker, C. .. .. | Purley. |
| Pearce, S. A. .. .. | Clapham Park. |
| Popham, W. W. .. | West Kensington. |
| Rayner, G. E. .. | Brentford. |
| Smith, G. A. .. .. | Northumberland. |
| Smith. Sidney .. .. | Snodland. |
| Tate, A. B. S. .. .. | Chiswick. |
| Taylor, J. A. .. .. | Grosvenor Gardens. |
| Turnbull, G. .. .. | Camden Town. |
| Walker, H. S. .. .. | Crowborough Camp. |
| Whetmore, S. A. H. .. | Bedford Park, W. |

# Telephone Phonetic Alphabet.

Amateurs are recommended to use the following phonetic means of expressing the letters of the Alphabet, which have been found very convenient for keeping distinct those letters which, used in telephony, are sometimes confused owing to their similarity of sound.

| | | | |
|---|---|---|---|
| A | .. Ac | N | .. Nuts |
| B | .. Beer | O | .. Orange |
| C | .. Charlie | P | .. Pip |
| D | .. Don | Q | .. Queen |
| E | .. Edward | R | .. Robert |
| F | .. Freddie | S | .. Sugar |
| G | .. George | T | .. Too |
| H | .. Harry | U | .. Uncle |
| I | .. Ink | V | .. Vic |
| J | .. Johnnie | W | .. William |
| K | .. King | X | .. X-ray |
| L | .. London | Y | .. Yorker |
| M | .. Monkey | Z | .. Zebra |

# An American Short-wave Regenerative Receiver.*

BY NORMAN A. NYQUIST.

A SUITABLE receiver was required for amateur relay work on 200 to 450 metres, a receiver that gave maximum signal strength and one sufficiently selective to exclude local interference while receiving distant stations.

The following design was adapted from an American Signal Corps interception receiver, and gave excellent results on all wavelengths between 150 and 750 metres. Tuning was very sharp and a pleasing degree of selectivity was obtainable.

Referring to Fig. 1 shows the schematic wiring diagram of the receiver, and it will be noted that the primary circuit consists of the antenna, primary variable condenser, primary variometer, primary coupling coil and ground, all connected in series.

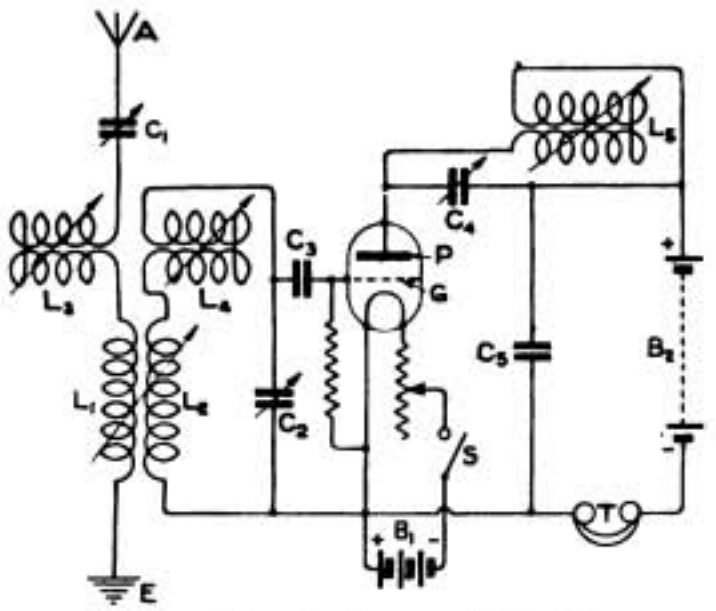



*Fig. 1. Circuit diagram of Receiver.*

The secondary circuit consists of the secondary variometer, secondary coupling coil and secondary variable condenser, all in series. One terminal of the secondary variable condenser is connected to the grid condenser and through the grid condenser to the grid. The other side of the variable condenser runs to the negative side of the filament battery and completes the secondary circuit.

There is a tertiary circuit, making the receiver of the Armstrong regenerative type. This circuit simply consists of a third tuning circuit similar to the secondary circuit, allowing the plate circuit to be tuned, for regeneration or to produce oscillations to receive undamped signals. It will be noted that the tertiary variometer and tertiary variable condenser are connected in parallel. One side of the tertiary variable condenser runs to the plate; the other side runs to the positive side of the high potential battery, and from the negative side of the high potential battery to the telephones.

* *Abstract from Radio News.*

through the telephones back to the negative side of the filament battery. A by-passing fixed condenser is connected across the high tension battery, and telephones to provide a path for the high frequency oscillations which would otherwise be

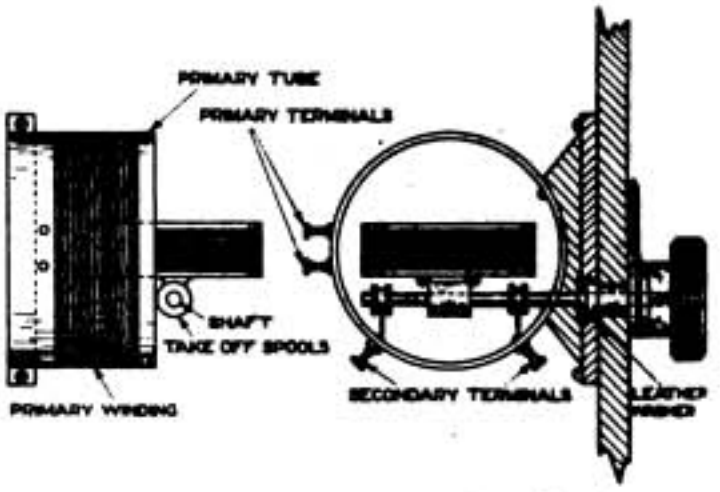



*Fig. 2. The Loose-coupler, showing constructional details.*

impeded by the high resistance of the telephones and battery. This completes the entire circuit with the exception of the positive side of the filament battery, which should be run through a suitable filament current rheostat to the other filament terminal.

Now, in regard to the construction of this receiver and its novel features: the primary-secondary coupler is shown cross-sectionally in Fig. 2 and is shown in the right hand upper corner of Fig. 3. It consists of a fixed tube 3¼″ in diameter fastened to the back of the panel. On this are wound 10 turns of 3-16 No. 38 Litzendraht wire and then varnished. The movable coil is 2¼″ in diameter and is pile wound with

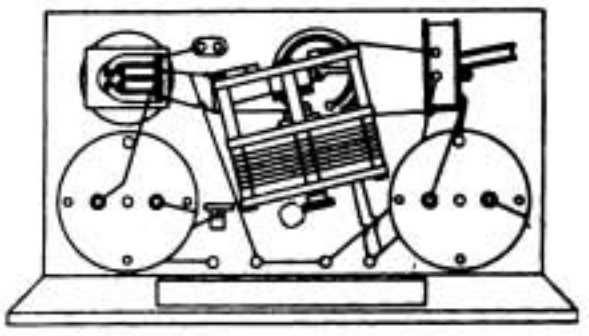


*Fig. 3. Rear view of the set. The secondary variometer and condenser are mounted at right angles to those in the other circuits.*

12 turns of wire, six to a layer. From the drawings it will be noted that a 90 degree range of coupling can be obtained from the zero point, and that a 10 degree range of coupling can be obtained in

the negative position (Fig. 4). This feature is to overcome any fixed primary-secondary coupling that may exist, due to the manner in which the receiver is wired externally.

The most important part of the receiver is the construction of the variometers. These variometers are mounted on the same shaft as the variable condensers. An ordinary variable condenser has a minimum to maximum capacity ratio of two and one-half to one. Likewise an ordinary variometer has a minimum to maximum inductance ratio of two and one-half to one. Placing a variable condenser and variometer in parallel, and both on the same shaft, working from minimum to maximum simultaneously, we get a wavelength range of at least five to one. In the antenna circuit we have a little different condition. The condenser and variometer are in series with the antenna and ground, which is really a condenser, and a wavelength range of only about five to one can be obtained. But in the closed circuits such as the secondary and tertiary circuit, and using specially shaped plates and good variometers, a range of eight to one can be obtained.

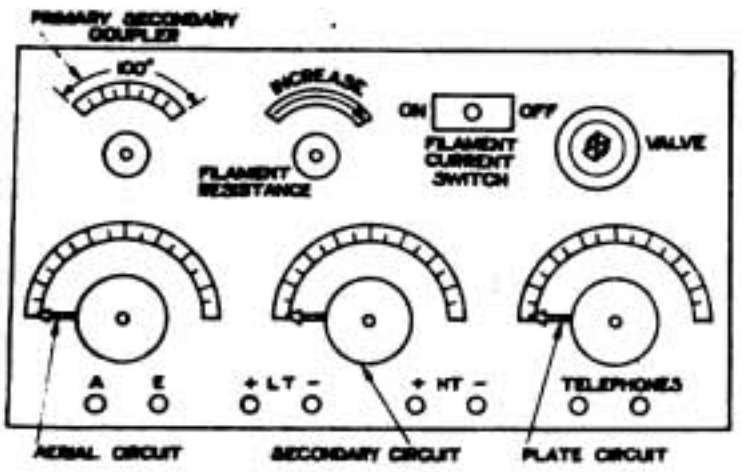



*Fig. 4. Front View of the Receiver in which the Capacity and Inductance of the Circuit are adjusted simultaneously.*

Fig. 5 shows cross-sectionally the construction of a variometer and the manner in which it is attached to the variable condensers. It is seen that one ebonite disc is fastened permanently to the back of the variable condenser by three spacers. This ebonite disc holds the stationary coils of one variometer. Another disc is attached to the variable condenser shaft. Only one take-off pulley is required to bring out one lead of the movable coil. The other lead of the movable coil is connected to the shaft of the variable condenser. The shape of these coils is shown in Fig. 6, which also shows the manner in which they are connected.

To wind these coils, a brass form is made, with the sides removable so as to remove the coils from the form after they are wound. However, before removing the coils they should be dipped in paraffin wax, form and all, and left to cool, so that the coils retain their shape. All the coils are wound with 3/16 No. 38 Litzendraht. The primary coils consist of six turns per coil (four coils per variometer, two stationary and two movable), two turns per layer and three layers. The primary coil has more turns than the other coils, as this variometer is in series with the antenna and antenna condenser and requires more induc-

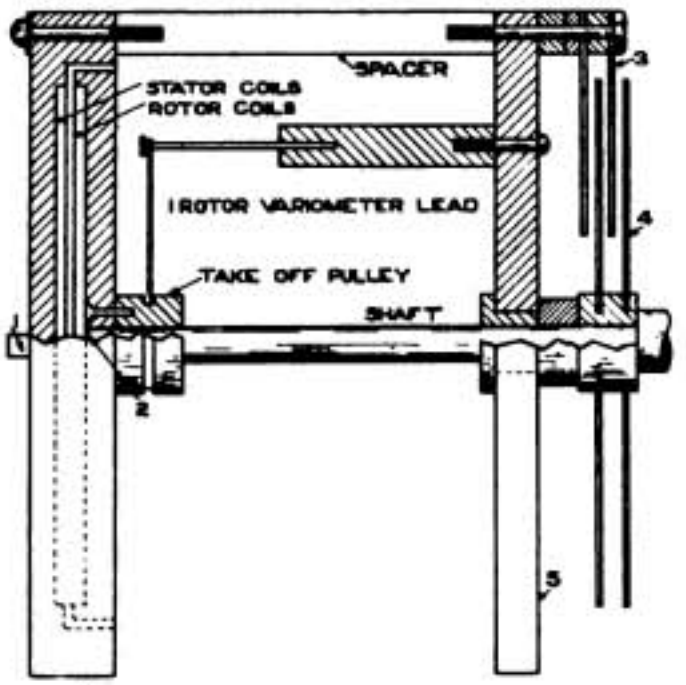



*Fig. 5. Details of Variometer Mounting on the Condenser Shaft.*

tance. The secondary and tertiary variometers have four turns per coil, two turns per layer and two layers. These finished coils are waxed to the ebonite discs, which have previously been machined to the required shape with considerable accuracy, as the forms should not rub during the 180-degree rotation and the face of the movable and fixed coils should be ten-thousandths of an inch apart.

The outside diameter of these coils is just four inches. Fig. 6 shows how to connect the four

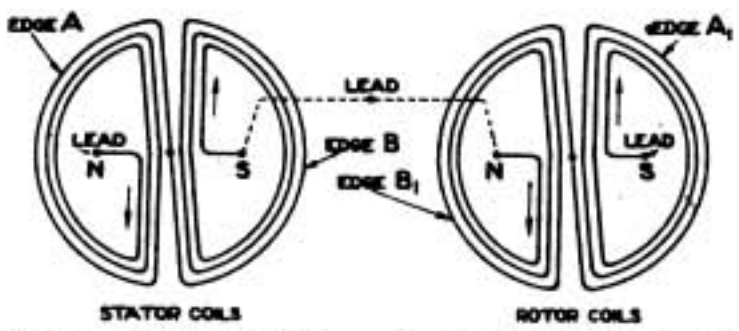



*Fig. 6. Showing the connections of the Coils in the Variometers.*

coils of one variometer so that they assist each other in the proper manner at all points on the scale.

Fig. 7 shows the construction of the grid condenser and by-passing condenser, both of which are fixed units. The grid condenser has four copper plates and five mica plates; the by-passing condenser has eight copper plates and nine mica plates, of sizes cut in accordance with the drawing.

The interior of the receiver is shown in Fig. 3 and

gives a good idea as to how to assemble the complete unit. Heavy wire should be used for the wiring between units, No. 12 B. & S. bare copper wire, soft drawn, and covered with black empire cloth tubing makes a very neat job. An ordinary valve socket can be purchased and mounted on the front of the panel or behind a window as may be desired and will save the trouble of manufacturing a socket. The filament current rheostat is mounted in the rear of the panel, controlled by a knob and pointer at the front of the panel. A small key or push-switch is mounted to light the filament.

It is noted that the primary condenser-variometer unit is mounted vertically and the other secondary and tertiary units are horizontal. This is arranged in this way to prevent fixed coupling between the primary-secondary, primary-tertiary and secondary-tertiary circuits.

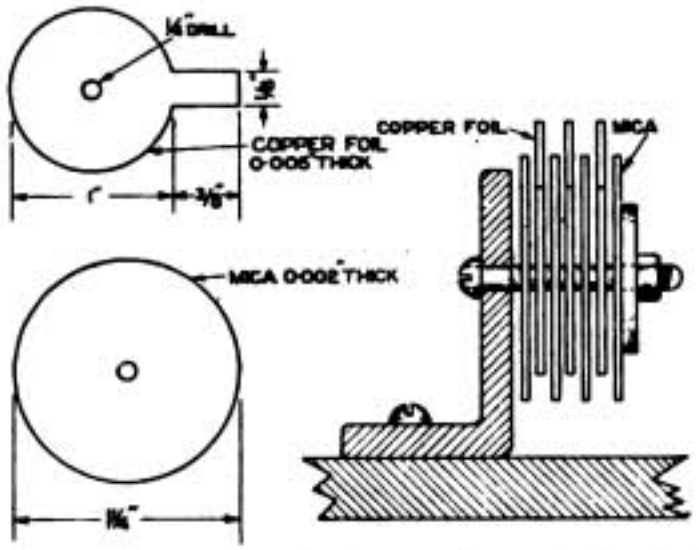



*Fig. 7. Details of the Construction of the Small Fixed Condensers.*

The operation of the receiver requires considerable care for best results. Assume that the receiver is ready for operation, the filament being light and the high potential battery being connected. Suppose that we wish to receive a station of unknown wavelength, then set the tertiary control at zero and the coupling at about 70 degrees. Now work the primary and secondary control simultaneously, starting at zero and working toward 180 degrees. Provided signals are incoming, you will pass points where signals will be heard. Release the secondary control at one of the points and tune the primary control closely. Then tune the secondary control to that same wavelength. Now taking the tertiary control, bring that toward 180 degrees. As you move the tertiary circuits, it immediately starts regenerating and the signal strength will increase gradually. As the signal strength increases with the forward movement, it will finally increase to a point where the tone of the spark being received changes and becomes *mushy*. At that point the regeneration has reached a point which has caused oscillation to start.

If, while tuning to one incoming signal, you are being interfered with by a second or third station, reduce the coupling toward zero, at the same time readjusting the primary and secondary controls. On reaching a point where the one desired station is being received, bring the tertiary control over starting regeneration, at the same time adjusting the coupling control and secondary control. Remember that when you reduce the coupling, you reduce the resistance in both the primary and secondary circuits, but at the same time reduce the amount of energy being transferred. There is a point when maximum signal strength will be obtained for all stations and it will never be at 90 degrees for weak signal when the receiver is properly tuned.

Wireless telephone signals are received just the same as spark signals or other damped types of oscillations. However, inasmuch as this receiver is capable of starting oscillations in itself, it can be used to receive continuous or undamped oscillations as well, on wavelengths of 150 to 750 metres.

The tuning is similar to tuning in spark signals, only the tertiary control must always be sufficiently near the 180-degree point of the scale to have oscillations generating all the time tuning is being done. That is, if your incoming oscillation is 1,500,000 cycles, you tune your set to generate oscillation having a period of 1,499,000 cycles, a difference of 1,000 cycles, and get a corresponding note in the telephones. This oscillation set up in the receiver can be varied by varying the tertiary control and any note desired produced in the telephones from inaudibility to a few cycles a second.

Inability to oscillate may be due to low filament temperature, low high potential battery, low grid leak, the tertiary circuit being improperly connected. To remove the trouble of the telephone cords acting as coupling from the tertiary circuit back through the body to the secondary circuit, the receiver case may be lined with sheet copper, connected to the negative side of the filament battery and grounded. The telephone cord should also be covered with copper braid and grounded as well.

## The Wireless Society of London.

THE Wireless Society of London concluded its last session on June 14th, when an address was delivered by Sir Oliver Lodge, F.R.S., at the Institute of Electrical Engineers.

Although the Society does not hold further general meetings until September, its activities are in no way curtailed, and the names of proposed new members and associates will come before the Committee at their monthly meetings, and all applications passed prior to the first meeting of the next session will be balloted at that meeting.

Under the auspices of the Society, a Wireless Exhibition and Convention is being held at the Horticultural Hall, Westminster, from Saturday, September 30th, to Saturday, October 7th, inclusive. Full details of the Exhibition will be duly advertised. Complete arrangements are being made in connection with the social side of the Exhibition, and the organisers have kindly offered to place at the disposal of the Wireless Society of London a number of complimentary tickets of admission, which will be distributed amongst the members of the Society and affiliated Societies.

The membership of the Society now stands at close on 600. Country members are admitted at half fee, and there is the grade of Associate Member for those not at present technically qualified in wireless work, but who are interesting themselves in the science. Societies affiliated with the Wireless Society of London now number over seventy, and any new Wireless Society which is being formed or has recently been formed is invited to make application for particulars of the affiliation scheme (if this has not already been done), to the Hon. Secretary, Mr. L. H. McMichael, 32, Quex Road, West Hampstead, N.W.6.

The Society publishes a journal, in which reports of lectures and proceedings of the meetings of the Society are fully dealt with. This journal is distributed to each member and associated member, and to affiliated societies.

Book of rules and application form for membership can be obtained on application to the Hon Secretary.

# Notes

### The Imperial "Chain."

In reply to a question in the House of Commons, Mr. Kellaway said:—"The Government have further considered the question of the Imperial wireless chain, and have decided to erect in England a station of the ultimate power contemplated by the Expert Commission, instead of the smaller power which they proposed should be used in the first instance. The Government are advised that this station will provide especially direct commercial communication with India, South Africa, and Australia. In India, the Imperial Government will erect and the Indian Government will work a station also capable of direct communication with England, South Africa and Australia. As a corollary of this decision the proposed second station in Egypt and the station in East Africa will be deferred; and the question of erecting stations at Singapore and Hong Kong will be reconsidered. Communication is proceeding with the Union Government as to the station in South Africa, and the experts of the Canadian Government are expected to reach England very shortly in order to discuss the participation of Canada in the scheme."

It is reported from Melbourne that the Commonwealth Prime Minister has received from the Secretary of State for the Colonies an outline of the Imperial Government's proposals

He regards the scheme as a complete justification of his attitude at the Imperial Conference in favour of direct communication.

Important modifications have been made in the scheme regarding the smaller links. Four suggested stations have been for the moment cut out. These are Suez Canal, Singapore, Hong Kong and East Africa. But as indicated by Mr. Kellaway, the stations at Singapore and Hong Kong may yet be established at no distant date, and the other two are even now in mind, the question of their erection being only deferred.

### North Atlantic Ice Reports.

Ice reports are issued by the American Hydrographic Office in respect of the movements in the North Atlantic. Information is received from the Coastguard cutter on patrol. The ice-patrol vessel will give ice information at any time to any ship with which the patrol vessel can communicate on 600 metres.

### American Invitation to Correspond.

Mr. George E. Hall, Jr., 17, Emerson Place, Lynn, Mass., U.S.A., will be glad to correspond with a British amateur.

### A Godalming Amateur Station.

The accompanying photographs show the aerial and apparatus of the station erected by Mr. W. G. Fudger, of Godalming. Mr. Fudger commenced his station in January last, and the results shown in the photographs were achieved by the beginning of May.

*Aerial at Mr. W. G. Fudger's Station at Godalming.*

*Interior view of Mr. Fudger's Station.*

### Mrs. Lloyd George Hears FL.

An interesting feature of the recent tour of the Western Counties by Dame Margaret Lloyd George, D.B.E., was the series of demonstrations of wireless telephony and telegraphy given by Mr. I. Chapman, Associate I.R.E., of Poole, Dorset.

The first and most interesting was given at Clifton Zoological Gardens on July 10th, when over 5,000 people attended the meeting.

A special transmission of music from **FL** by kind permission of the French authorities was given at 3.45 p.m., and Dame Margaret Lloyd George was an interested listener.

Successive demonstrations were given on following days at "Cumbre," Pennsylvania, Exeter, and Gyllyndune Gardens, Falmouth, when the usual daily telephony transmission afforded much enjoyment to the large gatherings of people.

### An Army Council Decision.

Before distributing the prizes at the half-yearly inspection of the cadets of the Royal Military Academy, Woolwich, the Earl of Cavan, Chief of the Imperial General Staff, stated that he looked to all young officers to obtain a knowledge of wireless.

He was sorry to learn that for financial reasons instruction in the elements of wireless had been dropped. He hoped that instruction might be restored. During the war he was horrified at the number of casualties among men engaged in burying telephone wires, and with the advance of wireless the question arose, "Why not abolish telephone wires?" In this connection the Army Council had decided that from "Division" to the front line there would be no telephone wires in future wars.

### Radio Education at Swansea.

Swansea Technical College is to have installed apparatus costing about £50 for the purpose of a course of telegraphy and telephony. The Education Committee decided to approve of the scheme on the recommendation of the Higher Education Sub-Committee.

### P.M.G. on Broadcasting.

The Postmaster-General said on July 18th, "I have intimated to a committee representing the manufacturers of wireless apparatus in this country the conditions on which I propose to grant licences for broadcasting, and I understand these proposals will be submitted to the general body of manufacturers forthwith. I have informed the manufacturers that in the event of their supplying the capital required and providing efficient broadcasting services, I will agree that the apparatus which it will be permissible to use under the Post Office licence for the reception of these services shall for two years be restricted to apparatus manufactured in Great Britain."

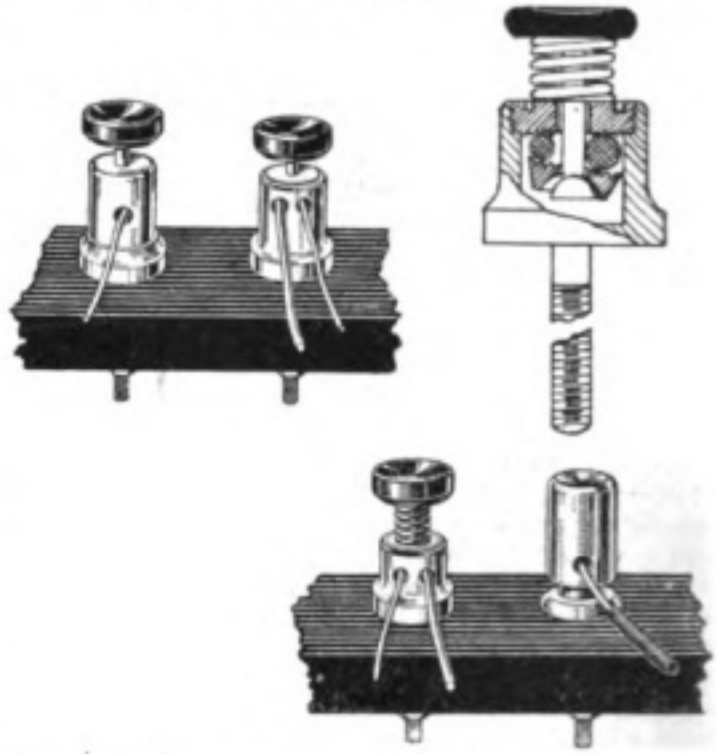
In reply to a question as to whether he had power to do what he proposes, Mr. Kellaway said: "The power is given me by this House to issue licences, and it is inconceivable to me that we should allow a new form of communication in this country to be exploited by foreign manufacturers."

Captain W. Benn asked, "Is not the right hon. gentleman taking advantage of the powers of licence to impose a protective system in this hole-and-corner way?" to which Mr. Kellaway replied, "No, not a protective system, but a proper method of protecting a new means of communication in this country."

Replying to Sir H. Brittain, Mr. Kellaway said: "A site for the proposed high-power wireless station has been selected provisionally. Its final adoption depends on the result of certain inquiries which are now in progress." He could not give a date for installation.

### A New Type of Terminal.

The accompanying illustration shows a new type of terminal which is shortly to be placed on the market. This terminal has distinctive features which should appeal especially to experimenters



who require to make constant and rapid changes in connections.

Instead of gripping the lead by screw-applied pressure, the new terminal grips by means of a spring, as indicated in the section illustrated. Various types of these terminals are made, some only being illustrated here. They are being made in both nickel and lacquered brass finish and with ebonite caps as shown.

### Transmitting from a Racing Car.

A very interesting wireless experiment was conducted recently by Mr. Colin Gardner in connection with Mr. S. F. Edge's world 24-hour speed record with a Spyker car.

A wireless set was installed on the car, the total time available for the equipment being only one minute 45 seconds. Mr. Gardner was successful in transmitting messages from the car whilst travelling at a speed of 85 to 90 miles an hour.

### Wireless Patent Action.

An action has been brought by Messrs. Marconi's Wireless Telegraph Company, Ltd., against Messrs. The Mullard Radio Valve Company, Ltd., for alleged infringement of valve patents. At the time of going to press, the hearing is proceeding.

### K.B. Units.

It is regretted that in the advertisement of K.B. Units, which appeared on page vii of the

July 22nd issue, the numbers relating to the units were misplaced.

**The Hague Concerts on Inceeased Power.**

It is announced that the *Daily Mail* and *Evening News* have entered into an arrangement with the organisers of the Hague Concerts, to support the latter financially so as to ensure the continuance of the transmissions with an increase of power. The transmissions of concerts between 7 p.m. and 8 p.m. on Thursdays and Sundays, will accordingly take place. On Thursday, 27th, the power used will be 800 watts, and by the following week this will be increased to 1½ k.W.

**Transmission by 2 LO (Marconi House).**

The Marconi Company hopes to transmit from 5 p.m. to 6.30 p.m., and again at 9 p.m. on July 29th. This Company will appreciate criticism by amateurs of the transmission of telephony by their station **2 LO**, and expresses willingness to endeavour to advise those amateurs who care to send stamped addressed postcards in advance, of the times of their transmissions.

# Correspondence

*To the Editor of* THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have from time to time seen correspondence in your columns dealing with harmonics radiated from various high-powered stations such as **GBL, GSW, GKU**, etc., and I have often wondered at what distance these could be heard. Much was my surprise when, on July 9th, at 2210 BST., I heard Barcelona (**EAB**) call **ICI**, when listening in on a wavelength of 430 metres. At the time I was using 4 valves, 2 being H.F. and 1 a note magnifier, and with these valves on an aerial 22 ft. high **EAB** was very strong. I switched off to one H.F. and one detector only, and he was still readable. Having heard **EAB** on several occasions on a wavelength of about 4,300 metres C.W., I quickly changed to this, and was much astonished when, with all four valves again, he was only slightly louder than the harmonic, which was probably his tenth harmonic. I searched, both above and below the true wavelength, for other harmonics of **EAB**, but the one on 430 metres was the only one I could hear. I also heard him some days previously on 430 metres calling **POZ**, but it was at the end of his message, so that I did not get a chance to follow the thing up. **EAB** is 850 miles away, so that I should think clear reception of his message on one-tenth of the true wavelength is somewhat strange. There was no fading or variation of the signal whatever. It was just dusk at the time, but, so far as I can remember, the reception of this harmonic on the previous occasion mentioned, took place in daylight.

I have also noticed several nights recently, when it was just dark, that S. Maries-de-la-Mer (**FFS**) came in as loud as Liverpool (**GLV**), both being on 600 metres spark, and the distance from the former being 800 miles, while the latter is only 70 miles away, both of these stations being readable at a distance from the telephones. I should be pleased to hear of other similar experiences which have no doubt occurred to many readers of *The Wireless World and Radio Review*.

B. L. STEPHENSON.

# Calendar of Current Events

**Saturday, July 29th.**

Hounslow and District Wireless Society. Demonstration at Hounslow Hospital Fête.

**Sunday, July 30th.**

Transmission of Telephony from 7 to 8 p.m. on 1,070 metres by **PCGG**, The Hague, Holland.

**Tuesday, August 1st.**

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

**Thursday, August 3rd.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

HACKNEY AND DISTRICT RADIO SOCIETY.
8 *p.m.*, at 111, Chatsworth Road, Clapton. Meeting.

**Friday, August 4th.**

SOUTH SHIELDS Y.M.C.A. AMATEUR WIRELESS SOCIETY.
8 *p.m.*, at Y.M.C.A. Buildings, Fowler Street, South Shields. Meeting.

**Sunday, August 6th.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

**Monday, August 7th.**

SOUTHEND AND DISTRICT WIRELESS CLUB.
Garden Fête in the Rectory, Leigh-on-Sea. Public Demonstration.

**Tuesday, August 8th.**

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

**Thursday, August 10th.**

Transmission of Telephony from 7 to 8 *p.m.* on 1,070 metres by **PCGG**, The Hague, Holland.

ILKLEY AND DISTRICT WIRELESS SOCIETY.
7 *p.m.* at Regent Café. Meeting.

STOCKTON AND DISTRICT AMATEUR WIRELESS SOCIETY.
Monthly Meeting.

HACKNEY AND DISTRICT RADIO SOCIETY.
8 *p.m.* Meeting.,

**Friday, August 11th.**

SOUTH SHIELDS Y.M.C.A. AMATEUR WIRELESS SOCIETY.
8 *p.m.*, at Y.M.C.A. Buildings, Fowler Street, South Shields. Meeting.

# Wireless Club Reports

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

### Wireless Society of Highgate.*

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

On Friday, July 7th, Mr. J. Stanley gave the fourth of his series of lectures on the theory of wireless telegraphy and telephony, dealing this time with detectors and telephones.

He first of all showed why signals could not be detected by simply connecting telephones in the receiving circuit, and explained that it was necessary for the high frequency oscillations to be rectified and converted into low frequency pulses. He then described how a crystal detector performs the function of rectification and explained the meaning of the characteristic curve of various crystals. In this connection he pointed out that in order to get certain crystals to work at the best point of their curve for rectification purposes, it is necessary to apply across them a steady voltage, and he showed how this could be done by means of a potentiometer and a small cell.

Mr. Stanley went on to deal very carefully with the construction and action of the telephones, mentioning specially the Brown telephones, and described also the action of the blocking condenser usually connected across the telephone terminals. Finally he showed the advantages in increased selectivity, which could be obtained by using loose coupling between the aerial and a closed circuit instead of coupling direct on to the aerial.

This proved to be one of the most interesting of Mr. Stanley's lectures and he was followed throughout with great interest, a very hearty vote of thanks being given him at the conclusion.

On Saturday, July 8th, the Society gave a demonstration at a garden party held by the Hornsey Branch of the National Council of Women of Great Britain and Ireland at The Grange, Highgate. A number of special transmissions from London amateurs were arranged, and in addition the transmissions from Marconi House and **2 FQ** to other fêtes were picked up. Owing to the wet weather the demonstration could not be given on the lawn as was intended, but two leads about 100 yards long were taken from the receiving set to the hall of the house, where a loud speaker (kindly lent by Messrs. Brown) was placed, and a large number of people had the pleasure of listening to some excellent music by radio.

The Hon. Secretary will be pleased to answer enquiries regarding the Society and to give particulars of the series of lectures now being held.

### The West London Wireless Experimental Association.*

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

At the meeting held on Thursday, July 6th, a fairly good attendance was made. Mr. F. E. Stadt continued his paper, "Interpretation of Wireless Circuits." In the course of his lecture he dealt with several "freak" circuits, and by diagrams on the blackboard showed how they could be illustrated to the best advantage for ease of interpretation. A very hearty vote of thanks was duly accorded the Vice-President for his instructive lecture.

The Commmittee hope, almost immediately, to arrange a half-hourly lecture at each weekly meeting for the benefit of the large number of new members who are not yet greatly acquainted with the science of radio-telegraphy and telephony. The Association is still adding to its apparatus and this will prove a very great help to its members.

A meeting was held on Thursday, July 13th, members attending in strong numbers. The Morse practice class was well attended and it is hoped that the new pattern buzzer recently presented by Mr. J. F. Bruce will have plenty of exercise. New members will be glad to learn that Messrs. J. F. Bruce and R. Cole have offered to give 20 minutes at each meeting to the explanation of construction of apparatus for beginners' use, so that by the time the members desiring this knowledge have attended a few of these classes they will be able to construct their own receiving sets.

Mr. F. E. Stadt, the President, again gave a paper, "Paul's Compact Crystal Receiver." After a full description of the apparatus and the inspection of same by the members, a very fine lecture was given. The dimensions and data of the windings of the coils, description and measurements of the crystal detector and condenser, together with the very little necessary alterations to make the set capable of tuning up to 600 metres, was very interesting and instructive. The lecturer then, by diagrams, showed how simple it was to alter the set to a one-valve amplifying and crystal rectification circuit. At the conclusion of the Vice-President's remarks a very hearty vote of thanks was accorded him, with much applause.

On July 20th a lecture was given on "A Three-Valve Variometer Circuit," by Mr. F. E. Stadt.

Information regarding the objects, subscriptions, etc., will be gladly given by the Secretary.

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

### Leeds and District Amateur Wireless Society.*

Hon. Secretary, Mr. D. E. Pettigrew, 37, Me borough Avenue, Chapeltown Road, Leeds. general meeting was held on Friday, July 14t at the Leeds University, Mr. G. P. Kendall, B.S (Vice-President), taking the chair at 8 p.m. Th Chairman called upon the Hon. Secretary to di charge certain business, which included an announc ment to the effect that as a result of a meeting the Committee, it had been decided that any pers

who is elected to the membership of the Society during the course of the remainder of this sesson, shall be entitled to all the benefits attached to the membership for that period, upon receipt of entrance fee of half-a-crown. The Chairman then called upon the Hon. Secretary to deliver a paper on the subject of "Maritime Wireless Communication."

The lecturer commenced his paper with a consideration of the great advantages that were resultant upon the installation of wireless apparatus at sea, and briefly reviewed the very many facilities that such apparatus readily presented. The subject was outlined historically from the day when Marconi installed his plant aboard the Italian cruiser "San Martin," exactly twenty-five years ago to the day, through the progressive years that followed, until the present day, when wireless has become almost an essential part of a vessel's equipment. The various apparatus used from the very first days of marine wireless, down to the plant as used nowadays, were described practically and theoretically with the aid of diagrams, which were distributed to the meeting. On the transmitting side, such apparatus as the plain aerial and tuned aerial sets using induction coils; power sets having fixed, rotary or quenched spark gaps, using low frequency alternating current; continuous wave valve transmitters using rectified L.F.A.C. were considered, and some actual working ranges as may be obtained with such sets were submitted to the meeting. Receiving gear was treated in a similar manner, various apparatus, including the magnetic and crystal detectors, valve and crystal circuits, low frequency valve magnifiers, separate heterodynes to enable the reception of continuous waves to be carried out, complete three-valve receivers, and single four-electrode valve circuits being described. The performance of such apparatus was also considered, and a brief sketch of marine wireless and direction finding work then followed. At the conclusion of the lecturer's remarks a discussion was opened by the Chairman, and various points relating to the valve sets were considered at length. Following upon the discussion, numerous lantern slides, kindly loaned by Marconi's Wireless Telegraph Co., Ltd., Radio Communication Co., Ltd., R.M. Radio, Ltd., and Mr. N. Whiteley, were exhibited and were a great aid to the lecturer, and the meeting especially from the practical point of view.

After a vote of thanks had been accorded to the Hon. Secretary, the meeting was declared closed.

### Wireless Experimental Association.*

Secretary, Mr. Geo. Sutton, A.M.I.E.E., 21, Troughton Road, Charlton, S.E.7.

On July 5th a very interesting evening was spent, and so great has the membership become, that late arrivals found accommodation difficult.

Mr. Hersey's description of his receiver was very interesting, especially as he gave detailed constructional information. Mr. Voigt described the many characteristics of valves, and their relative inefficiency as detectors.

The meeting held on July 12th was better attended than the previous weeks, and before long, larger accommodation will be necessary. This is convincing proof of the success of the recruiting campaign instituted not so long ago. The Chairman began by illustrating the various symbols used in electrical work. Many really simple signs were not easily recognised, especially a terminal, an arc, a selenium cell, a nodon valve and a fuse. This chat proved very interesting, as over 50 symbols were shown. During the second half, the Secretary exhibited and described many different pattern valves, including some very old and unknown types, and even an up-to-date four-electrode valve of foreign origin.

The Secretary is still waiting to hear from some more new members and will deal with any enquiries at the address given above.

### Radio Experimental Association (Nottingham and District).*

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

A meeting of the above Association was held in Room 74, Mechanics' Institute, at 7.30 p.m. on Thursday, June 29th.

Mr. Pritchett, who had consented to lecture during the evening, delivered his remarks with marked ability. The subject, "Functioning of Valve Circuits and Their Components," proved one of great interest. He dealt with the various parts of a valve receiver, showing clearly the way in which each worked, and also explained fully how it was possible to obtain the very best out of one's set. As usual, in a lecture of this description, the audience had before them "Characteristic Curves," and Mr. Pritchett explained how very essential it was to understand the particular characteristics of each valve in use. The lecturer also plotted an actual curve relating to a valve he had brought with him. He did not use any expensive apparatus, but only such as might be seen lying around any average amateur's receiving set, and the only piece of apparatus which could not be said to be home-made was a milli-voltmeter.

This demonstration was greatly appreciated by the members present.

During the evening Mr. Ley demonstrated the working of a "Lokap Lattice Coil Winder," and also exhibited a set of coils he had wound. This machine is for the use of members who pay a small nominal sum for the loan of it.

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

### The Southend and District Wireless Club.

Hon. Secretary, Mr. D. L. Plaistowe, 21, Oakleigh Park Drive, Leigh-on-Sea.

A general meeting was held at Headquarters, 51, Queen's Road, Southend-on-Sea, on June 30th.

Mr. Mayer took the chair. The minutes of the previous meeting were read and approved, and the Secretary's report dealt with.

A general discussion followed on topics of interest to members, and several interesting points were raised and disposed of by various members, after which the Chairman called upon Mr. Plaistowe to give the second of a series of lectures of an elementary nature for the benefit of the non-technical members.

The properties of oscillating circuits were enlarged upon and capacity and inductance, etc., were explained by analogy and also by means of the splendid diagrams provided by Mr. Jagged.

The lecturer was accorded a hearty vote of thanks, after which Mr. Mayer showed an extremely small and compact one-valve receiver that he had made out of odds and ends when in the Service,

and that could be packed up in the kit bag. A short description of the set was given.

The Club was represented at a Garden Fête at Leigh Rectory on Saturday, July 8th, and a good show of apparatus was arranged by members.

Successful results were obtained on the portable receiver, which, though not complete, as only three L.F. coupled valves were used instead of the two H.F. rectifier and two note magnifying valve, with which the set will be provided, gave loud and pure speech with "Brown" microphone relay and loud speaker.

Short lectures were given to the people, and during the intervals of telephonic transmissions from **2 LO**, and also **2 LZ** and **2 WW**, a high speed Morse operator read some of the ship stations.

One lady endeavoured to put on a pair of headphones while wearing a large hat, and was prevented in time from breaking the headband in trying to stretch it. In a case like this it was considered that elastic or other expandable material might be used.

The next public demonstration will take place on August Bank Holiday at the Garden Fête in the Rectory, Leigh-on Sea, when we hope to have a good exhibition of apparatus.

Those interested should communicate with the Hon. Secretary.

### The Radio Scientific Society of Manchester.

Hon. Secretary, Mr. H. D. Whitehouse, 16, Todd Street, Manchester.

An enjoyable outing was held by the above Society at Prestbury, near Macclesfield, on Saturday, July 15th. During the afternoon an aerial was erected and a five-valve amplifier brought by Mr. Halliwell was installed. Strong signals were received from ships and coast stations. Punctually at 4 p.m. Mr. Lewis (2 AY), of Sale, was heard calling up, and this was followed by a musical programme. Unfortunately, considerable interference was experienced. Certain portions were received clearly, the music and speech being excellent.

After taking tea at a neighbouring farm, about a dozen members and friends persevered with an additional three-valve set, but were only able to hear snatches of music and singing in the intervals between the Morse signalling from numerous spark stations In spite of the "jamming," the afternoon was voted a success by all who participated.

Although during the summer months the Society's efforts have been somewhat curtailed, it is hoped that anybody interested in amateur wireless will not hesitate to communicate with the Hon. Secretary, who will be very pleased to answer any enquiries at the above address.

### Southampton and District Wireless Society.

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

A meeting of the above Society was held on Wednesday, July 12th, a large attendance of members being present.

An interesting demonstration and lecture will shortly be given by Dr. Norman Aldridge. X-ray specialist of the R.S.H. & S.H.; who, by the way, is a member and a regular attendant at the Society's meetings.

The Society continues to enrol new members. Large attendances are being recorded, but there is still room for more. The Hon. Secretary will be pleased to furnish all particulars.

### The Belvedere and District Radio and Scientific Society.

Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent.

The inaugural meeting was held on Friday, July 14th, at the Erith Technical Institute, at which about 50 people were present.

Mr. T. E. Morriss took the chair at 7.30 p.m. in the absence of Mr. J. F. Watson, who was unfortunately called away on business at short notice.

Mr. A. G. Warren, who explained the desirability of forming a Radio and Scientific Society at the present time, was followed by the Chairman, who outlined the objects and constitution of the Society. Both speakers were then thanked by all present for their most interesting addresses, after which the following officers were elected:—President, Mr. J. F. Watson; Vice-Presidents, Mr. T. E. Morriss, Mr. W. Neagle, B.Sc., A.M.I.Mech.E., Mr. J. C. Williams, A.M.I.E.E.; Hon. Technical Adviser, Mr. A. G. Warren, M.Sc., M.I.E.E., F.Inst.P.; Hon. Secretary, Mr. S. G. Meadows, 1, Kentish Road, Belvedere, Kent; Hon. Treasurer and Equipment Engineer, Mr. S. Burman; Committee, Messrs. R. L. Chantrill, W. F. Ellis, S. W. Hurst, A.I.E.E., A.Fel.Aer.Inst., C. Morriss, L. W. Scudder, A.M.I.C.E., W. A. Selfe, H. H. Smith.

The necessary business was carried through successfully, and it was decided to hold the first general meeting on September 8th next.

All interested are requested to obtain particulars from the Secretary

### Halifax Wireless Club and Radio Scientific Society.

Hon. Secretary, Mr. Louis J. Ward, Clare Hall, Halifax.

The third annual meeting of the club was held on Wednesday, July 3rd, 1922. About 50 members were present under the Presidency of Mr. Walter Emmott, M.I.E.E., M.Inst.C.E., M.I.Cons.E. The President briefly reported on the past session and congratulated the members on the success achieved. The Treasurer's report showed that the club was sound financially.

The election of officers was as under:—President, Mr. W. Emmott; Vice-Presidents, Messrs. J. R. Clay, A. H. Gledhill, G. E. Rawling, H. Mortimer.

The ballot for membership of the Committee resulted in Messrs. W. R. Haswell, J. H. Hardy, W. J. Holroyd, H. Town, W. Scott, and T. P. Brennan being elected. Mr. J. R. Clay was re-elected Hon. Treasurer and Mr. L. J. Wood, Hon. Secretary. The Technical Committee, consisting of Messrs. J. R. Clay, J. E. Mitchell, H. Mortimer, and L. J. Wood, was re-elected.

Many members spoke in enthusiastic terms of the progress of the club, particular reference being made to the petition to the Postmaster-General, which was inaugurated by the club, and taken up by the London Society, which resulted in the weekly transmission of telephony from Writtle, and which has proved to be the forerunner of the present broadcasting scheme.

The rules of the club, which have been brought up-to-date by the Committee, were approved. Membership of the club is now sub-divided into

two sections. Full membership is only open to British subjects over 21 who have held a P.M.G. licence for 12 months, or who in the opinion of the Committee possess exceptional technical ability. British subjects under 21, or who have not held a P.M.G. licence for 12 months, will be admitted as Associates. Associates will have the full benefit of the club, but will not be able to take any active part in the management, or vote at meetings.

It has been decided to open the club-room each Monday, Wednesday and Friday, from 7.30 p.m., when an efficient steward will be in charge of the instruments. Members and others interested are invited to attend on these evenings with their difficulties, but non-members are not expected to attend more than once per month.

The instruments belonging to the club have been overhauled by the Technical Committee, and the club now possesses very efficient transmitting and receiving apparatus. In the event of broadcasting becoming an accomplished fact, the room will be open nightly, but due notice will be given of this.

If any amateur in Halifax and district who is not a member wishes to enjoy the advantages of the club, there is still room for a few more members or associates, and full details of the club will be supplied on application to the Hon. Secretary.

### Warwick School Wireless Society.

Secretary, Mr. P. Wintham, Warwick School.

A wireless society for members of Warwick School is in the process of formation to carry on the work of the Wireless Section of the Natural History Society, in view of the impetus given to the study of the subject during the last few months.

The School has had a receiving station for well over two years, and on its recent excursion to Edge Hill, the Wireless Section took a small two-valve portable set, which is shown in the accompanying hotographs.

*Portable Set used by Warwick School Society. The aerial is seen attached to the tower in rear.*

The set was erected and signals were being erceived within ten minutes of arrival. Eiffel Tower telephony and music were heard very distinctly, while **STB**, and, of course, **GKU**, **GBL** and many other stations came in well, and this despite the fact that the aerial was only about two feet six inches high at the lower (lead-in) end, while the earth was a nine-inch iron rod. Moreover, the set was placed by the highroad, which did not make it any easier to hear speech.

*Warwick School Society's Portable Set in use.*

The set taken was a two-valve resistance-capacity amplifier, using "Burndept" coils and Mullard "Ora" valves, and was placed in an old Mark I aircraft tuner case. It was put together quite hurriedly in the school.

The situation of the set on Edge Hill was very interesting, as it overlooked the famous battlefield, while the upper end of the aerial was attached to the well-known Edge Hill Tower.

### The Durham City and District Wireless Club.

Hon. Secretary, Mr. Geo. Barnard, 3, Sowerby Street, Sacriston, Durham.

The first meeting of the above took place on Tuesday, July 11th. The attendance exceeded all expectations, as also the enthusiasm displayed. In the absence of Mr. Morsen, Mr. Sargent very ably carried out the duties of Chairman.

Before proceeding to business, Mr. Barnard gave a few explanatory remarks, and also outlined the objects of a wireless club. A very interesting discussion then took place, which ended in the Club being formed, the name being as above.

It was decided to hold meetings every fourteen days, on the Fridays, at 7 p.m. A committee was then elected, consisting of the Rev. Perkins, of Shadforth, Mr. Brown, of Sherburn Hill, Mr. Nurthen, of Durham, Mr. Clark, of Chester-le-Street, Mr. Sargent, of Durham, Mr. Kelly (Hon. Treasurer), of Durham, and Mr. G. Barnard (Hon. Secretary), of Sacriston. It was decided to let the Presidency, Vice-Presidency, also Chairman, stand over for a few weeks.

The next meeting took place on Friday, July 21st, at 7 p.m., in the hall of The Rose and Crown Hotel, when the Rules and Regulations

were read, after which a lecture was given by Mr. Geo. Barnard, on "The Electro-Magnetic Theory and its Application to Wireless."

The Secretary wishes to thank the many brother secretaries who have so kindly sent letters of advice, thereby greatly helping to set the new club upon a sound foundation. He will also be very pleased to hear from anyone interested in radio who is desirous of joining the Club; better still, to attend personally the next meeting.

### Barnsley Amateur Wireless Association.

Hon. Secretary, Mr. G. W. Wigglesworth, 13, King Edward Gardens.

A general meeting of the Barnsley Amateur Wireless Association was held on Tuesday, July 11th, in the Guild Room of the Co-operative Education Department, Market Street.

The question of permanent headquarters was freely discussed and suggestions from the members present were considered, with the result that the Association is very hopeful that at a very early date some of the proposals brought forward will materialise and that the work of the Association will commence in earnest.

The annual subscriptions were fixed as follows:—Adult members, 10s.; age 18 to 21, 7s. 6d.; junior members, 5s.

The existing Committee was re-elected en bloc, viz.:—Mr. G. W. Wigglesworth (Secretary); Mr. J. A. T. Carr (Treasurer); and Messrs. C. Pickering, Crosley and Harding; with the following additions:—Messrs. Smith, Hattersley, Roseveare, Lewis and Rhodes, whilst Mr. C. Pickering was subsequently elected as Chairman.

The question of President, Vice-Presidents, etc., was then discussed and finally left in the hands of the Committee.

In conclusion, a vote of thanks was passed to the local Co-operative Education Department for the loan of the room for this meeting, and also to the Chairman of the evening's proceedings.

The meeting was then declared closed and new members were enrolled.

There were upwards of 40 members and prospective members present, and judging by the liveliness of the proceedings and the interest displayed, the future success of the Association is assured.

Intending members are requested to communicate with the Secretary.

### Walthamstow Amateur Radio Society.

Hon. Secretary, Mr. R. Cook, 49, Ulverstone Road, E.17.

At the meeting of the above Society, held at its Headquarters, Y.M.C.A., Church Hill, Walthamstow, E.17, on Wednesday, July 12th, a very interesting and enjoyable evening was spent. After the usual informal discussion between members, business of the Club was commenced; minutes of the last meeting were read and approved. Three new members were admitted to the Club, bringing the total up to 45 members.

Mr. Butler gave an interesting lecture (for the benefit of the more elementary members of the club), on how to make a crystal set, and demonstrated on the blackboard how to construct and wire same.

The Secretary invites any gentlemen interested in radio telephony to join the Society, which will give them most valuable help.

A public demonstration was announced at the above address on Tuesday, July 25th, at 7.30 p.m.

All applications for membership and terms of subscription, together with the objects of the Association, will be immediately replied to by the Secretary.

### Gravesend Wireless Society.

Communications for this Society should be addressed to the Hon. Secretary, pro tem., Mr. W. C. Birchall, Kirbydene, 29, Pier Road, Rosherville, Gravesend, and not to the Globe Hotel, as hitherto.

### Midland W. Herts. Wireless Club.

Hon. Secretary, pro tem., Mr. J. R. Francis, Ivy Cottage, Redbourn, Herts.

Correspondence from all willing to assist in the holding of meetings in St. Albans, Harpenden, Hemel Hempsted and Berkhamsted, in connection with this new Club will be welcomed by the Secretary.

### Hyde Amateur Radio Society.

Secretary, Mr. A. Stainthorpe, 5, Cheapside, Hyde.

The Society now boasts of about a dozen members. A meeting was held on Wednesday, July 5th, at the Flowery Field Hotel, and a discussion was held on the design of the forthcoming two-valve set, many good suggestions being given.

A series of lectures are to be delivered shortly.

### Clapham Wireless Club for Boys.

An endeavour is being made to form a wireless club for boys in the Clapham and Stockwell districts. Mr. E. J. Valencia, 34, Stockwell Road, S.W.9, is willing to receive the names and addresses of those interested.

### The "Radio Rendezvous."

Secretary, Mr. W. F. Fuller, Club address.

Amateurs in the districts of East Ham, Manor Park, Wanstead, Ilford, Forest Gate and Barking, are cordially invited to join the above club. The club rooms, 709, The Broadway, Manor Park, E. 12, are open until 10 p.m. daily, except Sunday.

### Sutton and District Wireless Society.

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

Although this is a comparatively new society, it is doing remarkably well and has already twenty members. There must be many other wireless experimenters in the district, however, who are still working on their own, and it is hoped that they will now come along and join forces in this society. In this way they will contribute to its success as well as get the advantage of each other's experience.

Full particulars and application form for membership may be obtained from the Hon. Secretary.

### Bridlington and District Wireless Society.

A wireless society for Bridlington and district is being formed. The undermentioned gentlemen would like to get in touch with those in and about Bridlington who are interested.

It is requested that communication be made with any of the gentlemen whose addresses are given below as soon as possible, who will gladly receive suggestions so that a society may be formed with little delay and of the most benefit.

Mr. O. Tholander, "Cliffcote," South Cliff, Bridlington; Mr. Norman E. Haigh, 24, St. John's Avenue, Bridlington; Mr. M. Horspool, "Darley," Marton Road, Bridlington.

# Questions and Answers

*NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules :—(1) Each question should be numbered and written on a separate sheet on one side of the paper, and addressed "Questions and Answers," Editor, The Wireless World and Radio Review, 12/13, Henrietta Street, London, W.C.2. Queries should be clear and concise. (2) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. (3) Each communication sent in to be accompanied by the "Questions and Answers" coupon to be found in the advertisement columns of the issue current at the time of forwarding the questions. (4) The name and address of the querist, which is for reference and not for publication, to appear at the top of every sheet or sheets, and unless typewritten, this should be in block capitals. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume." (5) In view of the fact that a large proportion of the circuits and apparatus described in these answers are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents. (6) Where a reply through the post is required every question sent in must be accompanied by a postal order for the amount of 1s., or 3s. 6d. for a maximum of four questions. (7) Four questions is the maximum which may be sent in at one time.*

**"A.B.C." (Leicester)** *asks* (1) *Whether the making up for his own use of various apparatus to circuits which contain patented features renders him liable to action for infringing the patents.* (2) *If he will be allowed to sell similar sets to friends.*

You may make up sets for your own experimental use without rendering yourself liable, but you must not make up sets for any commercial or similar use, and by the sale of such sets, both you and the purchaser would immediately become liable.

**"F.A.G." (S.W.1)** *gives details of coils and windings and asks* (1) *The wavelength range.* (2) *Winding data for a frame aerial to fit the lid of a Mark III tuner case.* (3) *Details of a five-valve circuit with switching arrangements for two, three, four and five valves.*

(1) You apparently wish to use a frame aerial set. If so, coils may be used to load up the frame, as many as required at any time being connected in series with it. The arrangement would not be very efficient, and we do not recommend using these coils at all. (2) Wind about 120 turns of No. 28 in a single layer on a former of the required size with tappings at 3, 6, 15, 30 and 60 turns. (3) See Fig. 3, page 31, April 1st issue. The range would be about 8,000 metres, with a 0·002 mfds. condenser.

**"G.R.G." (Marlborough)** *wishes to construct a Johnson & Rahbek loud speaker, and asks various questions about same.*

(1) Distortion would be introduced in this arrangement from the telephone diaphragm employed. (2) Yes, but this arrangement might be found less sensitive. (3) The windings would depend on the input winding of the amplifier. If L.R., make the primary 4 ozs. of No. 32; if H.R., 2 ozs. of No. 44. For the secondary use 4 to 6 ozs. of No. 44.

**"E.D." (Birmingham)** *asks* (1) *What is the longest distance telephony can be heard with head telephones, and the longest distance with Brown's loud speaker.* (2) *Details for making a set.* (3) *If the seven-valve set in "Amateur Valve Stations," page 14 is suitable for long and short distance telephony.* (4) *Would Brown's type A head telephones, wound with 4,000 ohms, be best, and the loud speaker wound for the same.*

(1) It depends entirely on the power of the transmitter and the sensitivity of the receiving set. Under favourable conditions telephony is possible across the Atlantic. (2) It is impossible to answer this without a more definite statement of requirements. Many good circuits have been given in these columns, almost any of which would serve your purpose, but we should recommend studying a textbook on the subject before starting to make a set. (3) The set referred to is quite unsuitable for your use or construction, and moreover it has no tuning circuits. It is purely a commercial amplifier. A three-valve set would be quite sufficient for your purpose. (4) 4,000 ohm telephones O.K. The loud speaker can have any standard high resistance telephones.

**"P.R.T." (Southport).**—(1) and (3) The circuit is incorrect; see Fig. 1, page 303, June 3rd issue, and many other recent diagrams for the correct arrangement of the valves. (2) About 0·0002 mfds. for short waves. (4) Not essential, but convenient if a large range of wavelengths is to be covered.

**"J.E.W." (Berkhamsted).**—The information you give is rather sketchy, and there is nothing to indicate why the circuit will not work. The diagram submitted is correct. We cannot give the wavelength range as you do not say the size of your inductance former. The capacity of the variable condenser is approximately 0·0003 mfds.

**"W.C.A." (Plymouth)** *asks* (1) *Why a single valve set gives no results.* (2) *Whether an indoor aerial of wires 17 ft. long under the roof would be satisfactory.* (3) *If an outdoor aerial 35 ft. long and 20 ft. high, somewhat screened, would be better than the aerial above.*

(1) We cannot say without more information. Your circuit may be wrongly connected, or have some accidental disconnection, or the valve may be defective, or see below. (2) The aerial is very poor and unlikely to give much except on a three or four-valve set. (3) Considerably better, but better still would be required for really good results.

**"NUMBERS" (Paddington)** *asks for winding data for tuning coils for various wave ranges with aerials ranging from 90 to 110 ft.*

It is impossible to predict sufficiently accurately to distinguish between such aerials, as the gauge of wire, height above ground, etc., would affect results considerably. The figures given must be

taken as approximate only. Reaction coil should preferably be small enough to slide inside A.T.I. Say, A.T.I. 2" diameter; reaction coil, 1½"; wire being No. 28.

| λ | A.T.I. | R |
|---|---|---|
| 180 | 25 | 40 |
| 400 | 50 | 50 |
| 440 | 55 | 50 |
| 1,000 | 180 | 100 |
| 1,050 | 200 | 100 |

**"C.B." (Cardiff)** *sends diagram of set and asks for a variation adding further valves.* (2) *If his present connections would be suitable for* **2 MT** *and* **PCGG.**

(1) See diagram Fig. 1. (2) The set is O.K. for the purpose, except that the reaction coil should be in series with the anode resistance and not in shunt across it.

**"J.L.S." (Huddersfield)** *asks* (1) *Which of the following coils, honeycomb, slab or solenoid, are best for various types of reception.* (2) *Dimensions for* 0·0001 *mfd. and* 0·001 *mfd. condensers, using* 0·01 *ebonite.*

(1) We have frequently pointed out that this is largely a matter of wavelength. Cylindrical coils are best, but become impracticable on long waves owing to the size involved. Therefore, at such ranges, the more portable but less efficient honeycomb and slab coils are used. Of these, honeycomb coils are considerably better than slab. (2) For 0·001 mfd. seven foils with an overlap for each of 3 cms.; for 0·001 mfd., 19 foils with an overlap of 10 sq. cms.

**"F.W.P." (Tooting).**—(1) The arrangement is quite good, but we should expect it to tune to higher values of wavelengths than you suggest. (2) We prefer the use of C.1 and C.2 to that of C.3 and C.4, but even with these condensers it will be necessary to use interchangeable or tapped transformers to cover the whole range. (3) Diameter, say 1½", length up to 4", windings varying from about 30 turns each up to about 50 turns each. Make the final adjustment experimentally.

**"J.G.G." (Holland Park)** *asks if it is possible to obtain results on a single valve set with a twin aerial* 28 *ft. long on masts raised at* 6 *ft. above a flat metal roof.*

The arrangement will give very poor results unless the height of the masts is increased. If the height is increased to say 15 or 20 ft., results should be quite satisfactory.

**"A.L.D." (Horsforth)** *asks for information with regard to a circuit.* (2) *For data for a tuner.*

(1) Quite satisfactory, except that for short waves A.T.C. should be in series with A.T.I., also that the set would give serious re-radiation. C.1, C.2 and C.4 may be 0·0005 mfd; C.3 may be

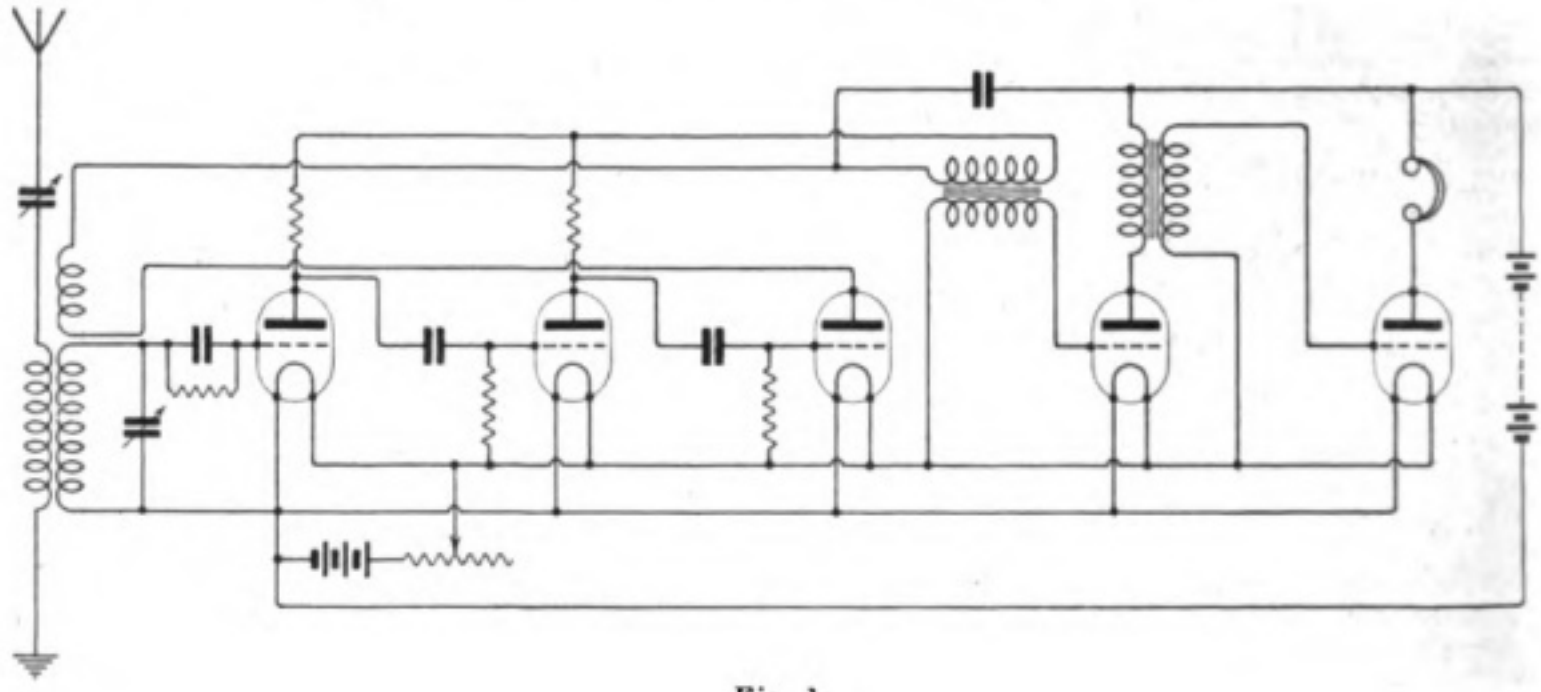


*Fig.* 1.

0·001 mfd. Grid condenser 0·002 mfd., and leak 2 megohms. (2) Coils used might be as given to **"J.D." (Cambridge)** above.

**"J.L.C." (Finchley)** *submits an arrangement for supplying H.T. for a valve from house mains and asks* (1) *If satisfactory.* (2) *If it is detrimental to an aerial to have it fixed to a tree with overhanging branches.* (3) *If he will be infringing a patent by using home-made apparatus which is patented by a commercial firm.*

(1) This depends on the voltage your valves will stand. The arrangement will give them practically full voltage of mains and will be correct if they will stand it. Otherwise, a number of lamps should be used in series as a potentiometer, and the valve tapped across the desired number to get the right voltage. (2) This will lead to some inefficiency. (3) See reply to **"A.B.C." (Leicester)** in this issue.

**"PETE" (Earl's Court)** *asks how to make a* 0·0015 *mfd. variable condenser as described in the issue of August* 21*st*, 1920, *which is now out of print.* (2) *What resistance telephones are required for the single valve set described in the issue of February* 5*th*, 1921.

(1) The condenser had 30 fixed and 29 moving plates, diameter of moving plates being 2·5/16", gauge of plates No. 20; spacing washers 2 mms. thick. (2) Anything over 2,000 ohms.

**"J.D." (Cambridge)** *asks* (1) *For a loose coupler for* 100/1,000 *metres with a* 0·002 *mfd. condenser.* (2) *Diagram for a three-valve panel to fulfil certain conditions.* (3) *If a crystal with separate heterodyne gives as good results as a single valve.* (4) *Approximate range with a* 1½ *kW. telephone transmitter and a three-valve receiver.*

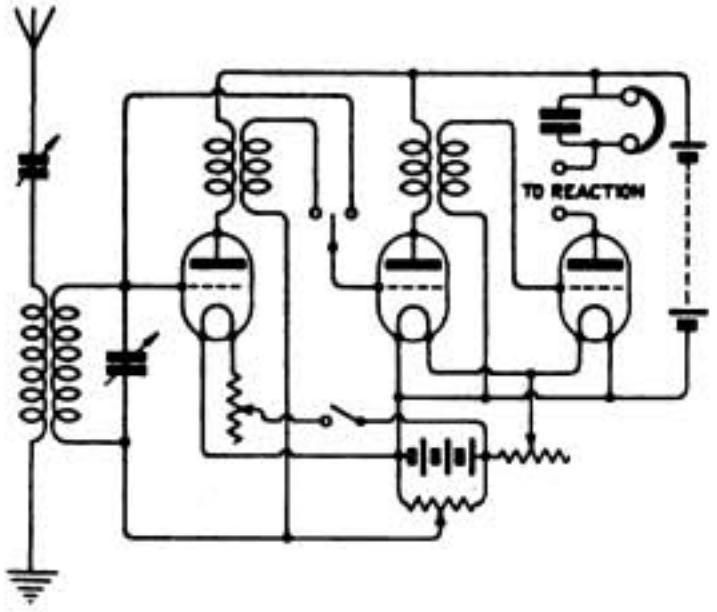



*Fig.* 2.

(1) Primary, 6″ × 4″ of No. 22, with a slider secondary 5″ × 3″ of No. 26, tapped at 1″, 2″ and 3″. (2) See diagram Fig. 2. (3) No. (4) About 100 miles for good results.

**"W.H.M." (Kingston)** *asks* (1) *If a larger aerial makes reception stronger, or if it merely governs the wavelength.* (2) *Asks for a multi-valve set to fulfil certain requirements.* (3) *If increase of his aerial will need the introduction of any instruments to bring the wavelength back to normal value.*

(1) Generally gives increased strength of signals. (2) See Fig. 2, page 276, May 27th issue, and many similar circuits, but we should caution you that the satisfactory construction of such a set is extremely difficult without previous experience with simpler types, as there are numerous pitfalls which can only be found out by experience. (3) The increase of your aerial will not very greatly affect your wavelength except at minimum values. The wavelength can be reduced again by the addition of a series A.T.C. if necessary.

**"MINOR" (Dartford)** *asks for information on the construction of a resistance capacity L.F. amplifier.*

The arrangement should be exactly similar to the H.F. amplifier of this type, except that the intervalve capacity used may be about 0·005 mfd., and the leak less than usual, say 200,000 ohms.

**"TREBLE" (Littleborough)** *asks* (1) *Whether it is possible to receive* 700 *ms. on a set arranged for* 1,500 *ms. and over.* (2) *If the earth wire may be connected to water-pipes going all through the house.* (3) *If various wires in his neighbourhood are likely to give him induction troubles.* (4) *If a frame aerial would give him any better results.*

(1) Not without various alterations to the set. (2) No, provided that the pipes run fairly near to the receiver. (3) The only wires likely to interfere seriously are the tram wires, but these are likely to give you a good deal of trouble. (4) This might help to cut out some of the trouble from the tram wires.

**"D.S." (Ferryhill)** *asks* (1) *Whether certain Brown telephone transformers are suitable for use with low resistance telephones.* (2) *Number of sheets of foil for a certain condenser.* (3) *Wavelength range of his set.* (4) *Whether a power station* 100 *yards away is likely to give him any trouble.*

(1) We cannot say without examination, but probably not, as many of these instruments are merely for use with the Brown telephone relay, with windings quite unsuitable for your purpose. (2) Four. (3) 7,000 ms. max. (4) Probably not seriously, although it is impossible to say for certain without test.

**"R.B." (Oldham)** *asks* (1) *Whether a single valve circuit would give good results on broadcasting at ten miles with a loud speaker.* (2) *For a good book on valve theory.* (3) *Windings for an A.T.I. and reaction coil for* 3,000 *ms.* (4) *Why telephony is receivable on a crystal.*

(1) No, at least one stage of note magnification would be required for good results. (2) Bangay's "Oscillation Valve" is quite a good book at a reasonable figure. Scott-Taggart's book on valves is also a good work on a larger scale. (3) Primary, 9″ × 6″ of No. 22; secondary, 7″ × 5″ of No. 26. (4) Because the audio frequency variations of the carrier C.W. have similar effects on the detector and the telephones as the audio frequency sparks of a spark set.

**"S.W." (Portsmouth)** *asks how to add an amplifying panel to his present single valve panel.* See diagram Fig. 3.

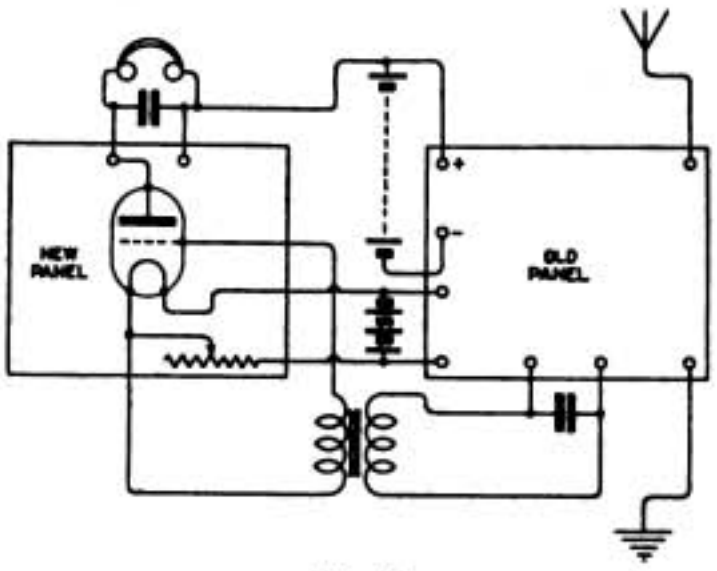



*Fig.* 3.

**"_____" (Folkestone)** *asks* (1) *For wiring for a variometer to tune a circuit from* 400 *to* 1,500 *ms.* (2) *For a reaction coil to suit a circuit up to* 15,000 *ms., and to use with a certain frame.*

(1) The prediction of a variometer to fulfil this requirement would be very difficult, and the instrument would be very inefficient at the shorter wavelengths. It would be much better to use a solenoid coil with taps, and a spherical at one end to provide tuning between the taps. Coil might be 8″ × 4″ of No. 22, with a 3″ spherical at one end. (2) Try 9″ × 8″ × 1½″, wound with No. 26, with tappings at 6, 12, 24 and 30 turns.

**"A.E.R." (W.1.)** *asks for diagram of a six-valve receiving set embodying five H.F. valves and one rectifier and making use of magnetic reaction.*

For circuit see Fig. 4. It is essential that the transformers should be of precisely the same value as in a multi-valve H.F. amplifier. Should one or two transformers have slightly different values they will filter out wavelengths on which the others are designed to give amplification. With an amplifier of this sort you are advised to adopt a construction for the transformers that will permit of them all being precisely the same. We would recommend you to wind the transformers on a 1" ebonite rod, making primary and secondary each of a single layer and insulated from one another by a single wrapping of empire cloth. Make both windings in the same direction and the finishing ends will go to grids and plates. The rectifying valve should be specially selected to give good rectification, such as "Q," "Qx," or "R4B."

**"C.H.H." (Sheffield)** *asks* (1) *Whether a certain three-valve set can be used with a frame to receive* **2 MT** *and other similar stations.* (2) *For the capacity of certain condensers.* (3) *What type of valve to use.* (4) *If the aerial and the set should be in the same room.*

(1) Possible, if not too badly screened. (2) Variable, 0·0005 mfds.; fixed, 0·0002 mfds. (3) Any good hard valve on the market. (4) Yes.

**"THREE VALVE" (Westcliffe)** *asks* (1) *For a three-valve circuit to fulfil certain requirements.* (2) *If H.F. is the best way to add a third valve.* (3) *Why long wave stations have gone weak on his set although it still gives short wave stations all right.* (4) *Why the positive plates of his accumulator have fallen to pieces.*

(1) See diagram for **"J.D." (Cambridge)**, using an L.F. transformer in place of the second H.F. transformer shown. (2) Yes. (3) Impossible to say without some knowledge of the type of circuit you are using; but it may be due to a bad connection or a short-circuited turn in some part of your circuit which is not in use on the shorter wavelengths. (4) This is a common result of careless treatment, too rapid charge or discharge, or wrong density of acid.

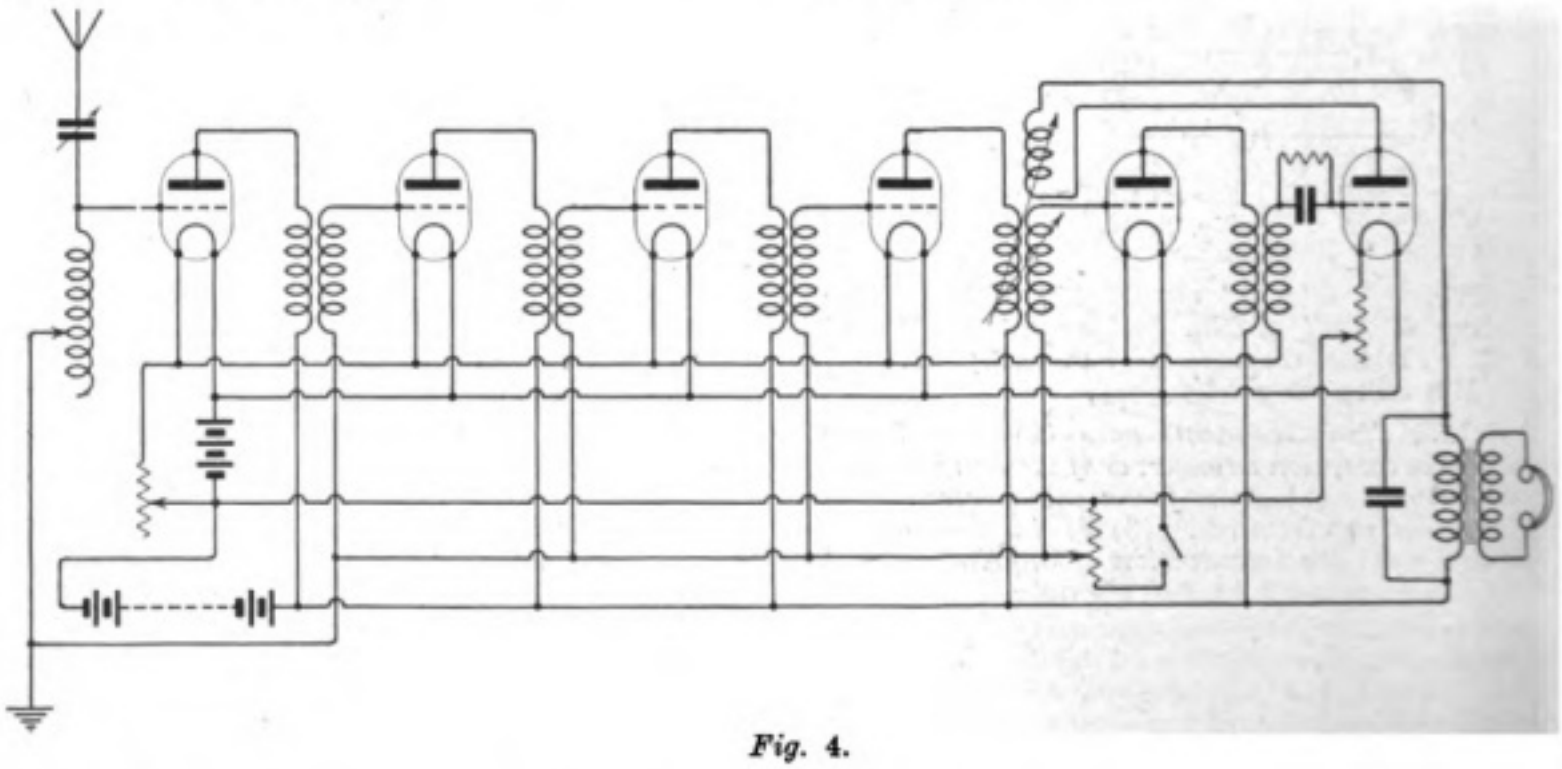


*Fig. 4.*

**"H.L.F." (Kensington).**—(1) Primary, 8" × 6" of No. 22; secondary, 6" × 4" of No. 26. (2) See Fig. 4, page 372, June 17th issue. The grid condenser may be 0·0002 mfds., and the grid leak 2 megohms. (3) Yes.

**"J.W.B." (Birmingham).**—(1) These coils will tune to about 2,600 ms. on an average P.M.G. aerial. We cannot state the minimum value at all accurately, but it will probably be less than 300 ms. (2) Yes. (3) For **PCGG** resistance coupling, but for broadcasting transformer coupling will be better. (4) Connect the reaction coil in the anode of the detecting valve. Use the condenser in series with the aerial tuning inductance.

**"R.G." (Newport, Mon.).**—(1) This is probably due to considerable capacity in these coils. (2) This might easily be the case if coils A and B were fairly tightly coupled. A similar effect might be noticed if your aerial circuit were not tuning properly. This is not an unusual freak effect obtained with an untuned aerial. (3) Do not use a microphone; use direct connection from the set.

**"N.S." (Manchester)** *asks where to obtain drawings of the seven-valve amplifier shown on page* 14 *of "The Construction of Amateur Valve Stations."*

This amplifier is the design of a commercial company, who have naturally not authorised the publication of their drawings, although diagrams of the instrument have appeared in various places, as for instance in Fleming's book of valves. The instrument is a commercial amplifier designed for special purposes, and is useless as a receiver without the addition of suitable tuning circuits.

**"W.G." (Hastings).**—(1) Circuit shown is quite correct. Wavelength maximum probably about 3,500. (2) See Fig. 5, page 124. (3) The telephones may be used without change. (4) Circuit should be efficient at all wavelengths.

**"C.H.S." (Wolverhampton)** *asks* (1) *If it is probable that the use of reaction will not be allowed in the case of broadcast receiving apparatus.* (2) *If there is a circuit which gives the advantages of reaction without the risk of reradiation.* (3) *For circuit diagram of a two-valve broadcast receiver.* (4) *For the errors to be pointed out in certain calculations he has made from data with regard to inductance and wavelength.*

(1) and (2) We cannot say, but we should imagine that no steps would be taken to prohibit the use of such an excellent property as reaction in receiving circuits, though every effort should be made to prevent the use of circuits in which the reaction coil is coupled back directly to aerial inductance. Reradiation is reduced by adopting intervalve H.F. coupling and arranging the reaction between grid and plate circuits of the second valve. See circuit Fig. 5. (3) See circuit Fig. 3, page 436,

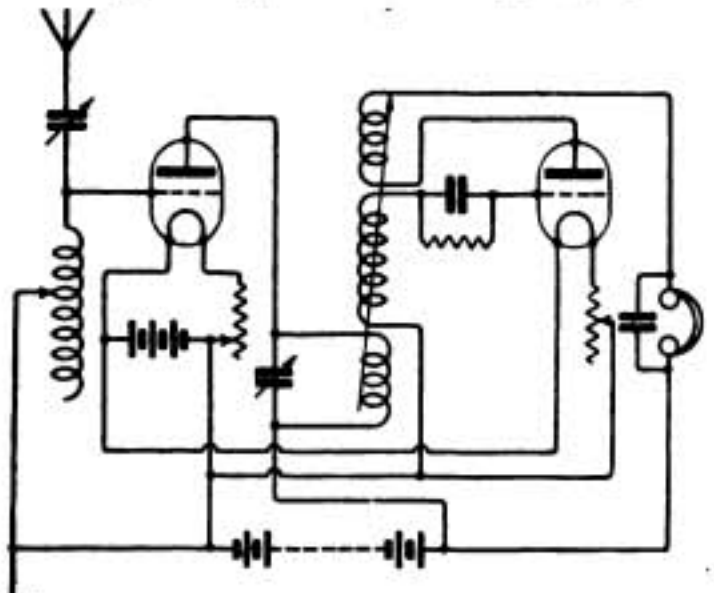


*Fig. 5.*

or Fig. 5, page 437, July 1st issue, omitting reaction coil in each case. (4) Without going deeply into your figures we would point out that any calculations of this nature are perfectly useless with regard to the determination of the values of loading inductances for use in amateur circuits. For instance, without calibrated apparatus it is not easy to determine the capacity or inductance of an aerial, but is comparatively simple to conduct a few experiments to find the amount of wire necessary to load to a given wavelength.

**"S.J.N." (Tottenham)** *asks* (1) *For criticism of an enclosed diagram.* (2) *Maximum wavelength of the set.* (3) *Maximum capacities of variable condensers.*

(1) The circuit shown is O.K. but the coil marked reactance is only a closed circuit inductance and not a reaction coil. A reaction coil might be added in the plate circuit of the valve, coupling with the above coil, which should, moreover, be wound with about No. 28 or 30. The values will then be O.K. (2) Approximately 3,599 metres. (3) 0·0005 mfds.

**"SPARKS" (Morecambe)** *asks* (1) *If a circuit enclosed is correct and suitable for telephony.* (2) *If the earth lead to a water-pipe* 10 *ft. away is O.K.* (3) *For a diagram for adding another valve to his set.*

(1) O.K., except that for short waves the A.T.C. should be in series with the A.T.I. (2) O.K. (3) See Fig. 1, page 119, issue for April 22nd.

**"UNCLE TOM" (Bournemouth)** *asks* (1) *For a diagram of a two-valve transmitter for C.W. and telephony.* (2) *Data for wiring transmitter.* (3) *If more valves can be added without dismantling set.* (4) *Values of condensers and resistances.*

(1) See diagram (Fig. 00). (2) It depends largely on the aerial. Try about 40 turns on a former 3" diameter for the A.T.I., and 80 turns on a 2" diameter former for the reaction. (3) Not usefully, except in parallel with the oscillating valve. (4) For grid condenser 0·001 mfds, with 250,000 ohms. Feed condenser try 0·0005 mfd.

**"N.S." (Pendleton)** *asks* (1) *Why transmitting stations give call signals in Morse and not speech.* (2) *For an opinion on B.T.H. portable set.* (3) *How to adjust his three-valve set.*

(1) Telephonic stations usually give calls in speech. Telegraphic stations call in Morse, as they are generally incapable of speech. Some telegraphic stations experimenting in telephony call in Morse as this is their normal method of communication. (2) This set is quite O.K. for getting various high power stations and ships under favourable conditions, but is not intended for short-wave telephony on which the range is poor, unless specially wound for the purpose. (3) Impossible to say without knowing the type of set to be employed.

**"BEGINNER" (Leyton)** *asks* (1) *If an amateur can construct an efficient portable set.* (2) *Where he can obtain details of construction of same.* (3) *In which issue can he get detailed instructions of a three-valve set.* (4) *Would this set be efficient on a frame aerial.*

(1) Yes, but we should not advise a beginner to work on a set of this type. (2) We do not know of any suitable detailed instructions. (3) and (4) A suitable set for this purpose is described in numbers 16 to 21, Vol. VIII, which can be obtained from the publishers.

**"T.J.W." (Much Wenlock)** *asks* (1) *The simplest way to add a valve to a certain crystal set.* (2) *What telephony he would hear if a valve were added.* (3) *Why he gets nothing with his crystal set although he gets clicks when joining up the telephones.* (4) *If a broadcasting station is likely to be established near.*

(1) The only easy way would be the addition of a note magnifier, as in Fig. 2, page 336, but a new set on the lines of Fig. 5, page 124, would give much better results. (2) You should get stations as in question 4, with the altered set. There is probably very little to be got at present. (3) The set and aerial are of somewhat poor quality. You are not likely to get strong signals on a crystal in your district. (4) Birmingham and Manchester will be the nearest stations, neither of which you are likely to get very strongly on a crystal set.

**"READER" (Norwich)** *asks* (1) *What is the maximum distance from which his set would receive telegraphy.* (2) *How much wire would wind a certain former full of No.* 26. (3) *Would his circuit be satisfactory using the inductance sketched.* (4) *What wavelength could he reach with a certain set which he describes.*

(1) You should get FL, Nauen, and a few similar high power Continental stations. (2) 700ft., say ¾ lbs. (3) O.K. (4) 4,500 metres.

**"DEAF" (Wolverhampton)** *asks* (1) *If there is any likelihood of the Post Office refusing to allow amateurs to use valve sets.* (2) *Will it be possible to receive broadcasting successfully on a crystal set and to use a loud speaker at about* 30 *miles distant.* (3) *The best crystal set which does not require a battery.* (4) *Can crystals be purchased which never need adjustment.*

(1) No, although sets capable of reradiation may be forbidden. (2) 30 miles can be done under favourable conditions on a crystal set, but it will not operate a loud speaker, which would necessitate the use of a two or three stage L.F. amplifier. (3) Zincite-copper pyrites is very good, but, like all other sensitive combinations, does require some adjustment. (4) Carborundum seldom needs adjustment, except a slight variation of potentiometer setting from time to time.

**"PARALLELEPIPED" (Bournemouth)** *asks* (1) *Could he receive at Bournemouth* FL *time signals and weather forecast with an aerial frame* 4′ *square and crystal detector.* (2) *How many turns of wire in the aerial would give the best results with* 2,600 *metre waves.* (3) *Would tram wires* 80′ *distant cause trouble.* (4) *What is the carborundum detector described on page* 359 *which requires no adjustable potentiometer.*

(1) No. (2) About 20. (3) Not unless you are using several stages of amplification. (4) The crystal used is of normal type. The absence of need for a potentiometer is due to the special circuit employed, of which we are not at present at liberty to give further particulars.

**"S.O.S." (Oundle).**—(1) Impossible to say on the little information you give. Either there is something seriously wrong with the connections or the coils are of unsuitable dimensions. (2) Yes, if condenser is used across the telephones, but the set will give serious reradiation trouble.

**"G.E.B." (Manchester).**—(1) This could be done but would not be very efficient. (2) Wind 40 turns on a frame 3′ in diameter, tapping at 5, 10 and 20. (3) Connect a condenser across this frame and a condenser across the filament and grid of the valve. (4) About 45 plates would be required.

**"J.H.B." (Muswell Hill)** *asks for criticism of a set.*

The circuit is fairly good, but a condenser is required across the telephones, also the use of coupled circuits would minimise reradiation; and we do not advise gas-pipe earths.

**"M.C.N." (Yarnton)** *wishes to make up receiving set to the diagram given on page* 368, *June* 17*th issue, and asks* (1) *Whether certain makes of inter-valve transformers would be suitable.* (2) *Whether any alteration is necessary.* (3) *The resistance ratios of the transformers marked* 1/1 *and* 10/1. (4) *Where he can obtain suitable variable condenser.*

(1) We should prefer you to use transformers of the type marked "B." It is essential that these inter-valve transformers be wound in such a way that their values can be relied upon to be identical. Should one transformer operate on a slightly different band of wavelengths to the others, it will filter out signals which the remainder of the transformers would efficiently amplify. (2) No alterations are necessary excepting that a much smaller aerial tuning condenser will be required, as you only intend to tune up to about 3,000 metres. (3) 9,000 to 1,700 ohms and not 1/1 as shown. 11,000 to 120 ohms for low resistance telephone receivers. (4) Use an aerial tuning condenser with air dielectric and a maximum of 0·0015 mfd.

**"W.E.C." (Putney)** *asks* (1) *If circuit diagram Fig.* 33 *on page* 340, *June* 10*th issue is suitable for use with "Oojah" slab coils and five inter-valve H.F. transformers for ranges of* 300 *to* 5,000 *metres.* (2) *Or alternatively, for a three-valve diagram embodying one H.F., one rectifier and L.F. magnifier.*

(1) Yes, these coils and transformers may be used as components for building up the circuit for wavelengths beyond 1,500 metres. You may find it easier to adopt resistance capacity valve coupling as shown in Fig. 2, page 294, June 3rd issue. (2) For suitable circuit see Fig. 1, page 58, or Fig. 1, page 37, in April 8th issue.

**"R.W.S." (Highbury)** *wishes to know how he can use a Marconi crystal receiver set, Type* 16, *in conjunction with a three-valve amplifier and loud speaker.*

You would be well advised to dismantle the crystal receiver and re-wire the components, making use of the potentiometer for controlling the grid of the first valve. The aerial circuit may stand as it is for tuning, and the closed circuit, together with its "Billi" condenser may be arranged to give reaction effects. Suitable circuit to use as a guide in effecting these changes will be found on page 304, June 3rd issue. You do not describe the three-valve amplifier, but if it is of the low frequency type you may fit the reaction coil in the plate circuit of the first valve, bridging the primary of the first transformer with a condenser 0·002 mfd.

**"J.A.R." (Walsall)** *wishes to install a receiver suitable for reception of broadcasted telephony, and asks* (1) *For circuit diagram and dimensions of coils, condensers, etc.* (2) *For details of high-tension transformer, if it is needed for use with his receiving set.*

(1) It is regretted that we cannot give you sufficiently complete details to be of help to you in setting up your receiving station. We would suggest that you read carefully the articles that we are publishing in alternate issues under the heading of "Experimental Station Design," the first of which appeared on May 27th last. The first instalment relates to the construction of aerials, and subsequent ones deal with the design of apparatus, and as you intend to construct your own outfit, it is probable that these articles will reach an advanced stage, giving you all the information required before you have had time to complete your outfit. (2) A high-tension transformer is not required for use in receiving apparatus, and no doubt you mean an inter-valve transformer, a description of which will shortly be given in the articles referred to.

**"J.G.C." (Ealing)** *refers to the article on an "American Short Wave Receiver," in the June* 3*rd issue, and asks the meaning of "Regenerative."*

The word "Regenerative" has usually the same meaning as reaction, and in the tuner referred to both grid and plate circuits are tuned by means of variometers, these adjustments facilitating the setting up of oscillations. The coupling back of the plate circuit to the grid circuit is effected by the relative dispositions of the various coils shown from Fig. 2, on page 283.

**"H.R.W." (Mildenhall)** *gives a cross sectional drawing of a former for constructing intervalve transformers, the diameter of which is 1", and asks for windings to cover wavelengths on 300 to 3,000 metres.*

For 300 to 500 use 450 turns for primary and the same number for the secondary; for 500 to 1,000 use 1,200 turns for each, and for 1,000 to 3,000, 5,000 turns. We recommend you not to make use of tappings, but to make separate transformers. As you propose to use a variable condenser with the transformer it is better to put the two windings on separately with insulation between. Put the windings on in opposite directions, taking the finishing end of the primary to plate and the beginning end and secondary to grid, the secondary winding being wound on over the primary.

**"HEAD WEIR" (North Devon)** *submits a circuit of a five-valve amplifier which makes use of break-jacks for varying the number of valves and circuit, and asks* (1) *For diagram showing the external connections and* (2) *For the number and dimensions of plates for the construction of the various condensers shown.*

(1) The aerial inductance is connected in series or parallel with aerial tuning condenser according to whether reception on short or long wavelength is required. The grid of the first valve and the common L.T. minus are connected across the ends of the aerial inductance. The reaction coil which is coupled to the aerial inductance, is plugged into the jack, which is connected in series with the plate circuit of the third valve. (2) The grid condenser should consist of three plates, being wound one in one direction, and two in the other, separated from each other by mica 0·002" in thickness, and having an overlap of 1" by $\frac{3}{8}$". The condenser which shunts the primary of the first low frequency inter-valve transformer, should consist of 15 plates, being 7 in one direction and 6 in the other, and having an overlap of 1" by $\frac{3}{8}$". Condensers are not required across the second and final L.F. transformers. The condenser which bridges the high-tension battery may have a value between 0·05 and 0·25 mfds., and can be made of tin foil with wax paper separation, and might roughly consist of 20 plates with an overlap of 4" × 6".

**"F.H." (Long Eaton)** *is constructing the American tuner described on pages 281 to 284, June 3rd issue and asks* (1) *The capacity of the grid condenser.* (2) *What wavelength 416 turns of No. 22 wire on a round former 6½" in diameter would give.* (3) *Whether the set is suitable for the reception of C.W.* (4) *Whether any additional apparatus is required.*

(1) A maximum value of 0·0005 mfd. (2) This depends upon the dimensions of your aerial, but with double cotton-covered wire the maximum wavelength would be about 3,800 metres on a two-wire aerial of the dimensions specified by the P.M.G. (3) Yes, but a little coupling between the grid and plate inductances is assumed owing to the manner in which they are arranged in the set. (4) No other apparatus is required to complete the single-valve receiver, and it can be thoroughly recommended for use exactly as shown in the diagram without the addition of other variable condensers.

**"M.A." (Nottingham)** *asks for windings of H.F. aperiodic transformers, using "Eureka" wire, and suitable for wavelengths between 300 and 1,000 metres.*

Wind with No. 47 S.S.C. "Eureka" wire on a 1" ebonite rod former, using 600 turns for primary, and 600 for secondary, separated from each other by a single layer of empire cloth, and both wound in the same direction. The leads which terminate at one end of the former are taken to grid and plate. 300 to 1,000 metres is rather a broad band for one transformer to operate on, and you will get better results if you provide a tapping at 200 turns on each winding for use on wavelengths of less than 400 metres.

**"E.H.N." (Colchester)** *sends specimens of variable condenser plates and asks* (1) *The number required to build up condensers of 0·0003, 0·0005 and 0·0015 mfds. capacity.* (2) *If he will be infringing patents by constructing and offering for sale, single, two-slide, and loose coupled tuning coils.*

(1) You do not say the spacing you propose to adopt between the plates, but if you make it one-eighth of an inch between consecutive fixed or consecutive moveable ones, you will require 7 fixed and 6 moveable for 0·0003 mfds., that is, 13 plates; 21 for 0·0005 mfds., and 61 for 0·0015 mfds. (2) We regret that we cannot constitute ourselves as advisers on questions relating to the use of patents.

**"A.C.D." (Leeds)** *possesses tuning coil and loose coupler, and asks for a three-valve circuit making use of this, and giving particulars of the other components required to build up a three-valve circuit.*

If you have fair experience in the manipulation of wireless apparatus you might adopt circuit tuning Fig. 1, July 1st issue. This circuit is described more fully on page 37, April 8th issue, where the values of the various condensers are shown. If you are a beginner we would advise you to follow the articles which are appearing fortnightly in this journal on Experimental Station Design. You will easily be able to embody your tuner in the making of the sets described.

**"H.B." (Birmingham)** *states that he is constructing an aerial tuning inductance 8" long by 6" in diameter, and proposes winding with No. 24 D.C.C., and asks for the positions for tapping off to give wavelengths 250/3,000, stepping up by ranges of approximately 100 metres in the lower values and 500 metres in the higher ones.*

It is impossible to say to what wavelength your inductance will tune as the range entirely depends upon the capacity and inductance of the aerial to which it is connected. Using a parallel condenser of maximum capacity 0·0015, your inductance will probably tune to a maximum wavelength of 3,500 metres on a two-wire aerial of the maximum dimensions specified by the P.M.G. If connected to a single-wire aerial the coil will probably only tune to 2,500 metres. We regret we cannot give tappings for the wavelengths you ask, but would recommend you not to bother about particular wavelengths, but to tap off at increasing intervals along the coil, bearing in mind that the wavelengths are proportional to the square of inductance, which is approximately directly proportional to the number of turns.

**"P.V." (Manchester)** *refers to a diagram of the Marconi seven-valve H.F. amplifier and asks* (1) *How to couple it to a tuner, making use of interchangeable coils.* (2) *Sizes of former, and wire for winding H.F. transformers suitable for reception of telephony.* (3) *The values of the condensers that bridge the primary and secondary windings of the transformers and* (4) *The method for connecting potentiometer to the rectifier valve.*

(1) Connect the aerial tuning inductance across the grid and potentiometer terminals of the first valve; *i.e.*, the two terminals shown on the extreme right. Reaction may be arranged in a variety of ways, but as the amplifier is only operative on a narrow band of wavelengths, perhaps the best way is to wind an inductance that can be coupled with the aerial coil, and connecting it to the terminals "G" and "F," leaving terminal "F" connected across to the next terminal on the right. Alternatively a small coil may be wound, say of 20 turns of No. 34 S.S.C. wire on a 1" former, and connected in series with the aerial inductance. This coil should be placed near the end of the third or fourth intervalve transformer. (2) The winding of the transformer is very important, and must be very carefully carried out. One faulty transformer will filter out wavelengths on which the others operate best. For wavelengths of 250-420 metres, wind the transformers with 260 turns of No. 38 S.C.C. on a 1" ebonite rod. Primaries and secondaries should have exactly the same number of turns, and be separated from one another by a single layer of empire cloth. The two windings should be in the same direction, and the leads which come from one end of the transformer are taken to grid and plate. (3) The six condensers bridging the transformer windings should be of the order of 0·0005 mfd. The condenser bridging the L.F. transformer to have a capacity of 0·001 mfd., that across the potentiometer 0·0003, and the one from the telephone transformer secondary to the L.T. minus, about 0·05 mfd. (4) Separate grid control for the rectifier valve can be arranged by connecting potentiometer across the L.T. battery, and taking the lead that would normally go to "G," after, if necessary, passing through the reaction coil to the sliding compact.

**"T.H." (Highbury)** *asks whether we would recommend the use of circuit Fig. 6 in "Construction of Amateur Valve Stations," for use with a frame aerial.*

This circuit cannot be recommended with a small indoor frame aerial. The circuit is not provided with reaction, a property which is practically essential for frame aerial reception. You do not say the maximum dimensions of the frame, but we would recommend you to adopt four feet to six feet at the minimum, and use a circuit built up on the lines of Fig. 7 in the book to which you refer.

**"V.G." (Luton)** *has a Mark III crystal receiver, 2,000 ohm telephone receivers, and an aerial 25 ft. high by 75 ft. long, and wishes to know if the outfit is suitable for reception at Luton of telephony from Marconi House and Writtle.*

You should be able to get the telephony from Marconi House, though perhaps with difficulty. It is doubtful if the telephony transmission from Writtle can be received on a crystal set at this distance. When a system of broadcasting on higher power than is used at present is established your set should prove quite useful.

**"C.W.G." (Hull)** *draws our attention to the diagrams given in connection with the article on single valve long range receiver which appeared in Volume 8, and points out a discrepancy in the practical wiring diagram and the circuit diagram.* (2) *If a diagram he submits is the correct way for rearranging the reaction coil.*

(1) You should wire exactly as in Fig. 1, on page 781. The construction in this set necessitates fair skill in pile winding, which if not carefully executed will nullify any merits there may be in the special design of the receiver. You would be well advised to follow the details given under the heading of Experimental Station Design, particularly that appearing in July 8th and subsequent issues. (2) The diagram you give for tapping out the reaction coil is quite correct and you should take care that the single layer winding for short wave, which is on the outside, continues in the same direction as the pile winding. The spindle connection is taken from the finishing end of the outer single layer, the short wave tap is taken from the connection between the outer layer and the pile winding, and the long wave tap from the beginning end of the pile winding.

**"L.F.S." (Edgbaston)** *submits a circuit comprising H.F. amplifier, detector, and note magnifier, and asks* (1) *For criticism.* (2) *For the completion of a skeleton three-valve diagram.*

(1) The condenser marked "A" has a capacity of 0·001 across the primary of the H.F. transformer, and, we presume, is variable. You should endeavour to operate this transformer without a variable condenser, and if that does not give good results, the maximum capacity condenser that may be used efficiently is 0·0004 mfd. The remainder of your circuit is quite correct and should give good results. It is advisable in such a circuit to use special valves designed to function efficiently in the various circuits in which they are connected. The H.F. and note magnifier valves should be of the "R" type. The detector valve should have good rectifying properties, such as "R4B" or "QX." As you use a potentiometer to control the grid potential of the rectifier, a soft valve, or one having a steep curve, would give good results. (2) We have scrutinised your diagram, and it is quite correct.

## SHARE MARKET REPORT

Prices as we go to press on July 17th, are:—

| | | | |
|---|---|---|---|
| Marconi Ordinary .. .. | £2 | 3 | 6 |
| ,, Preference .. .. | 2 | 1 | 0 |
| ,, Inter. Marine .. .. | 1 | 7 | 6 |
| ,, Canadian .. .. | | 11 | 0 |
| Radio Corporation of America:— | | | |
| Ordinary .. .. .. | 1 | 1 | 6 |
| Preference .. .. .. | | 14 | 0 |

The Report of the Directors of the Marconi International Marine Communication Company, Ltd., and Statement of Accounts for the Year ended 31st December, 1921, was presented to the shareholders on Tuesday, July 25th, 1922.

The Directors recommended the payment of a final dividend at the rate of 5 per cent., which, together with the interim dividend declared at the beginning of December last, amounts to 10 per cent. for the year.