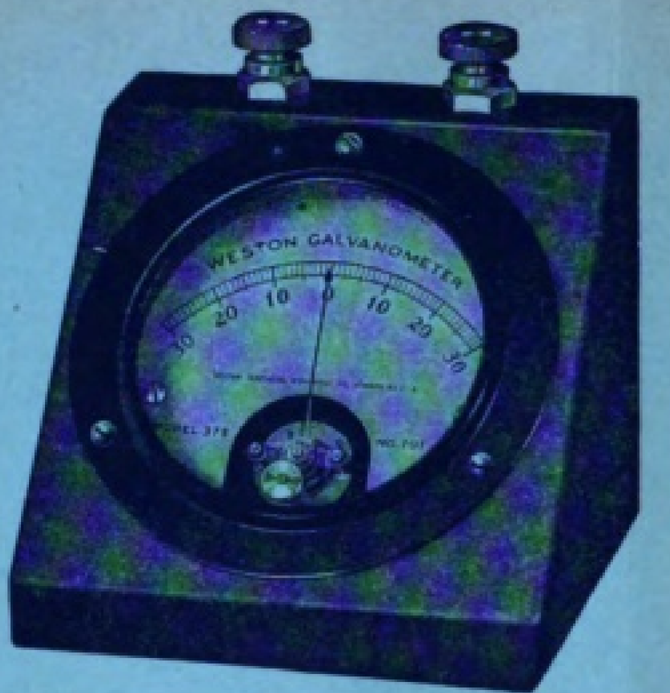
The WIRELESS WORLD

FORTNIGHTLY] AUGUST 6th, 1921. PRICE 6D. NET

WESTON

STUDENT'S GALVANOMETER



Model 375 Galvanometer is a moving coil instrument with a uniformly divided scale 2·35 inches long. Its resistance is approximately 29 ohms and the current required for a millimeter (1 scale division) deflection is 20-25 micro-amperes.

WESTON ELECTRICAL INSTRUMENT CO., LTD.

Audrey House, Ely Place, Holborn, E.C.

Telephone: HOLBORN 2029. Telegrams and Cables: "PIVOTED, LONDON"

R.A.F. Seven Valve Receivers

Brand new, in Mahogany Case, without Valves - - - -	£13 15
With set of seven R. Valves specially picked for use with receiver - - - - - -	£18
Set of parts to make R.A.F. Seven Valve Receiver, including H.F. Transformer cores, three wound L.F. Transformers, mahogany case, and all necessary screws, etc. - -	£8 8

Also many oddments too numerous to list, including Mark III Tuner parts. Abridged List Post Free.

British Wireless Supply Company
6, BLENHEIM TERRACE, LEEDS
Tel. 26926.

Attractive Offer

OF **"BROWN'S" Super-Sensitive RADIO 'PHONES.**

Messrs. S. G. Brown, Ltd., have for sale a limited number of **A-type 'Phones,** which they have acquired from the Disposal Board. These 'phones have been re-conditioned at Messrs. Brown's Works and are fitted with improved moisture proof "all metal" diaphragm, and are guaranteed. The advantage of obtaining these from the original makers is obvious, and the price is only

£2 2 0 per pair, for high-resistance, and
£1 19 0 per pair, for low resistance.
These prices include Army Cords.

As the supply is limited, Buyers' orders should not be delayed. Orders may be placed direct or through local dealers.

To ensure getting THESE re-conditioned 'phones, see that they are packed in boxes bearing BROWN'S label of instructions.

S. G. BROWN, Ltd.,
VICTORIA ROAD, NORTH ACTON, W.3.
Telegrams; Sidbrownix, London. Telephone; Chiswick 1469.

THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. IX. No. 36. AUGUST 6TH, 1921 FORTNIGHTLY

THE ELECTRON THEORY AND ITS APPLICATION TO THE STUDY OF THE THERMIONIC VALVE*

By F. A. SLEATH, Student I.E.E.

IN chemical compounds the ingredients will only combine in definite proportions, *e.g.*, 28 parts by weight of nitrogen will combine with 16 parts of oxygen, forming nitrous oxide. The smallest amount of this compound which could exist, while still retaining the properties of nitrous oxide is called a molecule. This molecule is composed of atoms of nitrogen and oxygen. Molecules are capable of exerting enormous attractive forces when brought within very minute distances. Now a bar of steel is very strong, but if it is broken no ordinary pressure will join it because the two pieces cannot be brought sufficiently close together for the molecules to exert their mutual attractions.

Molecules are always in a state of rapid motion, and the differences of this motion and the balance between the attractive forces, account for the various states of matter, *i.e.*, solid, liquid and gaseous.

In solids the molecules are anchored together by their mutual attraction, yet they are in perpetual agitation or rotation about their points of anchorage. We cannot, of course, see these motions. As an example of this, if a block of gold be left in contact with a block of lead for some time, traces of each metal will be found in each other.

* A Paper read before the Gravesend Wireless Experimental and Model Engineering Society on Thursday, June 23rd, 1921.

In liquids the bonds of attraction are partially released, and the molecules may slip freely over each other, but they are never far enough apart to escape their mutual attraction.

In gases, the molecules are fairly free from their mutual attraction, *e.g.*, one cubic inch of water will occupy 1,600 cubic inches when converted into steam. Thus, obviously the space between the molecules must be large in comparison with their size. Since vapour expands instantly to occupy any larger space opened to it, the velocity with which the molecules travel must be very great. A gas is actually an army of infinitesimally small particles, continually moving and being perpetually interrupted by collisions or encounters with each other, and with the sides of the containing vessel.

Thus the pressure on the vessel is the average result of blows from the army of molecules which bombard it. On the average a molecule of hydrogen has a speed of over 6,000 feet per second, and moves about one-quarter of a millionth of an inch between collisions. About two million molecules of hydrogen in a row would occupy only one twenty-fifth of an inch.

Vacuum Tubes.

The application of voltage across the electrodes of a tube such as is shown in Fig. 1 produces no result at ordinary pressure, but a partial exhaustion of the tube will produce conductivity and a narrow streak of crimson light results, as in Fig. 2.

Fig. 1.

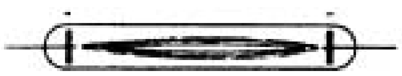


Fig. 2.

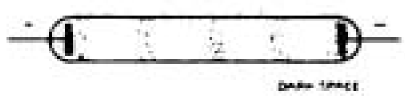


Fig. 3.

Fig. 4.

If the tube is exhausted still further, we get the effect indicated in Fig. 3, and if the exhaustion is practically complete a result such as is shown in Fig. 4 is obtained.

The rays possess the following properties :

1. Their path is straight.
2. They throw shadows.
3. They exert mechanical pressure.
4. They heat the object struck.
5. They are affected by magnetic fields.

The particles of which they consist are called electrons. There are many methods of producing electrons but the most familiar one to us is the application of heat. Certain metals, such as platinum and tantulum, when heated to a white heat, have the power of releasing a large number of electrons from their surface. This is probably the result of spontaneous explosions in the violently agitated molecules. The rate of expulsion of electrons from these heated surfaces increases rapidly as the temperature rises.

Under normal conditions the electrons of a gaseous molecule remain within the molecule which is therefore electrically neutral. It is, however, possible to drive some of the negative electrons out of some of the molecules when the latter cease to be electrically neutral and are known as positive ions. Under certain conditions the stray negative electrons will simply attach themselves to the neutral molecule, and molecules so affected are known as negative ions. These processes also follow the usual laws of electrostatic induction and attraction, etc. The process of converting a gas from a state where all molecules are neutral to a state where some are positive and some negative, is called ionisation. This point is extremely important.

It is fairly impossible to keep a gas perfectly non-ionised. The molecules are in a state of movement in all directions in the gas and with different velocities. The average velocity depends, of course, on the pressure of the gas, and the behaviour of an electron will depend upon the velocity with which it is moving when it first appears as a free electron. Whatever its initial velocity may be it will eventually come into close proximity with a molecule and mutual attraction will result. If the relative velocity of the two is low, the electron will fall into the molecule and thus produce a negative ion. If, however, the velocity is great (about 1.4 million feet per second) the moving electron will knock off another electron, thus another negative electron is "born," so to speak, and a positive ion is produced. This process is called "Ionisation by Collision," and is of very great importance.

The Mean Free Path of an Electron.

Suppose a stream of electrons to be projected into a gas. Some will strike molecules immediately they leave the source ; others will travel some distance before they do so. The average distance which the electrons pass through before the first collision occurs is called the mean free path. This is referred to as M.F.P., and will depend upon the relative velocity of the electrons and the number of molecules per unit volume.

An electron weighs about 1/1800th of a molecule. Usually the electrons are moving so much more rapidly than the molecules that the latter may almost be regarded as a fixed body. Thus, the M.F.P. depends entirely upon the density of the molecules, and it is obvious that this density depends upon the pressure of the gas.

If an electric field is applied to a gas any free electrons will move off along the field, and the further they move the more will their velocity increase. This increase in velocity is called acceleration. The field which is used in thermionic valves is sufficiently strong to give the electrons a great acceleration and they quickly acquire high velocities. The M.F.P. here is exactly the same as when we considered the stream of electrons to be projected into the gas. If the gas pressure is not too great the M.F.P. will be long enough for the average electrons to acquire an ionising velocity before their first collisions with molecules. Therefore, the average electron and all the electrons going further than the average will produce ionisation. The electrons whose M.F.P. is less than the average will merely fall into the neutral molecules and produce negative ions.

To produce electrons and positive ions we require :—

1. A long free path, which means a low pressure of gas, in other words a high degree of vacuum.
2. A strong field which means high applied voltages.

Thermionic valves possessing these properties are known as "hard" valves and are most frequently used.

To produce negative ions we require :—

1. A short free path, which means a high gas pressure or only an indifferent vacuum.
2. A weak field, *i.e.*, low applied voltage.

These valves are known as "soft" valves, and will not be discussed further as they are not nearly so efficient as hard valves, reasons for which will be given later.

The electronic theory assumes that the negatively charged particles are found in metals and carbon at all temperatures, they are in constant vibrating motion, and are free to move under the influence of an applied electric force. Normally they are retained in the metal, but if the velocity of any electron can be sufficiently increased, then its energy may be great enough to carry it beyond the surface layer of the metal, and thus it will escape into the surrounding space. The average velocity can be increased by the application of heat, and as the temperature increases more and more electrons will get through the surface layer and escape, the whole process being similar to the evaporation of a liquid with increasing temperature. The retaining forces are considerably reduced if we reduce the pressure of the atmosphere on the surface of the metal. Therefore the production of free electrons can be assisted if the heat is applied to a metal in a vacuum and a convenient method is found in using a filament to do the work. It may be said that when a carbon or metallic filament is heated in a highly exhausted bulb there is an emanation or evaporation from it of negative electricity in the form of electrons—the quantity emitted depending upon the nature and temperature of the filament and the nature and pressure of the surrounding gas. If no special steps are taken to collect these electrons, they will return to the heated filament and will be reabsorbed by it. If, however, we bring a positively charged body near to the filament the electrons will be attracted towards, and absorbed by, the positively charged body, their passage across the space constituting an electric current flowing from the hot filament to the positively charged body. In speaking of thermionic tubes, this body we call the "Anode" or "Plate," and the current is called a "Thermionic" current. If the anode is recharged negatively, the electrons will be repelled by it, and they will return ultimately to the filament, just as they would if the anode were not present. It should be noted that electronic emission is not the same thing as thermionic current, as the latter only takes place when the positively charged anode is present. If we gradually increase the potential at the anode, the number of electrons it attracts will gradually increase until finally we reach a point where any further increase in the anode positive potential fails to increase the number of electrons absorbed by the anode, the reason being that we are now absorbing all the electrons emitted by the filament. The valve is now said to have reached its "Saturation Point."

The foregoing theory although fairly satisfactory, takes no account of the action of the gas in the valve, which surrounds both the filament and the anode. The remaining gas molecules in our so-called vacuum have a marked influence on the emission from the heated filament in the valve. Neglecting the gas effect we know that there is a great army of electrons en route between the filament and the anode, and their numbers increase as we approach the saturation point. At this point the numbers will be so great that those at P in Fig. 5, near the anode will repel those at S, and those at S will repel those at T which are just leaving the filament. The total effect will be to throttle down the flow of electrons to the anode, and to neutralise the filament's action. As a result we shall not get at our anode the quantity we should expect to get. This effect, due to the presence of immense quantities of electrons in the space between the filament and the anode is known as the "Effect of the Negative Space Charge."

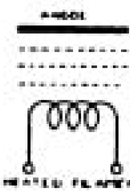


Fig. 5.

Now then, if a few molecules of gas are present another effect occurs which causes the neutralisation of the negative space charge, and thus increases our thermionic current. This effect is that previously mentioned as ionisation by collision. This residual gas whose presence, in the most minute quantities, is unavoidable, has a very considerable influence on the operation of the valve in supplying positive ions within the bulb, which neutralises the negative space charge effect, and enables larger thermionic currents to pass with an appreciable reduction of the anode positive potential. But the pressure of gas has certain disadvantages. In the first place the behaviour of the valve is uncertain and irregular, the increase of current not following regularly the increase of anode voltage.

Secondly, when working with the filament white hot and at a high anode potential, the production of thermionic current becomes irregular.

Another effect of the positive ionisation we said was the bombardment of the filament due to the ionisation by collision, and this is harmful to the filament and in time decreases the life of the valve by disintegrating the filament.

These facts have rendered the use of soft valves undesirable, and hard valves are now almost universally used.

It is to be noted, particularly with French valves, that the pressure of gas is low enough for the number of gas molecules present to be so small that the amount of ionisation by collision is very small.

The electrons reaching the anode practically all come from the filament.

INTERNATIONAL TECHNICAL WIRELESS COMMITTEE.

The objects of the Technical Wireless Committee which has been sitting in Paris since June 21st is to examine important questions connected with the development of wireless telegraphy and telephony, with special consideration of the advances made during the last few years.

The questions have already received a good deal of consideration at the International Conference on Electrical Communications, which was held in September, 1920, at Washington, but special questions were then reserved for discussion at the Paris conference.

The most important questions now up for consideration are :—

Classification of the different waves in accordance with their technical characteristics and definition of the uses reserved for each kind.

Distribution of wavelengths among the various services, such as naval and aerial services, point-to-point communications of all distances, wireless telephony, etc.

Direction finding and meteorological services.

Definitions of range and radiation.

The work of the Committee (which is composed of eminent experts from the various countries concerned) is being conducted in a spirit of goodwill and confidence which augurs well for success.

THE APPLICATION OF ACOUSTIC ANALYSIS TO THE PROBLEMS OF INTERFERENCE*

By J. Balderston.

IN expounding a possible solution, partial or complete, of the problem of radio interference, I have departed entirely from the beaten track pursued by so many professional and amateur research workers, because their most valiant efforts have not, as yet, been justified by the results obtained.

The views of a technical radio expert and those of an operator, on the subject of interference, are vastly different.

To the former, interference begins with the response of an aerial to æther waves emanating from a transmitter other than the one with which communication is desired, while to the latter, it begins only with the emission of alien sound waves from the diaphragms of the headphones.

Here, then, lies the nucleus of a new sphere of thought. Instead of trying to master unwanted æther waves, let us, by way of a change, endeavour to master unwanted sound waves. The laws of sound are just as tangible and sharply defined as the laws of electrical induction.

Electro-magnetic waves, and sound waves, have much in common, differing chiefly in their medium of propagation.

Both possess the properties of amplitude, frequency, and phase. The great thing to have clearly in mind at this juncture is that interference anywhere between the headphones and the antenna is purely electrical in nature, while between the headphone diaphragms and the ear-drums of the operator, it is purely of an acoustic nature.

As a preliminary to my proposed solution, I would request the reader for a moment to assume the personality of an operator who is endeavouring to receive a message while being "jammed" by another transmitter.

Supposing that the spark notes of the two respective transmitters are different in pitch (as would in all probability be the case), it is clear that the detector circuit is being traversed by two distinct unidirectional currents, differing in frequency, and superimposed, one upon the other.

As the ordinary telephone receiver diaphragm is more or less aperiodic, it is obvious that it will respond to both currents and thus propagate through the atmosphere in its vicinity, a complex sound wave, possessing, in acoustic form, all the vagaries of the superimposed detector circuit currents.

Before proceeding further, however, I would like to emphasise upon one vital difference between æther waves and sound waves. The vibrations of the former are at right angles to the direction of propagation, while those of the latter are in the direction of propagation.

The equivalent of an æther wave's crest and hollow is found in a sound wave in the form of periodic and alternate pulses of rarified and compressed air.

Just as two currents of identical frequency, but antagonistic phase relationship, can nullify the properties of each other, so can two sound waves under like conditions produce silence. If a sound wave emanating from one source is split up into two paths so as to impinge simultaneously on opposite sides of a resilient diaphragm, such diaphragm will not be affected if the two paths are of equal length, because the pulses of compression, and the pulses of rarefaction will oppose each other. If, however, the lengths of the two sound paths are capable of being varied independently of each other, a position can be found where a pulse of compression will reach the diaphragm on one side at exactly the same moment that a pulse of rarefaction reaches the diaphragm on the other side.

The acoustic phase relationship is then said to be harmonious, each split sound wave

* The following article is published as suggesting a field for experimental work. We have not tried the arrangement described and its suitability for wireless purposes cannot therefore be guaranteed.—Ed.

augmenting the effect of the other. Upon this phenomena of acoustics I base my suggestions for reducing interference.

Sound possesses definite velocity and wavelength.

The length of a sound wave may be taken as the distance between two successive pulses of compression.

It is obvious, therefore, that to obtain harmonious phase relationship under such circumstances as have been described, the difference in length of the two sound paths must be equal to half the wavelength of the sound itself.

It is equally clear that any increase or decrease in the frequency of the sound wave will upset the phase relationship, if the difference in the length of the two sound paths remain unaltered.

To apply the above facts in a practical form, I have devised an instrument which I call a "Monophone Receiver."

The following description and sketch will, I hope, make the nature of my device perfectly clear.

A and A′ are two sensitive watch pattern telephone receivers.

B is a mica diaphragm reproducer (similar to those in use with gramophones).

C is a double ended stylus, pivoted at its mid point, the lower end of which is secured to the centre of the diaphragm B, while the upper end is secured to the centre of the diaphragm of a microphone D.

E is a short tube connecting A′ to one side of C.

The other side of C is connected to A by a cylindrical shaped leather bellows F, provided with a micrometer movement G, such as the screw arrangement shown alongside the bellows.

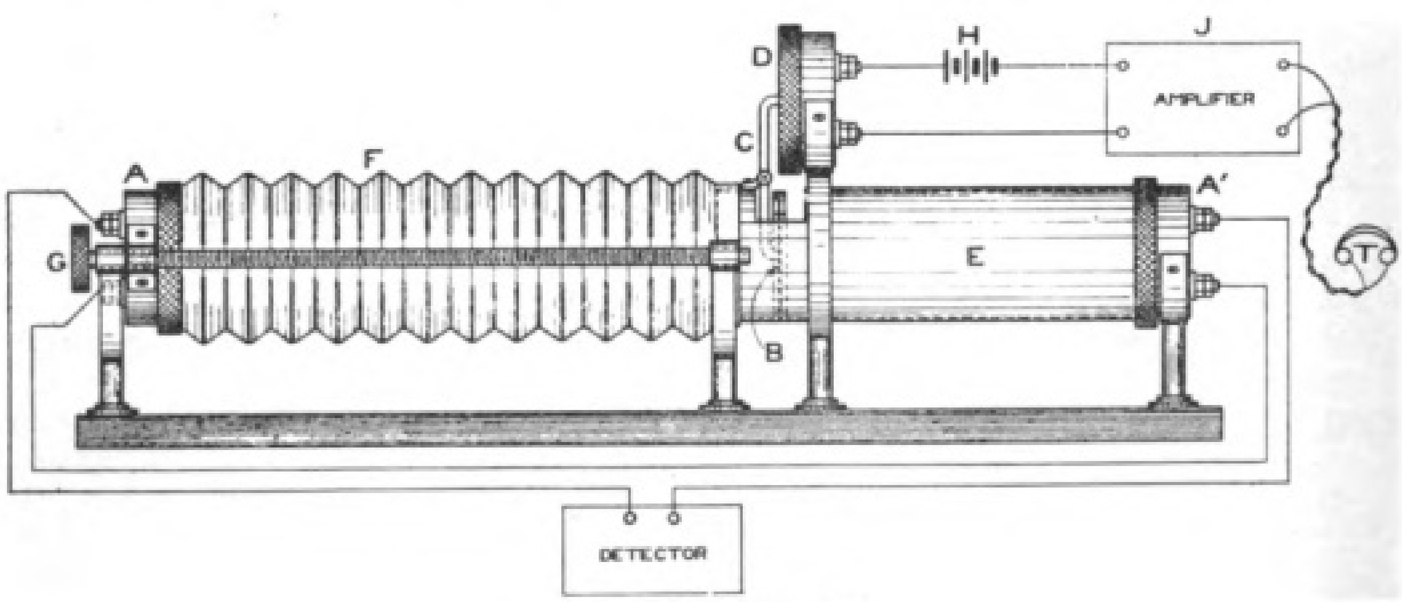
The receivers A and A′ are wired in series, and are connected to the terminals of the wireless receiving instruments in place of the operator's headphones.

The operator's headgear is connected to the terminals of the microphone D, in series with a battery H.

The actual *modus operandi* is as follows :—

During the reception of signals from a spark transmitter, the receivers A and A′ will be traversed by unidirectional currents of the same frequency as the spark discharge. As the diaphragms of A and A′ will vibrate synchronously, two pulses of compression (or rarefaction) will be simultaneously propagated, one through the tube E and one through the adjustable bellows F.

These two pulses will be immediately followed by two pulses of rarefaction (or compression), and these again by two pulses of compression (or rarefaction), and so on, as long as the sound wave lasts.



The Monophone Receiver.

The speed of propagation in both bellows and tube being identical, it will be clear that, as the bellows constitutes a sound path of variable length, either an antagonistic or harmonious phase relationship can be imparted to the pulses of compression or rarefaction arriving on opposite sides of the reproducer B. If the phase relationship is harmonious, the stylus C will be actuated, and, by conveying the vibrations of B to D will create response in the operator's headphones.

If "jamming" commences, and the interfering note is higher or lower in frequency, it will create antagonistic phase effects upon the diaphragm of the reproducer B.

If the frequency of the interfering note is twice, or half that of the note desired, the former will be completely destroyed while the latter will remain unimpaired.

An octave ratio between the frequencies is very rare, and therefore, under actual working conditions, the following alternative method of using the "Monophone Receiver" would be found more effective.

The length of the bellows is adjusted to produce *complete* antagonistic phase relationship to the frequency of the interfering note, so that it cannot be heard at all.

The phase relationship of the note desired (with the exception of octave ratios), will also be partially in opposition, and the note thus weakened.

This weakened note, however, can be compensated by connecting an amplifying device J between the microphone D and the headphones.

The effectiveness of a "Monophone Receiver" would be at a maximum during the reception of continuous waves by the "beat" method, as the interfering note could be made an octave of the note desired, by careful adjustment of the frequency of the local oscillator. The approximate velocity of sound (in air) is 1,100 feet per second, and if the frequency of the respective notes are known, their wavelengths are determined by simple calculation, viz. :—

$$\text{Wavelength} = \frac{\text{Velocity}}{\text{Frequency}}$$

Example :—Frequency = 500.

$$\text{Wavelength} = \frac{1{,}100}{500} = 2{\cdot}2 \text{ feet.}$$

To obtain harmonious phase, the difference in length of the bellows and the tube must be half the wavelength, and to obtain antagonistic phase, the difference in length must be *equal* to the wavelength.

Where the frequency is not known, the harmonious or antagonistic point is determined by experiment.

It may have occurred to the reader that, in accordance with the acoustic laws herein described, the interfering note can be completely "phased out" by adjusting bellows and tube to equal length. Such is the case, but this would "phase out" the desired note too. The correct method of "phasing out" the note of interference is to adjust bellows and tube for a difference in length equal to the wavelength of such note.

SOME WIRELESS HINTS FOR THE AMATEUR

By Capt. H. de A. Donisthorpe.

WITH the present restrictions imposed by the Postmaster-General on the wireless amateur, it is highly important that particular attention should be paid to the design and erection of the amateur's station in order to obtain the maximum results under the prevailing conditions. The following notes, therefore, may serve as a guide to any novice who is intending to join the ever increasing band of wireless enthusiasts.

Aerials.—Most amateurs pay far too little attention to their antennæ, and so sacrifice a large percentage of the efficiency of their stations. Having chosen a suitable site for the aerial the next important point to be considered is the type of wire to be employed. It is essential, especially in large towns, to use an insulated or enamelled wire in order to prevent corrosion taking place. It will be found that an ordinary bare copper or phosphor bronze wire will very shortly become covered with deposit when exposed to the open air. It has been ascertained by the following experiment that a bare wire wil. lose about 20 per cent. of its efficiency as an aerial after about three or four weeks exposure.

Two aerials of similar dimensions, one being of enamelled and the other of new bare copper wire, were erected on a certain date. The signal strength from a known station compared on each aerial daily, with the result that the signals due to the bare wired aerials gradually dropped off until there was a reduction of about 20 per cent., after which no further diminution was noticed. On examination this wire was found to have become corroded and covered with a deposit of oxide. The reason for the reduction in signal strength is doubtless due to the high resistance offered to the surface currents by this corrosion.

A two-wire aerial of enamelled or insulated wire should therefore be constructed and separated, so that they are at least 6 feet apart, by means of some light form of spreader. In leading in the aerial care should be taken that this wire is not in close proximity to the house. For the actual lead-in a short piece of high tension cable should suffice.

Earth.—The earth is another most important point, and the amateur in nine cases out of ten cannot do better than to use a water pipe, taking care that his connecting wire makes good connection, either by soldering or by the use of an ordinary telephone earth connecter. It is also important that the earth should be connected at a point as near as possible to where the water pipe enters the earth. Where a more elaborate form of earth system can be made, such as by means of large buried galvanised iron plates, the connection from the operating room to the earth should be carefully insulated all the way to the actual point where the wire meets the earth, otherwise faulty contacts to "earth" will be made at various spots which will reduce theaerial circuit's efficiency.

Circuits.—It is not intended to touch on the very numerous circuits that the amateur can employ and each individual must consider what he considers most suitable to meet his requirements and pocket. A novice, however, cannot do better than to employ the simplest circuit possible, and to build up gradually. A point which should be borne in mind in connect on with all types of circuits is that it is of the utmost importance to keep all connections clean, and where thermionic valve circuits are employed the insulations between terminals, etc., must be of the highest quality. Faulty insulation in this connection will produce a host of faults such as high tension battery leakage and parasitic noises in the telephones.

Thermionic Valves.—It is astonishing that nearly all the present day amateurs adopt the use of the "hard" or high vacuum type of thermionic valve for their experiments and circuits, when a "soft" triode is so far more sensitive and interesting in its action. The "hard" type is, doubtless, more stable, but when compared in sensitiveness to a "soft" triode, there is no comparison. This "soft" type calls for a certain amount of skill in its operation, but this should rather appeal to the amateur. There is vast scope for experimenting with such a triode, and the devising of circuits for its employment. One "soft" triode will give as much amplification as two "hard" valves, where one is used as a rectifier and the second as a

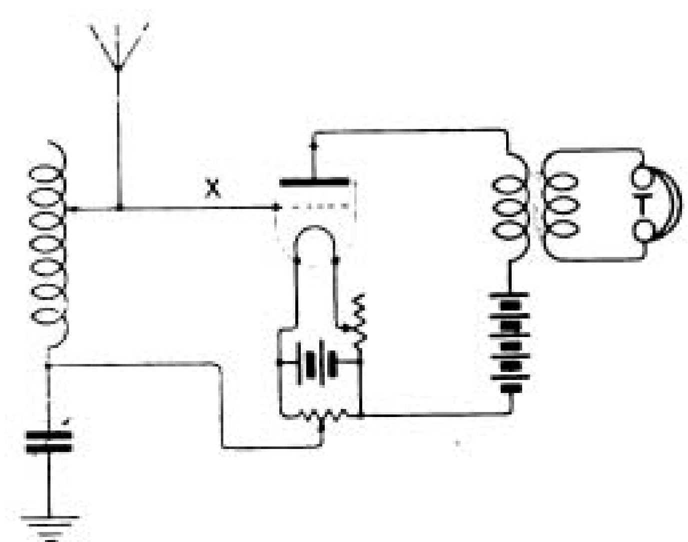


Fig 1

note amplifier, and in a reaction circuit the results are far superior and the signals more sharp and crisp than those produced by the "hard" type.

A simple circuit for the use of a soft valve is shown in Fig. 1, the usual grid leak and condenser being substituted by a potentiometer. The circuit will function quite satisfactorily with the former device, but a finer adjustment of grid potential is obtained by the latter where the characteristics are somewhat variable.

Using this simple form of circuit in conjunction with a soft triode, it will be found that the best results are obtained at the expense of a rather higher potential on the anode, and a careful adjustment of the triode's variables. Taking into consideration these points it should be possible for the amateur to obtain the maximum amount of success with the minimum amount of apparatus and cost.

LOUD-SPEAKING TELEPHONES—II.

By Philip R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E.

(Continued from page 261 of last issue).

SOME controversy has arisen on the question of priority in the discovery of the electrostatic effects described by Messrs. Johnsen and Rahbek, and a paper by Mr. Rollo Appleyard published in 1905 has been cited in this connection.* A table is given in that paper of the attractive force, or "retentive force" as it is there called, exerted on the metal electrode of the dielectric with various applied voltages, but the order of magnitude of the effects described seems to be much smaller than those obtainable with the lithographic stone, agate, etc., used in the demonstrations at the Institution meeting. The difference is probably to be found in the different nature of the dielectric, causing the less perfect establishment of the charged surface layer to which the effect seems to be due and to a lack of appreciation, at that time, of the mechanism of the phenomena in question. The condition of the surfaces of the materials used in those experiments was in all probability not best suited for the establishment of the large forces such as characterise the Johnsen and Rahbek apparatus. As we have seen in an earlier part of this article, the condition of the surfaces is all-important to the success of the experiments, so that unless care is taken in their preparation the results obtained will evidently not be nearly so useful.

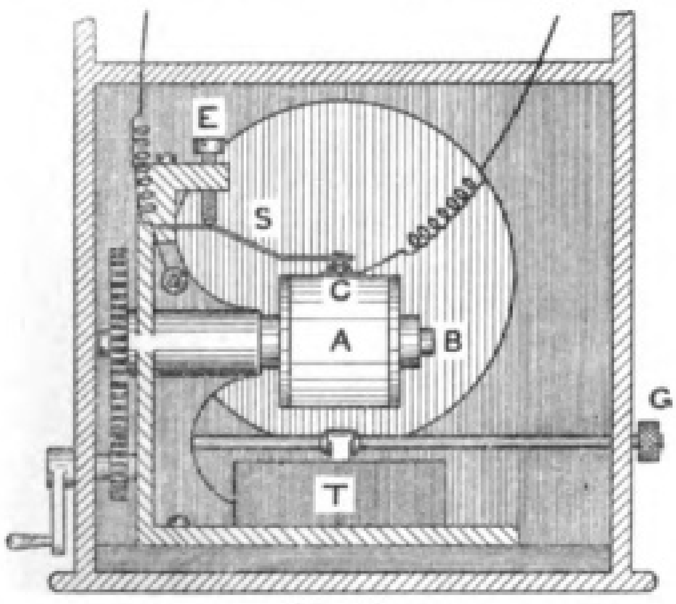


Fig. 11.

The idea of using a rotating cylinder in connection with a loud-speaking telephone is certainly by no means new, as it was employed by Edison in an instrument often termed an "electro-motograph," which was one of the earliest forms of loud-speaking telephone. In this apparatus—shown diagrammatically in Fig. 11—a cylinder of chalk A is rotated uniformly by hand by means of the gearing shown, or by means of a clockwork motor.

* R. Appleyard: *Proceedings of the Physical Society of London*, 19, pp. 724—739 (1905); *Philosophical Magazine*, 10, pp. 485—497, October, 1905.

This cylinder is formed of precipitated chalk to which a small proportion of mercury acetate has been added, the whole being moistened with a saturated solution of caustic potash and moulded into a cylindrical form by being subjected to hydraulic pressure. On the surface of the cylinder A a strip of platinum (shown in end view at C) rests, and has its other end attached to the centre of a thin mica diaphragm B. The spring S with pressure adjusting screw E, serves to maintain the requisite pressure between the platinum strip and the surface of the chalk cylinder. At the point where the platinum strip rests on the chalk cylinder a small platinum point is fitted, as may be seen more clearly in the diagrammatic side view of the apparatus given in Fig. 12. The lettering of this diagram corresponds with that of Fig. 11, so that corresponding parts may easily be recognised.

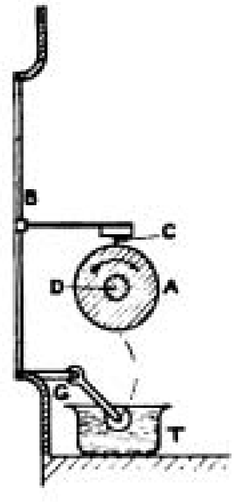


Fig. 12.

As mentioned above, the chalk is soaked in caustic potash solution, and must be maintained wet by occasional contact with the roller shown under the cylinder. This roller may be raised into contact with the cylinder by the handle G from its normal position in the reservoir of potash solution T. The terminals of the instrument are connected, as shown, between the platinum strip C and the metal core D of the chalk cylinder. The effects produced in this apparatus are somewhat different from those we have just discussed in the earlier parts of this article, since the effect of the passage of the current through the chalk is to cause a *reduction* of the normal friction between the chalk and the platinum. Similar effects are, of course, produced on the diaphragm which is thrown into vibration by the varying pulls on the platinum strip C.

It is a curious fact that neither unevenness of the surface of the chalk cylinder nor variations in its speed of rotation have any appreciable effect on the sound produced by the apparatus; it is merely the changes in friction between the platinum and the chalk which produce the sounds, and these changes are of a much larger order of magnitude than the natural slight variations due to unevenness of the surface.

Much discussion has arisen in the past as to the mechanism underlying the action of this apparatus, and the explanation that may be applied to account for the changes in friction. One suggestion is that the electrolysis of the caustic potash solution by the current causes the liberation of some gas on the surface of which the strip "floats", thus reducing the friction. This view was expressed at a meeting of the Royal Society of Arts in May, 1879, when a demonstration of the apparatus was given by Conrad W. Cooke, C.E.,* who explained the process as follows :—

"The physical cause of the reduction of the coefficient of friction must, I think, be looked for as an effect of electrochemical deposition. It may be with some substances employed due to the liberation of gas by the electrolysis at the negative end of the pole, which in the instrument before us is the platinum strip bearing on the impregnated cylinder. The sudden formation of a film of gas between the strip and the cylinder would perfectly account for the friction being reduced; and even if gas be not liberated, a change in the chemical constitution of the chalk cylinder at that point which is pressed by the platinum strip would be accompanied by a change in the coefficient of friction between them."

There are, however, some difficulties in the way of accepting this explanation, as some lag might be expected in the production and disappearance of the gaseous film—a lag which does not seem to exist, and in this connection it may be of interest to quote part of the abstract which appeared in *Nature*† of a paper by Prof. W. F. Barrett, presented to the Royal Dublin Society on

* *Journal of the Royal Society of Arts*, 27, pp. 558—569. May 23rd, 1879.

† *Nature*, 19, pp. 483—484, March 18th, 1880.

January 19th, 1880, "On the Theory of the Loud-Speaking Telephone":

"The author expressed his doubts as to the accuracy of the received theory which attributes the diminution of friction that occurs on the passage of a current to electrolytic action, a film of gas being thereby produced, and hence a reduction of the normal 'stiction' between the chalk cylinder and the platinum faced arm which vibrates the diaphragm. One objection to this theory is the enormous rapidity of the changes that must occur and the difficulty of conceiving how the film of gas is to be got rid of, even if produced in an infinitesimal portion of time. Moreover, the author showed that even when the chalk was dry, in the ordinary acceptance of the word, the action still took place, excellent speaking being obtained from a cylinder that had been exposed for a month to a highly heated room and not once touched with water since it had been in the author's possession; doubtless if the chalk were strongly heated its insulation would be too great, and the current would not pass.

"The tendency of a closed electric circuit is to enlarge itself, and it might be to this cause the phenomenon was due. But the electrodynamic action of the current should occur equally well between a metal cylinder bearing on the metal arm; the author had therefore replaced the chalk cylinder by a polished brass cylinder, and employing a microphone transmitter at the other end of the line, the ticking of a watch was perfectly well heard as soon as the brass cylinder was rotated. Whistling, too, was imperfectly heard, but not conversation. Here no electrolytic action could occur, and therefore the self-repulsion of a current on itself, or other electrodynamic action was shown to be a *vera causa*. The repulsive action of a current in passing from one conductor to another, described by Gore, and usually attributed to the production of heat and local expansion at the points of contact was another possible cause. But the author questioned the usual explanation of Gore's experiment, and conceived it probable that both it and the variations of friction in the Edison telephone receiver might be due to a common cause as in both the currents passed from a bad conductor to a good one, and it was the opinion of the late Principal Forbes, formed after much research and careful inquiry, that a peculiar repulsive force was called into play when both electricity and heat were transferred from a bad conductor to a good one. From any point of view the subject was one worthy of further investigation, which the author hoped to give to it.

"In conclusion the author described an arrangement whereby he had adapted the magneto telephone to the revolving cylinder in the Edison receiver, so that instead of having to do the entire work of vibrating the diaphragm, as in the Bell receiver, the magnetic action of the current simply varied the friction of the cylinder, and so varied the nature of the oscillations of the diaphragm which were set up by mechanical means. But as much success was not obtained as was anticipated, nor did the combination in one instrument of the chalk cylinder and the magnetic action give good results, the variations in function being probably not synchronous from the direction of impulse not being always in the same way."

The same author also showed in a letter to *Nature*, published on March 4th, 1880 (page 417), that feeble E.M.F.'s could be set up by such a receiver when the chalk cylinder was set in rotation. This effect may have been due to a species of electrolytic polarisation, or to the contact E.M.F.'s of the two conductors in contact with the chalk. In any case it serves to emphasise the distinction between the Edison receiver and the electrostatic one outlined above, apart altogether from the consideration of the opposite sign of the effects in the two cases —one being an increase and the other a reduction in the friction.

The discovery of the effects which led up to the design of the above-described arrangement of Edison's "electro-motograph" was made about 1872, when Edison discovered that if a strip of paper, moistened with a chemical solution that is readily decomposed when an electric current is passed through it, is placed on a metal plate and has a platinum point resting upon it with a gentle pressure, the friction exhibited by the platinum point to movement over the surface of the moist paper is instantly reduced when a current is passed through the paper between the metal plate and the platinum point. The point should be connected to the negative terminal of the battery. The friction is immediately restored to its initial value when the circuit is interrupted. By drawing the paper strip at a uniform speed under a platinum point mounted on a suitable lever, a relay can be constructed, the friction of the moving paper pulling the lever over and holding a contact open against a spring. On the passage of a current through the paper the friction is decreased and the spring causes the lever to close the contact.

Anyone interested in further details of this apparatus will find a description of the arrangements used by Edison in the *Telegraphic Journal*, 6, pp. 381-383, September 15th, 1878, together with a sketch of the apparatus.

(To be concluded.)

EXPERIMENTAL TRANSMISSIONS IN AND AROUND LONDON

REPORT OF A SPECIAL MEETING CONVENED BY THE WIRELESS SOCIETY OF LONDON

A meeting of the holders of Transmitting Licences in London and district was convened by the Wireless Society of London at 66, Victoria Street, S.W., on July 7th, 1921.

Present:—Messrs. Blake, Burnham, Bligh, Coursey, Clapp, Child, Crampton, Davis, Donisthorpe, Hambling, Hope-Jones, Haynes, Klein, Mayer, McMichael, Partridge, Pocock, Campbell Swinton, Sherwood, Tingey, Taylor, and Lieut. Walker.

The chair was taken by Mr. F. Hope-Jones, M.I.E.E., who read letters from Mr. William Le Quex, Guildford, and Mr. H. Burbury, of Wakefield, regretting their inability to attend, expressing their approval of the objects of the Meeting and making a variety of suggestions.

The Chairman briefly explained that the business of the meeting was to explore all possible methods of so organising and arranging transmission during the busy hours of the evening as to minimise jamming and interference.

The Meeting was opened for general discussion on these lines, as a result of which a number of suggestions were made, and the following possible alternatives were put up by the Chairman for full discussion :—

(1) Allocation of a definite day and a precise time for weekly transmission by each station; thus a time table could comprise 28 stations with four per evening.

(2) The reservation of half an hour every night (8 to 8.30) for regular weekly transmissions in the nature of a Concert.

(3) The appointment of seven specially competent transmitters with good equipment as Directional Stations to take it in turn to control all traffic for one evening per week each.

(4) A voluntary limitation of transmission to 15 minutes by each station between the hours of 8 p.m. and 10 p.m.

The Chairman invited advocacy of each of these in turn, and the following gentlemen took part in the discussion :—Messrs. Burnham, Blake, Clapp, Coursey, Crampton, Child, Basil Davis, Donisthorpe, Haynes, Klein, McMichael, Mayer, Pocock, Partridge, Sherwood, Tingey, Rickard Taylor and Lieut. Walker.

After summing up the discussion, the Chairman put the last proposal to the vote which, being carried unanimously, concluded the business of the meeting. The terms of the Resolution were as follows :—

That there shall be a voluntary limitation that no single station or pair of communicating stations shall work for more than 15 minutes at a time between the hours of 8 and 10 p m. legal time ; and that such station or stations shall wait at least 15 minutes before again transmitting.

The proceedings terminated with a vote of thanks to the Past President, Mr. A. A. Campbell Swinton, for the use of his offices, to which he responded.

WIRELESS CLUB REPORTS

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary.

The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies.

The North London Wireless Association.

(Affiliated with the Wireless Society of London.)

Particulars of membership, etc., can be obtained from the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

The meetings of this Association are now being held at the Northern Polytechnic Institute, Holloway Road, on Monday evenings.

At the twenty-seventh meeting, Mr. Norman Wilson lectured on the construction of telephones. Mr. Wilson had made throughout a very efficient pair of 8,000 ohm telephones, and was able to describe the difficulties met with very feelingly, and give many useful tips to those who wished to construct their own telephones. A lengthy discussion followed, and many questions were asked, which showed that the lecture was followed wit close attention and interest. At the conclusion a hearty vote of thanks was accorded Mr. Wilson

In closing the meeting, the Chairman said h hoped that other members would come forward with similar lectures or papers. Construction l details of apparatus were always welcome, and he felt sure that there were many members of the Association who could help in this way. Needless to say the Hon .Secretary will be glad to hear from any member who can oblige.

The West London Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

All enquiries regarding the Society should be addressed to the Hon. Secretary, 2, Providence Road, Yiewsley, Middlesex.

The Society held its usual weekly meeting on Thursday at 7 o'clock, on July 7th, at Belmont Road Schools, Chiswick.

Mr. Studt continued the course of wireless and lectured on the magnetic field round conductors, induced currents and self-induction. A lively debate followed on a statement that the lecturer had made, the finish of which, owing to lack of time, was left over to the next meeting.

Mr. Studt has very kindly presented the Society with a "Brown" Loud Speaker and Relay, which is greatly appreciated, as until now head telephones have been handed round to the members.

The Club has had some difficulties over the erection of an aerial, and is at present using an indoor one to P.M.G. measurements, which, however, is found to give quite good results.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

Hon. Secretary, Geo. Sutton, A.M.I.E.E., 18 Melford Road, S.E.22.

The Wireless and Experimental Association met at the Central Hall, Peckham, on Wednesday, July 6th, to hear Captain R. Tingey lecture on our common preoccupation.

For two hours he demonstrated and advised, with deft fingers now working amongst switches and condenser knobs, again with chalk and blackboard, treating his subject in a loving and reverential manner that carried conviction against the most hardened practitioner of "the other way."

The secret appeared to be that he did not expect the same valve to do everything all at once.

Perhaps this one valve one job principle might be worked by more of us amateurs with advantage.

A cordial vote of thanks moved by the Secretary and carried with acclamation brought a most successful meeting to a close.

All wireless amateurs undoubtedly wish for the best for our hobby, but does everyone think it worth while to make a move to interest others and so enlarge the circle?

An offer made by Mr. Geo. Sutton, A.M.I.E.E., Hon. Secretary of the above Society, to give a display at a Parochial Garden Party was eagerly accepted and the arrangements made worked without a hitch.

The permission of the Post Office authorities was readily granted with the usual stipulations, a single wire attached to the adjacent steeple acted as aerial, a stake wrapped with copper wire driven into a flower bed provided the earth, and with receiving valve and a C Mark III Amplifier and a Brown Loud Speaker our outfit was complete.

Blackboard and easel enabled the demonstrator to elucidate knotty points by the aid of sketches, and the many questions asked showed the deep interest taken in the subject.

Telegraph signals were taken by the audience as more or less a matter of course, but when a well-known voice burst out, "Hullo Lympne, Croydon calling," our mouths and throats were narrowly scanned for evidence of ventriloquism.

Later, our equally well-known friend Burnham weighed in with a promised gramophone record, and we couldn't be suspected of imitating all the instruments of the orchestra at once.

From four till closing time at eight we held the interest, and all appeared sorry that we had to pack up and dismantle.

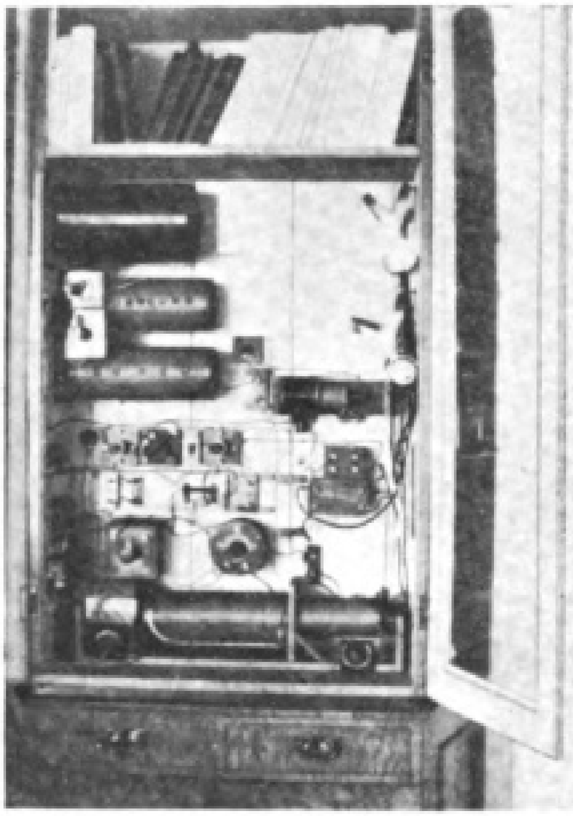
Edinburgh Wireless Club.

(Affiliated with the Wireless Society of London.)

The new Headquarters at 8, Forth Street, are now in order. The aerial has been erected, and proves surprisingly efficient for its town situation.

Meetings are being held every Wednesday at 8-10 p.m. Intending members are asked to enquire for particulars from the Hon Secretary.

An outing was held recently to Salisbury Crags with exceptional results. Using small portable apparatus several American stations were received well on a 30-ft. aerial 8 ft. high.



The above photograph shows the set belonging to the Hon. Secretary, Mr. W. Winkler. The set is arranged in a bookcase from which the shelves have been removed.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

Particulars of the club may be had from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21.

A meeting of the North Middlesex Wireless Club was held at Shaftesbury Hall, Bowes Park. After some time had been spent on Morse practice the chairman (Mr. A. G. Arthur) called on Mr. Gartland for his address on "The Transmission and Reception of Audio-frequency Signals."

Mr. Gartland, who had been very busy connecting up his apparatus with the assistance of several of the members, said that he was first made acquainted with this method of short-distance telephony when in France during the war, when, as an experiment, he connected his telephones across the aerial and earth and heard conversation which was being carried on in neighbouring telephone lines. He then experimented further, and had found a convenient way of transmitting music (gramophone records) and to a certain extent speech, over short distances. Interesting experiments were conducted by the lecturer.

After questions had been asked and answered, a vote of thanks was proposed by the chairman and carried with enthusiasm. Two new members were elected.

Birmingham Experimental Wireless Club.

(Affiliated with the Wireless Society of London.)

The Secretary (Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham) will be pleased to hear from local amateurs.

At a meeting held on Friday, July 8th, at Digbeth Institute, Mr. A. Woodcock gave an interesting and practical discourse on the "Conversion of a Mark III. Tuner." He exhibited such a tuner of his own conversion, describing the methods used in winding the tuning coils and adapting the set for valve use.

The President (Mr. A. L. Lancaster) proposed a vote of thanks, which was carried unanimously. A field day was arranged for July 16th, fifteen members promising to attend.

Bristol and District Wireless Association.

Hon. Secretary, Mr. E. C. Atkinson, M.A., F.R.A.S., 5, Pembroke Vale, Clifton.

During the Spring session, 1921, five general meetings of the Association have been held, and on June 25th the first "field day" with the portable apparatus was held at Keynsham. Membership now exceeds 40. The rules have recently been revised and printed.

On January 28th, 1921, Messrs. Mitchell, Marcuse and Atkinson contributed components from which a circuit was built up and connected to an aerial stretched across the lecture theatre. Whilst connections were being made, Mr. Atkinson discussed the effect of "dead ends" in modifying wavelengths, and showed how the mutual inductance between the dead end of a single layer coil and the active part could be read off from the inductance curve of the coil. When the connections had been completed the megaphone commenced to deliver the news of the world to the meeting.

On February 25th, Mr. W. R. Wade, in referring to the Transatlantic Tests, protested against the interference caused by self-oscillatory local circuits.

Committee and auditors for the current year were elected. Mr. G. Marcuse was elected delegate to the London Conference. Mr. G. Marcuse lectured on High Frequency Amplification. Amplification before rectifying was desirable, since all rectifiers are relatively insufficient for weak signals. In the Marconi 55 A exhibited, 6 amplifying valves (one or more of which can be cut out) are followed by a rectifying valve. The intervalve coupling through a high resistance transformer and small condenser is partly inductive and partly due to capacity of coils and condenser, so that the resonance effect is small and a wide range of wavelengths is satisfactorily covered with a single instrument. Self-oscillation is controlled by regulating filament temperatures, and by a condenser between No. 3 grid and No. 5 plate. Potentiometer control of the rectifying valve filament reduces jamming in spark work by adjusting to type of transmission.

On March 21st the accounts for 1920 were passed, and names of holders of transmitting licences collected for the London List. Mr. Marcuse reported on the London Conference.

Rev. H. W. Jakes introduced a discussion on "How to start an Amateur Station," describing his early experiences with ready-made apparatus. Other speakers advocated the home building of apparatus as teaching the experimenter more about his science. Mr. W. R. Wade was heartily congratulated on winning the Burnham Prize in connection with the Amateur Transatlantic Test.

On April 22nd, Mr. M. Burchill was elected a member of Committee in place of Mr. L. S. Palmer, who resigned on taking up Government duties in Portsmouth. The revised rules of the Association were submitted and accepted.

Mr. A. W. Fawcett discussed "Reception of Short Waves." Whilst most amateurs found difficulties in dealing with short wavelengths, the matter was important to them in view of the 180 m. allotted to them for transmission. A T aerial was advocated, and a series condenser was often required. The A.T.I. should not have a long dead end, and should have low self-capacity. For spark signals a small single layer coil was recommended without a tuning condenser. Round's circuit with a crystal rectifier was suitable. In C.W. work fine tuning was necessary, and body movements often affected this tuning sufficiently to occasion trouble.

On May 27th it was arranged to have an excursion with portable apparatus towards the end of June. Mr. Bennett suggested affiliation of the Association with the Bristol Philosophical Society.

Mr. C. E. T. Cridland lectured on "Automatic Reception of Wireless Messages." Such reception implied large local currents controlled by the signals in the antenna circuit. The lecturer received the various devices used for this purpose, starting with the coherer used by Marconi, which was decohered by automatic hammering. A self-decohering device used by the Italian Navy consisted of mercury between iron electrodes. A Lodge-Muirhead device consisted of a steel wheel revolving in mercury covered with a film of oil. An early distress scheme consisted of apparatus which responded only to a series of dots transmitted at one definite speed. Microphone relays were sensitive, but uncertain in action. The Turner valve relay, for which an amplification of 500,000 was claimed, was described. The Creed printer was referred to, but not described in detail. The recording of high-speed messages on a dictaphone, read by running at low speed, was referred to. A modern call scheme was discussed, and finally photographic records from a short period string galvanometer were described, in which messages could be taken at 600 words per minute on a film, developed and dried ready for reading in 4½ minutes.

On June 25th, the Association had a field day at Uplands Farm, Keynsham. Two stations working on 180 Spark were set up about 1,100 yards apart, and Clifton College Signallers made a station 300 yards away from station A. The weather was perfect, the wireless less so, but not a complete failure, and we gained useful experience as to arranging a programme for such work.

Cambridge and District Wireless Society.

A meeting of the above Society was held at the Reading Room of the Photographic Society's, Ram Yard, on June 22nd, at 8.30 p.m., with Mr. J. J. Butterfield in the chair. The next meeting was fixed for Wednesday, July 6th, at the Reading Room of the Photographic Society, Ram Yard, at 8 p.m., and Mr. Culpan will give some of his experiences in the reception of the Dutch Concert. The Chairman then called upon Mr. Symonds to give his address on his experiences as a wireless telegraphic operator in the war. Mr. Symonds then told how he was stationed on a boat which went to and from Singapore and Australia, and Singapore and China He gave the description of the sets he used and also how they worked. The subject was then declared open to discussion, and a hearty vote of thanks was passed to the lecturer. The meeting was then declared informal.

A meeting of the Society was held at the Reading Room of the Photographic Society on Wednesday, July 6th, at 8 p.m., Mr. Culpan in the chair.

A field day was arranged for July 21st at 7 p.m., when it was proposed to receive the Dutch concert. Mr. Culpan then delivered his address on his experiences in the reception of the Dutch concert. He described two or three sets which he found to be inefficient for the reception of the concert, and then went on to describe the set he found of most use.

The meeting was then declared informal. A hearty vote of thanks was expressed to the lecturer in the usual way.

The Gravesend Wireless Experimental and Model Engineering Society.

The third general meeting of the above Society was held at 7.15 p.m. on Thursday, June 23rd, at the Globe Hotel, with Mr. Sleath in the chair.

The minutes of the previous meeting were read and passed, and four new members enrolled.

Mr. Bunt was asked to give a few words on the prospects and aims of the Society, and he also kindly offered a prize of half a guinea for the best attempt at some simple workshop item such as filing a piece of mild steel on top and bottom. Mr. Bunt pointed out that this is not so simple as it looks, and most of the members heartily agreed.

The next item was a paper by Mr. Sleath on the "Electronic Theory," being a prelude to a future paper on 2 and 3-electrode valves. The paper was written in a clear and simple way, but doubtless some of the members are still wondering about "ions" and "electrons," and if they have anything to do with atoms or molecules (see pp. 281—284 in this issue).

The meeting concluded with a demonstration by Mr. Birchall of his 3-valve receiver which is readily arranged for various methods and amplification (both H.F. and L.F.) by means of simple switching devices.

The demonstration held at the Hospital Fête was a huge success owing to the fine results given by Mr. W. R. Tingey's personal attention and apparatus. The German 4-valve magnifier is a fine piece of work, and signals through a Brown Loud Speaker were as loud as the gramophone at the transmitting station. The sum of thirteen pounds was realised, and seven new members were enrolled.

South East Essex Wireless Club.

Mr. F. A. Mayer, Hon. Secretary, "Stilemans," Wickford.

The past two monthly meetings were held at the Club-room on June 6th and July 4th respectively. On June 6th the Vice-President, Mr. Day, gave a lecture on "High Frequency Currents," which was demonstrated practically by means of his static apparatus. Some very interesting experiments were shown, and a hearty vote of thanks was passed to Mr. Day for his interesting evening

On July 4th, Mr. F. A. Mayer lectured on "Wireless Transmitting Apparatus." A spark set was shown working, and the function of the various parts fully described. There were good attendances at both meetings, several new members being enrolled. During the summer months meetings will only be held on the first Monday in the month instead of weekly. For the benefit of local amateurs the Secretary will be giving a wireless concert on Sunday evenings between 8 and 9 p.m. on 1,000 metres. Only 5 watts power will be used in order to avoid interference as much as possible with other amateurs.

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held on June 24th, Mr. W. J. Lewarn in the chair.

This being the last meeting for the session, an election of officers for the next session was made, with the result that the undermentioned will act in the capacities noted during the session commencing September 12th, 1921.

Chairman, Mr. H. P. Mitchell; Secretary, Mr. W. C. Bodle; Treasurer, Mr. H. W. Langmaid; Librarian, Mr. J. P. Carter; Local Representative, Mr. L. E. Currah.

A vote of thanks was passed to the present Committee for their past services.

Will those interested please note that this will be the last communication of the Plymouth Wireless Society until mid-September.

The City of London School Wireless Society.

At an annual meeting held on June 14th, there were 200 people present. After the business of the Society had been carried out and two new members elected, the President called on Mr. Burrows, of the Marconi Company, to deliver his lecture, "A popular lecture on Wireless."

After the lecture, Mr. Burrows demonstrated Marconi's efficient amplifier, the 55 Type, and used it in conjunction with a 2-valve note magnifier and a set heterodyne generator. Wonderful results were obtained on the Club's 200 ft. aerial, and also the 6 ft. frame which was brought along.

Mr. Burrows, before leaving, kindly invited 40 of our members to the private cinema at Marconi House at some convenient time. The meeting was then closed.

On Tuesday, June 28th, at the annual meeting Mr. Haynes, from the R.M. Radio, Ltd., gave an interesting lecture on "The Design of the Amateur's Station." He dealt thoroughly with all points, and showed many of the instruments made by his firm. The lecture was fully illustrated by blackboard diagrams, and the lecturer was accorded a hearty vote of thanks.

Brondesbury and Cricklewood Radio Club.

This club having now been formed, local wireless workers and others interested are requested to communicate with Mr. J. F. Stevens, 119, Fordwych Road, Brondesbury, N.W. (*Hon. Secretary, pro tem.*), who will be pleased to furnish full particulars.

Bolton and District.

An invitation is extended by Mr. W. Howarth to any amateurs of his district to communicate with him with a view to the establishment of a wireless club. Mr. Howarth's address is care of 10, Cardwell Street, Bolton.

A Wireless Society for Southampton.

A meeting was held at Southampton on Thursday, July 7th, to consider the formation of a wireless society, with Mr. R. Harvey in the chair.

It was decided to form the Society under the title of "The Southampton and District Radio and Experimental Society." A working committee and the usual officers were appointed.

Further information can be obtained from the Hon. Secretary, Mr. G. T. Vivian, 8, Bernard Street, Southampton.

The Willesden Wireless Society.

Since our last appearance in print our Society membership has considerably increased. We have now permanent headquarters at 25, Station Road, Willesden Junction, and despite the hot weather and the call of the fields, our meeting average has never dropped below fifteen. The Society's wireless receiving set is now in course of erection, great assistance having been given by certain members in constructional details and apparatus. Owing to the holidays it has been decided to postpone the most important lectures until September, and a series of general discussions and demonstrations are now taking place. The Society has two buzzer sets, and buzzer practice is given. We have two ex-operators for instructors, and therefore hope to be able to report good progress. One of these instructors at our last meeting wrote a speed of 29 words per minute in quite legible writing.

The demonstration at our last meeting was quite a success, Messrs. Picker and Mann exhibiting and explaining the construction of a single-valve receiver, the work and finish of both instruments making one think that the wireless amateur is a natural instrument maker. A three-valve amplifier and loud-speaker (lent by Mr. Corsham) was then coupled to one of the sets, and after various details, such as howling, etc., were subdued, fairly good results were obtained with only 12 volts on the rectifying valve's plate and 48 volts on the amplifier.

Thanks to our latest announcement we have members from as far afield as Hendon, Ealing and Watford.

The meetings are held at 8 p.m. Tuesday evenings and anyone wishing for details of membership will be forwarded same from our Secretary at 87, Mayo Road, Willesden, N.W.10.

HINTS ON THE AERIAL AND EARTH FOR BEGINNERS

IN the erection of wireless aerials, both for transmitting and receiving, there are several important factors which must be considered. An aerial which is used for transmitting usually presents more difficulties than a plain receiving wire, so it will be sufficient to consider the points in connection with the former.

The insulation of the aerial is probably the most difficult problem which must be dealt with. At high potentials, unless there is very good insulation between aerial and earth, a considerable leakage of current will take place which will flow directly from aerial to earth through the defective insulator, and thus the radiating power of the aerial will be reduced. Further, the insulator has to serve the double purpose of preventing the flow of current to earth, and supporting the aerial. Most good insulators are comparatively weak mechanically, so that in the case of very heavy aerials they have to be of great size in order to stand the strain.

When selecting material for an insulator, the question of voltage must also be considered. When the aerial is oscillating, at certain instants, the potential between aerial and earth is equal to the potential applied to the oscillatory circuit, which may be of the order of 10,000 volts.

The following table gives the thickness of insulation required to withstand a pressure of 10,000 volts.

Insulator.	Thickness (Millimetres).
Rubber	0·3
Ebonite	0·2
Glass	0·4
Porcelain	1·0
Mica	0·1

Referring to the table above, we see that mica is obviously the best insulator, but it possesses the defect that it is weak and will not stand the machine process required to make it up. Ebonite can be machined and moulded but is very brittle Rubber is a very suitable insulator for small aerials, but requires to be replaced by something more rigid in the case of heavy wires. Porcelain, although comparatively a poor insulator, is slightly stronger than glass, and also possesses another advantage, which will be explained further on. Porcelain, therefore, is usually used for insulating large aerials.

Once set up, the aerial is not always very convenient to inspect and repair. The insulator, therefore, must keep its properties under all weather conditions.

This becomes a difficult matter in a place with frequent rainstorms. Moisture is a good conductor of electricity, and if the surface of the insulator is damp, a spark will be conducted over the surface, although the actual insulation is not pierced or broken down. A variety of ways are employed

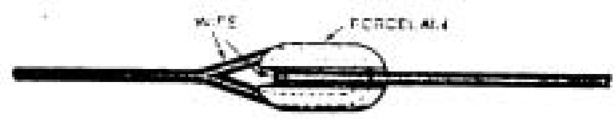


Fig. 1.

to overcome this defect. The insulator can be screened by suitable coverings, or it may be treated with waterproof varnish, which prevents the formation of a continuous film of moisture over the surface. It is in this respect that porcelain is superior to other insulators. The highly glazed surface tends to prevent the formation of a film of moisture, and, further, if the insulator is suitably shielded, the leakage from moisture is reduced to a minimum. Fig. 1 shows a small porcelain insulator used for single wire aerials, and Fig. 2 a larger size, with rain shields. An additional prevention of surface leakage is given by increasing the length of surface of the insulator. This is done, without making the insulator unduly long, by corrugating the material as shown in Fig. 3. The total surface length between the ends is clearly the distance obtained by measuring the depressions and "hills" of the insulator.

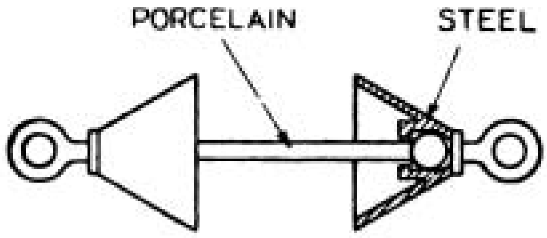


Fig. 2.

The aerial itself is usually made of stranded copper or phosphor bronze wire. The question now arises "What is the most suitable length, and how many wires are necessary?" The length is usually determined by local considerations, as well as by the wavelength it is desired to transmit.

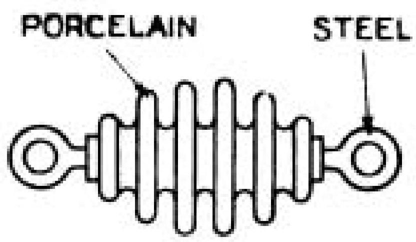


Fig. 3.

The wavelength of a plain aerial is approximately five times its actual length. So that we see that in the case of a 100-ft. plain aerial wire the wavelength is in the neighbourhood of 500 ft., which is somewhat low, except for small experimental stations.

It is obviously impracticable to increase the length, because of the strain on the masts, insulators and the wire itself. Remembering that the natural wavelength is proportional to $\sqrt{LC}$, the inductance and capacity of the aerial, we see that it is possible to alter the wavelength by varying the constants of the aerial. If we form the aerial of two wires side by side instead of a plain wire, the capacity will be doubled and the inductance approximately halved. With an increase in the number of wires, the length of the aerial could also be slightly reduced. Fig. 4 shows a plain two-wire aerial.

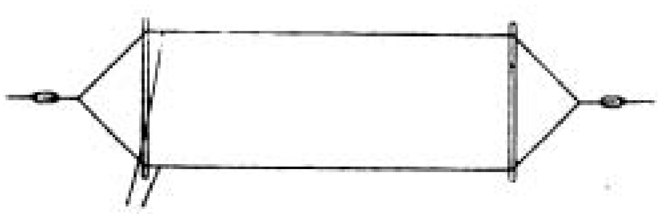


Fig. 4.

Having fixed the size of aerial to oscillate with the frequency of wave transmitted by the station it is desired to receive, it is still necessary to be able to alter it, according to the requirements of the transmitting station. It would obviously be awkward to have to adjust the length and size of aerial for every variation in the wavelength transmitted or received! These adjustments are made by inserting an inductance or capacity in the aerial circuit, which has the effect of shortening or lengthening the natural wavelength (Fig. 5.). The effective capacity of two condensers in series is less than the capacity of either of them, so, if a condenser is connected in series with the aerial, the wavelength will be reduced.

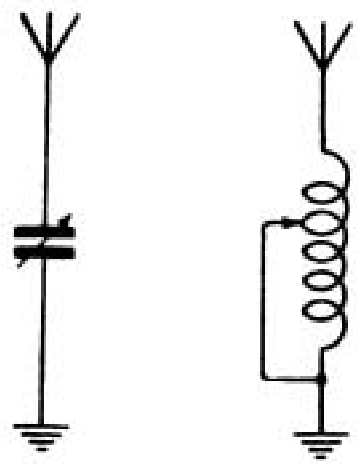


Fig. 5.

Similarly, inductance in series with the aerial will increase the total inductance, and increase the wavelength. The practical limits to the variation of wavelength by this means ar- waves one-half or double the natural wavee length of the aerial.

For example, with an aerial having a natural wavelength of 1,000 metres, it is not practicable to increase the length above 2,000 by means of an inductance, or to decrease it below 500 by means of a capacity. Above and below these limits the aerial circuit will approach more nearly to a closed oscillatory circuit and the radiating power will be diminished.

Besides increasing the number of wires, the capacity of the aerial may be increased by decreasing the thickness of dielectric, *i.e.*, bringing the aerial nearer the ground. This, however, will result in a lowered range of radiation, as the distance over which it is possible to transmit varies directly as the height of the aerial.

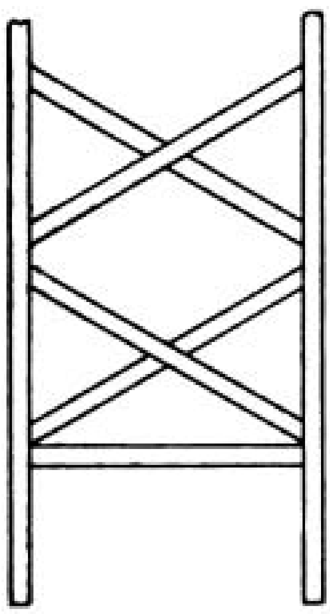


Fig. 6.

The masts supporting the aerials are usually made of wood in the case of small ones, and steel for large aerials. For small single-wire aerials bamboo makes a very suitable mast. One or more stays may be led from the top of the mast to the ground to add strength. These should also be insulated from the mast as carefully as the aerial. For high-power land stations, steel girder towers are used of the type shown in Fig. 6. In the case of steel towers the insulation of the stays is even more important, as otherwise the towers would form a sort of screening aerial, which would absorb the majority of radiation from the aerial proper.

• • •

The connection to earth is usually made by

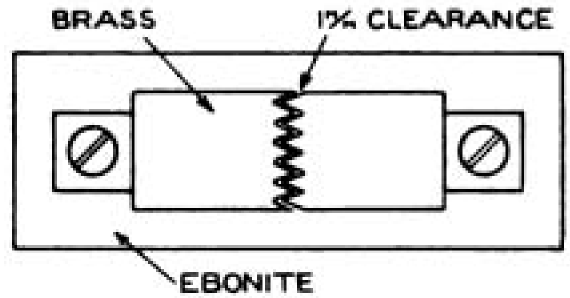


Fig. 7.

means of a number of strips or plates of metal buried a considerable distance under the soil.

Since the oscillatory current flows between aerial and earth, any resistance in either will result in a rapid damping of the oscillations and a decrease in power. The resistance of the earth will be lowered by using a number of plates buried at different points in the ground, and also, if the earth be moist. A special contrivance is sometimes adopted to secure moist contact, consisting of a cone of copper gauze filled with charcoal, but for small stations this is usually needless.

In conclusion, it might be noted that an aerial will act as a remarkably good lightning conductor. It is customary therefore to avoid damage to instruments by lightning by inserting a small spark gap between aerial and earth at receiving stations. This provides an easier path for the lightning than through the tuning inductance. The damage to delicate receiving apparatus is to a certain extent obviated. In the case of violent storms, the aerial could be connected directly to earth by means of a suitable switch. Fig. 7 shows a type of protecting spark gap.

NEXT NUMBER. The next number of "The Wireless World" will contain a six-page Directory of Experimental Transmitting Stations with maps showing locations, etc.

STAVANGER W/T STATION

The above photograph shows the site of the transmitting unit of the Wireless Station at Stavanger, Norway. The station was completed at the end of 1919, and was primarily designed for communication with Annapolis and Tuckerton. The call sign of the station is **LCM**, *well-known to all amateurs. The photograph reproduced was kindly supplied by a Norwegian amateur.*

BOOK REVIEW

THE PRACTICAL ELECTRICIAN'S POCKET BOOK AND DIARY, 1921.

(London : *S. Rentell & Co., Ltd.* Price, 3s. net).

The 1921 edition of this useful little book marks the twenty-third consecutive annual appearance of the volume.

The contents of the present edition show that extensive revision has been made to bring the book up to date, whilst additional matter has been included. The book is extremely valuable to practical electricians, containing as it does almost everything that is required in the everyday conduct of his work.

CONVERSION OF A "Mark IV" SHORT WAVE RECEIVER TO A SINGLE VALVE SET

By C. Hewins.

THE wiring of the set must first of all be stripped and re-wired to the circuit shown in the diagram, where :—

CO is a change-over switch for cutting out short-wave primary.

S is a switch for switching out short wave reactance.

A and B are sockets for plugs of external coils (primary).

C and D are sockets for plugs of external coils (reactance).

The coils L and L′ are coupled together.

The aerial tuning inductance old coils

must be stripped and rewound to the same size (basket type) with No. 36 D.C.C., which gives you a wavelength of 600-800 ms. (internal coils).

The reactance coil should be rewound the same as above. When the coils have been waxed they can be put into the ebonite cases.

The valve holder is made of 4 brass legs and screwed into the centre of the panel as shown in the photograph.

The external coils may be honeycomb, basket or slabs, preferably baskets as in the photograph.

The external coils are fitted with plugs into the sockets A and B, C and D.

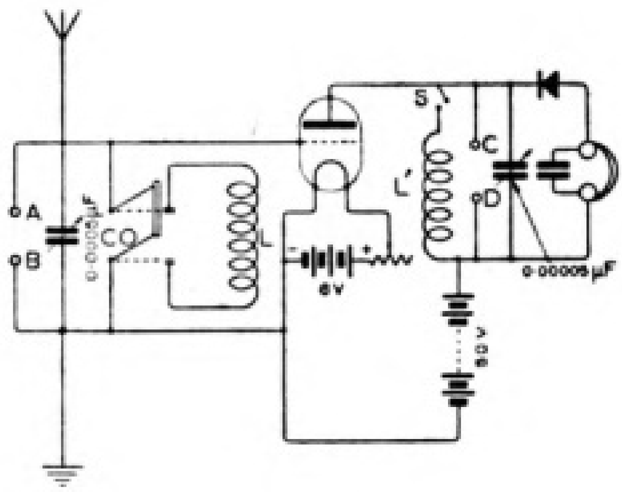
The telephones are preferably 4,000 ohm., Brown's or Sullivan's.

The H.T. battery may be made up of flash lamp batteries, preferably Siemens make, or may be bought in 15-volt units.

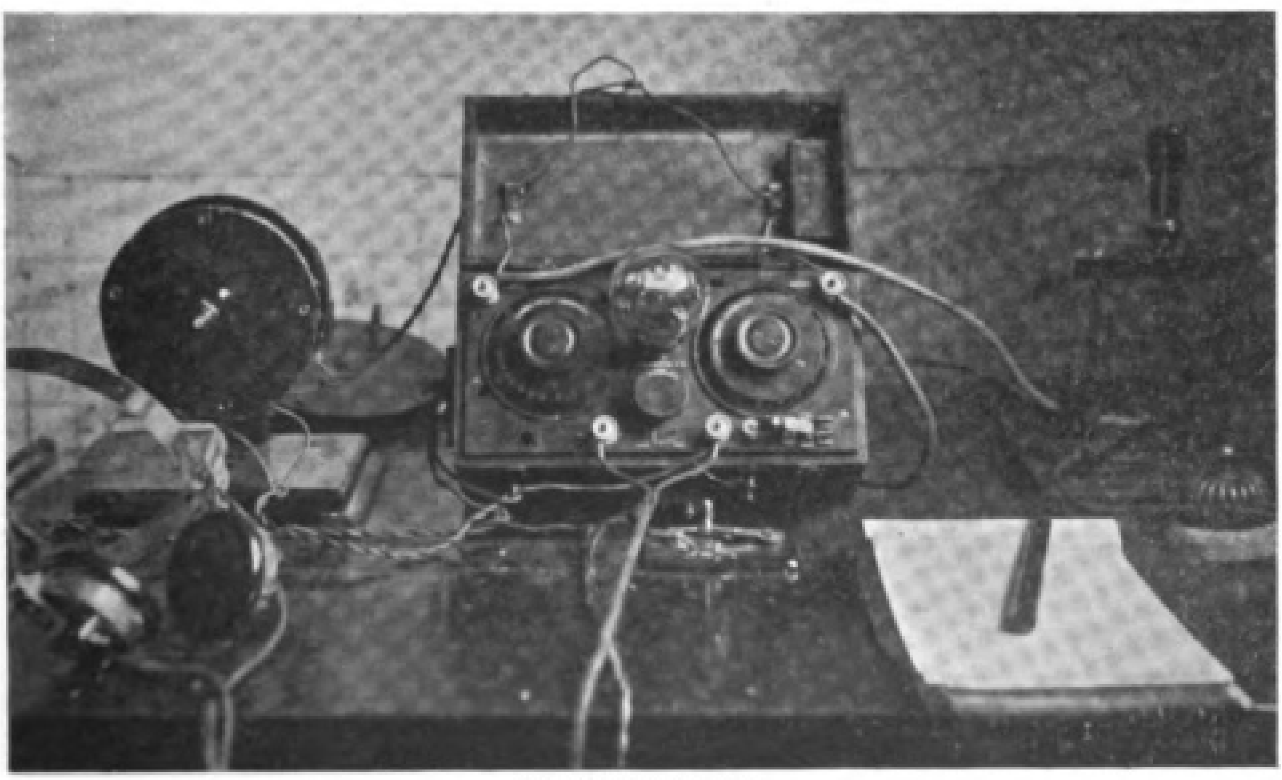
The filament rheostat is as described in *The Wireless World*, volume VIII, page 860, March 19th, 1921, or purchased from any wireless firm.

The crystals used are zincite-bornite, which gives excellent results.

A 2-wire type aerial is used, 80 ft. each side, 160 ft. including the lead-in wire, 35 ft. high one end and 25 ft. the other. The wire is 3/20 black enamelled.



A note magnifier may be added if desired, by removing the telephones and connecting the primary of the transformer to the terminals. PCGG concerts can be easily read with this set, strength 5-6, LP (Koenigswusterhausen) telephony comes in strength 9.



The Converted Set.

QUESTIONS AND ANSWERS

NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."* **(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.**

R.T. (Christiania).—(1) Either circuit will receive telephony, but not C.W., unless a separate heterodyne is used. For a self heterodyne circuit see page 853, March 5th issue.

(2) These pancakes are too small for an efficient long-wave receiver. For 9,000 ms., using 0·0005 mfds. across the A.T.I., use 9 pancakes, 4 cms. inside, 16 cms. outside diameter, wound with No. 26 for the A.T.I., and five similar ones for the reaction.

(3) The principle may be applied, but not the actual windings given in the article in question. You will find it more useful to use a condenser.

E.J. (Oldham).—(1) For a 0·002 condenser use 10 foils 4 cms. wide, and 6 cms. long, with overlap of 4 cms., and waxed paper dielectric 0·005″ thick.

(2) It is not possible to make one loose coupler to cover a range of 800 or 3,000 cms. efficiently. Try the following winding, which will give you 10,000 ms. on a P.M.G. aerial: A.T.I., 8″ diameter, wound with 12″ of No. 26. Reaction, 6″ diameter, wound with 6″ of No. 30, using a series parallel aerial condenser of 0·0005 mfds.

(3) Yes. Arrange the circuit approximately, as shown on page 186 of the May 28th issue, Fig. (3).

H.G.W. (Shoreham).—(1) The simplest way to add a valve to your circuit is as a note magnifier. Connect as shown in diagram, Fig. 1.

(2) The signals are not sufficiently strong to operate a Morse inker.

(3) Yes, if it is the only connection you can make.

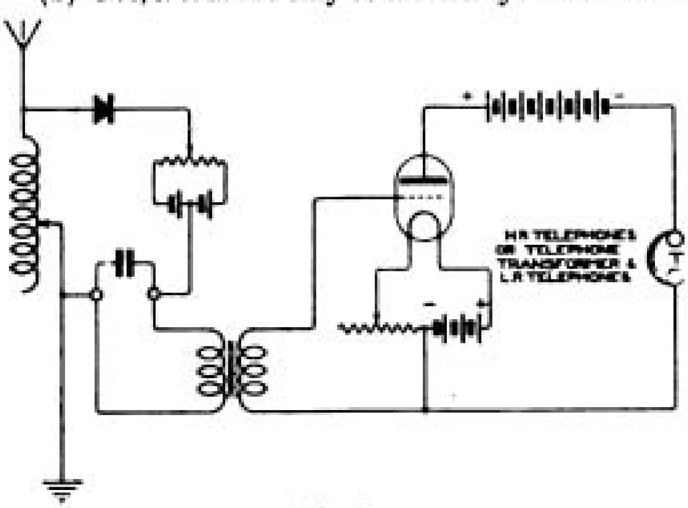


Fig. 1.

(4) During a storm connect the aerial direct to the earth, or let the aerial leads swing clear of everything.

QUAERE (Leicester).—(1) Thickness of sample wire 0·0045″ or 0·0114 cm. S.I.C. probably 2.

(2) Capacity approximately 0·0007 mfds.

(3) Capacity $= \dfrac{nKa}{4\pi d \times 900{,}000}$ mfds., where n = number of active plates, a = area of overlap in square cms., d = thickness of dielectric in cms., K = S.I.C. of dielectric.

$$\text{Capacity} = \frac{3 \times 2 \times 5 \times 3}{4\pi \times 0{\cdot}0114 \times 9 \times 10^5}$$

$$= \frac{5}{7{\cdot}16 \times 10^3} = 0{\cdot}0007 \text{ mfd.}$$

(4) Yes.

NOVICE (Dorking).—(1) Yes, provided you have a suitable tuning circuit, either plain aerial or a loosely coupled set, across the inductance of which you can connect the terminals A shown in the diagram to which you refer.

(2) You might possibly use this as a safety spark gap across your aerial to earth.

(3) Not so far as we know.

J.P.E. (South Shields).—(1) The coils are suitable, but the circuit is not quite right. See Fig. 8, page 19, of the June 11th issue, and arrange your circuit similarly.

(2) 3,500 ms. for the aerial circuit. Secondary with 0·0005 condenser across it approximately 6,000 ms.

(3) Nauen, Eiffel Tower, Poldhu, and others.

(4) Make a telephone transformer—described in issue for March, 1920—for your existing 240 ohm. telephones, and obtain a 0·0005 condenser in place of the test tubes.

V.C. (Russell Square).—For telephone reception the receiver should be brought almost, but not quite, to the oscillating point; it is then in its most sensitive condition for good speech. However, some people do not realise when their sets are oscillating, and so allow them to radiate and interfere with other people.

J.K.H. (Ashington).—The inductance of the standard Marconi 1½ kW set transmitting A.T.I. is 15 mhys., and that of the jigger secondary is 28 mhys. The expression "wavelength" of these coils is almost meaningless. The wavelength to which they would resonate depends on such quantities as their self capacities, and is quite indeterminate.

H.D. (Dartford).—(1) It would be easier to give you a suitable circuit if you told us something about your proposed intervalve transformers, *e.g.*, whether they are L.F. or H.F. Similarly your item 5 (one condenser, two plates 1½″ × 2½″, mica dielectric) is not very helpful without the thickness of the dielectric. If your transformers are L.F., use a circuit as in Fig. 7, page 190, in the issue for June 11th, adding the third valve in the same way as the second there shown. If the transformers are H.F., connect as in Fig. 4, page 663, of the December 11th issue, arranging connections between your first and second, and between second and third valves, as shown between the two valves in the diagrams.

(2) 1 megohm = 1,000,000 ohms.

E.R.W. (South Hackney).—We regret that there is very little in the sketch or description sent to give us a clue to the poor working of the set. All the connections shown are correct. The only thing we do not like is the mounting of the valve, etc., on the secondary coil. Coils carrying H.F. currents should always be placed as far from other leads and apparatus as possible. The most likely faults in your set are (1) a bad valve, (2) poor telephones, (3) possibly telephone transformer connected the wrong way round.

DOCTAH (Blundellsands).—(1) The wire could be used if very carefully wound, but we should much prefer silk-covered wire, of somewhat thinner gauge.

(2) Wind the bobbins one-third full for the primary winding, and fill up completely for the secondary. If possible close the iron core.

(3) Yes, this should be quite feasible.

(4) Make the coils about 1" internal diameter and 5" outside diameter, wound with No. 30 wire. You will probably want about a dozen of these connected in series and placed close together for the maximum wavelength.

J.N. (Willaston).—(1) We are unable to give the name of the station from the few details you give of the transmission. From your locality we should think it was very possibly one of the liners recently supplied with Marconi valve transmitters. (The effect of cloud and sunshine on the signals is very abnormal, and does not seem capable of simple explanation.)

(2) As you do not give the thickness of the dielectric of your parallel aerial tuning condenser, we cannot state the maximum wavelength. The total A.T.I. being about 45,000 mhys, your maximum is not likely to be less than 6,000 ms., and may very likely be considerably higher.

S.J.M. (Seacombe).—It is rather difficult to explain your difficulties in the pile winding in a few words; if possible get some "old hand" to show you, or even examine a professionally wound coil. Your sketch (1) is wrong; there should be no gaps as shown. Either of the methods of your sketches (2) is possible, but the first will give you rather neater work. Another arrangement, shown in Fig. 1, is quite good.

The finished winding does not come out "quite even"; there is a wrinkle and small gap where each wire leaves a top row to begin again at the bottom. If properly done, successive wrinkles do not come exactly opposite each other; each comes slightly after the preceding one, forming in the end a quite neat spiral pattern round the coil. This form of winding is largely a matter of "knack"; when this is obtained you will find it quite easy to get good results; until you do, it will be very hard.

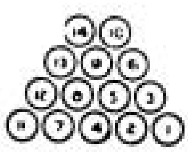


Fig. 2.

SERGEANT PILOT (Cricklewood).—(1) Many types of circuit are possible. One of the simplest is that of Fig. 2, page 98 of the April 30th issue, the third valve shown being represented by your first (rectifying) valve. Reaction may be introduced in the plate circuit of the first valve in the figure. There appears no reason why the same L.T. battery should not be used. If you get any trouble, put chokes in the leads; the chokes will, of course, have to be of low resistance.

(2) There is no reason why you should not place the valves as you suggest, provided that you can run the leads without interfering with existing connections.

M.D.M. (Cricklewood).—(1) It is quite impossible to give a definite rule for the relative proportions of tuning and reaction coils, for the following reasons:—The necessary condition for oscillation is the provision of a certain minimum of mutual inductance between the plate and grid circuits. The amount necessary depends on all the following factors, among others, the H.F. resistance of the circuits, the voltage amplification factor of the valve, the grid conductance, the plate conductance, and the frequency. As most of these are unknown in any given case, we cannot state the necessary mutual inductance, and, even if we could, we could not state the exact size of the reaction coil, which would still depend on the unknown degree of coupling between it and the tuning coil.

(2) Certainly.

(3) Yes, with a suitable valve; it may be considerably too much for some types.

(4) About 10 milliamps plate current; the exact amount varies considerably.

J.L.W. (Norbury).—The gauge of the wire submitted is No. 40. It should be fairly suitable for L.R. telephones, L.F. intervalve transformers, or even for H.F. copper transformers.

F.C.K. (South Norwood).—(1) Yes, certainly.

(2) A.T.C. may be 9" × 6" of No. 22.

A.T.C. may be 0·0003 mfds. Closed circuit inductance may be 6" × 4" of No. 24. Closed circuit condenser may be 0·0005 mfds.

(3) The reactance coil if introduced may be a small coil in series with the closed circuit coil, arranged to couple with the A.T.I. by any usual form of loose coupler.

L.J.N.K. (London).—(1) The connections shown are quite correct, and the set should work quite satisfactorily.

(2) You already show a condenser and leak to valve V_2. The use of a condenser and leak to V_1 is quite optional; on the whole we should prefer it with this type of set. $R_1 = 50{,}000$ ohms. $R_2 = 3 - 10$ megohms. Condenser $C = 0{\cdot}00005 - 0{\cdot}0001$ mfds.

C.W.A. (Putney).—(1) For C.W. yes; for spark or telephony, no.

(2) If the circuits are suitably designed the set will start oscillating for a certain value, or any greater value, of the coupling of your loose coupler.

(3) Any interference which can be produced by a circuit of this type will be quite small.

(4) To still further reduce it, use a 2-circuit receiver, coupling the aerial very loosely to the closed circuit in which the oscillations are set up.

UNSATISFIED (Aberdeen).—(1) The set is of quite useful type, but the amount of wire on the loading coil is about three times as much as necessary. The variable condenser is also about four times too big at maximum.

(2) For 600 ms. very little of the coil will be needed in the aerial-earth circuit; for FL, about one-third. It is impossible to predict the amount necessary across the variable condenser under the conditions you specify.

(3) Maximum wavelength about 14,000 ms.

(4) The set would have the usual advantages of a 2-circuit receiver. Make it about 8″ × 5″, wound with No. 26.

BISCUIT (Reading).—(1) Yes; we presume you mean basket coils.

(2) Wind 12 basket coils 2 cms. inside and 12 cms. outside diameter of No. 28 wire. Use eight for the A.T.I. and four for the reaction.

(3) Take tappings from the joints of the coils to the stud switch.

(4) Yes.

M.D.M. (Cricklewood).—(1) This seems a very good arrangement.

(2) A grid condenser and leak will probably give better rectification. It should be connected as in No. 1 sketch.

(3) 0·002 mfds. will probably be suitable for all three condensers.

H.M.d'A.S. (Wolverhampton).—(1) Interaction between the transformers probably causes the howling. Try reversing the grid windings one at a time.

(2) It is difficult to calculate, but probably 2,000 mhys.

1914 READER (Halifax).—With a single valve you will only just hear the Dutch concerts as you do now. To make signals stronger it will be necessary to add one or two valves as note magnifiers. If you only use a 4-volts filament battery it will be necessary to cut out the variable resistance. The condenser across the telephones should be 0·001 to 0·002 mfds., and may be connected across the H.T. battery as well as the telephones. The author of the article in question has been asked to communicate with you.

V.N. (Birkenhead).—(1) A 2-plate condenser of the dimensions given has a capacity of 0·00002 mfds. To find the capacity of your condenser (as you omit to tell us the number of the plates) multiply this value by the number of spaces between the plates.

(2) It is difficult to calculate the inductance of these coils. It is too big to be useful for a wireless circuit, except perhaps in connection with L.F. transformers.

(3) Yes.

G.A.H. (Farnborough).—(1) Ratio of turns should be about 10-1.

(2) It is impossible to say, as carbon resistance varies considerably.

(3) We think not.

(4) The object of inserting a condenser, whether fixed or variable, in an aerial circuit, is to vary the wavelength of the circuit. It is a case of two condensers in series giving a resultant capacity less than the capacity of either condenser singly. A fixed condenser makes a fixed reduction in the capacity and wavelength, and a variable condenser gives a variable reduction.

A.R. (Aberdeen).—(1) See diagram Fig. 3.

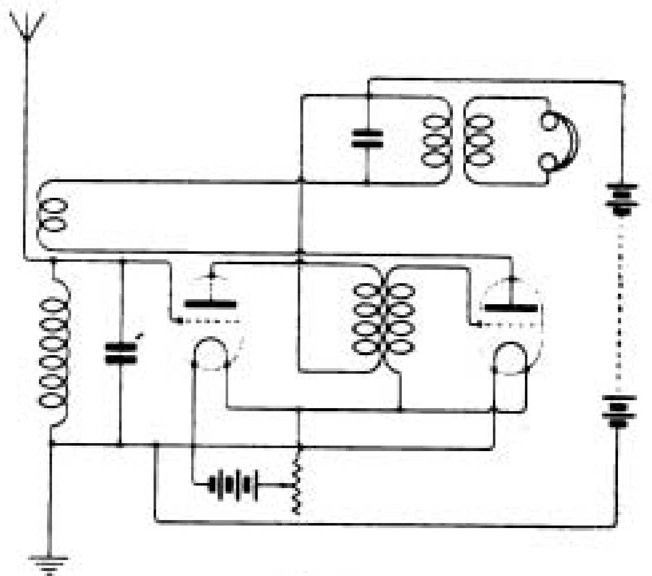


Fig. 3.

(3) No; insulation is quite unnecessary, and it is liable to rot when exposed to the weather, and look untidy.

BETTADUCH (Walthamstow).—(1) This is quite possible, if you introduce a step-up transformer (iron cored) in the place at present occupied by your telephones. The connections for the note magnifier will be as those of the last valve in the diagram of Fig. 7, page 190, of June 11th.

(2) We presume you mean for the grid leak and resistance? If so, in the absence of any instruments you will have to adjust these entirely by trial, using the values that give the best results. Do not make the resistance too small, or the capacity too big. If you use mica for the dielectric, use only two plates, with not more than a few square cms. of overlap.

C.C. (Retford).—We should prefer cylindrical to basket coils for a set of this type. If you use baskets for the A.T.I., use two coils of internal diameter 1″, and external diameter 9″, laid side by side. For secondary as above, but with external diameter 7″.

(2) By bringing the coils to be coupled into proximity with each other.

(3) The blocking condenser should be bigger, say 0·001 mfds. The tuning condenser is correct as shown.

(3) An iron-cored transformer of windings about 5,000 ohms and 100 ohms. See the article in the issue for March, 1920.

E.A.E. (Cheadle Hulme).—(1) Data for L.F. transformers have been given repeatedly in these columns recently. An article on H.F. transformers is appearing very shortly.

(2) Resistance coupled amplifiers are never satisfactory on short waves. No special alterations are necessary to the normal type of transformer amplifiers to fit them for short wave work, except the provision of suitable transformer windings (3) and (4). For both these items dealers in general wireless accessories advertising in this magazine, as we do not think the actual makers will care to supply such small quantities as you are likely to want for amateur work.

J.B.K. (Cambridge).—You will be very unlikely to get satisfactory results from a H.F. transformer to cover the range of 500-15,000 ms. by means of tappings. For such a range we should recommend a set of at least four transformers. The design of windings for a particular case is largely a matter of experiment, and as such, is outside the scope of these columns. An article on this subject is appearing very shortly, which if not giving values exactly suited to your case, will guide you as to what sort of values to try on your own set.

A.F.T. (Sudbury).—(1) The set is properly connected, except that it would be better to put the aerial tuning condenser in parallel with the A.T.I. Also connect the L.T. battery to earth, and not the positive side of the telephones as shown. Telephone condenser need not be variable, but should be larger than shown. We presume your telephones are of high resistance.

(2) Yes.

(3) If you have insulators at both ends of the aerial as shown at one end, nothing more should be necessary.

(4) We should recommend you to work with the circuit as corrected in (1) above until you get useful results before complicating the design further.

A.R. (Stockport).—(1) Not quite correct; the grid condenser and leak must be connected to the aerial side of the A.T.I., and a connection from the negative of the filament battery made to the earth side of the A.T.I. Increase the height of the aerial at the hot-house end.

(2) Primary 3 oz. of No. 44, secondary 6 oz. of No. 32.

(3) Honeycomb coils made to this size, 3″ diameter by 1″ wide, and about ¾″ thick, wound with No. 30 wire, are too big for receiving circuits, the inductance being about 80,000 mhys. Wind a number of coils 3″ in diameter, ¼″ wide, and some ¼″ and others ½″ thick, with No. 24 or No. 26 wire, and experiment with them.

(4) Yes, capacity about 0·0002 mfds.

KAISAR-I-HIND (Mountain Ash).—(1) The circuit shown should work satisfactorily, but seems to us to be a good deal more complicated than necessary. The many possibilities of poor design in a set of this type make it probable that the final results will be no better than could be obtained with much simpler methods.

(2) It is quite immaterial. If you use a helix, the A.T.I. might be 20 cms. in diameter and 45 cms. long, wound with two turns per cm.

(3) Difficult to predict. Try values round about 0·001 mfds.

(4) About 100 volts should be quite sufficient.

MANXMAN (Aigburth).—Please comply with rule (5) above, when your questions will be answered.

W.A.B. (Stockport).—(1) The set shown is of quite good type. The value of H.F. choke **LZ** is often critical on a set of this type—try varying it slightly. We take it that your microphone transformer is iron-cored; you show it air-cored? A mass of telephone wires within 10′ of the aerial and making an angle of 30° with it will certainly lead to poor results both for you and for the users of the telephone lines, with whom you will probably be exceedingly unpopular.

(2) Not necessary; if used, the grid leak should be considerably less than for reception. Try 100,000 ohms, with capacity of say 0·0003 mfds.

(3) No, but we should prefer to shift the 4 mfd. condenser to the end of the line nearest to the set.

B.E.T. (Birmingham).—(1) Try about 6″.

(2) You will probably have to use a tapping on the A.T.I., giving about 1/3 of the coil, for 600 ms.

(3) The service is between Chelmsford (3,800 ms.) and Paris (2,300 ms.). As you suggest, the service is practically continuous throughout the day, the greater part being high-speed duplex. Between stations in permanent communication with each other and no-one else in the way, there is evidently no necessity for a very frequent use of call letters.

F.M. (Cardiff).—(1) For sketch (1) the A.T.C. should be about 0·005 mfds., and secondary 0·0006 mfds.

(2) For use abroad, with no restrictions as to size, the aerial might be 250′ long, and as high as possible. Even larger might be used on a crystal set, but the results obtained would hardly be commensurate with the expense involved.

(3) Yes, if you omit the sliding crystal tapping, which is quite unnecessary. Connect crystal and telephones across the whole secondary inductance.

(4) There is not a detailed article on this subject still in print, but the general information on coil winding given in the constructional articles of the last year, together with the windings quoted in other replies in these columns should give you as much help as you require.

W.H.T. (Hampstead).—A simple way of testing a receiver consists in connecting the buzzer and cell in series across a few turns of wire in the closed circuit. On listening in your telephones and adjusting your circuits, you will be able to tune in the sound of the buzzer.

PREDICAMENT (Edmonton).—(1) Running the leading-in wires near to and nearly parallel to the horizontal part of an aerial certainly tends to weaken the signals received.

(2) The primary without an A.T.I. would tune a P.M.G. aerial to about 2,000 ms. The secondary could be used up to about 5,000 ms. with a suitable condenser.

(3) Yes, but the strength of signals will probably not be great with such a low aerial.

RADIOSIG (Norwood).—(1) For best results put the condenser across the jigger secondary, putting it across the jigger primary would increase the wavelength, but results would be much inferior. Maximum wavelength as we suggest would be about 2,000 ms. You can, of course, increase this by an additional A.T.I.

(2) The netting may get somewhat "live" in a thunderstorm, but we do not think that the use of a netting earth would be at all dangerous to the house.

(3) 6 volts 20 amp.-hour, or any higher capacity at this voltage.

(4) We are afraid we have no information of a receiver bearing this name.

P.S. (Lowestoft).—(1) With all the coils in series the maximum wavelength will be about 10,000 ms. POZ, working on 9,400 ms. will just come in. He works on this wavelength at 20.30 G.M.T., sending press. There are also Christiania (LCH), Nantes (UA) and FL, all working on C.W. round about 8,000 ms.

(2) Try a former 4" in diameter, wound with 6" of No. 20.

(3) Wavelength is approximately correct. Waves will be very damped, and will easily be detected on a valve set at different wavelength adjustments. We presume you are working with a coupled circuit, and not plain aerial.

D.H.B. (Ipswich).—(1) With one valve better results will be obtained with inductive reaction, many diagrams of which have been given recently.

(2) Tubular, 0·00025 mfds. Variable vane, 0·001 mfds.

(3) Inductance = 21,500 mhys. It will tune a P.M.G. aerial to 4,000 ms.

A.G. (Woodberry Grove).—(1) Make condensers as stated. The No. 1 should be about 0·003 mfds.

(2) The wiring diagram is correct.

(3) For 0·0015 mfds. you would require about 76 fixed plates with 75 moving plates. A condenser of this shape would be almost impracticable; you should use considerably larger plates.

G.C.J. (Luton).—(1) The Dutch concerts have been received on this set to our knowledge at distances of about 50 miles less than yours; but we think that in your case results will be poor at best, and probably almost nil without very skilful construction and manipulation.

(2) We should recommend at least a 3-valve circuit, using one valve for H.F. amplification, one for rectification, and one for L.F. amplification.

E.T.R. (Bristol).—(1) With one or two exceptions the set is quite suitable. A connection is shown joining one side of the secondary condenser and the positive H.T. to the aerial circuit. This connection should go to the bottom of the secondary inductance.

(2) Aerial circuit maximum is 11,000 ms., while secondary circuit only tunes to 4,500 ms.

(3) Rewind secondary with No. 28, and introduce either another coil in series with it, or increase the capacity to reach 11,000 ms.

(4) Yes, except when the battery is being charged.

ROBSKOFF (Newcastle-on-Tyne.—(1) This is largely an anti-howling condenser. It stops the amplifier from oscillating at an audio frequency. In other types of amplifier a direct connection is introduced in place of this condenser.

(2) A heterodyne wavemeter to use only one battery is shown in the figure given in May and June Constructional Articles. Coupling must be kept tight, and the two coils should be of approximately the same inductance.

(3) Because speech is broken up by the C.W. generated, in exactly the same way as a musical spark note is changed to a hiss.

H.B. (Rotterdam).—(1) For 20,000 ms., 56,000 mhys. will be required. The frame will only give a very small proportion of this, and you will have to make up the range with about 45,000 mhys. on a loading coil. We have no information as to the inductances of the coils you mention. To cover the complete range you will require about 4 different coils for L_1 and 4 for L_2. The circuit shown in your diagram will not be very efficient owing to the large amount of loading inductance necessary, and at least three valves will be required for good results.

R.C.P. (Rugby).—(1) The lead is too long for efficiency. If convenient, earth to a water pipe in the house.

(2) Certainly.

(3) A safety gap may be two rods of any metal mounted close to each other on a base of any incombustible insulating material, the rods being connected to the earth and aerial leads respectively. A separate earth is not necessary.

(4) Modulation of C.W. by a rotating variometer coil is not of much use, owing chiefly to its practical inconvenience. You will require a speed of at least 4,500 r.p.m., and will probably be troubled by noises from the driving motor. Connect the coil between the lower end of the A.T.I. and the condenser, coupling it with the coil. We should prefer a tikker.

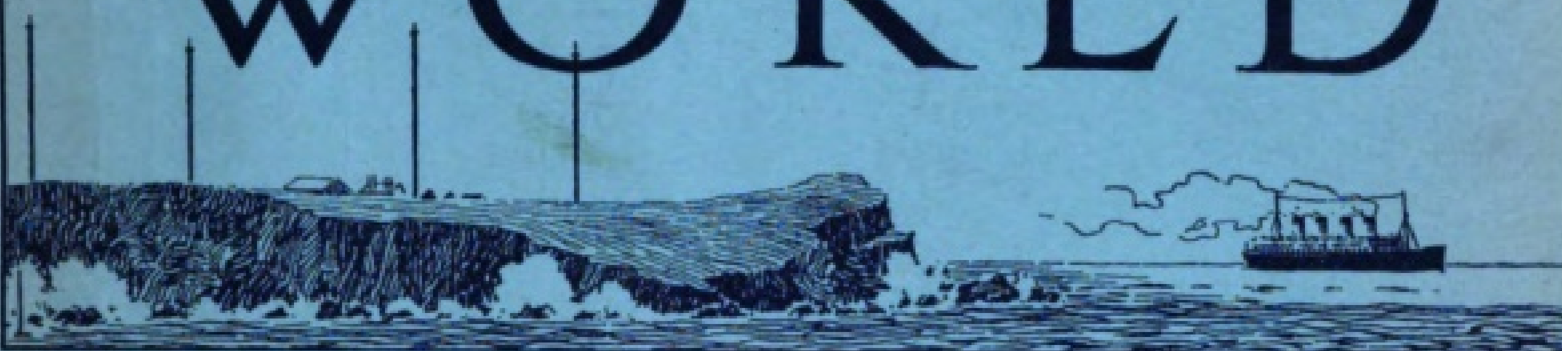
SHARE MARKET REPORT.

Business in the Wireless Group has been exceptionally quiet and prices during the last fortnight have remained practically unchanged.

Prices as we go to press, July 27th, are :—

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

The WIRELESS WORLD



FORTNIGHTLY] AUGUST 20th, 1921. PRICE 6D. NET

THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

Vol. IX. No. 37. AUGUST 20th, 1921 Fortnightly

AN ANTI-NOISE CIRCUIT

By G. P. Kendall, B.Sc.

THE valuable noise-reducing properties of the circuit here described were accidentally discovered by the writer in comparing the relative efficiencies of valve and crystal rectification.* A little experiment and modification produced a circuit which I think will be useful to many amateurs who suffer from bad interference by induction from power-circuits, tramcars, etc., and who are seeking for a circuit for general reception which shall reduce the noises, even at the expense of sensitiveness.

This circuit will entirely cut out noises due to bad high-tension supply, and those due to induction from lighting and power mains, while atmospherics are slightly reduced. Of course, to attain such a happy result something must be sacrificed in the way of

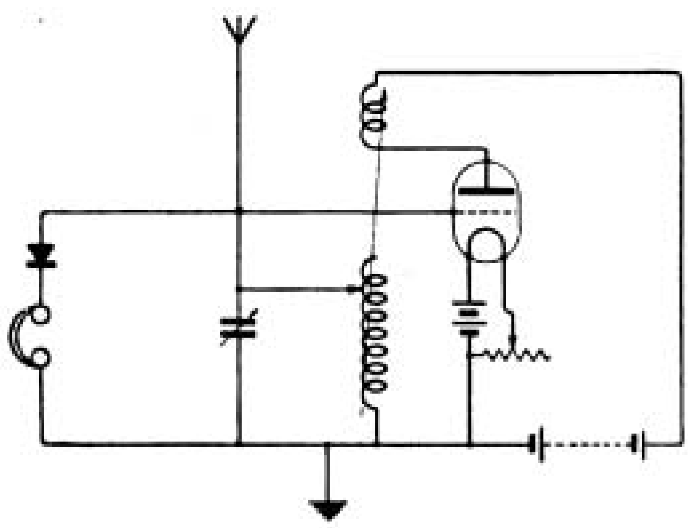


Fig. 1.

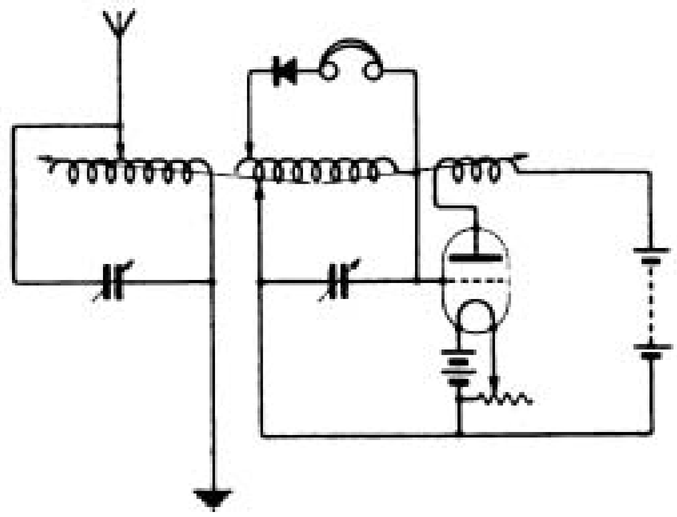


Fig. 2.

efficiency. After careful comparison with various other valve circuits, I conclude that the one under consideration is comparable with the simple valve detector with reaction coupling, but is slightly less sensitive. Unexpectedly, it gives the best results with C.W.

The circuit includes reaction, and hence must be used with due regard to the possibility of interfering with other stations. If the user is confident that there is no other station within, say, five miles of him, he may use the circuit with direct coupling (Fig. 1); but if there is the slightest chance of anyone

* A circuit employing this principle for reducing disturbances has been described by Dr. L. W. Austin (*Journal of Washington Academy of Sciences*, 3, p. 336 : 1913), and others.

listening-in at a lesser distance a loose-coupled circuit (Fig. 2) *must* be used. It would be difficult to over-estimate the importance of this point. To anyone who has the real welfare of the amateur movement at heart it is extremely distressing to note the amount of interference in the larger towns which is produced by the careless use of valves. I was listening to the Dutch Concert recently with a fairly high degree of amplification, and enjoyed the music very well—until certain local amateurs got on the job too!

At one moment there were no less than four valves audible simultaneously. They were audible, of course, not because my own receiver was in the oscillating condition, but because the interfering waves were producing beat-notes with the carrier-wave of PCGG. This kind of thing is trying, to say the least, and foolish too, for no one can hear telephony properly with his valve oscillating.

The circuit here submitted scarcely needs explanation; the two figures should make its working clear. As will be seen, amplification is obtained by means of reaction from the valve, while rectification is provided by the ordinary shunt crystal circuit. This arrangement is distinctly quieter than the type in which the crystal rectifier is placed across an inductance and condenser in the plate circuit of the valve, and, though less sensitive, is much easier to work, especially the circuit shown in Fig. 1.

A point worthy of mention is that there are various pairs of best adjustments of crystal and reaction, some much better than others; with a Perikon I got best results from a fairly heavy pressure on the crystal, and correspondingly tight reaction coupling.

If the loose-coupled circuit is used, slab, lattice, or some other form of disc coil is preferable for the tuning and reaction coils, since these coils, on suitable mountings, provide the readiest adjustments of the couplings used in this circuit.

It may be found possible in some cases to add a stage of note magnification to the circuit, but it generally brings back the interference, especially that from A.C. mains.

THE "THERMAGNION," A NEW RADIO DETECTOR

By Captain H. de A. Donisthorpe.

A DEVELOPMENT of thermionic valve practice, which, while of extremely simple application, gives immediate and great advantages and promises to lead to still further developments, is the "Thermagnion." The "Thermagnion" is the combination of a thermionic triode of special construction with a magnetic field.

It is well known that by applying an electrostatic charge to the grid of a triode a sensitive point can be obtained when the valve will operate suitably for the reception of wireless signals, production of oscillations and other numerous applications. A simple

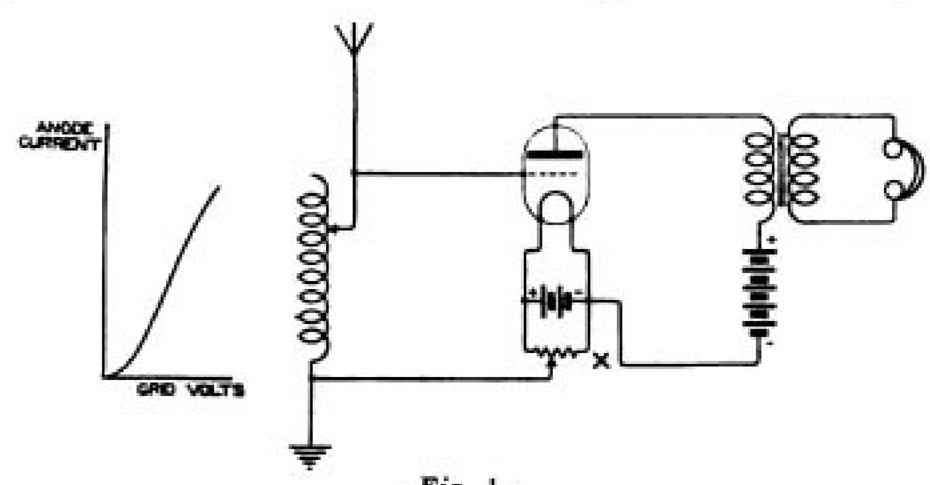


Fig 1.

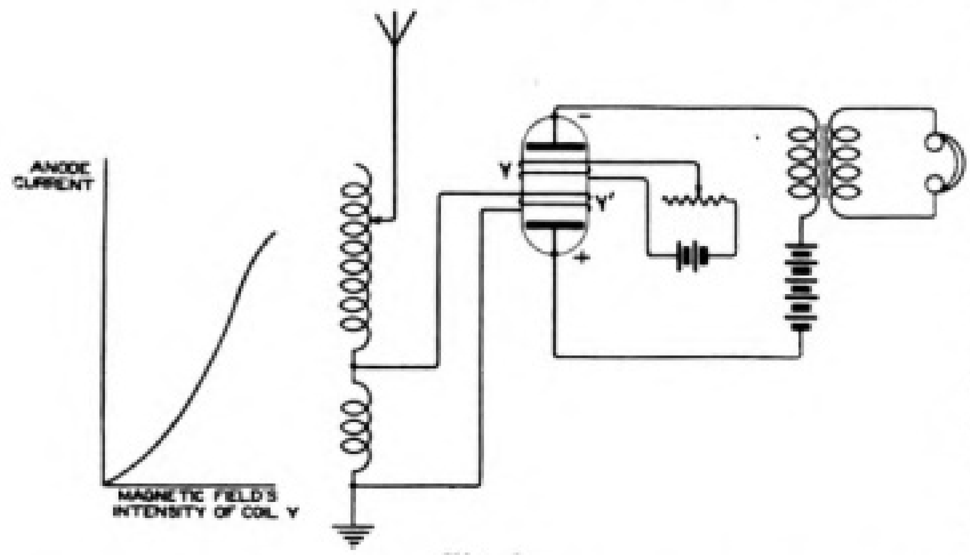


Fig. 2.

circuit utilising this effect for the reception of wireless signals is illustrated in Fig. 1, together with the characteristic curve. The correct electrostatic charge relative to the filament in this case is obtained by means of the potentiometer X.

Similarly, as shown in Fig. 2, a cold Kathode tube can be rendered sensitive by the application of a suitable magnetic field in the space occupied by the two electrodes. The correct point on the characteristic curve is obtained by the variation of the current flowing through the field coil Y, and in this manner the tube can readily be made to respond to wireless oscillations through variation of the field strength due to the coil Y'. The use of the "Thermagnion" differs from the last in that it takes a triode functioning in the usual manner and renders it super-sensitive, as will now be disclosed.

A "soft" thermionic triode is employed, of such a form that the space occupied by the three electrodes can be subjected to a magnetic field. A triode, where the filament and grid are entirely surrounded by a cylindrical anode, cannot be used, since in this form the field cannot be applied in a useful manner.

In these experiments an "R M R" triode (Fig. 3) whose anode and grid take a hemispherical form, was employed, and its external envelope or bulb was surrounded by a field coil so arranged that its general position and current could be varied.

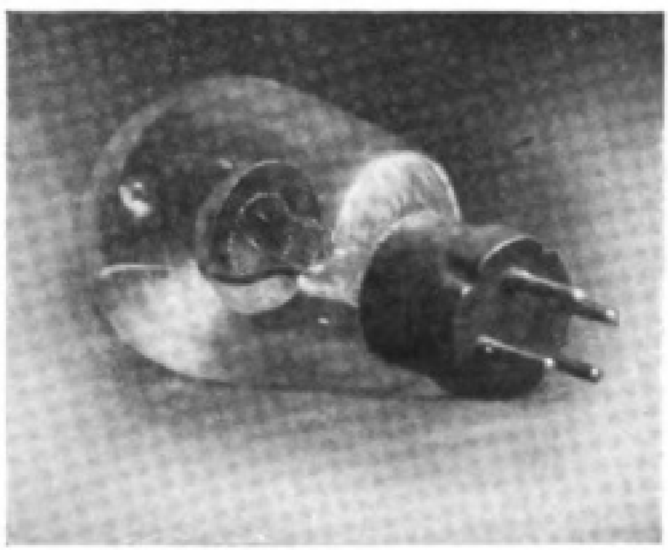


Fig. 3.

Now, utilising the circuit shown in Fig. 4, which is the same as that of Fig. 1 with the addition of the field coil "Z," it is possible, by suitably adjusting the position of the coil and the current strength, to alter the curve A to the steeper slope indicated at B. The

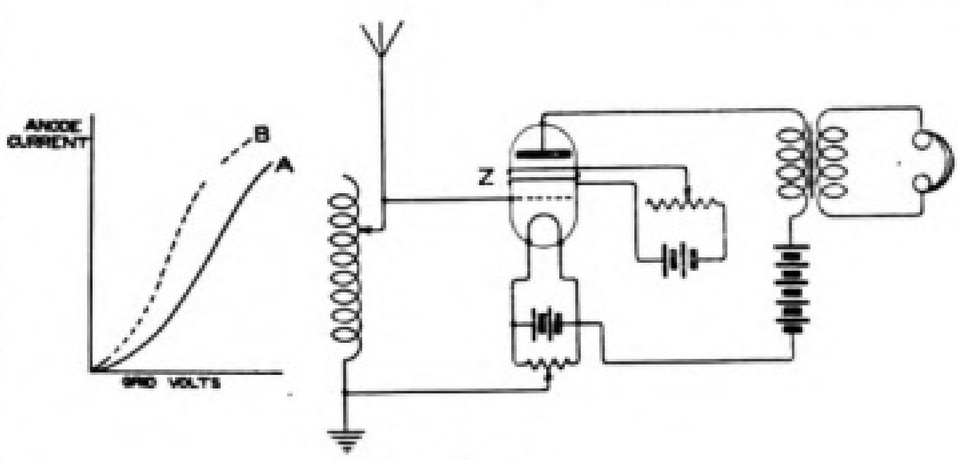


Fig. 4.

effect of this is that signals previously inaudible become easily readable and the general signal strength is increased to the extent of 100 to 200 per cent.

By altering the adjustment of the coil Z the valve can be made to oscillate and, in certain positions, the "Thermagnion" becomes a detector of continuous or undamped wave signals. A very interesting feature of this application is that the beats obtained appear to be quite independent of the tuning of the aerial circuit, usually a very delicate adjustment. The coil has only to be moved slowly until signals are heard, and the note frequency is then varied by the further adjustment of the coil, alteration of aerial tuning having no effect. Thus spark signals can be completely eliminated when receiving undamped wave signals of the same wavelength.

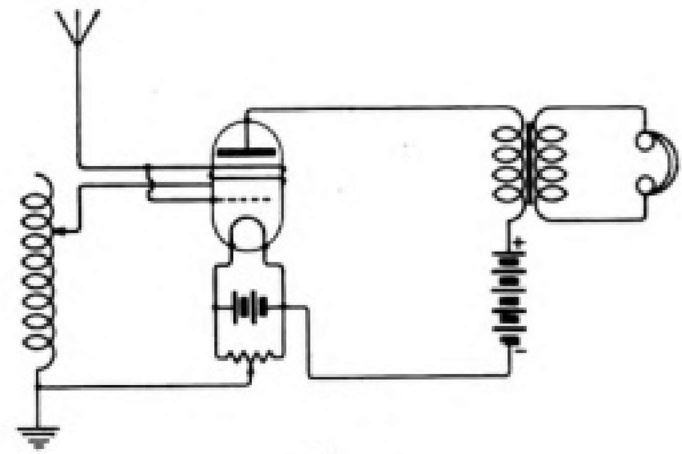
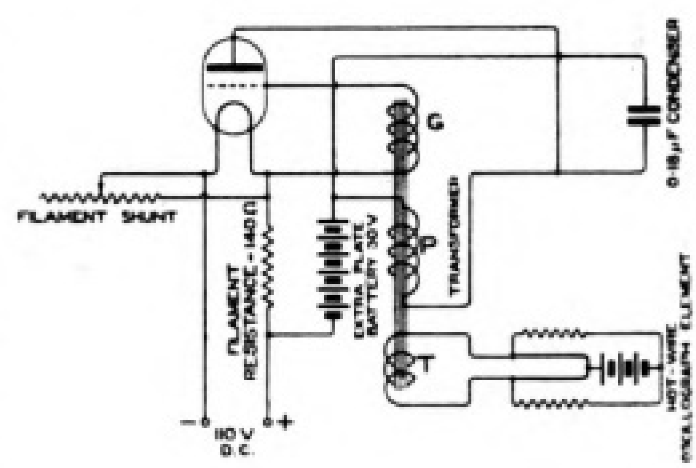


Fig. 5.

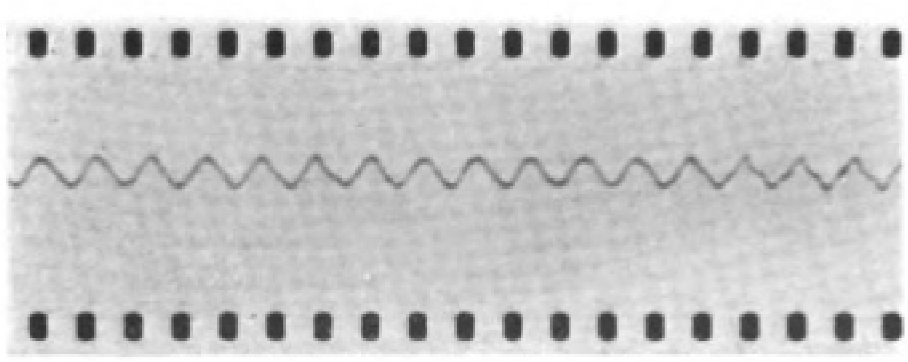
There are many other applications of the "Thermagnion," for the signals themselves may be passed through the field coil so that they react on the valve circuit, as shown in Fig. 5. These further results will be explained in detail at a later date.

RECORDING OSCILLATIONS

THE accompanying oscillogram has been sent to us by Mr. W. H. Lawes, and is obtained by the circuit arrangement shown in the diagram. The windings of the transformer coils are T 600 turns, P 6,000 turns and G 6,000 turns. The wires used in the iron core are of 0·5 m.m., and an open magnetic circuit is employed. The additional plate battery was employed to increase the amplitude.



The voltage on load was approximately half a volt and the current 0·04 amps. It was not possible to employ the usual shunted condenser to overcome the time-lag of the oscillograph so that the wave form is probably slightly distorted. The presence of harmonics can be detected in the oscillogram.



LOUD-SPEAKING TELEPHONES—II.

(Conclusion.)

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

A FORM of relay somewhat analogous to the one just described is disclosed by R. A. Fessenden in British Patent 11154 1910, but making use of electrostatic forces only and not changes of friction caused by electrolysis as in the Edison type of apparatus. In Fessenden's apparatus a metallic cylinder or disc is separated from an electrode which rests on its surface, by a thin dielectric such as a film of oil or a thin sheet of mica. The electrical potentials applied between the cylinder or disc and the separate electrode, cause attractions between them and therefore augmented friction if the cylinder or disc is kept in rotation. The flexible surface electrode will thus be moved by amounts depending upon the applied potentials, and these movements can be used to move a syphon recorder so as to record signals on a moving paper tape, or they can be applied to a microphone so as to produce amplified current variations in a local circuit. These two applications are indicated in Figs. 13 and 14, which show the cylinder and disc varieties of this apparatus respectively.

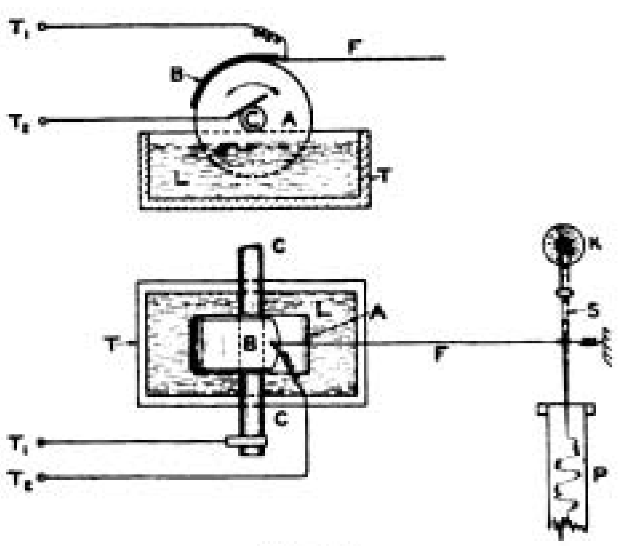


Fig. 13.

In Fig. 13, which gives a plan and elevation of one form of the apparatus, the metal cylinder A is rotated by the shaft CC in the direction indicated by the arrow, and dips into the trough T, containing some insulating liquid L, such as oil. On the surface of A the thin flexible metal band B, of aluminium or gold foil, rests and is maintained from electrical contact by the film of insulating liquid carried round on the surface of the rotating cylinder from the trough T. The metal cylinder and the band are respectively connected to the terminals T_1 T_2, which form the input terminals of the apparatus. The band B is kept from being pulled round by the cylinder by the fine thread F, which is attached to the arm of the ink syphon S, as shown. This syphon dips at one end into the ink-well K, and at the other rests lightly on the surface of the paper tape P, so as to draw a line when the tape is set in motion by a suitable clockwork motor.

When the input voltage is applied between T_1 and T_2 the varying attractions between A and B (through the dielectric film on the surface of A) cause varying pulls on the thread F, and hence inscribe a wavy line on the paper P.

Instead of connecting the thread F to the ink syphon it could evidently be attached to a large telephone diaphragm so as to reproduce a sound, and turn the apparatus into a loud-speaking telephone

In a disc form of this apparatus, illustrated diagrammatically in Fig. 14, a metal disc D, which forms one electrode and is connected to one input terminal T_1, has resting on its surface a small piece of very thin mica sheet M, coated on its outer surface with a metal foil electrode A which is brought almost to the edges of the mica. The mica is attached by the two threads F to the central plate F of a differential microphone, which is included in a local circuit formed by the battery B and the telephone transformer TR so as to operate the ordinary loud-speaking telephone T. This arrangement of the instrument thus serves as an amplifying relay between the input terminals T_1 T_2 and the output telephone T; but instead of being so arranged, the threads F could evidently, as described above, be joined directly to a diaphragm fitted with a horn so as to make the instrument into a complete loud-speaking telephone.

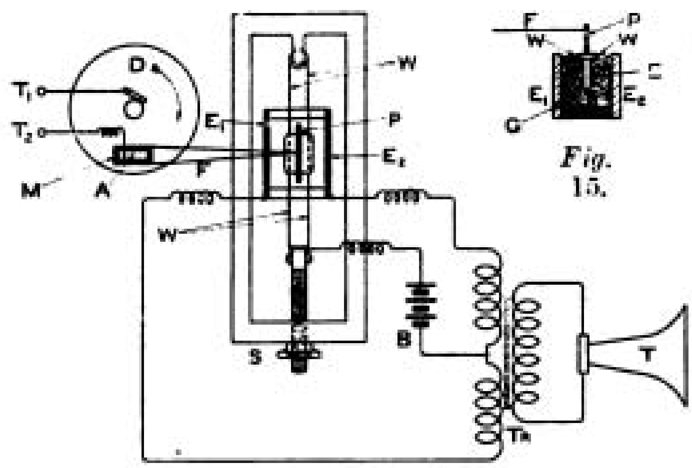


Fig. 15.

Fig. 14.

As the arrangement is perhaps of some interest, the details of the differential microphone attachment are given in Fig. 15, the parts of which are lettered to correspond with those of Fig. 14. The threads F are attached to the upper end of the plate P, which is suspended by the two wires W W, as also indicated in Fig. 14. These wires may be strained taut by the tensioning screw S (Fig. 14). The lower end of P carries the central electrode E (Fig. 15), which, by being placed in the centre of the mass of carbon granules G between the fixed side electrodes E_1 E_2, forms a differential microphone. As indicated in Fig. 14, the microphone is joined up to a differential telephone transformer Tʀ, which is merely an ordinary telephone transformer provided with a double primary winding instead of the usual single one, with the battery B in the common central connection.

When the plate P and electrode E are in their central undisturbed position the currents flowing through the two halves of Tʀ will be equal, but as soon as the plate is moved the resistance of one half of the microphone will be lowered and that of the other will be raised, so that a reinforced effect will be produced in the secondary of the telephone transformer if the windings of the two primaries are properly connected.

Both these pieces of apparatus evidently work upon the same principle as the Johnsen and Rahbek instruments that we have already described, in that they depend for their operation upon the effects produced by electrostatic attractions between two electrodes, but they differ from the Johnsen and Rahbek apparatus in that the effective distance separating the electrodes must be much greater, since the materials used to separate the electrodes are good dielectrics or *insulators*. The apparatus will obey the same laws of attraction as were set out in the first instalment of this article, but the values for the separation distance *d* between the electrodes will be much greater than the values that are effective when a "semi-conductor" is used between the two electrodes.

Probably the earliest telephonic application of these electrostatic adhesion effects exhibited by semi-conducting materials was made by Dr. Elisha Gray about 1873. The apparatus was described by him in a paper published in the *Journal of the American Electrical Society* of March, 1875, and a good description of it is also given in the paper by C. W. Cooke, published in the *Journal of the Royal Society of Arts*, to which reference has already been made.

These phenomena were first observed by Dr. Gray during some experiments with an induction coil. He noticed when a thin, dry metallic surface connected to one terminal of the secondary of the induction coil, was rubbed by the hand while the operator was holding the wire from the other secondary terminal in his free hand, that a sound was emitted by the hand at the point of contact with the metal. This sound had the same pitch and quality as that given out by the contact-breaker of the coil.

He later constructed a keyboard which controlled a series of reeds of different frequencies connected as interrupters for the primary of the induction coil, and was thus enabled to transmit musical notes or signals, or to play tunes on the apparatus, using these electrostatic effects to reproduce the sounds.

This experiment is one that can very easily be repeated, as it requires no complicated apparatus. A thin sheet of metal should be used, preferably of fairly large area—say a square foot or more—and should be supported at its ends only, so as to allow it the maximum freedom of motion. The metal should be connected to one secondary terminal of a small induction coil or step-up transformer, through the primary of which a feeble interrupted current is passed. This primary current should be quite small—not the normal primary current, if an induction coil is used—and may conveniently be obtained from a single dry cell, with a sensitive buzzer in series in place of the usual interrupter. It is not necessary that the secondary voltage of the coil should be greater than required to produce a just perceptible spark when the wires are brought together. The remaining secondary wire (one being connected to the metal sheet as mentioned above) should be held in one hand while the fingers of the other hand are drawn lightly over the surface of the metal. If the operator's fingers are in a suitably dry condition it will be found that a sound will be emitted by the metal while the fingers are kept in motion. If one's fingers are at all moist the effect disappears, for the reason that has already been given in connection with the measurements on the resistance of slate (in the second part of this article). In that case, better results can often be obtained by using one's finger-nails instead in the manner indicated in Fig. 16.

Fig. 16.

Very good results can be obtained by using a dry piece of slate, to which one moistened electrode has been attached in the manner already described, and drawing the edge of the slate along the metal as shown in Fig. 17. In this figure S is the slate, shown in edge-on view resting on the thin metal sheet M, which is supported away from the table by the blocks B B. The metal (tinfoil) electrode C is attached to the slate by moistening its surface, taking care that the remainder of the slate is not wetted. The lower edge of the slate that rests on the metal may with advantage be chamfered off an angle, as shown, so as to present a larger surface to the metal.

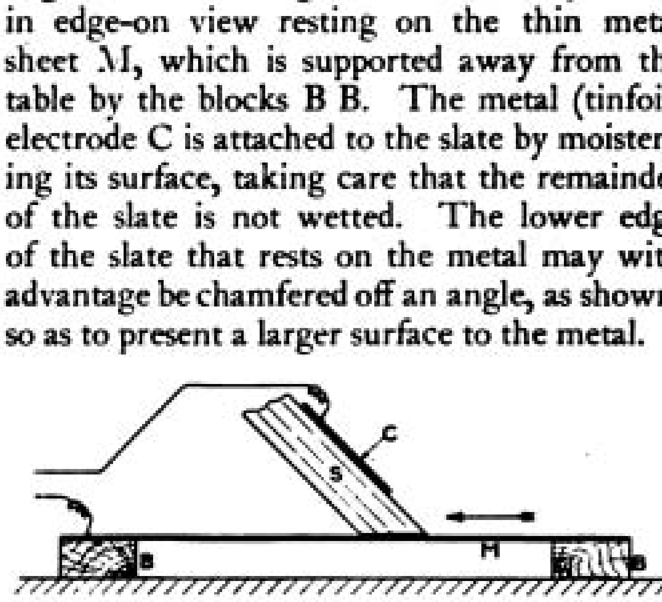


Fig. 17.

By connecting a microphone in series with the primary of the induction coil instead of the buzzer or interrupter, passably good speech can be reproduced by this means, while the slate is kept in motion. If the voltage from the coil is large enough some sounds are obtained when the slate is at rest, due to the larger electrostatic pulls set up by the higher voltage being sufficient to set the metal into vibration without calling the frictional forces into play, such as is done when the slate is in motion.

By using a metal cylinder or drum instead of a plate, and rotating the cylinder by a crank handle, Dr. Gray constructed an improved model of this apparatus, by which sounds could be continuously reproduced as long as the handle was turned. It was found with his apparatus that the volume of sound increased somewhat with increase of the speed of rotation, and that all sounds ceased when the rotation was stopped.

It was at first thought by Dr. Gray that the sound was produced by some physiological effect produced by the electric current on the nerves and muscles of the hand; but some experiments made by Dr. Tyndall, who exhibited the apparatus at the Royal Institution in 1879, proved that the phenomenon could in no way be connected with nervous influence, since he obtained similar effects with dead animal tissue. It has been stated that he obtained quite good results by using bacon rind as the semi-conducting rubber pressed on the cylinder.

It is particularly interesting to note that Dr. Gray found that the friction between the finger and the rotating drum was greater when the current was passing than when it was interrupted, and moreover, that the effects were entirely destroyed by the presence of moisture on the fingers, so that there seems little doubt that Dr. Gray was making use of identically the same effect of partially conducting materials as has been used by Messrs. Johnsen and Rahbek; but this fact should not allow us to take away from them the credit due to the development of the idea, with modern apparatus, and the perfecting of instruments that are capable of useful telegraphic and telephonic applications.

In addition to the references that have already been quoted in the course of this article, mention may also be made of the following articles, where those interested may find further useful information :—

Telegraphic Journal, 7, pp. 112—114, April 1st, 1879.

Engineering, 27, pp. 238—240, March 21st, 1879; also pp. 467—468, May 30th, pp. 488—489, June 6th, and pp. 506—507, June 13th, 1879.

Elektroteknisk Tidsskrift (Christiana), 33, pp. 269—272, November 25th, 1920,

the last containing an early description of the Johnsen and Rahbek apparatus.

THE DESIGN OF HIGH FREQUENCY RESISTANCE AMPLIFIERS

By Lieut. N. H. Edes, R.E.

(Continued from page 233).

DISCUSSION.

Mr. Maurice Child: As author of the paper to which Lieutenant Edes refers, I am very pleased indeed to think that my paper has been a subject of some interest. I would like first of all to say that the object of my original paper was not to deal with the theory, but to give more practical details regarding the construction of, or, rather, my experience of the construction of the instrument which I showed to the Society. Of course, when we are dealing with these amplifiers on theoretical lines, the problems which present themselves are somewhat difficult because we know at the outset that what we should have theoretically we cannot have in practice.

As Lieutenant Edes pointed out in his mathematical analysis of the amplifiers, theoretically, the plate resistance ought to be infinite in order to get the maximum ratio of voltage from the first valve to the second. Well, of course, that cannot be done. We have to have some reasonable resistance in the plate circuit. Some text books suggest for this resistance a value of about 80,000 ohms, while in the paper we just had read to us the value of the anode resistance was assumed to be equal to the internal resistance of the valve.

There is also another aspect of the question to consider, and that is the question of the normal grid voltage. It was suggested that a good plan is to cause the normal grid voltage to be of such a value that all the valves amplify except the last one. I have considered this point rather carefully in respect to the valves we have to deal with every day—that is principally the R valve, and I have also experimented on these lines, and I find that what one ought to do theoretically is not possible in practice. My contention is this, if we make the grids of all the valves preceding the detector valve negative in order to get amplification of the oscillation, instead of rectification, then we reduce the efficiency, because by this means we shut off so much of the plate current through the valves. In order to bring up the efficiency again one should, of course, increase the plate resistance. If we increase the plate resistance then, in turn, we get to a condition of extreme instability in the whole amplifier, and I found in practice, as I have said in my paper, that it is very difficult with these amplifiers (which comprise six valves) to keep them sufficiently stable and prevent self-oscillation.

I am rather sorry that Lieutenant Edes has not made a few suggestions at the end of his paper as to the values which would be correct in an actual amplifier of, say, three or six valves. Such data would be of use to us all. However, I think he has contributed a great deal of interesting matter, and I feel sure that a large number of the members here will be able to reap some benefit from his contribution.

Mr. R. E. H. Carpenter: There is one small point which seems to have been overlooked, and which may be of interest. That is, the input impedance of the valve. The vector diagram of the grid-filament circuit of the valves appears to have been assumed to be of the nature of a pure capacity. That, of course, is not the case. The grid has capacity to the plate, and the plate circuit has therefore an influence on the phase angle of the current taken by the grid.

One other point, with reference to the remarks of the last speaker, if in order to prevent the rising of the grid current you negativise the grids, one can get over the resulting difficulties that were mentioned by increasing the plate voltage. That seems to be a more natural way of getting over the difficulties than increasing the anode resistance.

Mr. Maurice Child: Of course, I realise that one should increase the H.T. battery as well as the resistances. But then one does not want to use high voltages, and, further, these excessively high voltages tend in practice to make it difficult to get the whole set to oscillate.

Mr. C. F. Phillips: With regard to the making of the grids of these valves negative, or whether it is desirable to make them negative or to leave them normally slightly positive, surely there are other factors which come into account besides the pure effect of damping. It may be noted that when you make your grids positive the resultant damping has a certain advantage. If you sufficiently damp the signals you can undoubtedly employ a large amount of magnetic or other reaction without obtaining instability in the whole amplifier, and what you actually lose by damping you can considerably make up for by the ability to use regeneration. This is an important factor, and, further, when you are using regeneration you get another advantage. Damping may exist in the grid circuits, but when the circuits come into true resonance that damping disappears, due to the resonant condition. I cannot explain that; I am not a sufficiently good mathematician; but it is a well-known fact. It seems that, as a result, the circuit is damped partially for other wavelengths, but not so greatly for that particular wavelength to which you happen to be tuned. That is an advantage, because it makes the amplifier to a certain extent selective.

Mr. A. A. Campbell Swinton: I am sure you will wish to pass a very hearty vote of thanks to the author of the paper, Lieutenant N. H. Edes, and also to Mr. Coursey for having so kindly taken upon himself to read the paper and for giving this very excellent explanation of it. It is not an easy subject, but there are one or two general questions which I think might be of interest. I would rather like to ask some questions, but I do not know who is going to answer them, whether Mr. Coursey or Mr. Edes.

I have had some personal experience with this kind of amplifier and with the ordinary transformer amplifier, and I have noticed certain effects which are interesting, and I would like to know whether they have been noticed by other people, and what is their explanation. To begin with, resistance amplifiers do not seem to work for short waves; they do not seem to be in it as compared with a transformer amplifier for anything less than about a 1,000 metres wave. I believe some French people have been able to get them to work down to 100 metres or thereabouts, but I have not been able to do so. I do not know whether it is due to my design.

Another thing I have noticed is that for telephony this kind of amplifier does not give such good articulation as a transformer amplifier. I have noticed that, over and over again. I mean that even with wavelengths for which it is quite suited, such as the transmissions from Chelmsford—I have forgotten what the wavelength was—with a resistance amplifier you cannot get (at least, I cannot), the same degree of articulation that you can get with a transformer amplifier. On the other hand, for ordinary telegraphic reception, they are very effective and much more easily heterodyned with electrostatic reaction than the transformer amplifiers.

Well, these are questions which I should like to have answered. I do not know who will answer them, or if they can be answered.

I would like to agree with Mr. Child in wishing that the author had given us some actual figures. I am in the throes of reconstructing an amplifier to try and make it better. There are little things which have a very large effect on this instrument, and I should have liked to have some particulars as to the relative position of parts and the length of wires. The data is much more effective than anything you can get by mathematics. I do not wish to decry the mathematical treatment, because I am sure it is valuable; but for an amateur society these little technical details, such as how to put the things together, are of vast importance.

I will ask you to pass a very hearty vote of thanks, both to the author and to the reader of the paper. (Applause.)

Mr. P. R. Coursey: I think the best way will be for the report of the discussion to be sent to Lieutenant Edes, so that he can reply as he sees fit to the points that have been raised; but I should just like to make one or two remarks here, if I may.

I agree with Mr. Carpenter that the best way of getting over the difficulty occasioned by making the grids negative is by increasing the anode voltage rather than the anode resistance; but I do not quite see his point about the input impedance.

Were you referring to the expression for Z_1, which I have used in connection with the paper?

Mr. R. E. H. Carpenter: In your diagram, Fig. 2,* the input impedance of the grid filament circuit appears to be represented by the capacity C_r.

Mr. P. R. Coursey: You mean the input impedance of the valve itself?

Mr. R. E. H. Carpenter: Yes; it has been shown by some German physicist (whose name has escaped me) that the input impedance of the grid filament circuit of the valve is not independent of the nature of the circuit connected with its plate, and that owing to the fact that you have a capacity coupling between the grid and the plate of the valve, you get an effect on the phase angle of the grid circuit

* See p. 236 of issue for July 9th, 1921.

depending on the nature of the circuit connected to the plate.

Mr. P. R. Coursey: I thought at first that you were referring to Z_1, which is given as $= 1/C_1\omega$. I remember, now, the point to which you refer; it has been mentioned in other papers, but I think that the author of this paper has assumed the input impedance to be a pure capacity, partly because he is assuming sufficient negative voltage on the grid to cut off the grid current. If the grid current is cut off, the grid-filament resistance is very high, and hence, C_2 is not shunted by any appreciable conductance. The fact that you have a capacity to the plate will, however, somewhat modify the results, but I am afraid I cannot say to what extent without further consideration. I am also in agreement with Mr. Campbell Swinton about the need for practical details.

Mr. R. E. H. Carpenter: There is one further little point. The worst crime of all resistance amplifiers, so far as I know, is the wipe-out effect. If you have capacities in series with your grid, a bad atmospheric is liable to paralyse the whole combination for a considerable length of time, and that puts all resistance amplifiers practically on the shelf so far as I am concerned.

Mr. P. R. Coursey: Yes; the wipe-out effect certainly is a disadvantage when working with these amplifiers.

With regard to Mr. Campbell Swinton's remarks, it may be noted that the equations that Lieut. Edes gives involve the term $\omega = (2\pi \times \text{frequency})$, which shows that the amplification must vary with the frequency provided that the amplifier is maintained the same, and he also suggests that the results may be improved by reducing the resistance of the grid leaks for the higher frequencies, *i.e.*, for the shorter wavelengths, but I have not tried out the effect to which he refers to see actually how it works out in practice.

With regard to resistance amplifiers for telephony I should suggest a possible part of the distortion mentioned is due to the very damping effect that Lieutenant Edes is referring to, because when damping is present and it is wiped out in part by retroaction (as mentioned by Mr. Phillips), it is wiped out for that one frequency only, and as telephony necessarily involves a band of frequencies,* there must consequently be some distortion introduced from this cause if the amplifier is at all selective in its amplification. A further point with regard to the use of these amplifiers for telephonic reception is that they are normally designed for telegraphic work, in which case the grid leaks are proportioned so that they will allow the grid potentials to return to their normal value between the signals, whereas in telephony these unmodulated carrier waves (of which there is usually plenty) is there all the time, and consequently the grid changes will not have any blank spaces in which they can leak away. The mean grid potentials will thus generally be much more negative when receiving telephony than telegraphic signalling, so that if the valves are working near the mid points of their curves normally, the representative point may be moved too near the lower bend of the characteristic in the case of telephonic reception, for undistorted amplification to be secured. It may be that one or both of these is possibly the cause of the distortion of the speech harmonics.

I do not think there is anything else I can refer to now, but I hope that Lieut. Edes will give us, later, a fuller reply to the points that have been raised.

Mr. W. H. F. Griffiths (*communicated*): As pointed out by Mr. Campbell Swinton, the amplification of signals gradually diminishes for wavelengths below 1,000 metres or so, somewhat as shown by Fig. A.

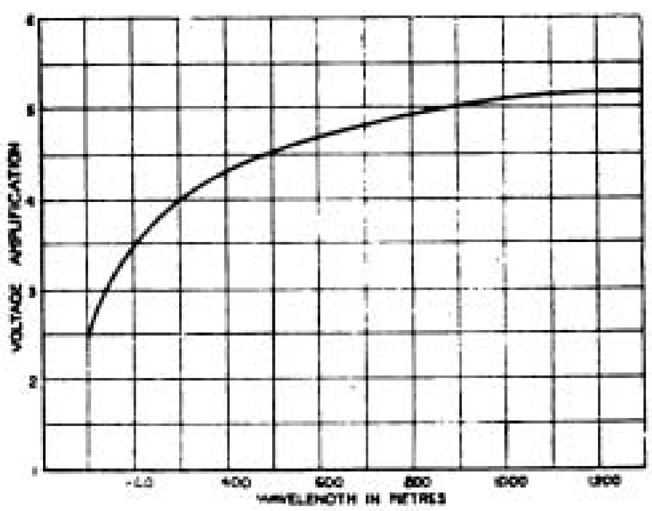


Fig. A.

The reason for this is to be found in the fact that the valve has an inter-electrode capacity of an appreciable value, especially when augmented by the capacity between the pins and sockets, and also by that between the leads connected to the valve electrodes.

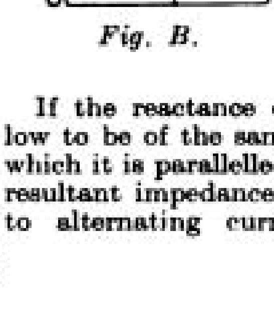


Fig. B.

This capacity has the effect of shunting the resistance of the filament-anode path with a condenser C_1, as shown in Fig. B, and, since B and O may be regarded as the same point for the consideration of the oscillating component of anode current, this amounts to the same thing as connecting a condenser C across the resistance AB, and thus providing an alternative path across it for alternating currents of very high frequency.

If the reactance of this capacity is sufficiently low to be of the same order as the resistance with which it is parallelled, it will appreciably lower the resultant impedance between the points A and B to alternating current, and, consequently, the

* If N is the frequency of the carrier wave, and n is the highest audio frequency used in the modulation, then practically all radio frequencies between $N - n$ and $N + n$ will be present at the transmitter and at the receiver. If the amplifier is selective there will be less amplification of the side frequencies $N + n$ and $N - n$ than there is of the resonant frequency N.

A.C. voltage drop across these points will be correspondingly reduced; the voltage amplification will be, therefore, also reduced.

Assuming the parallel capacity to be 4 micro-microfarads, or 4×10^{-12} farad, its reactance, $1/C\omega$, to alternating currents of 300,000 frequency, corresponding to a 1,000 metre wavelength, is approximately 130,000 ohms, too high a value to very appreciably reduce the impedance across AB. It would, taking actual figures, only reduce the impedance of a 60,000 ohm resistance to 54,000 ohms.

On shorter wavelengths, however, the loss of amplification due to this parallel capacity is much more marked, because the reactance of a condenser to alternating current is inversely proportional to the frequency of that current. For instance, at 300 metres wavelength (oscillation frequency 1,000,000), its reactance is only 40,000 ohms, so that, however high the value of the resistance AB, the resultant impedance between its ends to currents of this frequency can never be more than 40,000 ohms, and the impedance of a 60,000 ohms resistance will be lowered to approximately 33,000 ohms.

For a resistance of 60,000 ohms I have worked out the resultant impedance to currents of frequencies corresponding to various wavelengths, and have plotted the attendant loss of amplification in Fig. A, the maximum amplification, if the capacity reactance was infinity, would be 5·4 and on wavelengths longer than those shown, this figure is practically attained.

Mr. Carpenter drew attention to the fact that the effect of the grid-anode capacity in series with the external resistance R, which should be shown connected, across the capacity C_2 (Fig. 2)*, had been neglected in the consideration of the input impedance of the valve.

Actually this parallel impedance can never, even on short wavelengths, be less than the external resistance B, which is of the same order as Z_2 at wavelengths of 300 metres or so. Its effect may therefore be neglected, if, as Lieut. Edes suggests the capacity C_1 is made large relative to C_2, that is to say, of the order of 0·001 microfarad.

Lieut. N. H. Edes (*in reply, communicated*): First of all I desire to express my very deep gratitude to Mr. Coursey for all the trouble he has taken in the preparation of my paper and for the elegant way in which he has presented it.

My disappointment at being unable to attend the meeting was more than compensated for by the thought that the paper was to be put forward by one with qualifications so much greater than my own, and I feel convinced that what value my paper may have possessed has been greatly enhanced by Mr. Coursey's skilled exposition.

Some most interesting problems have been brought to light during the discussion. I will attempt to deal with them in turn.

Undoubtedly the theory of the subject must be tested by practical application, and I regret that, owing to difficulties in obtaining suitable apparatus, I have been unable to experiment as much as I should have liked with various values of the component parts. The practical experiences of a large number of experimenters are therefore most valuable. If only one could take into consideration *all* the processes which go on in the apparatus the theory is bound to be borne out in practice.

It should be remembered, however, that values which are found good by one experimenter may not work well with another, simply because one will lay out his apparatus in one way and another in another way, so that the first may get large stray capacities compared with the second. Again, the dielectrics of condensers vary greatly as regards insulation. Thus, even in testing the apparatus experimentally we are still beset by pitfalls.

The question of the resistance in the plate circuit resolves into a compromise between efficiency and economy in H.T. batteries, or, more cryptically, between one's ambition and one's pocket.

Regarding Mr. Child's point about the application of a negative potential to the grids, I should certainly compensate by means of additional H.T. voltage. The state of affairs—as regards plate current—is then exactly the same as before, and one has the advantage that the first five valves are giving pure amplification.

Experience does not lead me to agree with Mr. Child that increase of plate resistance causes greater instability (other things being equal).

With regard to the effect of inter-electrode capacities, previous speakers, notably Mr. Griffiths, have already dealt with the grid-filament and filament-anode capacities. The grid-anode capacity, unfortunately, has the effect of what might be called "anti-regeneration," that is, it reduces sensitivity somewhat. The effect, however, is present in any case, and I do not think it will affect the results of my analysis as far as comparison between different methods is concerned. Regarding Mr. Phillips' point concerning selectivity, I am inclined to agree that an amplifier in which grid current was compensated for by magnetic reaction would be more sensitive, but in the case of purely cascade amplifiers I believe in the eradication of any rectifying tendency in the amplifying valves.

I think Mr. Campbell Swinton's experience that resistance amplifiers are inefficient for short-wave work agrees with that of many other experimenters. The reason for this result is, of course, that parasitic capacities have a larger effect for short waves than for long, owing to their reactance varying inversely as the frequency and directly as the wavelength.

Regarding the reception of telephony, Mr. Coursey has pointed out that there is danger of the operating point being carried too far into the negative region. One would be tempted to reduce the value of the grid leaks for telephony and obtain rectification in the last valve by working at the lower bend—the grid leak being dispensed with and the grid being made even more negative than those of the amplifying valves in order to be at the bend. Otherwise the grid of the last valve would oscillate as shown in Fig. C, where:—

(a) shows Grid just rising above the potential where grid current commences.

* See p. 236 of issue for July 9th, 1921.

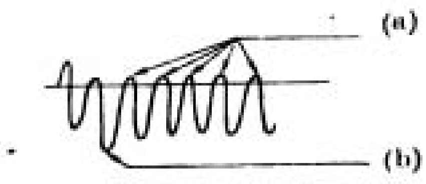


Fig. C.

The resulting negative charge is leaking away all the time through the grid leak.

(b) is oscillation due to carrier wave.

The rectifying action of a grid condenser and leak depends on the return of the grid to its normal potential, as in Fig. D.

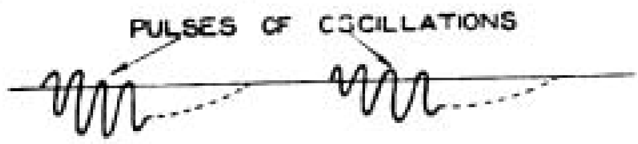


Fig. D.

The "pulses" of oscillations are, of course, provided in telegraphy by the heterodyne, and there are no such pulses in the case of telephony.

The above is merely surmise, and I have never tried it for actual reception of telephony.

As regards numerical values for the different parts, I think that considerable variation can be made without much alteration to signal strength, but, as I have already remarked, I should like further experimental confirmation of this.

I would suggest the following as being good all-round values for average commercial wavelengths:—

Plate resistances, 20,000 - 60,000 ohms (the higher the better, subject to limitations of H.T. available).

Coupling condensers, 0·001 - 0·002 microfarads (although, no doubt, good results can be obtained with smaller condensers).

Grid leaks, 2—5 megohms.

The above values are for "R" valves.

I am inclined to attach greater importance to the *qualitative* than to the *exact quantitative* design. For instance, I believe the presence of grid current damping would be more detrimental than having a grid leak of, say, 6 megohms instead of 5.

I think the only point still outstanding is one raised by Mr. Coursey, namely, the fact that $\omega = 2\pi f$, occurs in my expression (9) for the amplification.

At first sight the expression appears to imply that the greater the frequency (and the shorter the wavelength) the greater will be the amplification. We have, however, agreed to make $\frac{1}{C_1^2\omega^2}$ small, and, therefore, the effect will not be very marked and it will probably be outweighed by the increased losses due to stray capacities across the plate resistances, etc.

Whatever the values given to the various constants, the principles of keeping wires and pieces of apparatus as far apart and as well insulated as possible, will always hold good. Here, again, we must compromise between efficiency and convenience.

Finally, I should like to express my thanks for the very kind way in which my paper has been received, and for the numerous criticisms and suggestions which have been put forward.

NOTES

Honour for Mr. Marconi.

The Italian Government has renamed the Coltano (Italy) high-power wireless station "Guglielmo Marconi," as "a tangible and lasting proof of the country's gratitude for his meritorious discoveries in the field of radio-telegraphy."

Wireless Station for Jan Mayen Island.

A Norwegian expedition, which hopes to establish a wireless and meteorological station on Jan Mayen Island, 800 miles west from Hammerfest, left Copenhagen on July 26th. A number of foreign scientists are accompanying the expedition during the summer.

Wireless Telephone to Replace Pigeon Post.

The Railways and Harbours Administration is about to instal wireless telephone sets at Port Elizabeth and Bird Island. Communication between these two places has hitherto been carried out by means of a pigeon post.

Meeting of Transmitting Licence Holders in London.

The Wireless Society of London, through the Hon. Secretary, has asked us to point out that the recent meeting of those holding transmitting licences in London and district, which was reported on p. 292 of the August 6th issue of *The Wireless World*, was not an official meeting of the Wireless Society of London, and was not confined to their membership. The Hon. Secretary wishes it to be known that the invitation to the meeting was sent out to all those whose names and addresses were available to him.

Flight of the R.38.

The Transatlantic voyage of the giant airship, R.38, is provisionally arranged for August 25th. Preparations are being made for several warships equipped as wireless stations to line the route to supply information to aid the airship in navigation.

Morse Transmission for Learners.

It is suggested by a correspondent that those who are learning to read Morse should make a point of listening to the Dutch weather report from **BÉ**, which is sent out daily at 12.10 (British summer time) very slowly, and is repeated slightly faster. The transmission is on 900 metres spark.

The Co-optimists' Entertainment.

The Co-optimists' Entertainment.

An entertainment was recently conducted by the Co-optimists, of the Royalty Theatre. Performances by wireless telephony were conducted in aid of St. Dunstan's Hostel for the Blind.

Imperial Wireless Chain.

In reply to a question in the House of Commons on the Imperial wireless chain, Mr. Kellaway (Postmaster-General) announced that the wireless stations at Leafield (near Oxford) and at Abu Zabal (near Cairo), which were to form the first link of the Imperial wireless chain, would be ready for use before the end of the year. The delay in the completion of the stations has been due mainly to labour difficulties. A commission of experts was considering the design of the other stations recommended by the Imperial Wireless Telegraphy Committee. Pending the construction of these stations arrangements were being made for the further transmission to and from places beyond Egypt of telegrams forwarded by wireless between the Leafield and the Abu Zabal stations.

Negotiations were also proceeding between this country and Canada in regard to wireless communication.

Regular Transmissions.

Reprints of "Regular Transmissions of Wireless Stations," which appeared as a Supplement to the last issue of *The Wireless World*, are obtainable from the publishers, price 6d. post free.

Reception of Bordeaux in Australia.

Signals from the new Bordeaux station (Lafayette) are regularly received for a period of at least twelve hours per day at the radio station at Koo-wee-rup (Victoria), owned by the Amalgamated Wireless (Australasia), Ltd.

Weather Reports from Borkum.

The Radio Station at Borkum now transmits synoptic weather bulletins three times daily on a wavelength of 1,250 metres. The call letters are **KBN** and the times of transmission 07.30, 13.40 and 19.15 G.M.T.

WIRELESS CLUB REPORTS

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary

The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies.

Blackpool and Fylde Wireless Society.

(Affiliated with the Wireless Society of London.)

The Society recently held a series of interesting and highly instructive lectures and social evenings at their Headquarters, The Café Waldorf, Church Street, Blackpool, of which the following is a synopsis:—

On June 3rd, Mr. R. D. Ball, the Hon. Treasurer, lectured, for the benefit of the juniors particularly, upon how to measure the working efficiency of instruments in general use.

On June 30th the Hon. Secretary enabled the members to hear a series of wireless gramophone lectures depicting press and ordinary messages with and without jamming at various speeds, post office sounders, distress calls at sea, and most interesting of all, a record showing what the many difficulties are that an operator sometimes has to put up with in the execution of his duty. The gramophone fitted up by the Secretary himself was electrically operated.

On June 7th Messrs. L. R. Blackburn and B. D. Taylor initiated their audience into the intricacies showing the ease and correctness with which these useful pancake coils could be wound by means of a wonderful little contrivance made by Mr. C. V. Sharples.

On July 14th the Society was honoured by the presence of Mr. G. D. Crichton, Chairman and Vice-President of the Edinburgh Wireless Club. He captured the interest of his audience by a treatise on the properties of amber, electricity and magnetism, and showed how a number of eminent persons for many years past had all been striving for the same goal, namely, "Bridging the Universe without Wires." He informed them how his own Club was kept going, and complimented the Blackpool and Fylde Wireless Society on the efficient way in which it was conducted, especially in having over 60 members in the nine months since its inception. The evening was brought to a close with an interchange of cordial greetings and welcome invitations between the two Societies.

On July 21st Messrs. C. V. Sharples, L. R. Blackburn and B. D. Taylor lectured on Condensers and Grid Leaks, variable and fixed, how they measure their capacities, and how to construct them out of scrap material at a very low cost.

On July 22nd, by kind permission of Mr. G. H. Harrop, General Manager of the Tower Co., members of the Society ascended the tower to a height of over 500ft. The powerful wind which developed rendered the use of a floating or trailing aerial necessary instead of captive balloons, as had originally been intended.

The party which included Mr. G. D. Crighton, of the Edinburgh Wireless Club, and Miss Marjorie Joule, one of the local Society's three lady members, was conducted by the Chairman and the Hon. Secretary.

The first message which came through was from the Eiffel Tower (FL), and others were received from Berlin, Horsea and Carnarvon, as well as from ships at sea. Telephony was also heard.

Although the pitch of the note varied continually by reason of the wind which kept the aerial blowing up and down at an angle of 45 degrees, all the messages were perfectly distinct, and at times, in spite of the gale, were so clear as to be almost audible when the receivers were off the head.

The portable field set used (with amplifier), the tower structure acting as the earth, was operated by Messrs. B. D. Taylor, L. R. Blackburn and C. V. Sharples.

At the conclusion of the experiments a hearty vote of thanks was passed to Mr. G. H. Harrop, the Tower Co., who had caused the Tower to be closed to ordinary visitors while the experiments were in progress, and the attendants.

The Society's proposed plans for the near future include the descent of a coal mine, at the bottom of which further experiments, which should be interesting in the extreme, will be conducted.

Hon. Secretary, Mr. C. Sheffield Doeg, "The Poplars," No. 6, Seventh Avenue, South Shore, Blackpool, to whom all communications, etc., should be made.

Bradford Wireless Society.

(Affiliated with the Wireless Society of London).

A meeting was held in the Club-rooms on July 15th; the President was in the chair. The minutes of the previous meeting were read and passed as correct.

One new member was elected.

A very useful institution has been started; it is a box with a large slit, in which anyone can drop a question which he requires answering and is perhaps rather shy about asking it, as it may be of an elementary nature. These questions are then collected and read out by the Chairman, and those who are able, answer them to the best of their ability.

It has been decided not to hold any more formal meetings until the beginning of October, when the new session starts.

In the meantime there will be Morse classes and instruction lectures for new members.

The Hon. Secretary, Mr. John Bever, has now returned, to whom all communications should be addressed.—Hon. Secretary, Mr. John Bever, 85, Emm Lane, Bradford.

WIRELESS CLUB REPORTS

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the North Middlesex Wireless Club was held on Wednesday, July 27th, at Shaftesbury Hall, Bowes Park. After the usual Morse code practice, the chair was taken by the President, who called on Mr. E. M. Savage to give a demonstration of soldering.

Mr. Savage had provided himself with the usual soldering implements and a Primus stove. Commencing with a word of apology for taking up the time of those to whom soldering was so easy that they had probably forgotten their early difficulties, he said that he had gathered in conversation with some members that they had had great trouble in making a clean and neat job, and he proposed to show them how to "make the solder stick." He then joined together a number of pieces of metal of different kinds, explaining the process.

Other members afterwards put forward several useful tips applicable to special jobs, and the evening closed by a vote of thanks moved by the Chairman.

Particulars of the Club may be had from the Hon. Secretary, Mr. E. M. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21.

Folkestone and District Wireless Society.

(Affiliated with the Wireless Society of London.)

On Wednesday, July 6th, the monthly general meeting of the above Society was held at the Turkish Baths, Folkestone, at 7.30 p.m., Mr. Arnold H. Ullyett, F.R.G.S., in the chair.

The minutes of the previous meeting were read and confirmed, after which Mr. R. W. Piper was called on to deliver his lecture on "Inductance." The lecturer took great pains to make his very interesting subject quite clear, a fact which was greatly appreciated by all. At the conclusion of the lecture, Mr. Piper was accorded a hearty vote of thanks by the Chairman on behalf of all.

At a meeting held at Headquarters on Wednesday, July 20th, the Hon. Secretary read a letter from Sir Philip Sassoon, Bart., C.M.G., M.P., accepting the officers' invitation to become Patron of the Society.

Full particulars of the above Society may be obtained from the Hon. Secretary, Mr. H. Alec S. Gothard, A.M.I.R.E., 8, Longford Terrace, Folkestone.

Newcastle and District Amateur Wireless Association.

(Affiliated with the Wireless Society of London.)

At the last meeting of this Society it was decided to change the Club night to Thursday evening, beginning on Thursday, August 4th. This is being done in order that members may receive the Dutch concert. Members please note subscription for 1921-1922 came due on July 1st last.

Mr. Colin Bain, Hon. Secretary, 51, Grainger Street, Newcastle.

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting of the above Society was held on Friday, July 15th, 1921, at Dartford Grammar School. The minutes of the previous meeting were read and confirmed, the members then discussing various problems in connection with wireless transmission and reception. Signals were received on the club's crystal set, experiments with a two-valve amplifier giving fairly good results.

The Society anticipates getting a good programme of events for the coming winter, and all persons interested in wireless, whether in possession of instruments or not, are invited to communicate with the Hon. Secretary and Treasurer, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

Southport Wireless Society.

(Affiliated with the Wireless Society of London.)

During the past few weeks the meetings of the above Society have been somewhat interfered with owing to the change of headquarters. These are now situated at the Queen's Hotel, Promenade, Southport.

The next week should see the meetings again in full swing, the members at present being busily engaged in "making ready" for the instruments, etc., in the new room.

These headquarters are in an ideal position, and it is hoped that the coming months will see some very interesting evenings.

Intending members are requested to apply for particulars of membership to the Hon. Secretary, Mr. H. Sutton, 68b, Marshside Road, Southport.

The West London Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

Owing to the number of members who are taking their summer vacation in August, it has been decided that no meetings of the above Society will be held during that month, and the next meeting will therefore be on September 1st, at 7 p.m., at Belmont Road Schools.

On that date the Club expects to include among its apparatus a short wave tuner (specially constructed for telephony) in conjunction with the "Brown" Loud Speaker and Relay, which should give excellent speech.

Full particulars of the Society and its activities will be gladly forwarded by the Hon. Secretary, Mr. S. J. Tyrrell, 2, Providence Road, Yiewsley, Middlesex.

Manchester Wireless Society.

On Wednesday, July 20th, a wireless demonstration was given at the headquarters of the Society, under the patronage of the Lord Mayor of Manchester (Alderman Wm. Kay), and attended by members of the following institutions:– N.W. Students' Centre I.E.E., Manchester Association of Engineers, National Engineers' Association, and the Y.M.C.A. Wireless Society. The chair was taken at 8 p.m. by the President, Capt. J. Hollingworth, M.A., B.Sc.Eng., and a very interesting programme carried through successfully. After outlining the objects of the Society, the Chairman briefly explained the principles of wireless, after which he gave a very simple explanation of direction finding work, upon which subject he is, no doubt, an authority. Mr. J. C. A. Reid then explained the methods employed for the control of electrical circuits by wireless, and succeeded in lighting up a danger signal, illuminating an electrical sign, and exploding an imaginary mine in the shape of a toy balloon, the key of this latter circuit being manipulated by the Lord Mayor from his table. Following this, Mr. Y. W. P. Evans gave a demonstration of wireless telephony, during which speech and music were easily heard in every part of the room. Mr. Evans also succeeded in receiving a special message from General Ferrie and the staff at Eiffel Tower, addressed to the Lord Mayor and the Manchester Wireless Society. This was amplified by means of a 7-valve circuit, similar to the one described in *The Wireless World* on June 25th by Mr. A. A. Campbell Swinton, F.R.S., and which had been constructed for the occasion by Mr. Evans. The next item was a display of H.F. currents by the Chairman, Mr. J. McKernan, who held the attention of his audience by an exhibition which would have surprised Nikola Tesla himself. A fine assortment of instruments added lustre to these experiments, and our Chairman proved conclusively that there is yet a large amount of research to be carried out in this particular branch of electrical science before it can be said that every channel has been explored. Mr. McKernan also gave a demonstration of the possibilities of selenium cells, working various electrical devices by means of one of these cells and a ray of light. In conclusion the Chairman thanked the members of the various institutions for their kind attention and support, and expressed a hope that an interchange of lectures might be arranged during the coming winter session. He then announced that it was the express wish of the Committee that the Lord Mayor be invited to accept an hon. membership of the Society, and in order that his Lordship may be further tempted to accept, he (the Chairman) had much pleasure in presenting him with a miniature wireless panel (1¾" × 1¾"). The Lord Mayor, in returning thanks for the way he had been entertained, expressed a hope that such a display as had been given that evening would be accepted by all present as proof of the way in which the Society were endeavouring to further the interests of science. He had much pleasure in accepting an hon. membership of the Society, and in wishing them every prosperity and success in the future. The Chairman thanked his Lordship and declared the meeting closed. The success of the demonstration was due to the untiring efforts of the Committee and a few of the members. Messrs. Ashley's, of Liverpool, kindly sent an assortment of instruments and parts for exhibition, there also being on view a transmitter loaned by Messrs. Tingey of London, and a B.T.H. portable set loaned by Messrs. Franks, of Deansgate, Manchester.

Hon. Secretary's address, 7, Clitheroe Road, Longsight, Manchester.

The Wimbledon and District Wireless Society.

Hon. Secretary, Wm. Geo. Marshall, 48, Warren Road, Merton, S.W.19.

A meeting of the above Society took place at the Wimbledon Technical Institute on Wednesday, July 13th, Mr. W. A. Harwood (president) in the chair, the occasion being a lecture and demonstration on "Wireless Receiving in General," by Capt. W. R. H. Tingey.

Having outlined what he considered to be the best arrangement of apparatus to get maximum efficiency in the simple receiving circuit, Capt. Tingey proceeded to deal with more complicated circuits, demonstrating his main points on the apparatus he had brought with him. During the evening wireless telephonic communication was established between the institute and Messrs. Tingey's establishment at Hatton Gardens, the speech at this end being clearly audible throughout the hall. Great interest was displayed when the lecturer disconnected the aerial from his apparatus and connected up in its place a row of people holding hands. On this very unusual aerial signals were "tuned in" and made clearly audible to the whole of the audience.

In proposing a vote of thanks to the lecturer Mr. A. V. Ballhatchet said that the lecture we had just received was one from which amateurs in general could pick up quite a host of valuable information. It was quite possible that some of the junior members would have found considerable difficulty in following all the lecturer's remarks, but he advised them to store away some of the hints that had been given so that they may be available for future use. He thought that a number of amateurs were making a big mistake in trying to deal with very complicated circuits to commence with. They should start first with as simple a circuit as possible and then, having mastered it, supplement in whatever direction they desired.

The vote of thanks, seconded by Mr. J. H. Reeves, was duly accorded to the lecturer, and the proceedings terminated.

Grimsby and District Radio Society.

Members of the above Society are informed that no more meetings will be held until the beginning of September, when it is hoped that the new club-room will be ready.

The City of London School Wireless Society.

The summer session of this Society closed on Monday, July 25th, with one of the greatest functions that the Society has achieved.

It was in the form of a general exhibition of wireless apparatus. Some of the exhibits were made by the members of the Club and others came from Messrs. Burnham & Co., Mitchell's, Gamage, S. G. Brown, Radio Supplies, Marconi's, R. M. Radio, and F O. Read's. Messrs. Burnham sent an exhibit which was undoubtedly the most admired. This exhibit consisted of a Burndept Ultra III Receiver, a 3-valve note magnifier, a full range of Burndept coils, a transmitter and valves. The Burndept Ultra III Receiver gave wonderful results, and with the 3-valve note magnifier, Annapolis, Bordeaux, Clifden, Lyons, and Croydon's telephony was rendered audible by means of a loud speaker to all in a large lecture theatre. Croydon simply was shrieking from the loud speaker, and the set was altogether a thorough success.

Mitchell's sent us a wonderful range of goods, from a gas-engine and H.T. dynamo to a valve holder. Their apparatus, consisting mostly of small parts, was very interesting from the amateur's point of view. In the evening Messrs. Mitchell's transmitted a concert with great success. Gamage's sent some interesting small components, S. G. Brown a loud speaker and a pair of A and D type telephones. Radio Supplies sent a 2-valve receiver and small parts, as did Messrs. R. M. Radio.

F. O. Read's sent a W.R. 160 set, which is a 2-valve resistance capacity set with electrostatic reaction, a W.R. 171 set, and various specimens of their smaller manufactures. All their apparatus appeared neat and efficient.

Marconi's sent a single-valve panel type M.G: a single-valve set type M. 15, and a 3-valve amplifying detector type M. 3. All these exhibits were extremely interesting.

About 500 people visited the exhibition, and although the Society is a private one many members of the general public visited us during the day. The next session commences the first week in September.

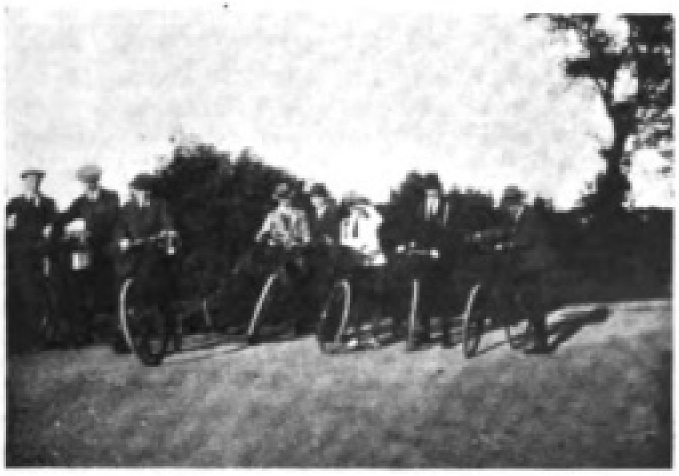
We are sorry to announce that Mr. J. A. Chapman, our Hon. Treasurer, is leaving us this term, owing to his leaving the school. Mr. J. A. Chapman founded the Society in December, 1920, and it is owing to his untiring efforts and enthusiasm that the Society has reached its present stage.

Hon. Treasurer, Mr. J. H. Gawler, City of London School, Victoria Embankment, E.C.4.

The Lowestoft and District Wireless Society.

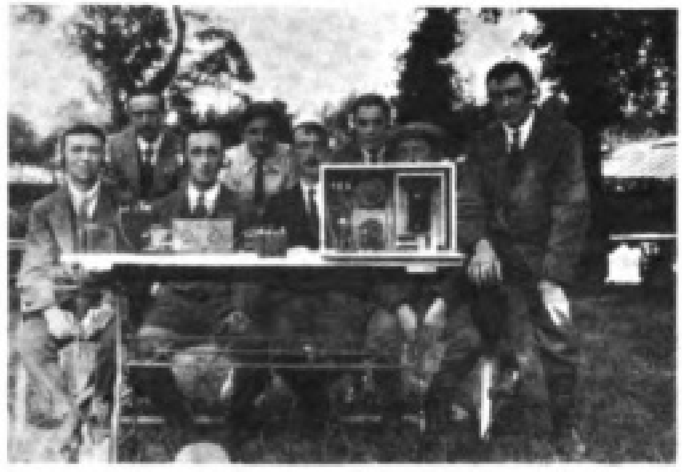
The Society's activities this month have been mostly of an *al fresco* nature, the first being a field day on Saturday afternoon, July 9th. Members assembled with their cycles at headquarters, at 2.30 p.m., and received instructions transmitted from the President's own set.

Two parties were then made up and proceeded at 2.45 p.m. to Parkhill, where the two sets were set up at different positions, and further instructions were received, one party going to St. Olaves, and the other to Hopton, and further messages and instructions were received. Both parties then met at Belton Tea Gardens, where an excellent tea was



The party setting out.

served at 5.30 p.m. The President was unfortunately prevented from joining the party for tea, owing to a slight mishap to his motor cycle. The party then returned home after a most successful day's outing. On Tuesday evening, the 12th,

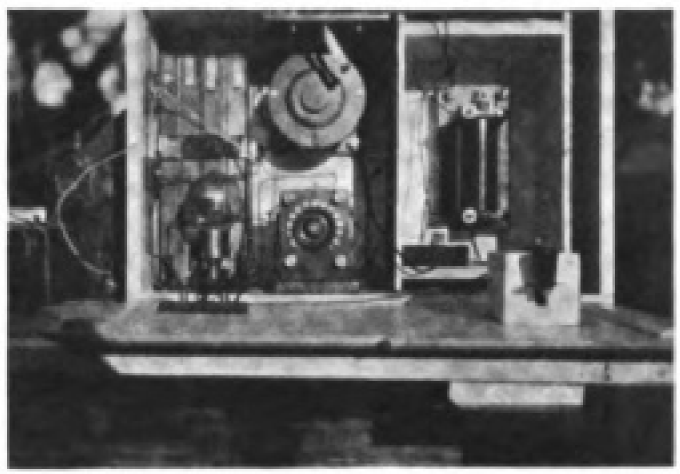


A field set in action.

the portable set was taken out, Mr. Searle and two members staying at home to transmit.

On Tuesday, July 19th, an interesting evening was spent plotting curves of valves, both transmitting and receiving.

On Tuesday, July 26th, members spent an enjoyable evening at the Secretary's house, where a 3-valve amplifier was set up on the lawn, Horsea providing the evening's buzzer practice in the



A nearer view of the apparatus.

absence of the Club instructor. Full particulars of the Society's activities are obtainable from the Secretary, L. Burcham, "Gouzeacourt," Chestnut Avenue, Oulton Broad.

Halifax Wireless Club.

The enthusiasm of the members of this Club was amply demonstrated on Wednesday evening. On one of the hottest days of the present heat wave the club room was filled to hear Mr. Percival Denison lecture on his transmitting set, and his very remarkable single valve receiver. Mr. Denison's transmitting set is well known to experimenters in the North of England, but this was the first opportunity on which full details of the set had been available.

With the aid of blackboard sketches and diagrams, Mr. Denison traced his circuit step by step from the simplest oscillating circuit, and retained the interest of his hearers for upwards of an hour as he unfolded all the little refinements which go far to make his instrument so efficient. Mr. Denison's modulation is admitted to be as near perfect as is possible, and how this is achieved was explained in the fullest detail. Following the description of the transmitting set, he described and demonstrated a portable receiving set he had constructed.

The Club continues to make good progress, and if the membership continues to increase as it is doing larger premises will be needed. Thanks to the Club's transmitter (2GU) Mr. Denison (2KD) and Mr. H. Burbury, of Crigglestone (2AW), the members are enjoying a varied selection of wireless telephony, and the general enthusiasm for this popular hobby is most certainly on the increase. On the occasion of the Dempsey-Carpentier fight some few days ago, the result was broadcasted to the members by wireless telephone two and a-half minutes after the fight, and 29 minutes before the cable message arrived in Halifax, being received direct from New Brunswick in this town. The local press complimented the Club on their achievement.

Secretary, Mr. L. J. Wood.

The Wandsworth Common Wireless Club.

We have had two well-attended lectures during the last fortnight, one by Mr. Gwynn (of Messrs. Cossor) and the other by Mr. Fry (of the Wireless Society of London). Mr. Gwynn gave a lecture on the principles of the thermionic valve, and brought a large number of valves of different types, many of which were of great historical interest, numbering among them some of the first ever built. Mr. Fry gave a most interesting talk on the construction of amateur apparatus. He exhibited some beautifully made gear, one thing that commanded admiration being a small cabinet loose coupler for short waves. The club set is practically finished, all but a few details being made.

On Friday, the 22nd July, the members took advantage of a most kind invitation issued by the Wandsworth club and visited them at their club-room, and had the pleasure of attending a splendid lecture by Captain Tingey and Mr. Auckland.

Meetings will continue to be held at the Institute, Wiseton Road, S.W.17, all through the holidays, and anybody who is interested is sure of a welcome.

The Committee of the above Club held a conference with the committee of the Wandsworth Wireless Society on July 22nd at the latter's headquarters, to debate the subject of merging with the Wandsworth Wireless Society.

Mr. T. S. Settle took the chair, and a discussion followed, which ended in the following resolution, moved by Mr. Turner and seconded by Mr. Thomas, both of the Wandsworth Common Wireless Club.

> "Having considered the invitation of the Wandsworth Wireless Society, the Wandsworth Common Wireless Club desire to merge with them."

The vote in favour was unanimous, and the title of the body will therefore be, in future, the Wandsworth Wireless Society, with a committee composed of members from both sections, with one headquarters at the Wandsworth Technical Institute. Any communications regarding above should be forwarded to Assistant Secretary, Mr. H. F. Buckmaster, 59, Hendham Road, Wandsworth Common, or Hon. Secretary, Mr. F. V. Copperwheat, 9, Birdhurst Road, Wandsworth.

Wandsworth Wireless Society.

The President, Mr. T. S. Settle, the Chairman, Mr. D. N. Griffiths, and members of the above Society, also a few members of the Wandsworth Common Wireless Club, were accorded a most interesting lecture demonstration on Friday, July 22nd, at 7.30 p.m., by Capt. W. R. H. Tingey, at the Wandsworth Technical Institute, the headquarters of the Society.

Shortly after the lecture commenced the Tingey receiver and transmitter were brought to bear on 2BZ—Mr. B. Davis, "Pavilion," Marble Arch—a member of the Society.

Bordeaux was then tuned in with good effect on a Brown loud speaker, and also a Morse inker relay set.

Frame aerial reception was the next item, followed by the experiment of using six of the members as a receiving aerial.

Question time arose all too quickly, and upon the cessation of inquiry the lecture terminated. The President thereupon proposed a vote of thanks to the lecturer for the very pleasant evening spent with him in our midst.

In a few well-chosen words, Capt. Tingey replied, urging all members to do their utmost in the experimental field. The apparatus, of which there was a good deal, attracted much attention, when, by the courtesy of Capt. Tingey, it was thrown open for inspection.

It was decided to close down the headquarters until Friday, September 23rd, at 7.45 p.m., when any intending members will be welcome.

Hon. Secretary, Mr. F. V. Copperwheat, 9, Birdhurst Road, Wandsworth, S.W.18.

Smethwick Experimental Wireless Club.

During the past month this Club has made rapid strides towards success, and is gradually placing itself on a firm footing, the membership being over 26.

At the meeting held at the Club's Headquarters (Technical School, Smethwick) on July 5th, a paper was read by the Chairman (Mr. C. Grew) entitled "The Condenser." A discussion followed, and a hearty vote of thanks was accorded to Mr. C. Grew.

During the coming winter a series of lectures will be given by the President, Mr. R. W. Hutchinson, M.Sc., A.M.I.E.E., F.R.G.S., the Club should then be in a position to make an interesting syllabus of lectures, demonstrations and discussions.

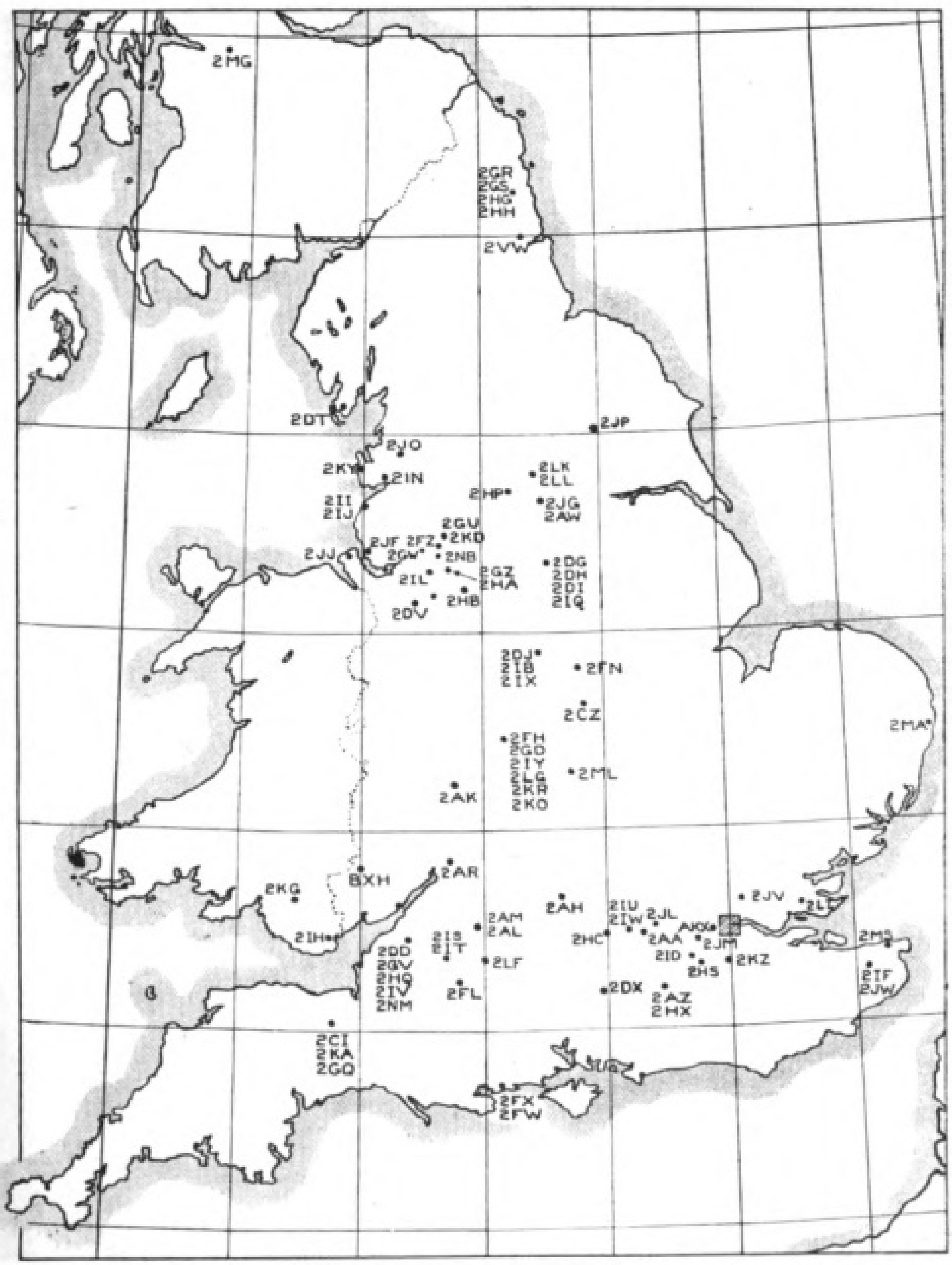
The Club anticipates holding an exhibition of amateur Wireless apparatus in the near future.

Anyone wishing to join the Club is cordially invited to communicate with the Hon. Secretary, Mr. R. H. Parker, Radio House, 31, Wilson Road, Smethwick, Birmingham, who will gladly furnish further particulars.

DIRECTORY OF EXPERIMENTAL WIRELESS STATIONS OF THE UNITED KINGDOM

Call Letters.	Power in Watts.	Wave-lengths in Metres.	Hours of Working.	System.	Name and Address.
2 AA	—	—	—	—	Radio Communication Company (Slough Experimental Station).
2 AB	—	200 700 1,000	2000–2200	Spark, C.W. and Telephony.	Capt. H. de A. Donisthorpe, Cathcart House, Cathcart Road, S.W.10.
2 AF 2 AG	—	—	2000–2200	C.W.	A. Rickard Taylor, 49, Idmiston Road, W. Norwood.
2 AH	—	—	2000–2200	C.W.	Oxford.
2 AK	—	300 600 800	—	Spark, C.W. and Telephony.	R.M. Radio, Ltd., Townslead Mills, Worcester.
AKX	—	1,000	—	C.W. and Telephony.	H. S. Walker, Park Lodge, Brentford, Middlesex.
2 AL	—	—	—	—	Marlborough College O.T.C.
2 AM	—	—	—	—	Marlborough College O.T.C.
2 AN	—	1,000	2115–2200 0930–1100 (Sunday)	C.W. and Telephony.	A. W. Sharman, Kelvin Lodge, 1, Morella Road, S.W.
2 AQ	—	180 1,000	—	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	1,000 3,000	2000–2100	C.W. and Telephony.	H. H. Burbury, Crigglestone, Wakefield.
2 AX	10	180	1900–2100	Spark	Geo. Sutton, 18, Melford Road, S.E.22.
2 AZ	—	1,000	1500–1600 2000–2100	Spark, C.W. and Telephony.	W. Le Queux, Lavender Cottage, Guildford.
BXH	—	—	—	—	Capt. C. H. Bailey, Gliffaes, Crickhowell, Abergavenny.
2 BZ	10	1,000	2100–2300	C.W. and Telephony.	Basil Davis, Electric Pavilion, Marble Arch, W.1.
2 CI	10	180	2000–2200	Spark	R. Brooks King, Widcombe, Taunton.
2 CZ	10	180 1,000	2000–2100 1100–1200 (Sunday)	Spark, C.W., Tonic-Train and Telephony	C. Atkinson, 17, Beaumont Road, Leicester.
2 DC	10	180 1,000	2000–2200	C.W. and Telephony.	M. Child, 60, Ashworth Mansions, Maida Vale.
2 DD	10	120	1900–2000	Spark	A. C. Davis, 105, Brynland Avenue, Bristol.
2 DF	—	—	—	—	Mitchell's Electric and Wireless, Ltd., Peckham.
2 DG	10	180	1900–2000 (Monday to Friday). Other days various.	C.W. and Spark	W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield.
2 DH	10	180	—	Spark and C.W.	W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. *Portable Set.*
2 DI	10	180	—	Spark and C.W.	W. Barnet, 63, Mount Road, Parkwood Springs, Sheffield. *Portable Set.*
2 DJ	10	1,000	2000–2200	C.W. and Telephony.	A. T. Lee, The Court, Alvaston, Derby.
2 DT	—	—	—	—	Barrow and District Wireless Association.
2 DX	—	—	—	—	W. Alford, c/o Mrs. Gulwell, Farnborough Road, Farnborough, Hants.

Call Letters.	Power in Watts.	Wave-lengths in Metres.	Hours of Working	System.	Name and Address.
2 DY		—		—	F. Haynes, 157, Phillip Lane, S. Tottenham, N.15.
2 DZ	—	—		—	F. Haynes, 157, Phillip Lane, S. Tottenham, N.15.
2 FA		—	—		F. G. Bennett, 16, Tivoli Road, Crouch End, N.8.
2 FC		—			London, S.E.
2 FG	—	180 1,000	2000–2200	Spark, C.W. and Telephony.	L. McMichael, 32, Quex Road, W. Hampstead, N.W.
2 FH	10	300	1930–2100	C.W. and Telephony.	T. S. Rogers, 2, Park Hill, Moseley, Birmingham.
2 FL	100 50	180 1,000	2100–2300	Spark and C.W. -	C. Willcox, 21, George Street, Warminster, Wilts.
2 FN	10	180 1,000	2000–2200	—	L. Baker, Ruddington, Notts.
2 FQ	—	180 1,000		Spark, C.W. and Telephony.	Burnham & Co.'s Experimental Station, Blackheath.
2 FW	—	—	—	Spark. - - - -	Rev. D. Thomas, St. Paul's B.P. Scouts, Bournemouth. *Also Portable Set.*
2 FX		—	2000–2100 (Monday to Friday). Other days various.	Spark, C.W., T.T. and Telephony.	H. C. Binden, Bournemouth.
2 FZ	10	180 1,000	1900–2100	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 GL	10	1,000	2100–2300	C.W. and Telephony.	W. J. Henderson, 2, Hollywood Road S.W.10.
2 GP	—	—	2030–2230	C.W., T.T., Spark and Telephony.	W. Gaitland, Highbury, N.
2 GQ	10	180	1930–2130	Spark - - -	1st Taunton Scouts, Parish Buildings, Wilton.
2 GR		—	1230–1300 1730–1900		T. Forsyth, Ashington.
2 GS			—		T. Forsyth, Ashington. *Portable Set.*
2 GU	10	180 1,000	2000–2200		Halifax Wireless Club.
2 GV	10	180 1,000	1900–2000	Spark, C.W. and Telephony.	Rev. J. Rigby, St. Lawrence Vicarage, Bristol.
2 GW	10		1930–2130	Spark, C.W. and Telephony.	Allan Cash, Foxley Mount, Lymm, Cheshire.
2 GZ	—	180 1,000		C.W. and Spark	A. L. Megson, Bowdon.
2 HA	—	180 1,000		C.W. and Spark	A. L. Megson, Bowdon. *Portable Set.*
2 HB	10	180 1,000	2000–2200	C.W. and Spark	L. H. Lomas, Macclesfield.
2 HC	10	180 1,000	1200–1300 2100–2200	C.W. and Spark	J. W. White, Windcombe Lodge, Bucklersbury, nr. Reading.
2 HG	—	—	1230–1300 1730–1900		T. Boutland (Senr.), Ashington.
2 HH			1230–1300 1730–1900		T. Boutland (Jnr.), Ashington.
2 HP	10	180 1,000	2000–2200	C.W. and Telephony.	H. C. Woodhall, 10, Holborn House, E.C.1.



Map Showing Locations of Stations.

LONDON AREA

ENLARGED MAP OF LONDON AREA SHOWING LOCATIONS OF STATIONS.

Call Letters.	Power in Watts.	Wave-lengths in Metres.	Hours of Working	System.	Name and Address.
2 HQ	10	180	2200–2400	C.W. and Spark	A. W. Faucett, 11, Leigh Road, Clifton, Bristol.
2 HR	10	180 1,000	1900–2200	C.W. and Telephony.	F. O. Read & Co., Ltd., 13-14, Gt. Queen Street, Kingsway, W.C.2.
2 HS	10	180	1900–2100	C.W., Telephony and Tonic Train.	G. W. Hale, 51, Grafton Road, New Malden, Surrey.
2 HT	—	180 1,000	2000–2200	Spark, C.W. and Telephony.	R. H. Klein, 18, Crediton Hill, W. Hampstead, N.W.6.
2 HX	—	—	0900–1030 2000–2100	Spark, C.W. and Telephony.	F. A. Love, Ivydene, Guildford Park Road, Guildford.
2 IB	10	1,000	2000–2200	C.W. and Telephony.	W. Bemrose, Littleover Hill, Derby.
2 ID	10	180	1530–1630 2030–2130	C.W. and Spark	E. S. Firth, Thames Ditton.
2 IF	10	1,000	2000–2100	C.W. and Telephony.	S. W. Bligh, 2, North Lane, Canterbury.
2 IH	—	—	—	—	Technical College, Cardiff.
2 II	10	180	2000–2200	Spark - - -	Southport Wireless Society, 74A, Kensington Road, Southport.
2 IJ	—	—	—	—	Southport Wireless Society, 74A, Kensington Road, Southport. *Portable Set.*
2 IL	—	—	—	—	3rd Altrincham Troop, Boy Scouts, Altrincham. *Portable Set.*
2 IN	10	280	2000–2200	C.W. and Spark	J. E. Fish, Ray House, Blackpool Road, Bispham.
2 IQ	—	1,000	—	C.W. and Telephony.	W. A. Ward, Albion Works, Sheffield.
2 IS	—	—	—	—	Rev. H. W. Doudney, St. Luke's Vicarage, Bath.
2 IT	—	—	—	—	Rev. H. W. Doudney, St. Luke's Vicarage, Bath. *Portable.*
2 IU	10	180	2100–2300	—	G. A. E. Roberts, Twyford, Winchester.
2 IV	10	180 1,000	1900–2100	Spark, C.W. and Telephony.	L. F. White, Priory Road, Knowle, Bristol.
2 IW	10	180	2100–2300	—	G. R. Marsh, Twyford, Winchester.
2 IX	10	1,000	2000–2200	C.W. and Telephony.	S. G. Taylor, Littleover, Derby.
2 IY	10	180 1,000	1800–1900 2100–2200	C.W. and Telephony.	J. Briggs, City School of Wireless Telegraphy, 66½, Corporation Street, Birmingham
2 JF	10	180 1,000	1930–2130	Spark, C.W. and Telephony.	C. G. Williams, 22, Scholar Street, Sefton Park, Liverpool.
2 JG	—	—	—	—	W. A. Seed, Crigglestone, nr. Wakefield.
2 JJ	10	180 1,000	1930–2130	Spark, C.W. and Telephony.	C. Worthy, 4, Riversdale Road, Egremont, Wallasey.
2 JK	10	180 1,000	2030–2230	Spark, C.W., T.T. and Telephony.	Philip R. Coursey, Woodland Villas, 138, Muswell Hill Road, N.10.
2 JL	10	180 1,000	2130–2330	Spark, C.W., and Telephony.	G. G. Bailey, The Beeches, Cowley, Middlesex.
2 JM	10	180 1,000	—	Spark, C.W. and Telephony.	G. G. Blake, 10, Onslow Road, Richmond, Surrey.
2 JO	10	180 1,000	Various	Spark, C.W. and Telephony.	J. W. Whiteside, 30, Castle Street, Clitheroe, Lancs.
2 JP	—	180 1,000	—	Spark, C.W. and Telephony.	M. C. Ellison, Huttons Ambo Hall, York.
2 JU	10	180	2000–2200	Spark, C.W. and Telephony.	E. J. Pearcey, 610, Fulham Road, S.W.
2 JV	10	180 1,000	2000–2200	Spark, C.W. and Telephony.	A. G. Robbins, Station Road, Epping.

Call Letters.	Power in Watts.	Wave-lengths in Metres.	Hours of Working.	System.	Name and Address.
2 JW	10	1,000	2100–2200	C.W. and Telephony.	J. R. Barrét, Westgate Court, Canterbury.
2 KA	10	180	1900–2300	Spark	N. Curtis, Belvedere West, Taunton.
KCLX	—	—	—	Spark	Prof. Wilson, University of London, King's College.
2 KD	10	180 1,000	2000–2200	C.W., T.T. and Telephony.	P. Denison, Rostellan, Saville Park, Halifax, York.
2 KF	10	1,000	2100–2300 1600–1800 (Sunday)	C.W. and Telephony.	J. Partridge, 70, Sydney Street, Chelsea.
2 KG	10	180 1,000	Various	Spark, C.W. and Telephony.	A. E. Hay, 6, Oxford Street, Mountain Ash, Glam.
2 KK	10	180	1900–2100 (Sundays: 1130–1230 2030–2130)	—	Hutchinson & Co. (F. Pinkerton), 101, Dartmouth Road, Forest Hill, S.E.23.
2 KL	10	180	1900–2100	Spark	F. Pemberton, 50, Peak Hill, Sydenham.
2 KO	10	180 900	2100–2300	C.W. and Telephony.	C. S. Baynton, 48, Russell Road, Moseley, Birmingham.
2 KR	10	180 1,000	1600–1630 2000–2230	C.W. and Telephony.	E. Edmonds, 2, Yew Tree Road, Edgbaston, Birmingham.
2 KT	—	180 1,000	2000–2200	Spark, C.W. and T.T.	J. E. Nickless, 83, Wellington Road, Snaresbrook, E.11.
2 KV	—	1,000	2000–2200	C.W. and Telephony.	W. J. Crampton, 73, Queen Victoria Street, E.C.4.
2 KY	10	280 1,000	2000–2200	C.W. and Telephony.	L. Pollard, 209, Cunliffe Road, Blackpool.
2 KZ	10	180 1,000	2000–2200	Spark, C.W. and Telephony.	B. Clapp, Meadmoor, Brighton Road, Purley.
2 LF	—	—	2200–2400	Spark and C.W.	P. Harris, Chilvester Lodge, Calne, Wilts.
2 LG	10	180 1,000	—	C.W.	H. Whitfield, The Glen, Primrose Lane, Hall Green, Birmingham.
2 LI	—	180 1,000	2000–2200	Spark, C.W. and Telephony.	H. E. Wilkinson, Lonsdale Road, N.W.6.
2 LK	10	180	2000–2200	Tonic Train and C.W.	S. Kniveton, Brooklands, Normanton, Yorks.
2 LL	10	180	2000–2200	Tonic Train and C.W.	S. Kniveton, Brooklands, Normanton, Yorks.
2 LP	10	180 1,000	Thursday and Sunday: 1500–1600 2200–2300 Other days: 2000–2100 2200–2300	Spark, C.W. and Telephony.	A. W. Knight, 26, Stanbury Road, S.E.
2 LU	10	150	—	C.W. and Telephony.	W. A. Appleton, Wembley Park.
2 LV and 2 LW	—	180 1,000	Mondays: 2030–2130 Other times by appointment.	Spark, C.W. and Telephony.	W. R. H. Tingey, Queen Street, Hammersmith.
2 LZ	10	180 1,000	Weekdays: 1930–2130 Sundays: 1100–1200 2000–2100	Spark, C.W. and Telephony.	F. A. Mayer, Stilemans, Wickford, Essex.

DIRECTORY OF EXPERIMENTAL WIRELESS STATIONS

Call Letters.	Power in Watts.	Wave-lengths in Metres.	Hours of Working	System.	Name and Address.
2 MA	10	180	Monday to Friday: 2000–2200 Saturdays and holidays at all times.	Spark . . .	P. S. Savage, 14/16, Norwich Road Lowestoft.
2 MG	10	180 1,000	2000–2100 2130–2230 Holidays: 1600–1700 2000–2100	C.W. and Telephony.	C. E. Millar, Arndene, Bearsden, nr. Glasgow.
2 MI	10	180 1,000	1000–1200	Spark, C.W. and Telephony.	L. McMichael, Stag Works, Kilburn, N.W.
2 MK	10	180 1,000	1800–2000	—	A. W. Hambling, 23, Winchester Avenue, Brondesbury, N.W.6.
2 ML	10	180 1,000	1930–2130	Spark, C.W. and Telephony.	R. C. Clinker, Bilton, Rugby.
2 MO	—	180 1,000	—	Spark, C.W. and Telephony.	Burnham & Co.'s Experimental Station, Chiswick.
2 MR	10	180 1,000	2030–2230	Spark, C.W. and Telephony.	R. H. Reece, The Corner House, 62, Addison Gardens, London, W. 14.
2 MS	10	180 1,000	1800–1900 2100–2200	C.W., Spark and Telephony.	R. H. Reece, "Basketts," Birchington, Kent.
2 MY	10	180 1,000	2200	C.W. and Spark.	H. M. Hodgson, Clifton House, Hartford, Cheshire.
2 NB	—	—	—	—	J. W. Barnaby, Sylvan House, Broad Road, Sale, Cheshire.
2 NH	10	180 1,000	1700–1800 2100–2200	C.W. and Telephony.	O. R. C. Sherwood, 41, Queen's Gate Gardens, S.W.
2 NM	—	—	—	—	G. Marcus, Little Combe, Combe Dingle, Bristol.
2 NP	—	180 1,000	1900–2100	C.W. and Telephony.	H. S. Treadwell, Middleton Cheney, Banbury. *'Phone, 3 Y Banbury.*
2 NY and 2 NZ	10	180 1,000	1900–2100 Holidays 1500–1600 1900–2000	C.W., T.T., and Telephony.	J. N. C. Bradshaw, Bilsboro', near Preston.
2 PF	10	180	—	Spark . . .	F. Foulger, S.E.14.
2 VW	—	180 1,000	2000–2200	Spark, C.W. and Telephony.	V. Watson, Featherstone, Forest Hall, Newcastle-on-Tyne.

NOTE.—The foregoing list of licensed transmitting stations in the United Kingdom is compiled from information kindly supplied by the owners of the stations concerned. It is realised that this list is by no means complete, and we feel sure that it would be very much appreciated by all experimenters if the owners of stations not included in the above list would supply particulars. Those who do not care to divulge their names would perhaps be prepared to send in their call letters and the name of their town only.

Since the preparation of the sketch-maps particulars of one or two stations have been received and consequently the locations of these do not appear in the maps.

The station 2 DV (Cheshire) appearing on the map has been dismantled, and 2 HP is now located in London, as indicated in the list.

DISTRIBUTION OF WEATHER FORECASTS. FURNISHED BY THE UNITED STATES WEATHER BUREAU*

FOR several years the Office of Communications of the Navy Department has broadcast through its radio stations weather information, forecasts, and warnings, furnished each night by the United States Weather Bureau. This service has expanded to a considerable extent since its inauguration and has necessitated the issuance of several circulars containing amendments and announcements of additional radio station distributions. The information contained in previous announcements is combined in this circular, which supersedes all previous circulars.

The information concerning wavelengths given herein is tentative only and will probably be changed to conform with the New International Radiotelegraph Convention as soon as the conference which is now working on that document has completed its labours.

EXPLANATION OF BULLETINS.

The bulletins broadcasted from each radio station are of the same general character, are based upon observations at 0100 Greenwich mean time, of the date of distribution, and contain reports, forecasts, and warnings.

The bulletins are divided into two parts and invariably begin with the letters USWB.

The first part is a report of actual weather conditions at 0100 Greenwich mean time, at certain stations. Each place is indicated by a code letter (or letters) which is followed by figures showing barometric pressure, wind direction, and wind force at that place. The first three figures express actual barometer readings, *in inches*, reduced to sea-level. The fourth figure is wind direction: 1 = north, 2 = north-east, 3 = east, 4 = south-east, 5 = south, 6 = south-west, 7 = west, 8 = north-west, 0 = calm. The fifth and last figure is wind force in the Beaufort scale, except when winds of force greater than 9 occur, words instead of figures will be used. If the weather conditions from any station cannot be supplied, the initial of the station will be given, followed by the word "missing," and if any portion of a report cannot be furnished such portion will be replaced by an equivalent number of the letter "x."

Scale of wind force.

Beaufort scale; force.	Designation.	Statute miles per hour.
0	Calm	From 0 to 3
1	Light air	Over 3 to 8
2	Light breeze (or wind)	Over 8 to 13
3	Gentle breeze (or wind)	Over 13 to 18
4	Moderate breeze (or wind)	Over 18 to 23
5	Fresh breeze (or wind)	Over 23 to 28
6	Strong breeze (or wind)	Over 28 to 34
7	Moderate gale	Over 34 to 40
8	Fresh gale	Over 40 to 48
9	Strong gale	Over 48 to 56
Ten †	Whole gale	Over 56 to 65
Eleven †	Storm	Over 65 to 75
Twelve †	Hurricane	Over 75.

* Abstracted from the *Radio Service Bulletin.*

† Whenever winds of force greater than 9 occur, words instead of figures will be used.

DISTRIBUTION OF WEATHER FORECASTS

The second part of the bulletin consists of wind and weather forecasts and, whenever conditions warrant, information as to storm-centres, storm and hurricane warnings, and advices to shipping. The wind and weather forecasts are for 24 hours, beginning at 0500. Whenever a storm exists that is likely to affect a section, the location and expected direction of movement of the storm centre will be given, followed by any storm or hurricane warnings and advices to shipping that have been issued.

EXAMPLE OF BULLETIN.

(First part.) USWB J 01662 S 00663 FP 98821 ML 95427 T 95846 NY 93258 DB 92888 LB 95612 CH 94216 H 94645 AV 98282 C 96682 B 00661, etc.

(Second part.) Winds off Atlantic coast north of Sandy Hook will be shifting gales with rain. Sandy Hock to Hatteras, north-west gales with rains followed by clearing weather. Hatteras to Florida Straits, strong north-west winds; fair weather. Storm of marked intensity central off New Jersey coast moving north-eastward. Storm warnings displayed Hatteras to Eastport.

TRANSLATION OF BULLETIN.

USWB		= United States Weather Bureau.						
J	01662	= St. Johns,	barometer,	30.16	wind direction,	S.W.	wind force,	2
S	00663	= Sydney,	,,	30.06	,,	S.W.	,,	3
FP	98821	= Father Point,	,,	29.88	,,	N.E.	,,	1
ML	95427	= Montreal,	,,	29.54	,,	N.E.	,,	7
T	95846	= Nantucket,	,,	29.58	,,	S.E.	,,	6
NY	93258	= New York,	,,	29.32	,,	S.	,,	8
DB	92888	= Breakwater,	,,	29.28	,,	N.W.	,,	8
LB	95612	= Lynchburg,	,,	29.56	,,	N.	,,	2
CH	94216	= Cape Henry,	,,	29.42	,,	N.	,,	6
H	94645	= Hatteras,	,,	29.46	,,	S.E.	,,	5
AV	98282	= Asheville,	,,	29.82	,,	N.W.	,,	2
C	96682	= Charleston,	,,	29.66	,,	N.W.	,,	2
B	00661	= Bermuda	,,	30.06	,,	S.W.	,,	1

The second part of the bulletin is always in plain language and requires no translation

The locations of the regular observation stations maintained by the Weather Bureau cover the area of the continent, the Gulf of Mexico, and a part of the Caribbean Sea; there are also Canadian stations. Key letters are indicated for stations reports from which are given radio distribution. These reports, supplemented by others picked up from vessels, can be used in the production of a quite comprehensive weather map, which will be of much value to navigating officers. Observations radiographed from vessels are in a code prepared by the Weather Bureau for "Vessel Weather Observers," and are easily translated by the use of that code.

DISTRIBUTING STATIONS.

The following is a list of Naval radio stations from which distributions are made, and the composition of the bulletins distributed by them :—

Arlington, *Va.*—Sending time, a few minutes after 0300 Greenwich mean time. Wavelength 2,500 metres. Beginning June 1st, 1921, a wavelength of 2,650 metres will be used in place of 2,500 metres.

Observation stations contained in first part and code letters.		Second part of bulletin.
St. Johns, Newfoundland	J	Winds off Atlantic coast north of Sandy Hook.
Sydney, Nova Scotia	S	Winds off Atlantic coast, Sandy Hook to Hatteras.
Fatner Point, Canada	FP	Winds off Atlantic coast, Hatteras to Florida Straits.
Montreal, Canada	ML	Storm warnings, Eastport, Me., to Key West, Fla.
Nantucket, Mass.	T	Location and expected direction of movement of storm-centre
New York, N.Y.	NY	affecting Atlantic coast.
Breakwater, Del.	DB	All hurricane warnings and advices.
Lynchburg, Va.	LB	
Cape Henry, Va.	CH	
Hatteras, N.C.	H	
Asheville, N.C.	AV	
Charleston, S.C.	C	
Bermuda	B	
Atlanta, Ga.	AT	
St. Louis, Mo.	SL	
Little Rock, Ark.	LR	
Nashville, Tenn.	NV	
Duluth, Minn.	DU	
Marquette, Mich.	M	
Chicago, Ill.	CH	
Detroit, Mich.	D	
Buffalo, N.Y.	F	
Cincinnati, Ohio	CN	Period covered by forecasts, 24 hours beginning at 0500.

This station broadcasts about 1700 Greenwich mean time, all storm warnings issued in the forenoon for the Atlantic coast and Great Lakes; also broadcasts at night (during the season of navigation on the Great Lakes) the same bulletin distributed by the Great Lakes station and at approximately the same hour.

Key West, Fla.—Sending time, a few minutes after 0300 Greenwich mean time. Wavelength 1,500 metres.

Observation stations contained in first part and code letters.		Second part of bulletin.
Hatteras, N.C.	H	Winds off Atlantic coast, Hatteras to Key West.
Charleston, S. C.	C	Winds over east Gulf of Mexico (east of longitude 90°).
Jacksonville, Fla.	JA	Winds over west Gulf of Mexico (west of longitude 90°).
Miami, Fla.	MI	Winds over Caribbean Sea (west of longitude 73°) and Windward
Key West, Fla.	K	Passage.
Pensacola, Fla.	P	Storm warnings Hatteras to Key West and for Gulf of Mexico.
Burrwood, La.	BW	Location and expected movement of storm-centres affecting
Galveston, Tex.	GV	Atlantic coast south of Hatteras and Gulf of Mexico.
Brownsville, Tex.	BV	Storm warnings Gulf of Mexico, Key West to Brownsville.
Fort Worth, Tex.	FW	All hurricane warnings and advices.
Kingston, Jamaica	KN	
Turks Island	TI	
Havana, Cuba	HA	
Guantanamo Bay, Cuba	GO	
Swan Island	SI	
San Juan, P.R.	SI	Period covered by forecasts, 24 hours beginning at 0500.

Point Isabel, Tex.—Sending time, 0500 Greenwich mean time. Wavelength 2,350 metres.

Observation stations contained in first part and code letters.		Second part of bulletin.
Key West, Fla.	K	Winds over east Gulf of Mexico (east of longitude 90°).
Tampa, Fla.	TA	Winds over west Gulf of Mexico (west of longitude 90°).
Pensacola, Fla.	P	Winds over Caribbean Sea (west of longitude 73°) and Windward Passage.
Mobile, Ala.	MO	
Burrwood, La	BW	Storm warnings for Gulf of Mexico, Key West to Brownsville.
Galveston, Tex.	GV	Location and expected movement of storm-centres affecting Gulf of Mexico.
Corpus Christi, Tex.	CC	
Brownsville, Tex.	BV	All hurricane warnings and advices.
Kingston, Jamaica	KN	
Swan Island	SI	Period covered by forecasts, 24 hours beginning at 0500.

Great Lakes, Ill.—Sending time, shortly after 0300 Greenwich mean time. Wavelength 1,500 metres.

Distribution is made from this station only during season of navigation on the Great Lakes, approximately April 15th to December 20th.

Observation stations contained in first part and code letters.		Second part of bulletin.
Duluth, Minn.	DU	Forecasts for upper Lakes (Superior, Michigan, and Huron).
Marquette, Mich.	M	Forecasts for lower Lakes (Erie and Ontario).
Saulte Ste. Marie, Mich.	U	Storm warnings for upper and lower Lakes.
Green Bay, Mich.	G	Location and expected movement of storm-centres affecting the Lakes.
Chicago, Ill.	CH	
Grand Haven, Mich.	GH	
Alpena, Mich.	L	
Detroit, Mich.	D	
Cleveland, Ohio	V	
Buffalo, N.Y.	F	Period covered by forecasts, 24 hours beginning at 0500.

All storm warnings issued in the forenoon for the Great Lakes also are distributed from this station about 1700 Greenwich mean time.

San Juan, P.R.—Sending time, 0200 Greenwich mean time. Wavelength 600 metres, damped oscillation first, followed immediately by 5,250 metres, continuous wave.

Distribution is made from this station only from June to November, inclusive.

Observation stations contained in first part and code letters.		Second part of bulletin.
San Juan, P.R.	SJ	All hurricane warnings.
St. Thomas, Virgin Islands	ST	In the absence of a tropical storm the following words will be sent each day "Weather normal."
Basseterre, St. Kitts	BT	
Roseau, Dominican Republic	RS	
Bridgetown, Barbados	BB	
Santo Domingo, Dominican Republic	SD	
Puerto Plata, Dominican Republic	SL	
Castries, St. Lucia	LU	
Willemstadt, Curaçao	W	
Port of Spain, Trinidad	PS	

Hurricane warnings also will be broadcasted from this station at 1500 Greenwich mean time, or as soon thereafter as possible.

QUESTIONS AND ANSWERS

NOTE—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Questions should be numbered and written on one side of the paper only, and should not exceed four in number. (2) Queries should be clear and concise. (3) Before sending in their questions readers are advised to search recent numbers to see whether the same queries have not been dealt with before. **(4) The Editor cannot undertake to reply to queries by post.** *(5) All queries must be accompanied by the full name and address of the sender, which is for reference, not for publication. Queries will be answered under the initials and town of the correspondent, or, if so desired, under a "nom de plume."*
(6) Readers desirous of knowing the conditions of service, etc., for wireless operators will save time by writing direct to the various firms employing operators.

G.R.G. (Marlborough).—(1) The diagram submitted is correct, except that the condenser A should be connected across the secondary of the loose coupler, instead of in series with it.

(2) Condenser A = 0·0006 mfds., resistance R = 3 ohms.

(3) We are afraid not. The expense of remaking and, in particular, re-pumping a valve hard makes the repair of burnt out valves not commercially practicable at present.

F.W.L. (Shoreham).—(1) Yes. L_2 might be 8″ by 5″, of No. 24. R could be 4″ by 3″, of No. 22, with two or three tappings on each.

(2) L might be 9″ by 6″, of No. 22.

(3) and (4) Not satisfactorily, as you would get too much hum in the telephones.

H.H. (Stockton). (1) For the inductance you ask for you will require, approximately, 25 turns.

(2) Yes.

(3) We cannot say without a sketch of your apparatus. In general this may be done if this point has been kept in mind in designing the components; but if no care has been taken to arrange this, it is not always possible without short-circuiting the H.T. battery or rearranging the connections.

(4) The filaments may generally be connected in parallel in this way; but care should be taken before this, that doing so does not short the battery.

X.X. (Leicester). (1) See Fig. 2, page 247, of July 19th.

(2) Iron core, of thin wires, total thickness about ½″. H.R. winding 3 oz. of No. 42. L.R. winding, 4 oz. of No. 32. Length of transformer about 3″.

(3) Usually almost immaterial. Try, and see which works best in your own case.

(4) Quite suitable.

F.N. (Oldham).—(1) A sketch to be of much use to us should show us the essential wiring connections of all parts rather than the actual shapes of the different pieces of apparatus. From this point of view your sketch, though beautifully drawn, is not very helpful. However, your telephones appear to be in parallel with the crystal, this alone is sufficient to explain lack of results. There may be other faults. We should recommend you to trace out the connections very carefully, sketch them out in simple diagrammatic form, and then compare them with various sketches of similar circuits that we have given recently.

H.J.M. (Rochester).—(1) A suitable set is described in numbers 23 to 26 of the last volume.

(2) Yes, at 6d. each, plus postage.

(3) There is much information of this nature given throughout the whole of the volume referred to above. We do not know of any other book very suitable.

(4) This is rather difficult to say. It depends, for instance, on how much of the parts you can make yourself. If you make practically everything yourself which is possible to an amateur, the cost will probably be in the neighbourhood of £3, inclusive.

"VEE" (Tooting). (1) No alterations will be necessary except such structural ones as are necessitated by the different shape of the valve, except that the H.T. voltage should be raised to about 60 volts.

(2) No grid condenser is shown because the set is designed with a view to use without one.

(3) L.R. telephones, with a transformer, are nearly always desirable with a valve set. In this particular set it is almost immaterial which is used.

(4) It will receive telephony efficiently, and we know that it has received the Dutch concerts successfully in the neighbourhood of London. This, however, is a pretty severe test for a one-valve receiver, and will need considerable skill in construction and manipulation, and you must not be surprised if you are not successful.

E.T.M. (Wimbledon).—(1) With a voltage operated detector such as a crystal best results are obtained when the inductance is a maximum and the capacity a minimum. At the bottom of the condenser the capacity is exceedingly small, and, consequently, you obtain stronger signals than with a smaller inductance and more capacity. Set the condenser at minimum and tune on the inductance by means of a temporary lead and a pin.

(2) There are several types of relay, some of which require an additional transformer. We do not know which your type is.

S.V. 79 (Dover).—(1) We have no definite information, but this is probably a two circuit crystal receiver, with a switching arrangement to connect the crystal and telephones across either the A.T.I. or the secondary inductance.

(2) It probably has two terminals marked valve, by means of which it is possible to connect an amplifying detector across the secondary inductance, but this would not be suitable for the reception of C.W. unless a separate heterodyne were used, or a reaction coil provided to couple into the secondary inductance.

R.A.E.J. (Putney).—(1) The design of an efficient receiver for 300–30,000 ms. is beyond the scope of these columns. You will do well to try the slabs advertised in the July 9th issue of *The Wireless World*.

(2) Telephony will be obtained on 900 ms.

(3) It would probably take about 2lbs. of wire.

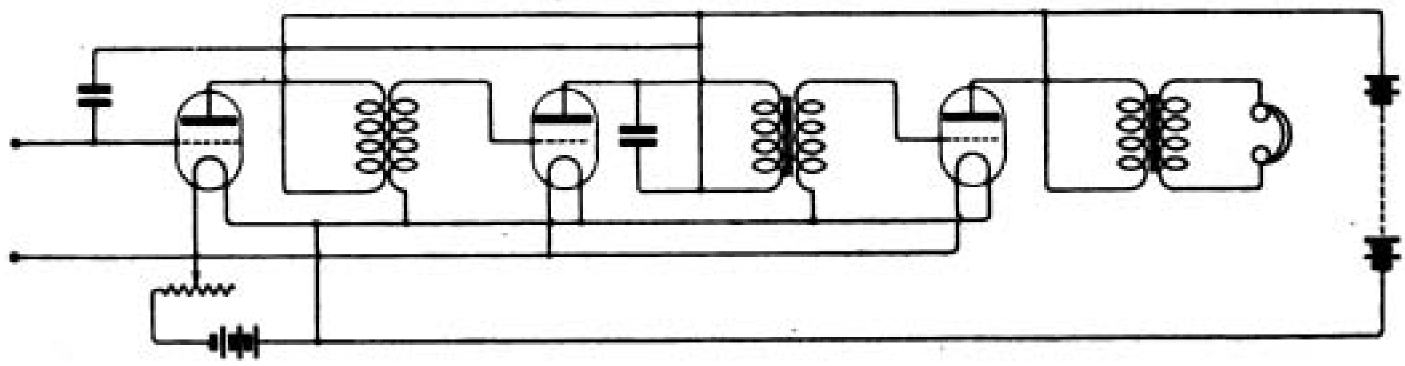


Fig. 1.

C.E.G.B. (Kensington).—(1) See diagram, Fig. 1.

(2) It will be less trouble, and the results will be almost as good if a single wire aerial the full length is used.

(3) No.

(4) Do not use the 0·008 mfds. condenser across the reaction coil. Connect 0·002 mfds. across the transformer winding in the reaction circuit instead. On the 4′ frame use 40 turns of No. 22, and make a frame about 1′ square for the reaction. Wind it with about 100 turns of No. 24. With a frame aerial you will probably get better results with 2 H.F. magnifiers and a rectifier, instead of 1 H.F. and 1 L.F. magnifier.

PERPLEXED (Newcastle).—(1) The symptoms are rather puzzling. They do not appear explicable in terms of low frequency induction, as from electric light or power leads. We are inclined to think the noise is due to intermittent oscillation at critical reaction settings due to the absence of a condenser across the telephones, and possibly the presence of a small leak across the windings of the telephones. Introduce a condenser, and if this does not cure the trouble write us again, in particular mentioning whether you can change the pitch of the roar by altering the tune of the set.

R.W.J.P. (Greenwich).—(1) A 12″ with two V24's is no good at all. Make a 4′ frame and wind with about 50 turns of No. 24, with several tappings. Use three valves at least.

(2) Reactance coil 1′ square, wound with 100 turns of No. 24.

(3) Several diagrams have been given recently.

(4) You may get 600 ms. on the 4′ frame on one of the tappings, if it has no "rejector" effect for this wavelength. If it has, alter the winding slightly.

H.G. (Forest Hill).—(1) There are no reliable formulæ available for accurately calculating the inductance of the lattice coils.

(2) You omit to mention the diameters of the fixed and moving formers of your coupling unit.

(3) The number of turns must be experimentally determined.

A.C.B. (Valparaiso).—Your question is not very clear, but apparently you wish for a full treatment of the problem of inker reception, at the same time telling us that any reference will be of no use to you. We think that with further consideration you will realise that this would involve more space than we can spare in these columns. Briefly, since you have the amplifiers, you had better put one L.F. magnifier after the H.F., and introduce a P.O. relay, preferably of high resistance windings, in the plate circuit of the last L.F. valve. This relay can be used to operate a Morse inker in the well-known wire telegraphy manner. You can try using both your L.F. amplifiers if you wish to, but you will very likely get trouble from too much L.F. amplification if you do.

F.D.C. (Bristol).—(1) You may have a difficulty in making a 200 m. valve set oscillate, especially if the circuit used is that given in Fig. 1 in the article in question. Better results will probably be given with a separate reaction coil. Try a 5 cm. former wound with 5 cms. of No. 20. Separate reaction coil should be 4 cms. diameter, wound for 5 cms. with No. 26.

(2) The power input to a valve is usually taken to be the input to the anode circuit, *i.e.*, anode volts X anode current. Therefore, for a voltage of 100 a power of 10 watts would be given by a current of 100 milliamps. In practice, if small valves of receiving type are used, giving a plate current of 5—10 milliamps each, a good number would be required to give the full 10 watts allowed.

(3) Probably about 5 miles telephony and 15 miles C.W.

(4) No, it will not work satisfactorily. Use a buzzer, buzzing through a transformer in the grid circuit.

BILLI (Melton Mowbray).—(1) and (2) The circuit of Fig. 2, page 247, July 9th issue, will show you about the best type of circuit for the purpose, and also how to connect the batteries.

(3) We doubt if you will have room for anything else useful.

(4) You should be able to get fair results, but they are not likely to be very strong.

J.M. (Edinburgh).—(1) The width of the gap should not be more than 1/64″. The size of the plates is unimportant, provided they are reasonably robust.

(2) Yes, if of good design.

(3) Either is quite good, but that given in the March issue is probably cheaper to make and somewhat more efficient.

(4) The tikker can be used in place of the crystal.

A.C.M. (Woolwich).—The complete Brown relay consists of two parts, the relay proper, and a transformer unit. We cannot decide from your sketch and letter whether you have both of these or only the transformer unit. The relay is of very special construction and is intended for the amplification of very small currents, such as the speech currents in a telephone line. The instrument can be used in place of or after a L.F. amplifier, but is rather "flukey" in action and difficult to adjust. It will give an amplification of about 20 times, but it needs fairly strong signals to work it. The transformer unit alone is of very little use. The three pairs of terminals are for input, output and local battery.

S.E.B. (Stroud Green).—We should recommend you to get a book, such as Bangay's "Elementary Principles," and thoroughly master that. At the same time, study descriptions of apparatus and methods of making it in *The Wireless World*, and join a wireless club in your neighbourhood. The minimum cost of a licence is 10s., and of a set made by yourself from £2 to £3. In making a set be content with a simple crystal set to begin with.

W.G. (Bridgnorth).—(1) There does not appear any reason why your set should not work provided that the proportions of the parts are about right. About this we can say nothing, as you give us no information. The noises you mention point to the valve being all right and properly connected. If the condenser marked "large" has a capacity greater than 0·001 mfds., results will be poor. A potentiometer is not required with a set of this type, and is in any case shown wrongly connected in your diagram.

YOUNG SPARKS (Bolton).—(1) The circuit is quite unusual, but should work if you keep the capacity of the variable condenser small—say, 0·0005 mfds. If you have any tuning troubles, or do not like the results obtained, try one of the normal circuits as given frequently in these columns.

(2) Quite satisfactory up to about 1,500 ms.

(3) Blocking condenser may be about 0·002 mfds. Telephone transformer may have windings as follows: H.R. winding, 3 oz. of No. 44: L.R. winding, 6 oz. of No. 30.

GREEN 'UN (Peckham).—(1) Use of a waterpipe earth does not involve extra risk from lightning. If the aerial does get struck the pipes will very likely get damaged, but so they would if the house were struck in any case. Moreover, an aerial has to a certain extent the property of a lightning conductor in minimising the likelihood of a stroke.

(2) Yes.

(3) Screening from any direction tends to weaken signals. In your case signals from the directions of the ends of the aerial will probably be weakened, and signals from the sides very little affected.

R.C.S. (Bath).—(1) The set will do very nicely if you wind the aerial former with No. 22 instead of No. 36. The tuned circuit condenser might with advantage be somewhat smaller.

(2) About 5″ × 3″ of No. 28.

(3) Generally speaking, increase of size lessens the amount of tuning inductance or capacity needed; but in special cases, as for instance, when the capacity of an aerial is reduced by raising it, a small effect in the opposite sense may be obtained

(4) Very doubtful at such a distance.

F.O. (Romford).—If your set will receive C.W. and spark corrected, there is absolutely no technical reason why it should not receive telephony, for which the adjustments should be the same as for spark. Make sure that the reaction coupling is weakened sufficiently to prevent the set from oscillating. It is quite useless to give us the sizes of the plates of a condenser without specifying the material or thickness of the dielectric.

MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY, LTD.

The balance sheet and profit and loss account for the year ended December 31st, 1920 indicates that the Company's business during the past year has continued to show expansion. The gross revenue amounted to £933,567 12s. 6d., as compared with £772,018 16s. 1d. in the preceding year. The increase is due in substantial part to higher remuneration paid to the telegraph operators, from which the Company does not derive profit. The profit amounts to £117,570 9s. 1d., as compared with £198,141 5s. 2d for the year 1919. The reduced profit is due very largely to exceptional circumstances. In common with all other businesses, there has been a substantial increase during the past year in all working costs, including material, clerical salaries, travelling, stationery, etc. Under normal conditions the increased cost of working would have been more than counterbalanced by the greater volume of business.

On June 30th last the capital represented by Government securities and moneys abroad had appreciated and the loss substantially diminished. A considerable amount was brought forward from the preceding year to the credit of profit and loss account and after making adequate allowance, as the directors are advised, for Excess Profits Duty and Corporation Profits Tax, a substantial balance remains.

The Directors recommended a final distribution of 10 per cent., which, together with the interim dividend of 5 per cent. paid in January last, makes a total of 15 per cent. for the year. During the year under review 1,414 debentures of a par value of £28,280 were redeemed.

SHARE MARKET REPORT.

Dealings in the Wireless Group have been very dull during the past fortnight. Prices throughout show a slight depreciation.

Prices as we go to press, August 11th, are:—

Marconi Ordinary	£2	0	0
,, Preference..	£2	0	0
,, Inter. Marine	£1	3	7½
,, Canadian		6	6
Radio Corporation of America:—			
Ordinary		8	9
Preference		9	9