The WIRELESS WORLD

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 21. JANUARY 8TH, 1921 FORTNIGHTLY

WIRED WIRELESS TRANSMISSION

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

IN the transmission of messages from place to place by the ordinary methods of wireless telegraphy and telephony, the transmitting apparatus, of whatever form it may be, serves to establish high-frequency oscillatory currents, modulated by telephone transmitter or by key, in accordance with the signal to be sent. These high-frequency oscillatory currents, as is well known, are the means of setting up electro-magnetic waves, which are radiated through the aether from the aerials of the transmitting station. In ordinary radiotelegraphic transmission on earth these waves are not able to spread out uniformly round the transmitter as they would were the sending station an isolated point in space separated from other material electrical conductors. It is indeed fortunate that this is so, as owing to the sending and receiving stations being located on the earth's surface much more effective signalling is possible over long ranges than would otherwise be the case The conducting earth's surface, in fact, serves as a guide for the radio waves.

The reason for this fact can easily be seen if the mechanism by means of which the waves are set up by the transmitting aerial system is considered for a moment. The electrons oscillating in the aerial wires carry with them in their motion the ends of the electrostatic lines of force to which they are always attached. The ends of these lines rest on the conducting aerial wires, and the wave becomes detached from the sending aerial when the ends of these lines of force move downwards on to the surface of the earth surrounding the station. In the propagation of the waves from the sending station the ends of these lines of force on the earth's surface move along it as the wave is propagated outwards from its source. In a sense, therefore, we may say that the waves are guided by the conducting surface of the earth, and they can in fact be so guided along any electrical conductor. A wire between the two stations provides an excellent guiding means of this type.

The main difference between radio transmission of the ordinary type with the earth as the guide, and this special type of transmission with a wire as guide, is to be found in the reduction of energy necessary at the sending station in the latter case, for signalling over a given range between the stations. The reason for this difference lies in the localisation of the energy sent out from the transmitter into one single direction only instead of allowing it to spread out in all directions round the sending aerial. This case of wire guiding of the radio waves may thus be likened to ordinary radio transmission with an ideally perfect directive sending aerial. Receiving stations in other directions will under these conditions hear nothing of the signals passing between the two stations concerned.

Since radio-receiving apparatus is extremely sensitive to minute impulses of the frequency to which it is tuned—particularly if a valve

detector is employed with regenerative amplification and beat reception—the importance of this method of wire communication lies in the possibility of establishing communication between the two stations, even if the intervening line wire is, electrically speaking, in a very poor condition. A line that for ordinary telegraphic work would be too leaky to be used at all will be found quite workable for radio-frequency transmission. This in itself is a considerable advantage, but with it must be coupled the possibility of transmitting a number of messages—either telegraph or telephone simultaneously—along the same line by using a different "carrier-wave frequency" for each. Not only so, but these multiple transmissions may be superimposed upon the line without interfering with its ordinary use for telegraphy or telephony by the usual wire methods.

Turning now to the more practical side of the subject, the apparatus used consists practically of an ordinary wireless transmitter and receiver at each station, but of quite small power. When "wired-wireless" methods (as they are generally called) were first introduced, the type of apparatus available was very different from what may be used to-day. Damped wave transmission was almost exclusively employed, so that the first transmitters used a buzzer as the source of the necessary oscillatory current, a tuned circuit being shunted across the buzzer contacts in the usual way. Crystal detectors were employed for reception.

In Fig. 1 is shown a schematic arrangement of one of these circuits in its simplest form, so as to indicate the essential elements rather than the practical details.

In this diagram W_1 and W_2 represent the lead and return wires of, say, an ordinary telephone circuit between two stations, A and B. Across these lines at each end "repeating coils," or transformers, T_1 T_2, are joined for coupling the lines to the ordinary telephone instruments. In series with the lines additional coupling coils, L_1 and L_2, are inserted. These are generally air-core coils of a few turns only, since they have to deal with high-frequency currents. Their presence in the circuit will not interfere with the ordinary telephonic transmission to any appreciable extent, since for currents of telephonic frequencies their impedance will be quite negligible.

Coupled inductively with L_1 is the coil L_3, which in conjunction with the condenser

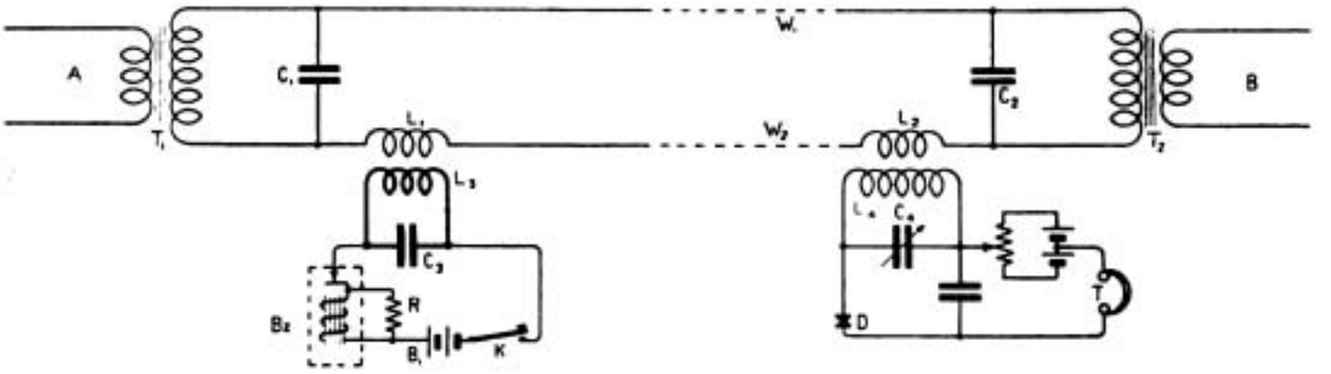


Fig. 1.

C_3 forms the main oscillation circuit of the radio-frequency transmitter. Oscillations are established in this circuit by means of the buzzer Bz which is excited by the battery B_1 in series with the signalling key K. Across the windings of the buzzer is shunted the non-inductive resistance R, which serves to absorb the extra e.m.f. due to the self-inductance of the magnet windings, thus eliminating the spark at the contact and giving a cleaner and quicker interruption of the circuit, enabling stronger oscillations to be set up. By means of the coupling L_3 L_1

the energy of these oscillatory currents is transferred to the line wires, from which it is picked up again at the receiving station by the detector D. This detector, in series with its telephone receiver T is shunted across an oscillation circuit L_4 C_4 tuned to resonance with the oscillations set up by the transmitter. This resonance circuit is coupled to the lines through the coils L_2 L_4 in a very similar manner to an ordinary wireless receiving circuit, the coil L_2 representing the coupling coil used in the aerial circuit with the ordinary arrangements.

The function of the condensers C_1 and C_2 remains to be explained. As far as the ordinary telephonic transmission along the lines is concerned these condensers are not required, and if their capacity is small they will not interfere with such transmission at all, but as regards the high-frequency currents from the coil L_1 they act as a bypath shunt to the windings of T_1 and T_2, such shunt having a very much lower impedance to the radio-frequency currents than have these windings. As a result almost the whole of the high-frequency current will pass through the condensers, and an unappreciable amount through the transformer windings. The impedances of these windings will therefore not seriously damp out the strength of the oscillations, as they would were no condenser shunts provided.

The transmission of radio-frequency signals in this manner along telephone lines will not in any way interfere with the use of these lines for ordinary telephonic purposes, nor will their use for telephonic transmission hinder their employment for radio work, as we have just seen. As a matter of fact in practical working the circuits are not usually so simple as would appear from the above diagram, as some kind of filtering circuits are required to prevent any of the low-frequency telephonic transmission from penetrating into the radio-frequency receiving circuits. Some such filtering circuits are also required when two-way and multiplex transmissions are concerned, in order to maintain the separate frequencies quite distinct from one another.

For two-way working two different frequencies must usually be employed—one for transmission from A to B, and another for signalling in the reverse direction. The radio-frequency apparatus sketched in Fig. 1 will thus be duplicated, so that at each end of the line both a transmitter and a receiver are installed. The use of different frequencies for signalling in each direction, in conjunction with the tuned circuits at the receiver, enable the currents of different frequency to be sorted out, so that each receiver is affected only by its appropriate transmitter.

The advent of practical thermionic-valve apparatus enabled great strides to be made in the development of this type of communication, as by using the continuous waves from a valve generator radio-frequency telephonic as well as telegraphic transmission is possible, while, further, the greater sensitiveness of the modern 3-electrode valve-receiving apparatus enables much greater ranges to be accomplished with a smaller expenditure of power at the transmitter. We shall return to a consideration of modern practical installations in a later article.

(To be continued.)

PRIZES FOR AMATEURS

FURTHER OFFERS FOR TRANS-ATLANTIC ACHIEVEMENT.

As we go to press we learn that further offers of prizes in connection with the above test have been made by Messrs. Burnham and Co., Deptford, and by Messrs. Halliwell and Good. Ltd.. Manchester. Further particulars will be given in our next issue.

THE ALEXANDERSON HIGH FREQUENCY ALTERNATOR

By E. Blake, A.M.I.E.E.

TO make the electromagnetic waves which are employed in wireless telegraphy it is necessary to set up in the transmitting aerial alternating currents of extremely high frequency, these being generally known as high-frequency oscillating currents. Regarding 20,000 metres as (roughly) the longest wave used for commercial, or everyday, radio work, and 300 metres as the shortest, the fact emerges that for the production of these wavelengths and those of the intermediate orders we must employ oscillations of frequencies varying from 15,000 per second to 1,000,000 per second. No ordinary dynamo is capable of delivering current at a frequency anywhere approaching even the lower of these values.

Up to about 1914 most wireless communication was effected by means of damped waves produced by the discharge of a spark, but although the "spark" systems have done yeoman service and are, indeed, still largely employed, "continuous" or undamped waves are rapidly approaching the premier position, not only because their use permits of greater selectivity in receiving instruments, but because they are essential to wireless telephony and, moreover, are produced with much simpler and less bulky apparatus. It is not, however, the purpose of this article to discuss the case of *Spark* v. *C.W.*

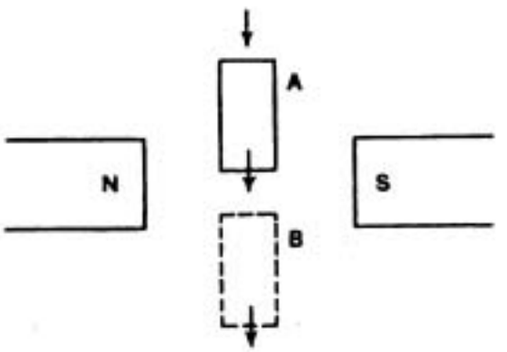


Fig. 1.

In spite of the fact that the "arc" systems, the Marconi "timed spark" system and the thermionic valve transmitter are all hard at work on the world's high-power stations, the idea of producing oscillating currents by means of a machine built along the lines of the ordinary power house dynamo is very attractive, and the machine invented by Mr. E. F. W. Alexanderson, Chief Engineer of the Radio Corporation of America, is one of the several successful attempts to cope with the problem. Before examining

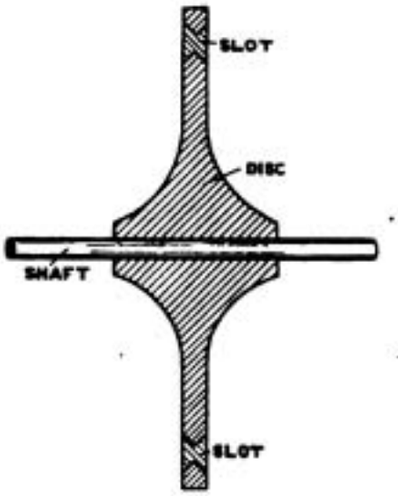


Fig. 2.

the alternator in detail we may profitably consider the electromagnetic principles upon which its design is based.

General Principles.

A magnetic field which is changing in strength—such as one which is being built up round a wire or which is collapsing upon it,—will set up an electromotive force in a conductor suitably placed within it. The direction of the e.m.f. will be at right angles to the direction of the field. Changes in the strength of the magnetic field between the poles of an electromagnet may be caused by altering the strength of the current passing through the windings of the magnet *and as*

the pole faces are conductors in a plane at right angles to the direction of the magnetic field an e.m.f. will be set up in them and will originate eddy currents.

There is, however, another method of altering the strength of the magnetic field, of which advantage is taken in the design of the Alexanderson alternator. The introduction of iron into a magnetic field reduces the resistance (called reluctance or reluctivity) of the magnetic circuit; in other words, the magnetic field becomes concentrated. Therefore, whilst the iron is entering the field as at A in Fig. 1 an e.m.f. will be set up at right angles to the direction of the field and to that of the motion of the iron, as a result of the changing field strength. If

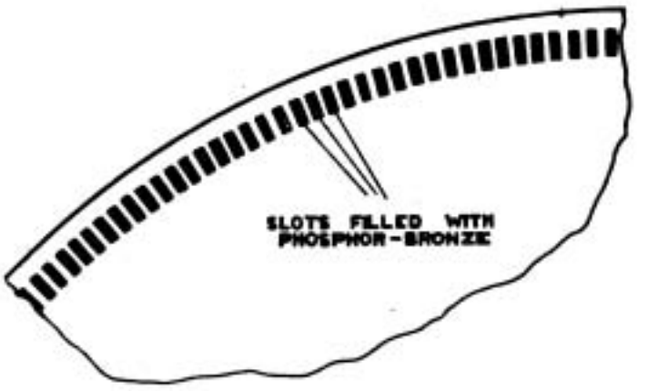


Fig. 3.

the iron passes across the field and, finally, out of it, as at B in Fig. 1, the field strength will increase to a maximum and then gradually decrease to its original value. The resultant e.m.f. will follow a similar cycle, and, unless special precautions are adopted, eddy currents will exist in the pole faces. The Alexanderson machine primarily depends for its action upon the *utilisation* of the e.m.f. set up by the movement of magnetic material —chrome-nickel steel—across a magnetic field.

Description of Parts.

The Rotor.

The revolving part of the machine takes the form of a chrome-nickel steel disc of peculiar shape. (See Fig. 2.) As it has to revolve at an enormous velocity the disc is shaped as shown in order to equalise, for the greater part, the internal strains set up by centrifugal force. The disc is driven at a velocity of 20,000 revs. per minute

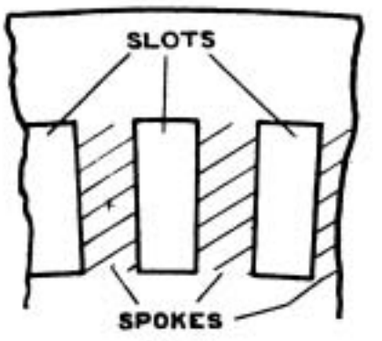


Fig. 4.

by a driving motor working at 2,000 revs. per minute, coupled to a double helical gear. Round the edge of the disc, and about $\frac{1}{8}$" apart, are cut 300 slots (see Fig. 3), the peculiar form of which is shown in cross-section in Fig. 2. It is important to note that by this means the periphery of the disc is provided with 300 spokes, each $\frac{1}{8}$" wide (see Fig. 4), in which the slots are shown blank and the spokes shaded. In order to reduce the wind resistance the slots are filled up with a non-magnetic metal such as phosphor-bronze, the material being brazed into the disc. This does not affect the action of the machine, and the disc may be regarded as toothed, the teeth being the shaded parts of Fig. 4. Each tooth can be considered analogous to the piece of iron (A and B) of Fig. 1.

The Stator.

Considering now the arrangements made for the provision of a magnetic field for the above-described teeth (or spokes) to cut, let us refer to Fig. 5, which is a cross-section diagram of the alternator. The armature is made up of two separate parts, A and B, which form the greater portion of the frame of the machine. When these are assembled and the framework is completed by the addition of the portion of the outer frame shown shaded (F in Fig. 5) there is left a space, S, for the field coils, C, which, when energised, create a constant field across the gap between

the two armature parts and therefore through the slotted part of the disc D.

Thus far we have described the arrangements for the provision of two out of the three essentials, (1) a magnetic field, and (2)

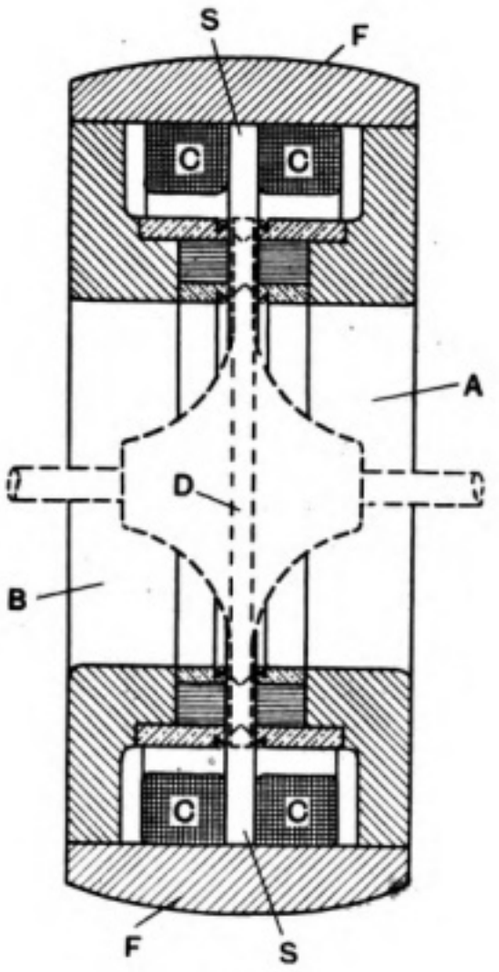


Fig. 5.

masses of magnetic material to pass through the field. Next we come to the winding of the stator. The face L in Fig. 6, which is a separate drawing of A or B of Fig. 5,

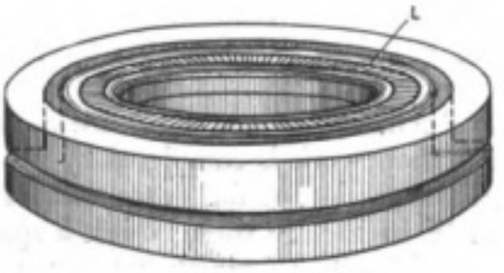


Fig. 6.

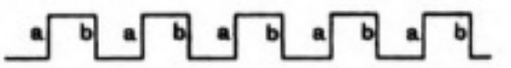


Fig. 7.

is laminated and provided with 600 radial slots in each of which is placed one conductor. The conductors are joined in series, and each pair (*a* and *b*) forms a complete loop, so that for every loop there is one rotor spoke. Fig. 7 indicates the manner in which the conductors

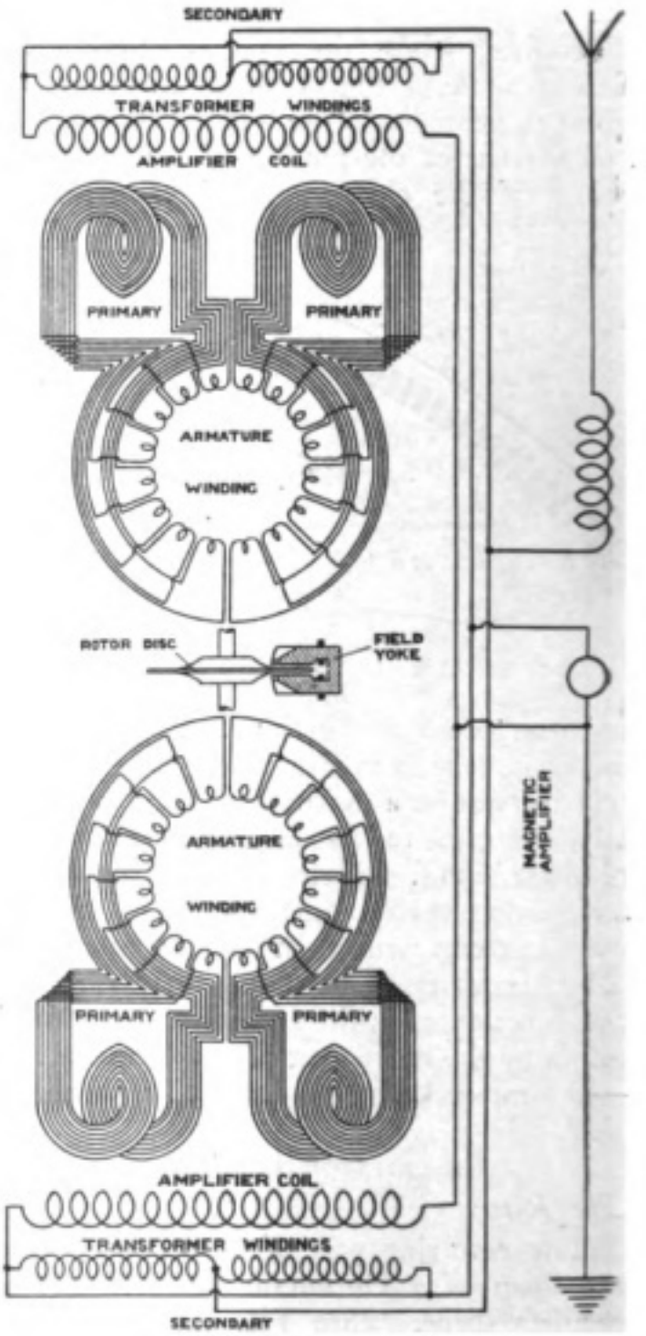


Fig. 8.

are joined. The distance between the rotor and the laminated stator faces is adjustable, but is generally maintained at about a millimetre. It should now be clear that upon the revolution of the rotor and the production of the sinusoidal e.m.f.'s in the armature windings resulting from the rhythmic increase and decrease of the field intensity across the air-gap, alternating currents will flow in the armature windings. For an increasing magnetic field will produce a current in a direction opposite to that of the current produced by that field when decreasing, so that in the particular machine described here there will be 300 alternations per revolution of the rotor. If, then, the rotor moves at 20,000 r.p.m., we get a frequency of 100,000 cycles.

Fig. 8, re-drawn from an illustration in *The Wireless Age*, shows the scheme of the connections of the alternator circuits.

Fig. 9 is a photograph of a 200 k.w. Alexanderson alternator with its driving motor, as installed at the New Brunswick station in 1918, and which has given consistently satisfactory results. The alternator is run at an output of 80 k.w. giving an aerial current of 400 amperes, although the machine is capable of supplying 600 amperes to the aerial. The normal wavelength employed is 13,600 metres.

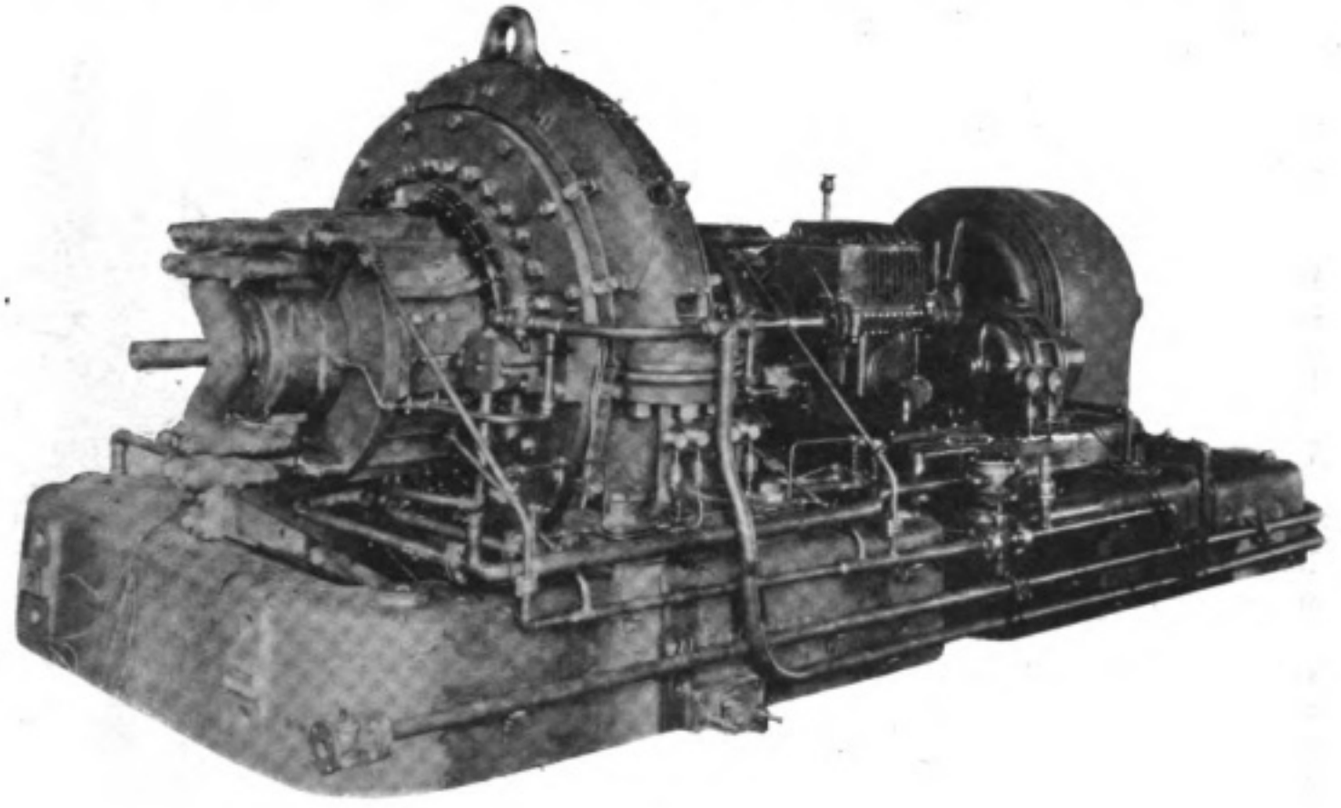


Fig. 9.

Wireless and the Stock Exchange.—For the first time in the history of Wall Street the wireless telegraph supplanted the ordinary telegraph lines on December 14th in the carrying on of stock market operations between New York and Chicago. The wire lines were disrupted by a storm early in the morning of that day, and during the final hour of trading on the New York Stock Exchange W. J. Wollman & Co. conducted business with Clement, Curtis & Co., of Chicago, by wireless.

After the close of the stock market the operations by wireless were checked over the private wire between New York and Chicago, and it was found that not a single mistake had been made.

AN AMATEUR VALVE-RECEIVING STATION

By J. H. Savage.

THE following is a description of an experimental receiving station, and as a good deal of the apparatus is home-made, a description of the various rrangements may be of interest.

The amplifier consists of four Type V24 valves, the first for high-frequency amplification, which is resistance-coupled, the second for rectification, and the last two for note magnification. The plate-resistance used with the first valve consists of about ¼" of paper soaked in Indian ink, and is approximately, 100,000 ohms, the necessary leak from the grid of the second valve being made in a similar way, a much thinner strip being used.

The coupling condenser (·0003 mfd.) consists of two small strips of tin-foil, interleaved with two of waxed paper, and rolled up together.

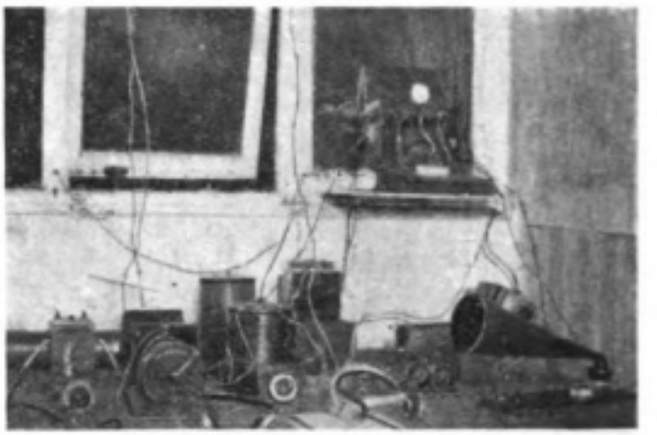
A separate filament resistance is provided on the second valve, so as to obtain the best point for rectification, whilst the last two valves are coupled-up with iron-core inter-valve transformers.

The valves themselves are mounted on an ebonite shelf at the top of a box with a hinged side and lid, in which is mounted a small ammeter to register the filament consumption.

The box is fitted with four sets of insulated terminals, two input, two output, two high-tension and two low-tension, also a filament switch and a plug switch for reversing the direction of reaction when used for self-heterodyne.

A 6-volt battery is used to light the valve filaments, and two 15-volt battery units supply the necessary plate potentials. The telephones are connected in the plate circuit of the last valve.

Considerable difficulty was experienced, at first, in getting rid of valve noises due to mechanical vibration and induced current from local A.C. lighting circuits, but this has been almost entirely eliminated by mounting the amplifiers on a thick pad of felt, on a shelf as far away as possible from the lights.



The General lay-out of the Station.

For short-wave reception (400—2,000 ms.), the jigger seen on the middle left of the photograph is used. This has a sliding contact on the outer cylinder, which is wound with No. 26 D.S.C., and a rotary switch on the inner, a small condenser being used across the inner for fine tuning. For longer waves (2,000—18,000 ms.), the large loading coils seen in the centre of the photograph are used in conjunction with a series of pile-wound coils.

The connections from both are brought to rotary switches and a condenser placed across them. When these coils are used, the amplifier is connected direct across the loading-coils.

The head-telephones are a pair of 4,000 ohms Brown's "A" Type, and are connected in series with a loud-speaker made from another Brown's telephone, and a small brass phonograph horn, a switch being provided to short-circuit whichever is not in use at the time.

NOTES AND NEWS

Dr. Alexander Muirhead, F.R.S.—We regret to have to announce the death, on December 13th, of Dr. Alexander Muirhead at the age of 72. This pioneer of wireless was associated with Sir Oliver Lodge in the latter's early work in connection with wireless telegraphy.

FL Weather Reports.—The following programme will be carried out by Eiffel Tower as from November 1st, 1920. The code used is as given in *The Wireless World*, May 29th, 1920, issue :—0245, 0815, 1130, 1415, 1930. The following alterations have been made to the list of stations :—

01 Rochefort	13 Mayence	27 Alencon
02 Biarritz	14 Montpellier	28 Amiens
03 Bordeaux	15 Paris	29 Cosne
04 Bruxelles	18 Rennes	30 Le Havre
07 Dijon	19 Strasbourg	31 Istres
08 Calais*	21 Toulouse	32 Metz
09 Limoges	22 Tours	33 Privas
11 Saint Mathieu	24 Saint Julien	34 Sommesous

*Saint Inglevert.

The B.C.M. report is issued at 1130, the other transmissions being reserved for the S.M.M. In the former reports stations are indicated by letters thus :—

S	Stornoway	CF	Clermont—Ferrand
V	Valentia	N	Nice
C	Copenhagen	PE	Perpignan
HE	Le Helder	BI	Biarritz (Sacoa)
PR	Prague	CR	La Corogne
P	Paris	R	Rome
O	Ouessant	A	Alger

The wavelength remains the same.

A Novel Application of the Amplifier.—Experiments have recently been tried on a suburban railway line for calling out the name of the station, so that it can be heard above the noise of the train. To this end the vacuum tube was again introduced. A loud speaking telephone was hung in the centre of each coach reproducing the voice of the guard to such a volume as to be heard above all local disturbances, with marked distinction.

Intensity of Wireless Signals.—A method of measuring and comparing the intensity of signals received by a radio station has been worked out in France with good results. This method, which can be employed only for undamped waves, essentially consists in comparing intensities of reception of the signal, and of the sound produced by a local source of oscillations of the same frequency and form, constituted by an ordinary heterodyne. By modifying the intensity of the action of the auxiliary oscillation-generating device upon, say, the antenna, a rough equalisation is first obtained ; afterwards by manœuvring convenient shunts to the telephone an absolute equality of intensities is obtained. The ratio of intensities is proportional to the shunt resistances. Moreover by inserting a thermo-galvanometer in the antenna the absolute value of the intensity of the auxiliary signals can be arrived at. The error in the practical use of this method is said to be from 5 per cent. to 10 per cent.

The s.s. "Oropesa."—It is interesting to note that when as far south as the Straits of Magellan, this vessel was still in touch with Europe, as well as San Francisco to the Far North, and the Cocos Island Station in the distant Pacific. Throughout her whole tour she was only two days without press news from Europe.

Royal Corps of Signals.—A Wireless Telegraphy Course for officers of the Royal Corps of Signals assembles at the Signal Training Centre, Maresfield, on February 7th, and terminates on April 4th. The course is intended for Captains and Subalterns who did not attend the short wireless telegraphy course of the wireless telegraphy portion of the Royal Corps of Signals, Officers Qualifying Course. Applications for vacancies should be forwarded by commands to the War Office as early as possible.

An Army Order states that a bounty of £100 will be paid to 650 wireless operators, 150 wireless electricians, 150 fitters and 75 instrument makers presenting themselves for enlistment or re-enlistment in the Royal Corps of Signals, subject to final approval after passing the prescribed trade test at the Signal Service Training Centre, Maresfield. These figures include the numbers enlisted or re-enlisted in the Corps since May 14th, 1920.

Wireless Time Signals.—Wireless telegraph equipment is being installed at the Huddersfield Tramway Offices to the design of the son of the Tramway Manager with a view to picking up the Eiffel Tower Standard Time Messages. A governor clock has been fixed and the tramway clock, which is recognised as the standard time-keeper in the district, will be checked each day by the Paris message. The wireless installation is to be made by members of the tramway staff, and is expected to be completed within an early date. Huddersfield is the first English municipality to take its official time direct from the Eiffel Tower.

Air Ministry.—In the Half-Yearly Report on the progress of Civil Aviation recently published by the Air Ministry, we learn with interest that the wireless direction finding apparatus installed at Croydon has proved its value in enabling airmen to correct their course in thick weather. The Report goes on to say that the equipment of aircraft with the wireless telephone is extending as it is found to be of considerable assistance to navigation.

The installation of wireless stations for telegraphy and telephony has been continued, and stations are now open at Croydon, Lympne, Castle Bromwich, Manchester and Renfrew. The British proposals for the new Radio Telegraph and Telephone Convention, including all forms of communication to and from aircraft stations, have been framed, and these are now being considered by an International Conference at Washington.

The Marconi Scientific Instrument Co., Ltd., have recently published two new pamphlets describing their wireless telegraph, telephone and auxiliary apparatus. These pamphlets may be obtained upon application.

THE PROCEEDINGS OF THE WIRELESS SOCIETY OF LONDON

A FOUR-ELECTRODE THERMIONIC DETECTOR FOR DAMPED OR UNDAMPED ELECTRIC OSCILLATIONS OF HIGH OR LOW FREQUENCY

By J. A. Fleming, M.A., D.Sc., F.R.S.

Continued from p. 683, *December* 25*th*, 1920.

DISCUSSION.

J. Scott-Taggart: I am sure we are all very privileged indeed to have the pioneer of valve work here to-night to give us a description of his latest invention. The question of producing relay effects at a receiving station has always been one which has had the greatest fascination for experimentalists. The audible or visible indication of an incoming signal is always more satisfactory than merely a sound in a pair of telephone receivers. Professor Fleming's valve shows us how it is possible to work local relays, printers or other similar devices in a simple manner, with a minimum of special apparatus.

One arrangement, in which I have used a double anode valve for this purpose, is illustrated in Fig. A. The current in the transformer will be of an alternating nature, and consequently we cannot employ the ordinary relay or galvanometer to produce the indication. It is necessary to produce some form of rectifying effect, which, in fact, is accomplished by Professor Fleming in the 4-electrode valve. In this particular case, the two ends of the transformer windings, T_2, are connected to two anodes, A_1 and A_2, which surround the filament, F. The relay, or galvanometer, is connected by means of a tapping from the transformer winding, T_2, the filament and anode batteries being in the positions shown. When an incoming signal is applied to the terminals A, B, alternating current is produced in the inter-valve transformers and by the time it reaches the windings T_2 it has considerable value. The potentials in T_2 are now rectified by the double-anode valve, producing a uni-directional current through the relay R for each half alternation.

Fig. B shows another arrangement which has previously been used, and, I believe, is employed in the Creed apparatus. The battery B, of considerable negative potential, is connected in the grid circuit of an ordinary three-electrode valve. The working point is therefore at the foot of the characteristic curve, so that there is no current flowing in the anode circuit of the valve under normal conditions. When, however, an incoming signal produces an alternating current in T_2, the positive half-wave produces an anode current, which flows through the relay of the galvanometer R, while the negative half-alternation cannot, of course, produce any effect in the anode current, which is normally zero.

The valves that have been described to us to-night are of great interest to me, since I made, when with the Ediswan Company, some of the early experimental valves, which I designed from a mechanical and electrical standpoint to Professor Fleming's general description.

Moreover, I carried out a number of experiments with these valves, which I have constructed. A modification, not an improvement, of the arrangement which shows the action of the valves is shown in Fig. C. An ordinary valve, similar in shape to an R valve, contains a plate, A, which acts as an anode or, as Professor Fleming calls it, a collecting plate, and is placed directly above the horizontal filament, F, on each side of which are placed two other plates, G_1 and G_2. The incoming potentials

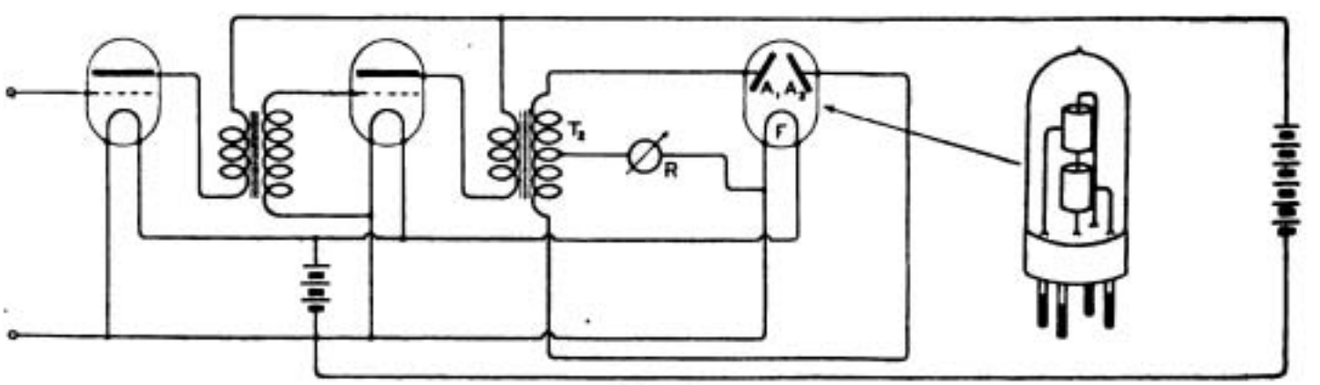


Fig. A.

are now applied to the two plates, G_1 and G_2, and vary the flow of current from the filament, F, to the anode, A. The actual circuit is shown in Fig. D. Here we have the two potential plates,

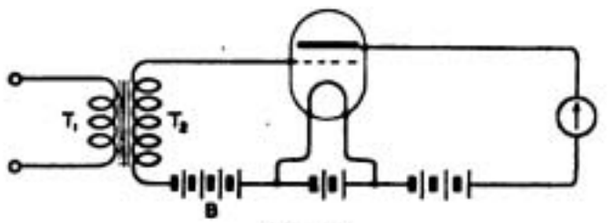


Fig. B.

G_1 and G_2, acting as controlling elements of the electron current from the filament, F, to the anode, A. The action is identical with the valves we have been shown to-night.

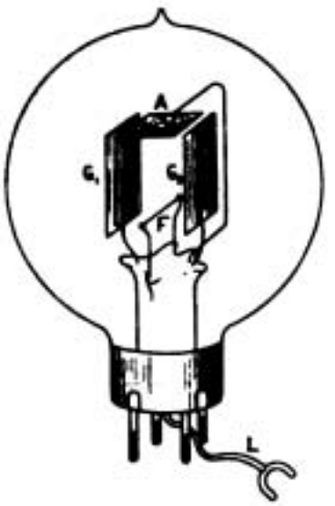


Fig. C.

I think, if anything, Professor Fleming has underestimated the value of his valve. There are several applications of it which have not been mentioned by him, but which undoubtedly are known to him. For example, several of these valves may be connected in cascade with intervalve resistances so as to produce a succession of amplifications. These resistances are placed in the collecting plate circuits, and the potentials across them are applied to the potential plates of the next valve, and so, by connecting a series of these valves together, a greatly amplified effect is obtained.

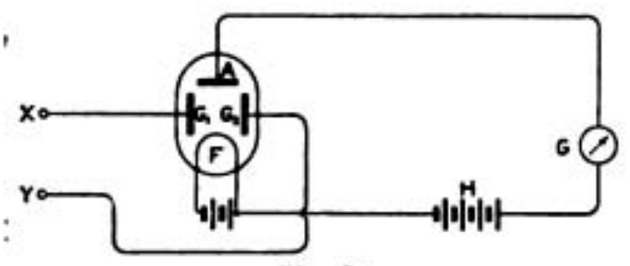


Fig. D

Another application of the valve is that it may be used to change the frequency of alternating or oscillating energy. The alternating currents are led to the potential plates, and preferably an oscillatory circuit, tuned to twice the input frequency, is included in the anode circuit. To this anode circuit may be coupled a circuit, tuned to twice the frequency or half the wavelength. If, then, the incoming frequency is 500,000, the oscillations drawn away from the valve will have a frequency of 1,000,000.

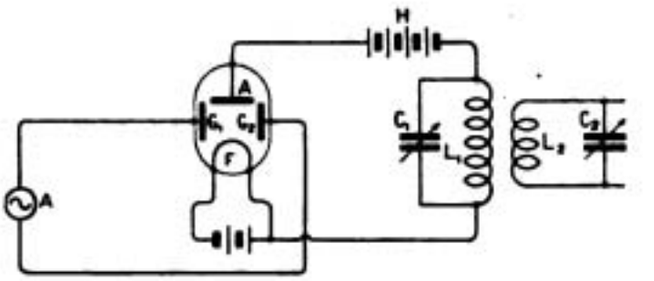


Fig. E.

Perhaps there are one or two points which were not quite clearly explained by Professor Fleming, of which we would be pleased to have further details. We should like to have a little more information as to the part played by the potential plates, their exact effect and the currents flowing to them. We have not seen, from any of the curves shown to-night, what the value of the currents are that are passed to the potential plates, and I consider that characteristic curves showing the potential plate currents would be of interest. There is another point connected with the testing of the valves while pumping during manufacture. From my experience of the manufacture of valves, I think I can safely say that no valve, while actually on a pump, can be tested. The irregularities of vacuum, the continued changes of vacuum during the process of manufacture do not permit of reliable tests being made while the valve is actually being constructed, so that to get an efficient and reliable idea of the best vacuum to use with this valve it would be necessary to make a number of different types with varying degrees of vacuum.

J. Scott-Taggart (*communicated*): The applications of a 4-electrode valve to frequency doubling, referred to above, is illustrated in Fig. E, showing the circuits, C_1 L_1 and C_2 L_2, which are tuned to twice the initial frequency.

Mr. Basil Binyon: Mr. Scott-Taggart has dealt so fully with various points connected with the valve that I do not feel there is anything more I can add, save that I was keenly interested in Professor Fleming's remarks concerning the contacts and the most suitable forms of contacts to use for relays. I was a little surprised, perhaps, that he did not mention a very well-known combination, viz., that of tungsten and copper, used, I believe, during the war to a considerable extent for vibratory contacts, in one of the field sets where it was desired to deal with fairly heavy currents in the form of vibratory contacts, for producing alternating currents. I believe, after

many experiments, the stickiness of the contacts was overcome by employing a combination of tungsten and copper. To-day, platinum is hardly ever used on key contacts, in view of the very superior nature of tungsten for that purpose. Never having had any experience with the carbon-gold contacts, these may, perhaps, be more suitable than tungsten for the finer classes of instrument carrying very small currents. I was interested to note what Professor Fleming said about placing an oscillatory circuit across the contacts which were sparking, because I remember that many years ago—I think it was in 1908—I was up against the same difficulty myself.

I was sent out to instal a wireless station in a rather remote region in the tropics and experienced enormous trouble with sparking at the key, which I did not know how to overcome. I put a very big condenser across the contacts, but the sticking was almost worse than before. However, by winding an inductance out of a piece of resistance wire and putting it in series with the condenser, the sparking was almost entirely damped out. As a matter of fact, it nearly led to a disaster, because the next thing I observed was a cloud of smoke coming out from under the bench on which the arrangement was fixed. So much energy was absorbed by the resistance that it became white hot and burnt the wood. An oscillatory circuit placed across the sparking contact, provided there is sufficient damping in the oscillatory circuit, is very useful for absorbing the heat from the spark.

The call device shown is a very pretty arrangement indeed, depending on the mechanical lag, but I believe there has been a very good arrangement in use for some time in ordinary telegraph work which depends on electrical inertia, and that is the arrangement of utilising across the relay a form of condenser, a certain time being required to elapse before the relay is brought into operation. I believe that is in quite general use on telegraph lines on which the ordinary Morse signal does not give a call sign. This arrangement does not trip the call-relay until the signal has arrived at a certain period, and allows a certain potential in the condenser which is sufficient to operate the relay. I do not think I have anything else to add beyond saying that our thanks are due to Professor Fleming, and I should also like to congratulate him on the success of his experiments.

Mr. Child: There is one question I would like to put to Professor Fleming. When he is operating the relay with the valves he has shown us to-night, does he make any provision for preventing the valve being acted upon by the possible spark or minute self-induction effects from his local sounder? It seems to me that when experimenting with relay effects, the valve is very easily acted upon by reaction from the sounder or the printer or whatever apparatus is being used locally. I should like to ask Professor Fleming, with reference to that point, whether he has any special means of getting over that difficulty.

The President: Some years ago I was trying to work an ordinary motor-horn with a vibrating contact off a wireless system, and spent several days endeavouring to make it work, but sparking always upset the arrangement. I tried to put the entire apparatus into metal boxes, but since it was necessary to have wires coming out of the boxes, the wires apparently picked up the reaction and I found it was impossible to get an apparatus such as an ordinary make-and-break motor-horn to work off a wireless apparatus at all.

I am sure we are all very much indebted to Professor Fleming for coming here and giving to this Society the latest fruits of his inventive mind, and it is refreshing to have something really new in the way of thermionic valves. I think we are only at the beginning of this phenomena in vacuum tubes, as applied to wireless and many other apparatus, and I should like to congratulate Professor Fleming upon breaking new ground. I should also like to congratulate this Society in being fortunate enough in having Professor Fleming coming here and giving us the results of his experiments and showing them in such an excellent manner.

Professor Fleming (*communicated*): There is a point I overlooked in connection with the bell call. In the actual apparatus I should not employ oil damping as in the experimental apparatus shown. I should utilise magnetic damping for producing the viscous resistance to motion which is required. The call would be made with a high conductivity copper disc, having a shaft in ball bearings, and a pulley on the shaft, round which a string, having a weight at the end (see Fig. F), would be wound. The copper plate would be embraced by the pole pieces of strong permanent magnets N N so as to resist sudden motion by the eddy currents created in the disc, as in the case of certain house meters. The disc would carry a pair of curved iron-cores, P_1 P_2, which are partly included in a pair of solenoids, M_1 M_2. Hence, if a sudden or very brief current passes through these coils, the disc, owing to magnetic friction, would not be turned. If, however, the current is prolonged for a time the disc would be rotated and contacts at *a* and *b* would be made so as to ring a bell. The whole arrangement might be hung in gimbals when used on board ship.

Returning then to the valve under discussion, I will briefly reply to one or two of the questions raised. Mr. Child has mentioned one matter which gave me great trouble at the beginning, viz., the influence of self-induction effects. When the valve is employed with a relay to open or close contacts by the reduction of the thermionic current—when the potential plates have a P.D. made between them the induced electromotive forces produced by this opening or closing seem to be propagated back through the wire connections to the valve, and so act on the potential plates (which are very sensitive) as to cause a chattering effect or a delay in the recovery of the thermionic current to full strength after it has been reduced.

I find it is necessary to earth parts of the relay, and also to shunt the relay contacts with a small condenser in series with a resistance to stop this back action.

There are other ways of overcoming the difficulty which it would take too long to describe.

I am pleased to hear that Mr. Scott-Taggart with his great experience in valve construction, sees possible useful applications of this type of valve. He kindly assisted me by making some of the experimental valves I devised in earlier stages of my work. Some of the applications or arrangements of it he has mentioned have been known to me for some time past, and I think that others

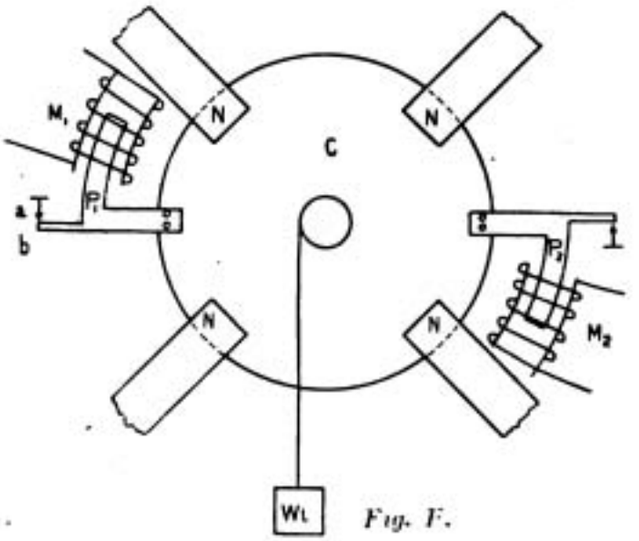


Fig. F.

N = Poles of permanent magnets.
C = Copper disc.
P_1 P_2 = Soft iron pole pieces attached to C.
M_1 M_2 = Solenoids into which P_1 and P_2 are pulled when a prolonged current is passed through them.
a b = Relay Contacts.

will be found as soon as these valves come into general use, but I did not refer to them for want of time.

The measurement of the current flowing into the potential plates is a matter I am now investigating. It is, however, a very small current. Broadly speaking, I trust that the *modus operandi* of this valve is as I have described. The transverse electric field produced when the potential plates are charged causes a deflection of some of the electrons moving to the collecting plates, and so reduces the thermionic current. There is, however, much yet to be found out about the action, and in particular why the thermionic current rises more slowly than it falls.

One thing seems clear, *viz.*, that valve invention is not yet by any means at an end. There are still great possibilities in connection with it, and there may be in the future, perhaps, a special branch of electro-technics in valve engineering and working.

As regards transmitters in wireless telegraphy, the high-frequency alternator and the thermionic valve will probably occupy the field to the exclusion of all else in the near future.

In conclusion, let me thank the President and the members, especially those who have spoken in the discussion, for their kind welcome to me to-night, and for the interest they have taken in my attempt to make a little fresh departure in this fascinating subject of the thermionic valve.

Mr. Hope-Jones : I have one or two business announcements to make. The East Kent Wireless Society has applied for affiliation, which has been granted by the Committee at its meeting this afternoon.

The notices for our Annual General Meeting, which you have received, contain a list of the recommendations of the Committee for the various offices that have to be filled and also make a proposal for a slight alteration in our Rules, which can only be carried out on the occasion of the Annual General Meeting or a Special General Meeting called for the purpose. One small omission has been noted in these proposed alterations, and that is that as our constitution stands we shall lose the services of our retiring President. It is too late for us constitutionally to remedy that omission at the forthcoming Annual Meeting, in that it must be sent by written notice to every member. We therefore propose that our first meeting in the new year shall be dignified by the name of a Special General Meeting, at which this proposal shall be made, that the retiring President shall become, *ex-officio*, a member of the Committee.

The meeting was adjourned at 7.45 p.m.

WIRELESS CLUB REPORTS

Wireless Society of London.

The Annual General Meeting was held at the Royal Society of Arts on December 21st, 1920, when Professor Whiddington, of Leeds University, delivered a lecture entitled "Wireless Valve Circuits Applied to the Measurements of Physical Quantities."—Hon. Secretary, Mr. L. McMichael, 32, Queux Road, W. Hampstead, N.W.16.

Glasgow and District Radio Club.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting of the Club was held on Wednesday, December 8th.

The question of trans-Atlantic tests between British and American radio enthusiasts was raised, and it was decided that the Club should take part and a Committee, consisting of Messrs. W. K. Dewar, W. S. Hay, M. McLennan, T. Senior, and E. Snodgrass, was formed to make arrangements, and to provide suitable apparatus, etc.; the Hon. Secretary to write Mr. Philip Coursey for further particulars of the programme.

In this connection Mr. Eric Snodgrass, who has had considerable experience with short-wave reception apparatus, gave a few constructional hints which should prove of considerable service to individual members entering the contest on their own account.

Mr. W. K. Dewar exhibited a single-valve set he had just finished making, which tunes in wavelengths between 2,000 and 18,000 metres. Mr. Dewar has recently heard American high-power stations on this apparatus, which is both efficient in service and neat in appearance.

Mr. McGregor had an ex-R.A.F. 3-valve Amplifier on view, which was much admired; several members sought and obtained helpful advice on the construction of gear, upon which they are engaged.

The remainder of the evening was spent in discussion of various wireless problems.

Three new members were enrolled at this meeting.

The Club seems to have recovered its pre-war vim as shown by the enthusiasm and activity of both old and new members, and the untiring efforts of its live Committee.

A meeting of the Club was held on Wednesday, December 15th. Members are asked to specially note that the present postal notice will be discontinued forthwith, and infuture, notice of meetings will be advertised in the Public Notices of the *Glasgow Evening News* on the Monday preceding each fortnightly meeting.

New Club Rules, on the model of those of the Wireless Society of London, are being prepared, and it is hoped to put these into operation early in the new year.

A reply from Mr. Philip R. Coursey, of *The Radio Review*, in reference to the trans-Atlantic test, was read, after which members of the Committee, appointed in this connection with these tests, put their views before the Club.

Since the beginning of the present session in October, twenty new members have been enrolled, and the Club continues to gain numerical and financial strength. While the majority of our members do not specialise in mathematics, we are always ready and willing to assist from a practical point of view,

Intending members should communicate with the Hon. Secretary, Mr. Robert Carlisle, 40, Walton Street, Shawlands, Glasgow, or during day-time call upon Mr. W. K. Dewar, at the North British Wireless Schools, 206, Bath Street, Glasgow, from whom full particulars can be obtained.

Burton-on-Trent Wireless Club.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting of the Club was held on December 17th, Mr. F. V. A. Smith presiding. A discussion took place with regard to widening the scope of the Club so as to include the study of other branches of science and engineering. Several members expressed the opinion that the Club was a wireless Club, and inaugurated solely for the purpose of studying the subject of wireless, but it was ultimately resolved that the Club could see no objection to an occasional lecture on other subjects, and Mr. L. G. A. Sims, who had raised the question at a previous meeting, promised to arrange lectures and to give one himself at the end of January.

Mr. A. J. Selby, assisted by Mr. Maurice Lloyd, gave a very interesting Paper on High-Power Wireless Stations, illustrated by lantern slides kindly loaned by Marconi's Wireless Telegraph Company, Ltd.

It was reported that a party of members of the North Staffs. Railway Electrical Dept. Wireless Society paid a visit to Burton on December 11th to see the Club apparatus. The party were received at the Club Headquarters by Mr. A. Chapman Vice-President) and Messrs. Butt, Selby, Smith and Parkin, B.Sc. The visitors also visited Mr. Selby's station, and before returning expressed their thanks for the facilities afforded them during their visit

The next meeting of the Club will be held on Friday, January 14th.—Hon Secretary. Mr Roger Rose, 214, Belvedere Road, Burton-on-Trent.

Sheffield and District Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting was held on December 3rd, when a Paper was delivered by Mr. J. G. Jackson on "Single-Valve Receivers."

The author showed how simple and serviceable apparatus, capable of receiving trans-Atlantic signals, could be made; he also explained a number of different systems of connections. The Paper was accompanied by a successful demonstration in reception. Various faults, with their symptoms and remedies, were dealt with very clearly and illustrated by means of the apparatus.

The Paper was followed by an instructive and lively discussion, and a hearty vote of thanks was accorded to Mr. Jackson for his lecture.

On December 16th a new departure was inaugurated by the Society in the form of a social evening, at which about 100 members and their friends were present.

The programme was divided into three parts: a whist drive, a concert, and a wireless telephony demonstration, with several gramophone records, to which the members danced.

All the items in the concert programme were carefully chosen and artistically rendered, Mr. Crowther, the Hon. Secretary, and Mr. Biggin being especially applauded.

This is the first time that the members have had an opportunity of getting away from the sterner realities of wireless engineering, and it was a very pleasant experience for the audience to discover that they had so much musical talent in their midst.

The dance to wireless music was a distinct novelty—in fact, the Society claims the first record in this country in holding a public wireless dance. The Society is indebted to Mr. Johnson dnd Mr. Ward for arranging the details of the demonstration.

Mr. Patrick, who is Chief Engineer of the Sheffield Section of the G.P.O. and a Vice-President of the Society, gave a Paper on December 17th, the subject being "Machine Telegraphy."

His Paper was liberally illustrated with lantern slides and practical demonstrations were given with high-speed instruments.

He principally described the Creed and Bandot systems, and although his Paper was essentially one dealing with line or wire telegraphy, he pointed out that the more modern practice with wireless telegraphy is to employ machine high-speed senders and receivers,—Hon. Secretary, Mr. L. S. Crowther, 156, Meadow Head, Woodseats, Sheffield.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the Club was held on Wednesday, December 1st, at Shaftesbury Hall, Bowes Park, the President in the chair. After the usual business, Mr. A. J. Dixon was called upon to give

his lecture on "Voltmeters, Ammeters, and Gadgets." Mr. Dixon commenced by describing the different kinds of volt and amperemeters, drawing diagrams to show the principles of the hot-wire, the moving-iron, and the moving-coil types. He passed round specimens with backs removed to show the working and movements. For the benefit of the younger members of the audience, Mr. Dixon described the method of using an ammeter to read to higher values than that to which it was calibrated by connecting a shunt of known value across the terminals.

Passing on to "Gadgets," the lecturer described a number of very useful dodges, some of which, though not entirely novel, were new to members. Among these was the safety-pin switch, a very handy way of connecting experimental circuits. He also handed round a valve made by the Edison Swan Electric Co., which would oscillate on three pocket lamp batteries.

Mr. Dixon then described a method of winding pancake coils, but pointed out that, although these might be useful by reason of the small space occupied, the older way of sliding the secondary inside the primary was still the most efficient way of coupling two circuits.

Touching on power buzzers, he explained briefly the principle of working, and on Mr. Holton's suggestion, it was decided to arrange for experiments with these at some future date, and if possible to arrange a "Field day" on some Saturday afternoon.

The Chairman thanked Mr. Dixon for his interesting lecture, and the meeting closed.

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

The Cardiff and South Wales Wireless Society.

(Affiliated with the Wireless Society of London.)

A general meeting of the Society was held at Room 305, the Technical College, Cardiff, on Thursday, December 2nd.

Amongst other business dealt with, it was decided that an Entrance Fee of 5s. should be payable by all new members enrolled as from January 1st. The Annual Subscription remains unaltered, and is at the rate of 5s. for Full and Corresponding Members, and 2s. 6d. for Associate Members.

At the conclusion of the ordinary business Mr. E. G. Farrow gave a short explanation of wireless procedure, in which he clearly and briefly explained the general rules for Operators, as laid down in the P.M.G.'s Handbook.

A Paper entitled "Rambles in Radio" was then read by Mr. W. E. Groves who, after discussing the advantages and disadvantages of various types of earths, gave details of pancake-coil construction, showing various types and windings, and explaining various ways of making formers upon which to wind them.

With regard to earths, he suggested that one of the simplest and most efficient forms was that made by burying a large sheet of corrugated iron or other metal, leads being taken from each of the four corners. The leads should, however, not be soldered, but preferably bolted to the iron sheet. The whole connection could then be soldered and given a good coat of pitch or paint. An earth made in this way and buried deep enough to be always in moist ground would, he thought, amply repay any time and trouble expended on its construction. Such an earth made the reception of weak signals much more efficient than a connection made to a water or other pipe.

The meeting was then terminated and members adjourned for buzzer practice, general discussion or listening-in.—Hon. Secretary, Mr. W. G. J. Howe, 25, Plasturton Gardens, Cardiff.

Three Towns Wireless and Model Engineering Club.

(Affiliated with the Wireless Society of London.)

At a meeting held on December 1st, Mr. Rose gave a most interesting lecture on Aerials. Having experimented very freely in that direction the lecturer was able to keep his audience highly interested. A tin bath, the frame of an umbrella, a stair rod in a glass bottle, and insulated cables laid along the ground have all given him satisfactory results.

The badge of the Three Towns Wireless Club.

On December 8th, a lecture on "The Methods of Measuring Resistance" was given by Mr. Harris. The Wheatstone Bridge and its adaptations, the Metre Wire Bridge and the Post Office Box were among the methods lucidly described.

At the meeting of the Club, held on December 15th, an interesting lecture was given by Mr. Langman on the subject of Electric Clocks. Many different forms of electric mechanism were clearly and ably described, though lack of time prevented the lecturer from dealing as fully with his subject as he would have wished. A mechanism of his own design was demonstrated which presented several novel features.

Full particulars of the Club will be gladly furnished by the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At a meeting on December 22nd the Secretary read a letter from the P.M.G., authorising the use of his transmitting permit to signal to the members generally on 100 metres, to enable them to adjust their short-wave receiving sets. The President, Mr. Wm. Le Queux, promised a gift of books to the library. The Secretary then entertained the members with a description of some of the processes in the manufacture of paper cables.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

The Association had a very interesting discussion on Relays and Relaying Apparatus, at their meeting at the Central Hall, Peckham, on December 8th. Introduced by the Secretary the various types of this instrument from the early forms up to the numerous telegraph family on to the telephone group, and now the ultra modern thermionic valve, were discussed with interest.

Mr. Nicholson (a member) subsequently gave a graphic account of his war-time experiences with a Mark III tuner.

Buzzer practice was carried out and nearly all the members showed a surprising improvement in their receptive abilities.

The Association met at the Central Hall, Peckham, on Wednesday, December 15th, when Mr. Davis gave an interesting and informative lecture on the testing of valves and their use in the forthcoming American Amateurs' Trials. These descriptions were so lucid that we felt quite guilty for not having before applied them to the apparatus which we possess, so as to be familiar with their characteristics. Considering the wavelength and consequent frequency, combined with the minuteness of the power allowed, Mr. Davis was not very sanguine of our success on the American attempts with special apparatus.

Applications for membership should be made to the Hon. Secretary, Mr. G. Sutton, 18, Melford Road, East Dulwich.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting was held on December 15th, the President, Mr. A. G. Arthur in the chair. Owing to the unavoidable absence of the Secretary the minutes were taken as read and the Chairman called upon Mr. C. Midworth, A.M.I.E.E., to give his promised Paper on "The Ratio of Inductances."

Judging by the pertinent questions asked and the discussion promoted, this Paper was much appreciated, so much so that Mr. Midworth is being approached with a view to going deeper into this all-important subject at a later date. A vote of thanks to Mr. Midworth was proposed by the Chairman, and duly accorded.

Particulars of the Club can be obtained on application to the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

Liverpool Wireless Association.

(Affiliated with the Wireless Society of London.)

The Annual General Meeting of the Association was held on Wednesday, December 8th. In the absence of the Treasurer, the Hon. Secretary gave an interim account of the financial position of the Association. Messrs. Grindrod and Hyde also reported with regard to the suggested amendments to the Association's rules, after which, officers were elected for 1921. In the first place it was agreed that Dr. E. W. Marchant be invited to act as President, and that Dr. Richardson and Councillor D. Jackson be invited to act as Vice Presidents. Messrs. Grindon and Lowey were re-elected as Hon. Engineers, and Messrs. Grindrod and Henderson as Hon. Auditors. Mr. L. Wainwright was elected as Hon Treasurer. The following gentlemen were elected to the Committee:—Messrs. Hyde, Lowey, Frith, Grindon, Moore, Grindrod, Henderson, Lapthorn, Irvine, Balmer, Forshaw, and Johnston. Mr. J. Coulton, 98, Ampthill Road, Liverpool, was elected Hon Secretary.

Southport Wireless Society.

(Affiliated with the Wireless Society of London.

On Tuesday evening, December 7th, the Annual Meeting of the Southport Wireless Society was held in the Officers' Mess at the Drill Hall, Manchester Road. The meeting was well attended, those present including Mr. E. R. W. Field (President), Mr. H. Sutton (Hon. Secretary), Mr. R. W. Brown (Hon. Treasurer), Messrs. A. E. Lomas, T. Moor, R. Wilde, J. C. Henshaw, S. H. Shipley, A. F. Stock, Capt. F. Poulton, O.B.E., Messrs. E. Hudson, W. Otter, T. C. Ormrod, F. Burns, A. H. Fielding, and F. J. S. Stansfield.

Mr. E. R. W. Field was in the chair.

Mr. H. Sutton presented a report as follows:—The Society was inaugurated on December 8th, 1919, Mr. E. R. W. Field having invited a number of gentlemen to discuss the formation of the Society. At that meeting it was decided that the name should be "The Southport Wireless Experimental Society," and gentlemen were elected officers for the first year. On January 27th, 1920, a Social and Exhibition was held in the Officers' Mess, Manchester Road Drill Hall (by kind permission of Colonel A. D. Lomas). The event proved in every way most successful. In February the Society's library was opened, and Mr. A. E. Lomas accepted the position of Librarian. During the same month the Society became affiliated with the London Wireless Society, and thanks are accorded to the London Society for the help given through affiliation by reports of their meetings, and correspondence regarding the latest developments in wireless experiments. In July last the Society was fortunate in obtaining a room for its headquarters.

During the past few weeks permission has been granted by the P.M.G. to instal wireless apparatus for transmission and reception at the Society's headquarters, and also for portable apparatus, with limited power, range and times of working.

Recently the name of the Society was altered, and is now "The Southport Wireless Society."

The Society is greatly indebted to Colonel A. D. Lomas for the many kind services rendered during the past year. Colonel Lomas has also accepted the position as one of the Vice-Presidents of the Society.

The financial statement showed:—Receipts (subscriptions and entrance fees), £6 6s. 6d.; donations, etc., £28 9s.; total, £34 15s. 6d. Ex-

penditure (stationery, postages, club furniture, etc.), £25 8s. 0½d.; balance in hand, £9 7s. 5½d.: total, £34 15s. 6d.

The Treasurer stated that an anonymous letter had been received that day, in which £1 was enclosed. The Society was in a sound position, having in hand a good balance. When the subscriptions for the ensuing year came in, the Society would be able to cover all expenses for the ensuing year, and also have money enough to purchase various necessities for the installation at its headquarters.

The Chairman extended thanks to all who had very kindly given gifts in various ways to the Society.

The following gentlemen were elected as officers for the coming year:—President, Mr. A. S. Black, A.M.I.E.E; Vice-President, Colonel A. D. Lomas; Chairman, Mr. R. Wilde; Hon. Secretary, Mr. H. Sutton; Hon. Treasurer, Mr. R. W. Brown; Committee, Mr. C. H. Hanley and Mr. E. R. W. Field; Librarian, Mr. A. E. Lomas.

Particulars as to membership may be had on application to the Secretary, Mr. H. Sutton, 68b, Marshside Road, Southport.

The Gloucester Wireless and Scientific Society.

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

A Lecture and Demonstration was given before the above Society, at the Science Laboratory of Sir Thomas Rich's School, Gloucester, on the evening of December 1st, Mr. E. F. Price, B.A. (the Headmaster) presiding.

Mr. F. J. Freeman, B.Sc. (President) gave the Lecture—which was on the lines of a popular exposition of the main principles of wireless. By means of various instruments he explained some of the first principles and gradually led up to the wireless receiving set itself (a four-valve amplifying set.) On this set signals were received, and by means of resonance magnifiers fitted to Brown's telephones, some of the large European stations were made audible to an audience of about 80 persons. Some of the press news was taken down by the Secretary and Mr Sandoe, and written on the blackboard as a sample of the kind of messages sent out.

A meeting of the Society was held on December 16th at headquarters.

The evening was spent in the examination of instruments brought forward by various members. A very neatly arranged set, belonging to Mr. G. T. Peck, was exhibited, with which some excellent signals were received on the Club's aerial. The Secretary had a small 600-metre C.W. and telephony transmitting set on view.

The New Year session will open on January 20th, 1921, and on this date the first lecture of a series, forming an outline of the course for the P.M.G. Wireless Certificate, will be given.

Meetings are held fortnightly, and all information concerning the Club, can be obtained on application to the Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

Cambridge University Wireless Society.

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

This Society has recently been formed under the presidency of Mr. E. J. E. Hubbard, of Jesus College.

Membership is confined to Undergraduate members of the University. Senior residents, however, are eligible to become honorary members.

To date there are thirty-six members and six honorary members.

The first meeting was held on October 31st, 1920, when Colonel Stratton gave a highly interesting lecture upon the development of wireless in the B.E.F.

At subsequent meetings the following Papers were read:—"Duplex Telephony in Aircraft" (on November 15th), read by Mr. Wynn (late of Biggin Hill): "A Homemade 4-Valve Receiver" (on November 29th), read by the President, and followed by a general discussion.

The following is a list of officers:—

Vice-Presidents, Prof. Sir Ernest Rutherford, F.R.S., and Colonel F. J. M. Stratton, D.S.O., R.E.; Secretary, Mr. C. C. A. Hines (Gonville and Caius College); Hon. Treasurer, Mr. F. P. Burch (Gonville and Caius College); Representative Member of the Wireless Society of London, Mr. N. C. B. Carrick (Jesus College).

Efforts are being made to secure premises for the Society, but owing to the crowded state of the University, considerable difficulty is being experienced. It is hoped that next term will see a large increase in the membership. Anyone interested should apply to the Hon. Secretary, Mr. C. C. A. Hines, 13, Park Parade, Cambridge, from whom full particulars may be obtained.

The Wireless Society of Hull and District.

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

At a meeting of the Society, recently held at the Marlborough Room, Metropole (Mr. G. Strong presiding), Mr. Hy. Strong read his promised Paper on "Valves," including some twenty-five drawings of curves, characteristics, and circuits. Three different ways in which the valve can be utilised in wireless work were described by the lecturer.

A vote of thanks was proposed by Mr. Featherstone, seconded by Mr. Jephcott, and carried unanimously.

Hon. Secretary, Mr. J. Jephcott, 79, Freehold Street, Hull.

Derby Wireless Club.

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

An interesting paper was recently given, by Mr. Lowe, on "Detectors." and on December 1st Mr. A. N. McInnes, B.A., read a Paper on "Inductance and Capacity," which was followed by a discussion.

Hon. Sec., Mr. W. Bemrose, Littleover Hill, Derby.

Bradford Wireless Society.

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

A meeting of the Society was held on December 3rd, the chair being taken by the Vice-President. Following the signing and accepting of the minutes, one new member was elected.

A very neat set, belonging to one of the members, Mr. Brarbér, who was unfortunately away on business, was exhibited.

Connected with an L.F. amplifier this set gave exceptionally good results.

The Secretary would be pleased to hear from

members of any neighbouring Clubs who would be willing to give a Paper before the Bradford Wireless Society, by whom all expenses would be paid.

Hon. Secretary, Mr. John Bever, 85, Emm Lane, Bradford.

Stockport and Cheshire Wireless and Scientific Society.

The Annual Meeting and Dinner was held at Crossley's Café, Stockport, on Tuesday, December 7th, and the occasion was much enjoyed by the members. After dinner, Mr. H. Fildes, M.P., presided, supported by Mr. A. Roberts and Mr. Z. A. Faure, Hon. Secretary.

The Secretary gave some few remarks relating to the Society's formation some months ago. The following officers were selected for the coming year:—President: Le Général Férrie; Vice-Presidents: Captain H. T. Round, Mr. H. Fildes, M.P., and M. A. Roberts; Chairman, Mr. A. Roberts; Secretary, Mr. Z. A. Faure; Treasurer, Mr. H. Pickford; Librarian, Mr. H. A. Barlow; Auditors, Messrs. J. Joule and H. A. Barlow; Committee, Major J. G. Swart, Messrs. H. Woodyer, H. Driver, J. McLocklen, F. W. Emerson and W. Law.

Some of the members of the Stockport and Cheshire Wireless and Scientific Society at an outing on October 8th, 1920.

A large receiving set was installed by Messrs. Faure and Cartwright. A congratulatory message transmitted by telephony by two members from a distance of ten miles was received in addition to signals from Moscow, Annapolis, Paris, Madrid, Rome, etc.

Thanks were conveyed to Mr. J. Winson, of the U.E.S. Co., Ltd., Brown Street, Manchester, for kindly loaning the Society two Brown's loud speakers, and intervalve transformers for the occasion.

A capital *musicale* was afterwards gone through.

Hon. Secretary, Mr. Z. A Faure, 3, Banks Lane, Stockport.

Greenwich Wireless Society.

A General Meeting of the Society was held on December 18th at the Octagon Room, Royal Observatory, Greenwich, the Astronomer Royal, Sir Frank Dyson, President, in the chair.

After the draft rules had been read and formally approved, it was announced that the headquarters of the Society would be at the Ranger's House, Greenwich Park, and that a general meeting would be held at 8.30 p.m. on the first Tuesday in every month for the purpose of conducting the general business of the Society, reading Papers and lectures, and that meetings of members might take place on the last Saturday in every month for the purpose of experiments, etc., at 6 p.m.

It was decided to apply to the P.M.G. for a licence for transmission and reception, and it was also agreed that ladies could become members of the Society.

The first Annual General Meeting of the Society will be held on Tuesday, January 11th, for the conduct of the Society's business, after which there will be a lecture on Low-Frequency Amplification, followed by a discussion. Visitors will be welcome.

The joint Hon. Secretaries will be pleased to hear from any lady or gentleman desirous of becoming a member of the Society, the annual subscription being one guinea.—Joint Hon. Secretaries, Messrs. W. W. Burnham, 18, Blackheath Rise, S.E., and A. F. Bartle, 2, Drive Road, S.E.

The North London Wireless Association.

The third and fourth meetings of the Association were held on December 10th and 17th respectively.

Some interesting apparatus was exhibited at the meeting of the 10th. An American loose-coupled tuner, wavelength 200 to 3,200 metres, being a much discussed item. A 6-valve amplifier, and a single-valve short-wave tuner, of very neat design, also attracted a good deal of attention. Very good signals were received on the installation at the disposal of the Club, and were much appreciated by the members.

At the meeting held on the 17th buzzer practice was carried out. This is to be a regular feature of future meetings. Five new members were proposed and duly elected.

Any interested reader wishing to join, please communicate with the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

Dartford and District Wireless Society.

A meeting in connection with the formation of a wireless society at Dartford was held on November 27th. It was proposed and accepted that the Society be known as the "Dartford and District Wireless Society." Dr. Miskin was elected President, and Mr. E. C. Deavin, Hon. Secretary and Treasurer, these two officers being sufficient for the present requirements of the Society. The yearly subscription was fixed at 5s.

It is hoped that in the near future the Society may be able to obtain the permanent use of a room, and G.P.O. permission to erect an aerial, thereby giving members an opportunity of testing their instruments to the interest and benefit of fellow members.

It was decided that the Society be affiliated with the Wireless Society of London, the President kindly offering to pay entrance fees.

Meetings are being arranged for buzzer practice, and it is hoped that all persons interested will not fail to attend.

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

WIRELESS CLUB REPORTS

The Coventry and District Wireless Club.

This new Club held its first meeting on Wednesday, December 8th, when some twenty-two members were enrolled, nearly half of whom are already licensed by the P.M.G., and possess receiving sets.

Mr. E. E. Stewart was elected to the chair, with Messrs. R. Liebin and A. Wakefield as Secretary and Treasurer *pro tem.*

Business relating to the subscription and entrance fees was settled, and a Committee was appointed to obtain a suitable room for the Club premises, where an aerial could be erected and apparatus installed.

Considering the engineering activities of the town, and the highly technical industries carried on in the district, a very successful future is anticipated. The acquisition of suitable premises is of paramount importance. In the meantime Mr. E. E. Stewart, Ash Green House, Eshall, Coventry, will be glad to receive all communications respecting membership, etc.; also any offers respecting suitable premises.

Aberdeen and District Wireless Society.

A meeting of the Society was held on November 30th at 41½, Union Street, Aberdeen, when Mr. J. Mitchell gave details of the construction of amateur apparatus, and dealt with various devices for making variable inductances. The lecture was greatly appreciated by the beginners who are anxious to get on with the construction of their own apparatus.

On the 7th inst, Mr. W. Inder gave a lecture on the elementary principles of valves dealing briefly with rectification, magnification, reaction, and amplification.

We have now secured an excellent room in St. Nicholas Lane, thanks to the kindness of our Chairman, Mr. F. H. Cartwright.—Hon. Secretary, Mr. W. W. Inder, Crown Mansions, 41½, Union Street, Aberdeen.

Radio Society of South Africa.

The Inaugural Meeting of this Society was held at the Chamber of Commerce Room, St. George's Street, Cape Town, on September 3rd 1920.

The Cape Provincial Committee has been elected, the officers being:—Acting Vice-President, Sir J. Carruthers Beattie, Kt., D.Sc., F.R.S.E.; Chairman, Professor A. Ogg; Vice-Chairmen, Messrs. H. E. Penrose and J. E. Williams; Hon. Secretary, Mr. A. T. Stacey; Hon. Treasurer, Mr. L. Buckley Bridge.

The membership at Cape Town alone stands at 74, while throughout the Cape Province and the South-West Protectorate 50 members are expected to enrol. The Johannesburg and Durban Provincial bodies are in process of formation, and further particulars will be announced later.

A General Meeting was held at the Engineering Lecture Room, University Buildings, Cape Town, on October 29th, when Messrs. Rogers and Bridge gave a demonstration of wireless telephony, and telegraphy, speech and signals being excellent. There was an exhibition of very interesting apparatus, including a telephone transmitter (constructed by Mr. Bridge) and a 3-valve receiver; two Marconi portable sets, various types of valves, variable condensers, inductances, loose-couplers, etc. were also on view.

Persons in the Cape Province and the South-West Protectorate wishing to be enrolled are requested to communicate with the Provincial Hon. Secretary, Mr. A. T. Stacey, P.O. Box 2055, Cape Town.

The Walthamstow Amateur Radio Club.

At the meeting of the Club, held on Dec. 15th, a Sub-Committee of six members was elected.

A definite programme was also arranged, as follows:—7.30 p.m. to 8.15 p.m. will be set apart for discussion and questions. 8.15 p.m. to 9.15 p.m. will be taken up by lectures on electricity and wireless theory, and 9.15 p.m. till 10 p.m. will be spent in Morse practice.

The Hon. Secretary, Mr. Hardie, 58, Ulverston Road, Upper Walthamstow, E.17, would advise those interested to join while the Club is young.

Exeter and District Wireless Society.

A meeting of the Society took place on Dec. 10th, Mr. C. Hoskins, senr., in the chair. After the usual business of the Society had been concluded, Messrs. Allcock and Brooking exhibited a 7-valve high and low frequency amplifier of their own design and manufacture. By the kind permission of the P.M.G., an aerial was installed on the premises, and a demonstration given with the instrument. The weather reports and time signals from English and French wireless stations were received.

The objects of the Society are to assist and bring together local amateurs, the furtherance of all matters and studies connected with wireless telegraphy and allied subjects, and the promotion of intercourse and exchange of ideas between experimenters in wireless telegraphy. Whilst the Society is open to all scientific members, there are no technical qualifications required to gain admission to membership, the main qualification being keen interest in the science.

Date and place of next meeting will be notified to each member.

Hon. Secretary, Mr. H. E. Allcock, 11, Richmond Road, Exeter.

N.S. Rly. Electrical Dept. Wireless Society.

The members spent a most enjoyable and interesting evening at the Stoke-on-Trent Wireless Society's Club-room on Tuesday, November 30th, by the kind permission of the members of that Society.

The Society is extremely indebted to Messrs. Wilson, Hackney, and Adams for much useful information *re* the construction of apparatus

The Stoke-on-Trent members are very keen, and have some really fine home-made apparatus. The time went all too soon; the meeting closed with a vote of thanks by our Chairman, Mr. F. T. Scragg, to which Mr. Wilson and Mr. Hackney responded.

On December 8th the members were the guests of F. E. Wenger, Esq., The Hollies, Brampton, Newcastle-under-Lyme, where they spent a most enjoyable and instructive evening.

Mr. Wenger possesses some very fine apparatus, ranging from the very earliest made, to the latest up-to-date instruments, including a very fine piece of apparatus, "A Syphon Recorder," which proved of great interest to the members.

Signals from Warsaw, Poldhu, Nauen and Annapolis were extremely good, especially when the "Brown's Trumpet Receiver" was being used.

Mr. Wenger gave the members some very useful instruction in the use of the apparatus. The members are also indebted to Mrs. Wenger for the charming manner in which she entertained them.

Hon. Secretary, Mr. P. E. Banks, 87, Spencer Road, Shelton, Stoke-on-Trent.

Manchester (Y.M.C.A.) Wireless Club.

On Wednesday, November 25th, a meeting of the Society was held to which were invited several members of the Radio Scientific Society. Sixteen members of the first-mentioned Club and eight members of the latter attended, and a very interesting programme was drawn up. Mr. Thomason was unanimously elected Chairman. The first speaker was Mr. A. L. Megson, Chairman of the Radio Scientific, the subject taken being "Manufacture of Apparatus." Several sets were passed round for examination, each one having been personally manufactured by Mr. Megson; needless to say one, so skillful with his hands made a very interesting and convincing lecturer.

Mr. Grocott next gave us a short talk on various subjects including the Creed Receiving Perforator and Printer. In the short time at his disposal, Mr. Grocott succeeded in pushing home several points to even the most learned of us. This speaker was followed by Mr. Holmes who put forward a few arguments and theories regarding Tuning Coils.

And last, but not least, a general summing up of ground covered by all three speakers was given by Mr. Halliwell. A vote of thanks was proposed and seconded to the Radio Scientific Society for giving us a most enjoyable, interesting and profitable evening. Following a few words by Mr Manfield, concerning the proposed amalgamation of the two Clubs, the meeting was adjourned.

On December 1st, another meeting was held, and Mr Thomason in the chair announced that Mr. Halliwell had agreed to give an hour's talk. For the benefit of members not greatly conversant with the subject, Mr. Halliwell commenced what we hope will be a series of lectures, with a general survey of the Electron Theory. His views were so put that the merest beginner could have had no doubt as to their meaning. A vote of thanks was accorded to Mr. Halliwell and the meeting adjourned.—Hon. Secretary, Mr. A. Day, 56, Peter Street, Manchester.

York Y.M.C.A. Wireless Club.

At a meeting on December 16th Mr. Ellison gave a lecture on "Some Aspects of Modern W.T. Receiving," followed by a demonstration with a 6-valve amplifier and loud speaker, both on the outside aerial and also on the frame. There were about twenty members present, and that they were keenly interested was evinced by the number of questions asked at the conclusion of the lecture.

The Committee then met to discuss the affairs of the Club, and the following officers were elected:—President, Mr. Backhouse; Vice-President, Mr. A. Cooper; Hon. Secretary, Mr. M. C. Ellison; Assistant Hon. Secretary, Mr. Fletcher.

It was decided that special classes for beginners should be held and that more apparatus should be obtained. The erection of the Club's aerial was then discussed, and the proceedings terminated at 10 p.m.

The Club has a splendid room at its disposal, and has also some very efficient receiving apparatus. The membership is at present about forty, and new members will be welcomed. All communications should be addressed to the Hon. Secretary, Mr. M. C. Ellison, Hutton's Ambo Hall, York.

Wimbledon District Higher Education Committee.

A Wireless Club is being formed, and with the consent of the Committee will be housed at the Institute. As at present arranged, the Club will consist of members of the class studying the subject and the general public, who wish to take a serious view of this important matter. Perhaps it will not be out of place to remind those who are ignorant of the fact, that this was the first Technical Institute in the country to obtain a licence from the P.M.G., and become a receiving station. Further details may be obtained from the Committee upon application at the Technical Institute and School of Art, Gladstone Road, Wimbledon, S.W.19.

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

At a meeting of the above Society held on Thursday, Dec. 9th, at the Y.M.C.A., North Shields, Mr. Stanley Todd, of Tynemouth, lectured upon "The Principles of Thermionic Valves."

After a most absorbing and highly interesting lecture, a discussion was held in which members took part.

A vote of thanks to Mr. Todd was proposed by the Secretary, and seconded by Mr. R. Morley.

Any interested gentlemen desirous of becoming members, are invited to communicate with Mr. L. L. Sims, Hon. Secretary, Amateur Wireless Society, Y.M.C.A., North Shields.

The Stamford Hill and District Wireless Society.

At a meeting of amateurs held in the district, it was decided to form the above Society. The present membership numbers 12, and a cordial invitation is extended to the yet unknown amateurs in the neighbourhood. Will those who are interested kindly communicate with the temporary Secretary, Mr. W. J. Law, 17, Hermitage Road, Green Lanes, Harringay, N.4., who will be pleased to furnish details of the latest developments.

Huddersfield (Y.M.C.A.) Wireless Society.

The weekly meeting of this Society was held at Laund Hill, on December 6th.

A demonstration was given by Mr. Stafford Dyson, with his 3-valve amplifying set. The lecturer touched upon the majority of the instruments used in connection with wireless telegraphy, giving a brief description of each, and at the same time, explaining the theory of the various apparatus.

Signals were received from Eiffel Tower, Carnarvon, and (later in the evening) Poldhu.

The Chairman gave a brief explanation of the theory of electricity as applied to wireless telegraphy.

The Secretary read the rules of the Society, and a vote of thanks was passed to Mr. Dyson. It is

proposed to hold a social in aid of the Society early in the new year.

Hon. Secretary, Mr. F. Simpson, 3, Daisy Street, St. Andrew's Road, Huddersfield.

Nottingham and District Wireless Society.

It was announced on October 20th that the Secretary had applied, and been granted, a licence for a portable receiver. As the licence was now obtained, it was agreed that the pieces of apparatus promised by members should be brought to the next meeting and fitted up.

On November 3rd the Secretary read a letter inviting members to take part in the trans-Atlantic tests.

As there was no business to transact on November 17th, the meeting resolved into a general discussion, with the inspection of apparatus brought by members.

It was decided to instal a more efficient aerial, and two members volunteered to give the matter their attention.

On December 1st the Secretary, Mr. J. H. Gill, asked to be finally relieved of his duties, and as he had, at a previous meeting, agreed to carry on until December, his resignation had to be accepted.

Mr. H. R. Cater was elected to the office of Hon. Secretary.

At the meeting held on December 15th, in the absence of Mr. Garthwaite, Mr. J. H. Gill took the chair.

As there was no business to transact, Mr. J. Thornton gave his Paper on "The Official Procedure adopted in the Transmission of Messages." This was both interesting and instructive.

Prospective members should apply to the Hon. Secretary, Mr. H. R. Cater, 22, Cranmer Street, Nottingham, who will be pleased to give all information.

PRESS PROGRAMMES.

Name.	Call-letters.	Wave-length. Metres.	Times in G.M.T.	System.
Paris	FL	8,000	0430	C.W.
,, ...	,,	3,200	1100	Spark.
,, ...	,,	8,000	1900	C.W.
Lyons ..	YN	15,000	0330, 0530, 0830, 1900	C.W.
Nauen ..	POZ	9,500	1330, 2000	C.W.
,, ...	,,	12,600	2300	C.W.
Poldhu ..	MPD	2,800	0100	Spark.
Horsea ..	BYC	6,000	2400, 1200, 2000	C.W.
Carnarvon ..	MUU	14,000	1630	C.W.
Budapest ..	HB	3,600	1900	C.W.
Varsovie ..	WAR	2,100	1010	Spark.
Moscow ..	MSK	5,000	0300, 1130, 1300, 1800, 2230	Spark.
,, ...	,,	7,680	2315	C.W.

WEATHER REPORTS.

Name.	Call-letters.	Wave-length. Metres.	Times in G.M.T.	System.
Air Ministry ..	GFA	1,400	0205, 0805, 0915, 1415, 1905, 2000	C.W.
,, ,, ..	,,	1,680	0725, 0925, 1025, and at 2 hour ints. till 1825	C.W.
Brussels ..	BAV	1,400	0715, 1315, 1815	C.W.
,, ...	,,	1,680	0725, 0925, 1025, and at 2 hour ints. till 1825	C.W.
Paris	ZA	1,400	0745, 0800, 1150	C.W.
,, ...	,,	1,680	0725, 0925, 1025, and at 2 hours ints. till 1825	C.W.
Amsterdam ..	PCA	1,400	0820, 1420	C.W.
,, ..	,,	1,680	0920, 1020	C.W.

AMATEUR CALL SIGNS

Call Sign.	Power in Watts.	Wavelengths in Metres.	Hours of Working (G.M.T.)	System.	Name and Town.
2AL	—	—	—	—	Marlborough College, O.T.C.
2AM	—	—	—	—	
2AZ	—	—	3-4 p.m., 8- 9 p.m.	C.W. and Telephony	Mr. William Le[illegible] Quect. Guildford
2CZ	10	150 and 180	11-12 am., 8-9 p.m.	Spark	Mr. C.T. Atkinson, Leicester
2DF	10	180 and 1,000	8-9 p.m., 10-11 p.m.	C.W. and Telephony	Mr. H. Heather, Peckham.
2DG	10	180	7-8 p.m. Mondays to Fridays. (Other days hours of working are various.)	Spark and C.W.	Mr. Burnett, Sheffield.
2DH	10	180	(Portable Station)	" "	" "
2DI	10	180	" "	" "	" "
2DT	—	—	—	—	Barrow and District Wireless Association
2DV	10	180	- -	Spark	Mr. H. C. Woodhall, Bramhall, Ches.
2FG	—	—	—	—	Mr. H. L. McMichael, West Hampstead, N.
2FH	—	—	—	—	Mr. T. I. Rogers, Mossley
2FN	—	—	—	—	Mr. L. Baker, Ruddington, Notts.
2FW	—	—	(Portable Station)	Spark	Rev. D. Thomas, St. Paul's B.P. Scouts, Bournemouth.
2FX	—	—	8-9 p.m. Mondays to Fridays. (Other days hours of working are various.)	Spark, C.W., T.T. and Telephony	Mr. H. C. Binden, Bournemouth.
2GP	—	—	8.30-10.30 p.m.	Spark, C.W., T.T. and Telephony	Mr. W. Gaitland, Highbury, N.
2GR	—	—	12.30-1p.m.,5.30-7p.m.	—	Mr. T. Forsyth, Ashington
2GS	—	—	(Portable Station)	—	
2GU	10	180 and 1,000	8-10 p.m.	—	Halifax " Wireless " Club.
2GW	—	—	7.30-9.30 p.m.	—	Mr. A. Cash, Lymm, Ches.
2GZ	—	180 and 1,000	—	C.W. and Spark	Mr. A. L. Megson, Bowden.
2HA	—	180 and 1,000	(Portable Station)	—	
2HB	10	180 and 1,000	8.-10 p.m;	C.W. Spark	Mr. L. H. Lomas, " Macclesfield.
2HG	—	—	12.30-1 p.m. 5.30-7 p.m.	—	Mr. T. Boutland (Snr.) Ashington.
2HH	—	—	12.30-1 p.m., 5.30-7 p.m.	—	" " (Jnr.)
2HP	—	—	(Portable Station)	—	Mr H. C. Woodhall, Salford.
2ID	10	180	3.30-4.30 p.m., 8.30-9.30 p.m.	C.W. and Spark	Mr. E. S. Firth, Thames Ditton.
2II	—	180	8-10 p.m.	—	Southport Wireless Experimental Society.
2IJ	—	—	(Portable Station)	—	
2IK	—	- -	—	—	3rd Altrincham " Troop Boy Scouts, Altrincham.
2IL	—	—	(Portable Station)	—	
2IU	10	180	9-11 p.m.	—	Mr. G. A. E. Roberts, Twyford
2IW	10	180	9-11 p.m.	—	Mr. G. R. Marsh, Twyford.
2JK	10	180 and 1,000	8.30-10.30 p.m.	Spark, C.W., T.T. and Telephony	Mr. P. R. Coursey, Muswell Hill, N.10.
2PF	10	180	—	Spark	Mr. F. Foulger, London. S.E.14.

A MORSE PRACTICE SET

By Carl H. Parkinson.

THIS set was designed for two purposes :—(1) To be of convenient size for portability, and (2) to be used in conjunction with a practice-circuit (for two operators). In the first case, on depressing the key, a buzzer sound is produced in the telephones. In the case of the practice-circuit, on depressing the key, a buzzer responds in another room. When the key in this second room is depressed an induced sound is likewise produced in the telephones. A better idea of the circuit will be obtained on referring to the diagram of connections (Fig. 1).

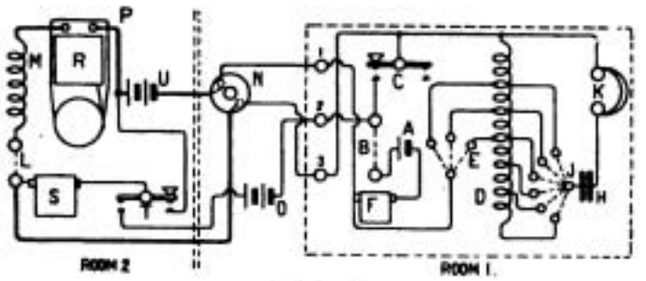


Fig. 1.

The set is contained in a box made of ½" wood, stained and varnished. Its outside measurements are 10½" long, 8½" high, and 4½" broad. The instruments, etc., contained in the box are : key, dry-cell, buzzer, auto-jigger, condenser, 1, 3, and 6-way switches, plug-socket (for telephones), and terminals. The box is not designed to carry the telephones intact, but they may be packed by removing the two receivers from the head-bands.

The front of the box is hinged at the bottom and locked at the top. On unlocking it, the same drops down—forming a small desk, with the transmitting key fitted on the right-hand side.

The key is a " 5s. Gamage." It is fitted with three terminals, but the front and middle contacts only are needed.

The power is supplied by one dry-cell of the ordinary type, 1½ volts being quite sufficient.

The buzzer is a " Gamage 2s. Wireless Type." It measures about 1" × ¾" × ½" and it never gives any trouble once it is correctly adjusted.

The auto-jigger is required to produce the sound in the telephones, and is more compact than a jigger with primary and secondary windings. It consists of six separate layers of copper instrument-wire, about No. 24 S.W.G., (S.C.C.), wound on a small induction coil bobbin, 3½" long, core ⅜" in diameter, made of No. 24 S.W.G. annealed iron wire. The end of each layer is connected to its neighbour, thus making seven tappings altogether.

The condenser consists of 20 sheets of tinfoil, 3" × 1½", interleaved with sheets of thin paraffined paper, 3¾" × 2¼". The lugs of the tinfoil sheets are turned back on to one side of the condenser, a hole punched through the whole, and a terminal inserted.

The switches need no description, as any 1, 3, and 6-way switches will suffice. Those used in the set under description are very small and fitted on ebonite bases.

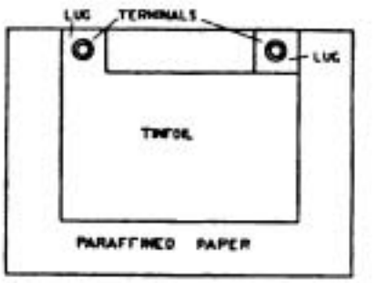


Fig. 2.

Two sets of terminals are fitted to bases of pieces of old gramophone records, cut to size, and polished. One base has two terminals for connecting the dry-cell ; the other has three for use with the outside circuit.

The plug-socket was obtained from an old house-telephone, and needs no description.

The telephones were made out of two old house-telephones and a couple of " Meccano "

strips. The telephone part of the instruments was cut off at the brass tube, A (Fig. 3), connecting it to the handle and microphone. The screw, B, fastening the eyelet, C, was

Fig. 3.

then remo ed. Two pieces of "Meccano" strip were ben in the form of Fig. 4, and fastened to the telephones by the screw, B. Two 13½" "Meccano" strips were bent in the form of a semicircle for the two head bands. The telephones have a resistance of 50 ohms per ear-piece, and are connected in s ries.

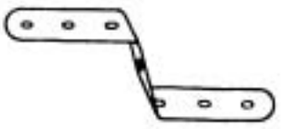


Fig. 4.

On referring to the photograph (Fig. 7) it will be seen that inside the box there is a small enclosure in the left-hand corner, made by two pieces of wood, the front forming the switchboard. Inside this enclosure are the buzzer, auto-jigger, and condenser. The former is packed in cotton-wool to deaden the sound as much as possible.

The position of the switches may be seen from Fig 7; the six-way at the top, the three-way and plug-socket in the middle, and the external circuit terminals at the bottom. Between the side of the enclosure and the right-hand side of the box is a partition, the space to the left of this partition being occupied by the dry cell, and the space to the right by the key when the front is closed. At the bottom of this space are the battery terminals and switch for disconnecting the battery when the set is used in conjunction with the external circuit. Connection from the dry-cell to the battery terminals is made by two short lengths of wire brought through a hole in the partition. The key connections are made by way of the hinges of the box front.

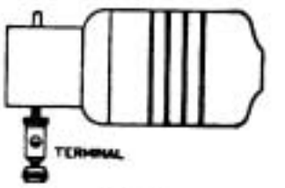


Fig. 5.

On referring to Fig. 1 the buzzer circuit includes the dry cell A, the switch B, the key C, the auto-jigger D, the three-way switch E, and the buzzer F. The telephone circuit consists of the auto-jigger D, the condenser H, and the six-way switch J. When the switch B is closed and the key C depressed, the buzzer responds. The current passes through either one, two, or three layers of the auto-jigger winding according to the position of the three-way switch. An induced sound is then produced in the telephones, K, the loudness of which depends on the position of the three and six-way switches. The condenser is placed in series with the telephones to sharpen up the note. Since by altering the position of the three-way switch, more wire is brought into circuit, also more resistance, the note of the buzzer is lowered as well as making the signals louder in the telephones. Thus there are six different strengths of signals for each position of the three-way switch. Leads are taken to the terminals, 1, 2, and 3 (Fig. 1), from the common contact of the three-way switch, the front and middle contacts of the key respectively.

A MORSE PRACTICE SET

I will now describe the action of the practice-circuit for two operators. The two termini of the circuit are in two rooms. To save wire the existing bell circuit was used, thus necessitating the laying of one wire only. The bell circuit is indicated in the diagram by thick lines. A switch, L, was inserted

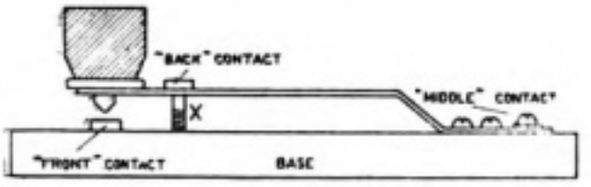


Fig. 6.

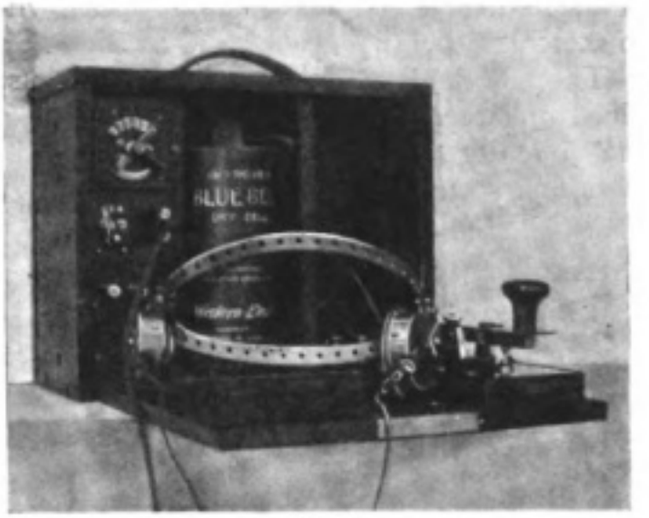


Fig. 7.

near the indicator coil, M, to cut the bell and indicator coil out of circuit when practising telegraphy. When the set is used with this circuit the dry-cell, A, and the buzzer, F, are cut out of circuit by opening the switch, B. Two leads were taken from the push, N, in the first room to an ordinary $\frac{7}{8}$" batten-holder, fitted on the skirting-board (not shown in the diagram). A wire from the battery, O, consisting of two Leclanché cells, was connected to the metal case of the holder. This affords a three-way plug. The same method was used in the other room but this time connections to the inside of the holder were made to the terminal, P, of the bell, R, and to the side of the switch, L, remote from the indicator coil, M. The other pole of the battery, O, was connected to the metal of the holder.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A FRAME AERIAL RECEIVING SET—VI.

THE mounting of the component parts of the amplifier and tuning panel now being completed it is necessary to consider how the set is to be finished off. Apart from the frame, we have the tuning panel and amplifier panel, together with a 50-volt high-tension or anode battery, a 6-volt filament accumulator and telephones. If the set is to be portable, all parts, with the exception of the accumulator, should be mounted in one box. If the set is not required to be portable, only the tuning and amplifier panels need be boxed. A suitable box is shown in Fig. 13.

It may be made out of $\frac{3}{8}$" wood, preferably three-ply for lightness and strength. Compartment A will contain the tuning panel, compartment B the valve panel, and D the anode battery. The telephones may be placed in C. The space allowed for the anode battery is $6\frac{1}{2}" \times 4\frac{1}{2}" \times 3"$. This is sufficient to take a 50-volt dry-cell battery, made by the British Ever-Ready Co.

The overall length of the box should be $19\frac{1}{8}"$, the width $7\frac{1}{2}"$, and the depth 6"—all being internal measurements. If only the two panels are boxed the length should be $11\frac{7}{8}"$, other dimensions remaining the same. The partitions separating the units may also

be made of ⅜" wood, and mounted as shown in sketch.

The box should be built up with all joints glued and screwed together, on account of the difficulty of dovetailing three-ply wood. If ordinary wood is used, ⅜" thick, the ends

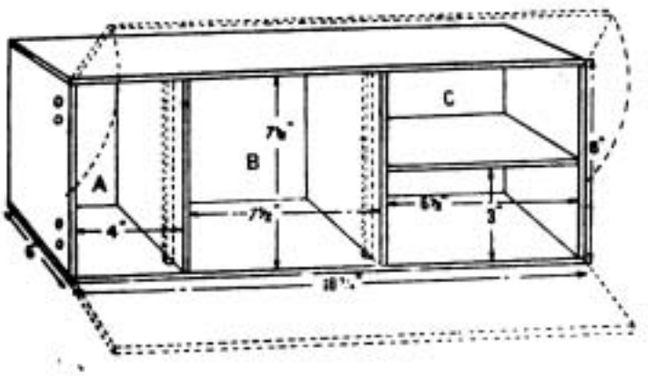


Fig. 13.

may be dovetailed, and the partitions fitted into shallow grooves.

The deepest panel is the tuning panel, 4½" deep, which, with the thickness of the panel ¼", gives 4¾" overall depth. The box is made 6" deep, so that we can drop the panels in and allow sufficient space for the terminals and valves to be clear of the lid.

Two methods of fixing the panels into the box suggest themselves, either by screwing ¼" battens, as shown in Fig. 13, and drilling clearance holes for small wood screws in the panels, or to use metal-thread screws put through the sides of the box and screwed into the edges of the panels. This latter method is the more difficult one and will require accurate dri ling and tapping of the ebonite. Before the tuning panel is finally mounted it should be wired up. The connections will be easily followed from the sketch, Fig. 14.

An additional switch—two contacts and an arm—should be mounted on the tuning panel and connected in circuit, as in the diagram, so that for long waves the loading inductance is in series with the frame, and for short waves cut out.

For the reception of continuous waves with this set a separate heterodyne oscillator will be required. A description of such an oscillator was given in the issues of this journal for May 29th and June 12th last, and reference should be made to them. The oscillator there described was suitable for wavelengths up to 7,000 metres. By increasing the inductance of the coils the range can be increased to 15,000 metres. The B coils should be wound to 4" diameter with No. 38 D.W.S. instead of No. 36. In the grid-circuit connect one coil, and in the anode circuit two coils, joined in series in such a way that when current flows from one coil to the other it goes on in the same direction, *i.e.*, the mutual inductance between the two coils adds to the inductance of the two coils in series. Use a ·003 condenser or a lower value variable, with fixed condensers added in series.

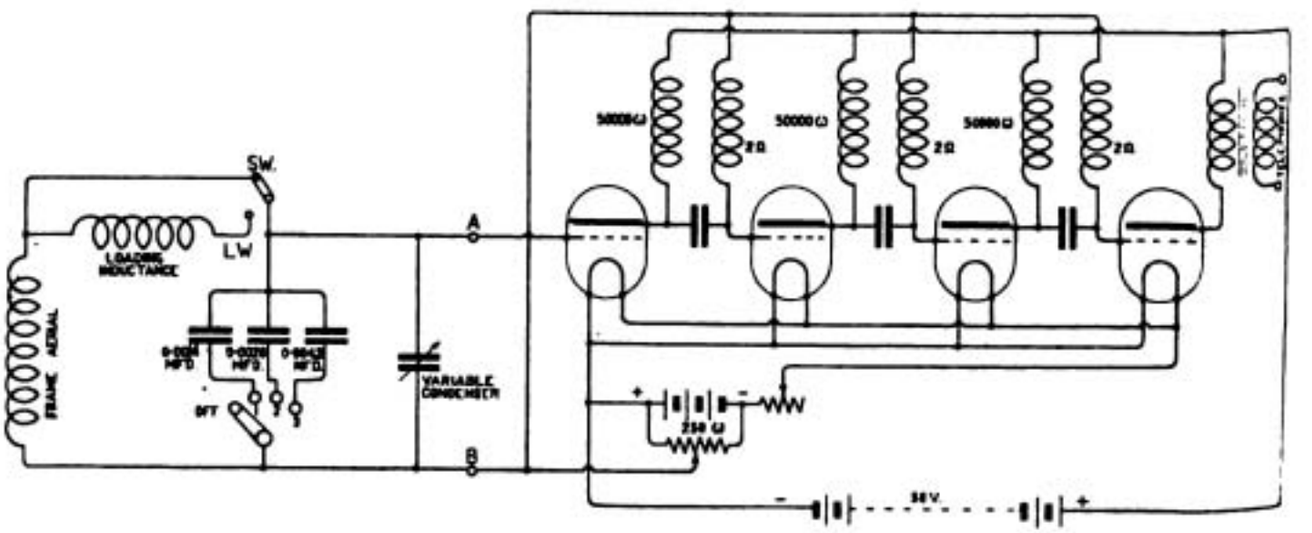


Fig. 14.

Connection from the batten-holder in the first room to the terminals, 1, 2, and 3, of the practice set is made by means of three-way flex. This flex has an adaptor at one end and tag-terminals at the other. The third connection on the adaptor is effected by removing one of the pins and inserting a terminal in its place, thus making connection to the metal of the holder (see Fig. 5). By inserting the adaptors in a certain way the connections are properly made. The terminal-tags have 1, 2, and 3 rings filed round them respectively, so as to distinguish one from the other when connecting up to the terminals, 1, 2, 3 (Fig. 1).

The buzzer, S, and the key, T, are fitted to a small board, connections being made to the holder in the second room by the same method as before This buzzer is made out of an old electric bell, a piece of tin with a platinum contact replacing the armature. The key, T, is made out of a "Meccano" strip and a small wooden knob. Three contacts are needed and are arranged as Fig. 6. The back-contact is afforded by the screw, which goes through one of the holes in the strip, yet only makes contact with it when the key is in its normal position. Thus on depressing the key the contact is broken.

Referring again to Fig. 1 it will be seen that when the switches, B and I, are open and the key, C, depressed, the buzzer, S, responds by agency of the battery, O. When the key, T, is pressed the buzzer, S, responds by agency of the battery, U (belonging to the house-bell circuit). In the latter case the current passes through the windings of the auto-jigger, thus producing an induced sound in the telephones. Thus communication may be maintained between the two rooms.

A pair of t.lephones may, of course, be connected up in the second room of the circuit by means of another small auto-jigger inserted in the lead connecting the battery, O, to the back-contact of the key, T.

The amateur will probably save himself much trouble if he purchases honeycomb coils instead of winding basket coils. Before purchasing he should plan out the range of wavelengths to be obtained from each set of coils with his condenser. With tightly coupled pancake coils it is not safe to calculate on more than a two to one increase in wavelength from minimum to maximum capacity of his condenser. When ordering these coils it is better to specify the inductance in microhenries required rather than wavelengths, unless the capacity of the condenser is given when ordering.

This heterodyne may be either mounted as a separate unit, or on a panel in a similar fashion to the other two, and mounted in the box—say in compartment C. In this case it will be necessary to make up a small coupling coil of half-a-dozen turns which may be joined in series with the frame—the coupling coil being placed near the coils of the heterodyne, so that the local oscillations may be induced into the tuning circuit.

THE WIRELESS SOCIETY OF LONDON.

The next meeting of the Society will take place at 8 p.m., on January 27th, at the Royal Society of Arts, John Street, Adelphi, W.C., when Lieut. Duncan Sinclair will deliver a lecture entitled "The Wireless Stations of British Commercial Airways."

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.**

A.E.H. (Nottingham) *asks for information with regard to the principal stations which can be heard in England.*

Consult page 97 of May 1st issue and pages 273, 274, 275, 279 of July 1st issue for data of high-power stations. For information concerning the numerous low-power stations, consult the Year Book of Wireless Telegraphy.

C.H. (Woodstock) *sends sketch of a simple crystal receiver, and asks* (1) *What power would be required to receive with this set, and where to fix the battery.* (2) *Would an ordinary telephone receiver do to receive messages, and if not, why not.* (3) *Would a 4-volt dry-cell or a 4-volt accumulator be better for this set.*

(1) No battery is necessary for many crystals; for some, however, *e.g.*, carborundum, a battery and potentiometer are very desirable. For connections see Fig. 7, page 374, of the current volume of *The Wireless World*, omitting the condenser there shown.

(2) Any telephone of resistance greater than about 1,000 ohms can be used. Lower resistance telephones are too insensitive without a telephone transformer.

(3) It is immaterial which.

S.M.D. (Loughboro) *asks* (1) *What effect would an electric power station 300 yards distant have on his apparatus, and how can he overcome any trouble from it.* (2) *Can a spark or crystal receiver be altered to receive C.W. or telephony by means of valves, and how.* (3) *Where he can obtain a full list of call letters of stations and ships.*

(1) It is quite likely that you will not get much trouble at this distance, particularly if the supply is D.C. If, however, you get induction, you will find it rather hard to eliminate. The best way will be to screen your receiving circuits, as much as possible, with metal.

(2) A crystal receiver will receive telephony without the addition of a valve. A valve for C.W. can be introduced into almost any crystal receiver, but it is in general, better to rearrange the whole set. You do not say what gear you have at your disposal; but for a typical set see Fig. 5, page 500, of the current volume of *The Wireless World*.

(3) See reply to **A.E.H. (Nottingham)**.

H.J. (Ravenscourt Park) *asks* (1) *What is the diameter of the former for the 168 turn pile-winding referred to at the end of "The Construction of Amateur Wireless Apparatus" (Part 2), page 465 of "The Wireless World" for September 18th, 1920.* (2) *Is the enclosed diagram for a C.W. reception set workable, and is the grid-leak necessary in this case.*

(1) Calculation points to the diameter having been approximately 20 cms.

(2) The set shown is correct, excepting the arrangement for reaction. A reaction coil between the plate of the valve and the positive of the H.T. battery, inductively coupled to the grid-circuit inductance, would give much better results than the coils you suggest.

• • — • • — • —— (Catford) *has a coupler, the dimensions of which are:—Primary, 6½" × 10", secondary, 4¾" × 10", and asks if this coupling is too tight.* (2) *If the windings on the above two coils should be wound in the same direction or the primary clockwise and the secondary anti-clockwise, or vice-versa.* (3) *Why a variable condenser made of tinfoil and wax paper is unsatisfactory for receiving.* (4) *Is glass a good dielectric for receiving condenser.*

(1) Yes, if one is pushed right inside the other, but if almost or quite outside, no.

(2) It is of no importance which way they are wound.

(3) Variable condensers of foil and paper are all right if the variation is discontinuous and obtained by switching in fresh sections, but not if an attempt is made to make it continuous by moving the foils.

(4) Yes, good electrically.

M.C. (Rome) *asks* (1) *For a diagram of a 7-valve resistance amplifier with crystal rectification (galena), after the seventh valve; also for details of a design for such a set. He asks if this amplifier would give good results with a frame aerial 1¼ metres square, or whether it is better to rectify with a supplementary valve.* (2) *The condenser connected across the frame being of ·006 mfds. maximum capacity, how many turns, etc., are necessary to tune from 600 to 10,000 ms.* (3) *What would be the approximate range of such amplifier.* (4) *What will be the call-letters and wavelength of Bordeaux (Croix d'Hinge), and if it has begun its experiments.*

(1) We cannot deal with questions relating to the complete design of such apparatus in these columns. See the article in the issue of March, 1920, page 701, for the general principles of such an amplifier and for details of design. It seems superfluous to employ a crystal detector with a set of this type, as it will probably function as a cumulative rectifier in any case. A good amplifier of this type will give the best possible results on long wavelengths.

(2) 50 turns on the frame and a loading coil of 1,000 mhys. will tune to the desired wavelength, but the condenser is much too large for the purpose; better, ·0003 mfds. maximum.

(3) It is quite impossible to say.

(4) We believe that experimental work is now being carried out, the call-letters used being LAF.

W.A.S. (Kilburn) *sends a description of his set, and asks* (1) *What alterations to the set are necessary on increasing* A.T.I. *to about* 18,000 *mhys.* (2) *If a valve detector can be used in place of a crystal.* (3) *If on doing this would he need to increase his battery power.* (4) *What would be the maximum wavelength.*

Your questions are very difficult to answer, as you do not send a sketch, or describe how your set is connected up.

(1) If the set is auto-coupled to the circuit receiver, no alterations will be necessary.

(2) A valve could be used as you say, but a single valve would give little better results than a crystal; telephony is audible on either.

(3) With a 3-electrode valve, an additional battery would be necessary for the plate-circuit. As you do not say the size or kind of cells in your present 6-valve battery we cannot say whether it would be suitable for lighting the filament of the valve.

(4) About 5,000 ms.

H.T.A.N. (Wellington College) (1) *Sends a diagram of a receiver for criticism, and asks* (2) *The maximum wavelength it will receive.* (3) *For details of an intervalve transformer.*

(1) Your circuit should be quite satisfactory, but a potentiometer is not required for a resistance amplifier. The reaction condenser should be smaller than ·0001 mfds.

(2) The secondary circuit will tune to about 6,000 ms., the primary to about 3,500 ms. We should advise rewinding the secondary with about No. 32 wire.

(3) For an intervalve transformer use a bundle of iron wires about 3 in. long by ¼ in. diameter for the core. The windings should be ¼ oz. and 1¼ oz. of No. 44 wire. This is for L.F. of course; for H.F. it would be necessary to know the conditions of use before giving a design.

PANCAKE (Bristol) *asks* (1) *for a good single-valve long-wave circuit to comply with certain conditions as to apparatus. He also has other gear and asks* (2) *If he should use as a separate short-wave receiver, or connect-up to make a single crystal or valve receiver with the previous gear. He also asks* (3) *How to find the correct polarity for connecting-up* H.R. *telephones in a valve circuit.* (4) *If a permit is necessary to use a small power buzzer over, say, half a mile, and if it is likely to be granted, if necessary.*

(1) See Fig. 4, page 338.

(2) We think you would get most useful results from the two circuits used independently.

(3) Either by checking the winding, if visible, and the polarity by a compass needle, and using Ampere's rule, for which see any elementary electricity text-book. Failing this, hang just as much weight on the telephone magnets as they will support. Switch on a small current. The direction of the current which makes the weight fall is the wrong direction.

(4) A permit is necessary. It will probably be granted, except in the neighbourhood of an important receiving station.

G.C.P. (Cheltenham) *asks* (1) *In using a radio-frequency resistance amplifier receiver with capacity-reaction, what is a suitable maximum capacity for the reaction variable condenser.* (2) *What length of the enclosed slate pencil gives a resistance of* 4 *megohms, and could this be used as a grid-leak.* (3) *Ref.* "*The Wireless World,*" *December,* 1919, *page* 530. *Reed's receiver. Later* C_2 *is given as* ·00005 *mfds. Are signals improved by making* C_2 *variable or with a leak, and what maximum value is the special condenser* C_2.

(1) It depends considerably on the details of the receiver. ·00001 mfds. will probably be sufficient.

(2) About 4 cms. This could be used, if enclosed in a glass or similar tube, to obviate variations of resistance through dampness.

(3) A grid-leak is necessary. See also reply to **W.A.H.**, page 294, and various other queries on this receiver, about which we have no detail information.

P.T. (Brussels) *refers to the* "*very low frequency*" *amplifier of Messrs. Abraham and Block described on pages* 53 *and* 54 *of the April* 17*th issue, and asks* (1) *For values of capacities and resistances of the above.* (2) *Whether it can be used to operate a relay requiring* 3 *milliamperes.* (3) *If not, can we recommend him a design of relay easy to construct.*

(1) We have no further information regarding this amplifier. Possibly you may be able to trace the original paper of Messrs. Abraham and Block.

(2) It depends on the resistance of the relay, but we should judge that such a circuit is certainly capable of operating a sensitive relay if suitably wound, *i.e.*, to a resistance of about 10,000 ohms.

(3) We should advise you to rewind your present relay if necessary.

F.J.R. (Midlothian) *encloses a plan of his aerial arrangements and asks* (1) *If the aerial wires are too near the ridge of the zinc-covered roof.* (2) *If sample of wire enclosed is suitable for an aerial.* (3) *With reference to* (1), *if the wire is too close to the zinc ridge could this be insulated by a coat of paint.* (4) *With reference to the article on telephones in October* 2*nd issue, page* 495, *if* 42 *or* 43 *enamelled copper wire would be suitable. If so, how many yards would be required for each bobbin for low resistance telephones.*

(1) Your aerial appears to be somewhat too near the roof. We would advise masts attached to the chimney stacks.

(2) Your wire appears to be steel, and would not therefore be very suitable owing to its high resistance.

(3) No, this would do no good.

(4) 25 yards per bobbin would give you 50 ohms. resistance for each. This gauge of wire is unnecessarily high, however.

G.F.K.B. (Mombasa) *states that he is constructing a* 3*-valve* H.F. *amplifier on the lines of the Marconi* 55A *type. He finds that he gets no signals at all unless the grid connection of the* Q *valve is broken. He asks* (1) *How it is that the circuit functions at all in these circumstances.* (2) *If* 800 *ohms is satisfactory for the intervalve transformers, or should they be multilayered coils wound to a high resistance.* (3) *If* ·00035 *mfds. is a correct value for the trans-*

former condensers. (4) *With reference to a statement in "The Wireless World" to the effect that the resistance of the windings were 24,000 ohms, if this is a misprint for 2,400 ohms, or if the intervalve transformers should be multilayered.*

(1) Rectifiers in which the grid is apparently insulated from the filament are well-known. In reality there is a leakage path which permits the charge on the grid to escape. Your result certainly seems surprising, with a Q valve and only 50 volts. We suspect faulty insulation in your transformer which should have the effect of raising the potential of the grid.

(2) No; too low. See answer to (4).

(3) Yes, about right.

(4) Statement quite correct. Transformers of this type are usually wound in multilayered sections to reduce self-capacity, this being a compromise between pile-winding and the ordinary multilayer method.

CONSTANT READER (Kingston-on-Thames) *wishes to instal a small* W.T. *transmitter such as described in August 24th issue in the Proceedings of the Wireless Society of London, and gives a list of apparatus in his possession. He asks* (1) *What further apparatus he would require.* (2) *If we could give him an alternative circuit.*

(1) Apart from the aerial there is nothing further absolutely necessary to complete your set, but a filament rheostat is desirable. The condenser of ·01 mfds. capacity is too large for a shunt condenser as given in the above article, but would be suitable if used as a series condenser in the aerial circuit. You might then use an additional A.T.I.

(2) The set shown in reply to **B.G.H. (Wembley Hill)** on page 601 of the November 11th issue might suit your purpose.

N.B.—We are glad your previous difficulties are now overcome, though we fear we were not able to be of very much use.

W.J.T. (Lurgan) *submits a circuit for criticism and asks* (1) *If the tikkler coil should be of a constant value for any wavelength, and if so, what value, using a Marconi type* V.T. *(American).* (2) *What is the value of the resistance marked* R *shunted across the amplifier transformer secondary.* (3) *For an alternative circuit using only one* H.T. *and one* L.T. *battery for both tubes.*

A condenser is required across H.T. battery and transformer of the first valve to by-pass H.F. current, value about ·003 mfds. See also answer to (2).

(1) The coil may be of constant value, but should be variably coupled to A.T.I. Value difficult to predict as it is usually found by experiment. Try it with the largest wavelengths, as these require most coupling.

(2) We do not see the use of this resistance; it will certainly weaken signals, and had better be omitted.

(3) Put your H.T. battery on the filament side of the transformers, and connect your filaments parallel to your common L.T. battery.

E.J.H. (Sidcup) *encloses diagrams of two circuits, and asks* (1) *for criticism of* A, *which is designed for use up to* 4,000 *ms.* (2) *If an ordinary fixed condenser, say,* ·0005 *mfd. would do instead of a variable one across his* H.T. *battery and telephone transformer.* (3) *With reference to circuit* (x), *for an explanation of certain fluky results.* (4) *If this circuit constitutes a capacitance circuit.*

(1) Subject to the following criticisms, your circuit is correct, and the values of the components well chosen.

(*a*) The condenser across the H.T. and telephone transformer would be better if ·003 mfds.

(*b*) The condenser across the primary of the first transformer (and preferably the H.T. as well) is necessary for proper reaction working. Value ·003 mfds.

(2) Yes, but it should be ·003 mfds.

(3) Your circuit shows the grid connected through a leak to the positive of the H.T., and otherwise insulated. This is certainly wrong with any design that we know. Try putting the leak from grid to filament.

(4) Your circuit is a variety of the de Forest ultra-audion circuit, the reaction being effected by connecting plate and grid to the extremities of a tuned circuit. This is not a capacitative reaction.

VIC EE (Birmingham) *wishes to design a valve receiving set to work efficiently on both short and long wavelengths, and specifies certain material he has at his disposal. He also encloses a sketch showing a tuner for the above as a suggested starting point. He asks a series of questions relative to the details of the design of such an apparatus.*

We regret that we cannot undertake to design complete sets in these columns. Our object is to help readers with specific difficulties, and we have all too little space and time at our disposal for this purpose. We advise you to obtain working drawings from any of the firms advertising in *The Wireless World.*

With regard to your diagram, your long wave tuner shows two tuned circuits coupled, your short wave tuner no tuned circuits at all. The former arrangement is very unstable, the latter not at all selective. See reply to **F.B. (Hornsey)**, on page 598 of the November 12th issue, for a circuit which we advise in preference. We note that you also suggest tentatively the employment of a H.F. amplifier after the rectification stage, and connected to your set by an iron-cored transformer. This of course is not correct; your H.F. amplification should be done before rectification.

J.R.B. (Helston) *has a* C.W. *receiver and a* L.F. *amplifier. On connecting the input of the latter to the telephone terminals of the former, he gets no signals unless the telephones are also retained across these terminals. He asks* (1) *Why.* (2) *For a sketch of the winding required to use a valve instead of a crystal in the S.W. Tuner Mark* 3.

(1) Your L.F. amplifier shows a small condenser alone across the grid and filament of the first valve. If therefore you remove your telephones from the plate circuit of the receiver valve, the plate circuit of this valve has exceedingly high impedance for L.F., and practically infinite resistance for D.C. This explains failure to work. You will find that any iron-cored choke of fairly suitable dimensions will do instead of the telephones. It should have roughly, the dimensions of the H.R. winding of a telephone transformer. The reason for your

finding better results with two pairs of telephones is that the impedance of two happens to suit the circuit better than that of one.

(2) See note on page 626, November 27th issue.

L.R.L. (London) *sends diagrams of two sets, and asks* (1) *For criticism, particularly as to relative sizes and gauge of wire and formers.* (2) *The maximum and minimum wavelength to which the apparatus will tune.* (3) (*a*) *Range, using* P.M.G. *aerial.* (*b*) *Range, using valve and frame.* (4) *The connections needed for the inclusion of a 3-electrode valve in the circuit.*

(1) The general arrangement of the set is satisfactory. The primary coupler-coil is unnecessarily large, and wound with too thin wire. A series A.T.C. is not necessary, except for very short wavelengths.

(2) We cannot say exactly, as you do not give enough data; probably about 6,000-7,000 ms. maximum.

(3) We cannot say.

(4) Your Fig. (2) is useless. See Fig. on page 65, April 17th issue, for a suitable circuit.

BEGINNER (Warwickshire) *asks* (1) *For a diagram of a small receiver to tune to* 16,000 *ms.* (2) *What alterations would be necessary for transmission.*

(1) We strongly advise you to adopt a much smaller range to begin with, as simple sets suitable for construction by a beginner are not efficient on long wavelengths. You will find a suitable set described in the issue for December, 1919, or see Fig. 7, page 601, of the issue for November 13th. Either of these sets could be reconstructed on more advanced lines when you get the necessary experience.

(2) You will not be able to adapt the receiving set for transmission, as quite different proportions and arrangements are necessary for this purpose.

C.D.F. (West Ealing) *asks* (1) *If it is possible to receive with a crystal receiver on an aerial* 26 *ft. long and* 30 *ft. high.* (2) *If so, what is the best circuit to use.* (3) *If not possible, what is the simplest valve circuit to use.*

(1) This is possible, but the range will be rather unpleasantly limited with such a small aerial.

(2) Fig. 10, page 502, should be satisfactory.

(3) Fig. 5, page 500, amended as there suggested, would be better than a crystal, but a multi-valve amplifier, *e.g.*, Fig. 9, page 502, would be still better.

F.H.C. (Yardley) *proposes to instal a crystal receiving circuit, and asks* (1) *What kind and gauge of wire is suitable for an earth lead.* (2) *If a sheet of galvanised iron* 3 *ft. by* 3 *ft. would be suitable for an earth.* (3) *If aerial wire would be suitable for the lead-in.* (4) *If a type of aerial sketched would be suitable.*

(1) 16 S.W.G., copper, or the larger the better.

(2) Yes.

(3) Yes, if due regard is paid to insulation.

(4) Fairly good. It would be better if you could arrange a mast attached to the tree so as to keep the aerial well above the branches.

R.W.P. (Sandgate) *wishes to receive* C.W. *on a 3-valve amplifier (sketch enclosed), and asks* (1) *If it is possible to do so without using another valve.* (2) *If a second valve is necessary, would a second arrangement (sketched) be suitable for use with a small aerial.* (3) *If the following alterations would be advisable:—*(*a*) *Grid-leak to first valve;* (*b*) *condenser across telephones;* (*c*) *iron core to first transformer (sketch* 2). (4) *For correct resistance and sizes of wire for primary and secondary of first transformer (sketch* 2)

(1) Yes; connect a ·003 mfd. across plate and filament of first valve, with a reaction coil in series with it, coupled to the tuned circuit.

(2) The arrangement sketched is not necessary, but would do. See (3) (*c*) below.

(3) (*a*) Yes, but the grid condenser should be in series with the grid and not across grid and filament, as you show.

(*b*) Yes, not greater than ·003 mfds

(*c*) Yes, if the first valve is functioning as a detector. The arrangement corresponds to our suggestion in (1), but with an extra stage of L.F. amplification. Otherwise you may make the second valve the detector (with condenser leak or otherwise) and make the first valve the H.F. amplifier.

(4) See article on page 588 of the November 13th issue for details of a suitable transformer for the second alternative in (3) (*c*). For first alternative, make a transformer similar to your existing ones.

P.B.W. (Tunbridge Wells) *asks* (1) *The inductance of a coil* 10″ *by* 4″, *wound with No.* 2 *enamelled copper wire.* (2) *The inductance of a coil* 13½″ *by* 5″, *wound with No.* 22 *enamelled copper wire.* (3) *Whether the coil* (1) *as* A.T.I. *and coil* (2), *as closed inductance (both variable), can be used as a loose-coupler.* (4) *The maximum wavelength obtainable with a* 75′ *aerial,* 30′ *high.*

(1) 2,200 mhys.

(2) 8,000 mhys

(3) You will find using (1) as a closed circuit inductance, and (2) as A.T.I., more satisfactory.

(4) Arranged as we suggest, probably about 2,000 ms.

J.D. (London) *wishes to convert a single-circuit receiver into a two circuit one, and asks* (1) *Gauge and length of wire to use on a* 4″ *former for the secondary circuit with his existing* A.T.I. *as primary.* (2) *What is the cause of a continuous howl in the telephones when using a reaction coil with a valve.* (3) *If No.* 24 *or* 30 *wire can be used in the above secondary.*

(1) and (3) Using 24 S.W.G. (which is the better of the two), 14 inches of winding will give you 4,000 ms., employing a ·0005 mfd. condenser. (This is a suitable value.)

(2) Audio-frequency oscillations are being produced by the stray fields of your circuit, or else the circuit itself is wrong, and gives you audio-frequency reactions instead of radio-frequency, which we presume you want.

C.S.L. (Fence Houses) *sends a sketch of a receiver, and asks* (1) *If circuit will work.* (2) *If the connections of the aerial circuit are correct* (3) *If the inductance of the coil in the closed circuit should be equal to that of the coupling-coil in the aerial, or if more inductance may be added.*

(1) Circuit should be satisfactory.

(2) Yes.

(3) We do not understand what you mean by describing a coil as " $=641\lambda$." You will probably find it necessary to increase the tuned circuit inductance considerably.

ENTHUSIAST (Sheffield).—Your questions are very vague. We think you would do well to get an elementary book on the subject of wireless and study it carefully, as your conception of things appears somewhat nebulous.

(1) See Fig 7, page 601, November 13th issue.

(2) We cannot state the range from the information you give. Two wires can be used.

(3) The condenser can be about ·0005 mfds Inductances will depend on the size of the formers, which will depend on the wavelength required. See various recent replies.

(4) None.

J.T. (South Shields) *asks* (1) *For a simple single valve circuit for use with a frame aerial.* (2) *If formers which he possesses for a loose-coupler can be used, and if so, what windings he should use.* (3) *For values of condensers, etc.*

(1) A single valve circuit will not in general be sensitive enough for satisfactory work with a frame aerial. Any circuit of this type, which might be made to give results would be very critical in adjustment, and need very skilled handling. We suggest Fig 1 as a fairly satisfactory alternative.

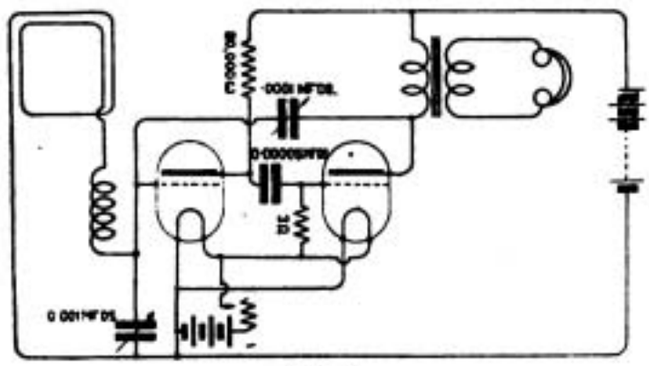


Fig. 1.

(2) You do not give any particulars of the sizes of your formers. However, the aerial sketched, having capacity reaction, does not need a coupler.

(3) See Fig. 1 above.

J.E.J. (Dulwich) *gives particulars and a diagram of his set, which he states does not work, and asks* (1) *If there is any obvious reason why he gets no results.* (2) *Whether, if the tuning inductance is too small, he could get results by inserting more in the aerial circuit as shown in his sketch.* (3) *If the inductance in his set is inadequate and cannot be remedied as in* (2), *what size inductance should he have.* (4) *If the aerial is too small to give any results could he improve it by connecting any form of indoor aerial in series or parallel with it.*

(1) Your set appears to be all right, and we cannot say why you get no results. We suggest the following possible faults: (*a*) Badly situated aerial. (*b*) Bad earth. (*c*) Bad connections in any part of the apparatus. (*d*) Leaky blocking condenser, only allowing the strongest signals to pass through the telephones. You should test with blocking condenser removed, it is not essential to the working of the set. Your detector seems to be working correctly.

(2) Your existing inductance should enable you to tune to 600 ms. You can tune to higher wavelengths by either of the methods you suggest.

(3) You should be able to hear many 600 ms. stations.

(4) We hardly think so.

J.K.H. (Rotherwood) *hears a " peculiar tapping noise " in his telephones whenever a motor lorry (petrol) passes the house. It has been suggested to him that this is due to high-frequency radiation from the magnetos. He asks our opinion.*

You do not say what type of set you are using, nor how far from you the lorries give trouble. Induction of this sort from magnetos does give trouble at times, *e.g.*, on aircraft; and in certain of the Marconi Co.'s sets special provisions are made for overcoming this trouble. However, we should not have expected trouble of this sort under the circumstances you suggest unless you were using exceedingly powerful amplification. If you are not, the effect is more probably due to mechanical vibration affecting a loose contact somewhere on the set.

SPARKS (Margate) *asks for dimensions of coils to tune to* 18,000 *ms. on a single valve receiver with an* 80 *ft. single wire aerial.*

We do not recommend such long wavelengths on a single valve set. However, try A.T.C. of ·003 mfds. in parallel with A.T.I.—3-pile—of No. 24 wire on a former 8″ × 6″. Tuned circuit condenser ·001 mfds. and inductance—3-pile—of No. 26 on a former 10″ × 5″. Reaction coil, 8″ × 4″ single layer No. 28.

C.A.B. (Exeter) *asks if and where he can obtain hard valves in England suitable for a resistance-coupled amplifier.*

Practically no soft valves are now made. See our advertisement pages for names of manufacturers of hard valves, almost any of which will be suitable (with correct H.T.) for your purpose.

SHARE MARKET REPORT.

The market is steady and prices as we go to press :—

Marconi Ordinary	£2 - 5 - 0
„ Preference	£2 - 2 - 6
„ Marine	£1 - 2 - 6
„ Canadian	7 - 0

The WIRELESS WORLD

VOL. VIII. No. 22, NEW SERIES] JANUARY 22nd, 1921. [FORTNIGHTLY

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 22. JANUARY 22ND, 1921 FORTNIGHTLY

WIRED WIRELESS TRANSMISSION

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

(*Continued from Page* 701)

THE application of high-frequency currents to the transmission of appreciable amounts of energy along wires is no recent invention, although, as was pointed out in the first part of this article, its development has received a powerful impetus by the application of the three-electrode thermionic valve to its problems. Hertz, the discoverer of the properties of electromagnetic waves, was the first to apply these waves to wires, by setting up stationary waves in long horizontal wires, the lengths of which were adjusted to resonate with the frequency of the impressed oscillations.* These stationary waves could be detected at various points along the wire and, therefore, could have been employed for signalling purposes. At that time, however, such application was not appreciated, any more than was the use of the free electromagnetic waves for similar purposes until Marconi's development of practical wireless apparatus.

At the present time it is very customary to give General G. O. Squier (Chief Signal Officer of the U.S. Army) the credit for the invention of multiplex wired wireless, but although about 1910 he developed a practical a paratus for communicating by this means and thus brought the subject to more general notice, the actual origination of the idea took place at a much earlier date.

Developments of the early ideas of using Hertzian waves for communication along wires were made in 1900 by M. Turpain, while in 1886, before the days of ordinary "wireless," M. Leblanc had laid down the principles of wire telegraphy and telephony with high-frequency currents. The developments of the oscillating arc and high-frequency alternators as generators of high-frequency currents enabled greater success to be obtained.

The transmission of telephonic messages in this manner necessitates the use of a steady source of continuous oscillations for transmitting, whereas for telegraphic purposes damped oscillations can be employed, although better results are naturally possible with sustained oscillations.

The damped waves which may be employed for telegraphic signalling may be produced by a buzzer in the manner already indicated in the first part of this article, but where greater powers are required quenched spark transmitters have been used with success over considerable lengths of time.

E. Ruhmer succeeded, in 1909, in transmitting three telephonic conversations simultaneously along a short line, using Poulsen arc transmitters, while G. O. Squier also used continuous oscillations for telephonic transmission by this means, and in 1911 transmitted speech

* See earlier articles in this series, *The Wireless World*, No. 8, p. 73, May 1st, 1920, and p. 217, June 26th, 1920.

over a cable 11 kms. long, using an Alexanderson high-frequency alternator at the transmitting station. Medium frequency alternators (of 6,000—7,000 ~) have also been used for wired wireless transmission, by tuning the circuits to harmonics of the fundamental frequency, so as to obtain an effective working frequency above the audible limit.

The advantages of this method of communication, when the lines have too poor an insulation for satisfactory signalling by ordinary means, have already been pointed out. During the war the problems of communication under similar conditions were brought very much to the fore for two reasons—the great difficulty of maintaining lines in good electrical condition in battle areas and the scarcity of suitably insulated wires. In attempting to overcome these difficulties the U.S. Signal Corps carried out researches to test the practicability of this means of communication over bare wires, which may be either simply laid on the ground, buried beneath the surface, or sunk in the sea or in rivers. An ordinary pattern of C.W. wireless transmitter, using an oscillation valve, was employed at one end and a valve amplifier and detector at the other. Satisfactory communication was established over some considerable lengths of buried bare wires.

During 1917 and 1918 the application of valve transmitters and receivers to wired wireless over ordinary land lines showed considerable progress, and such installations are now in regular practical use in Germany. The Western Electric Company, in the United States, have likewise developed a successful apparatus for multiplex high-frequency telephony, employing the same means.

The chief features of a high-frequency telephone circuit using valve transmitters and receivers are shown in Fig. 2, in which W_1 and W_2 are the outgoing lines to the distant station, and W_3 are the local lines to the ordinary subscribers' telephone instrument working on the ordinary system. In general the lines W_3 are connected to the switchboard of the ordinary telephone exchange, so that any subscriber on the exchange may be connected to them and thus speak over the outgoing trunk lines.

The coils L_4 L_5 are joined in series with the outgoing lines W_1 W_2, the former being coupled to the transmitting valve V_1 by the coil L_3 and the latter to the receiving valve V_2 by the coil L_6. The frequency of the transmitted oscillations is determined by the circuits

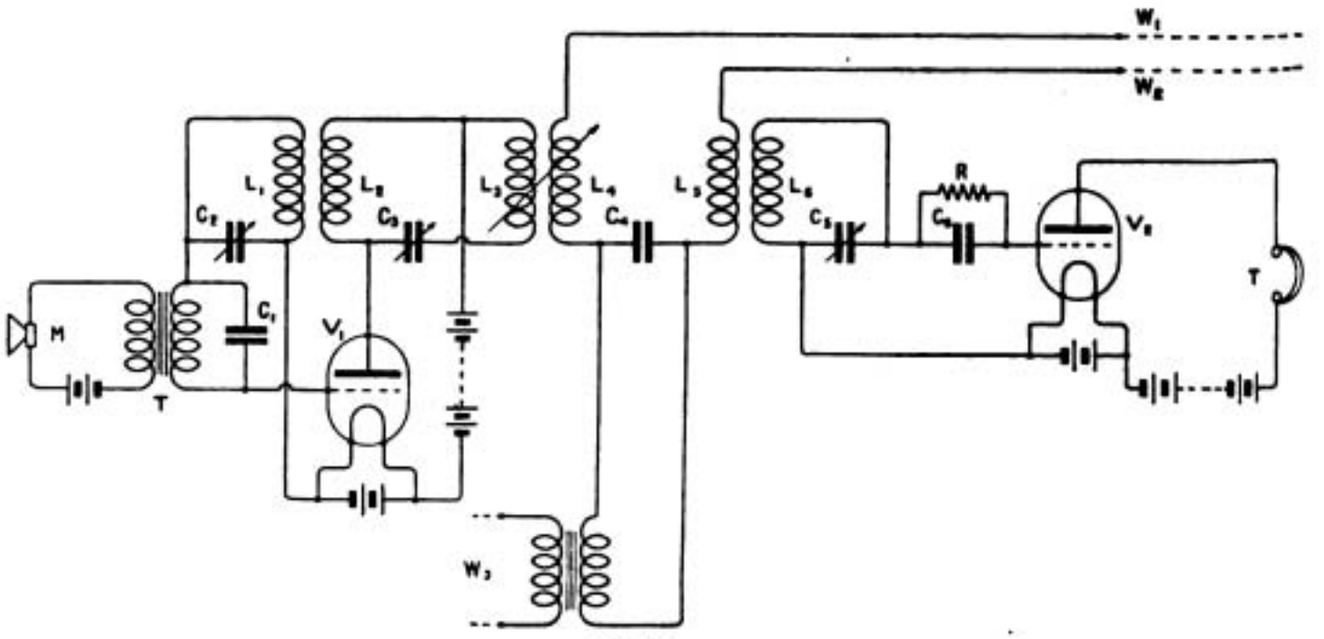


Fig. 2.

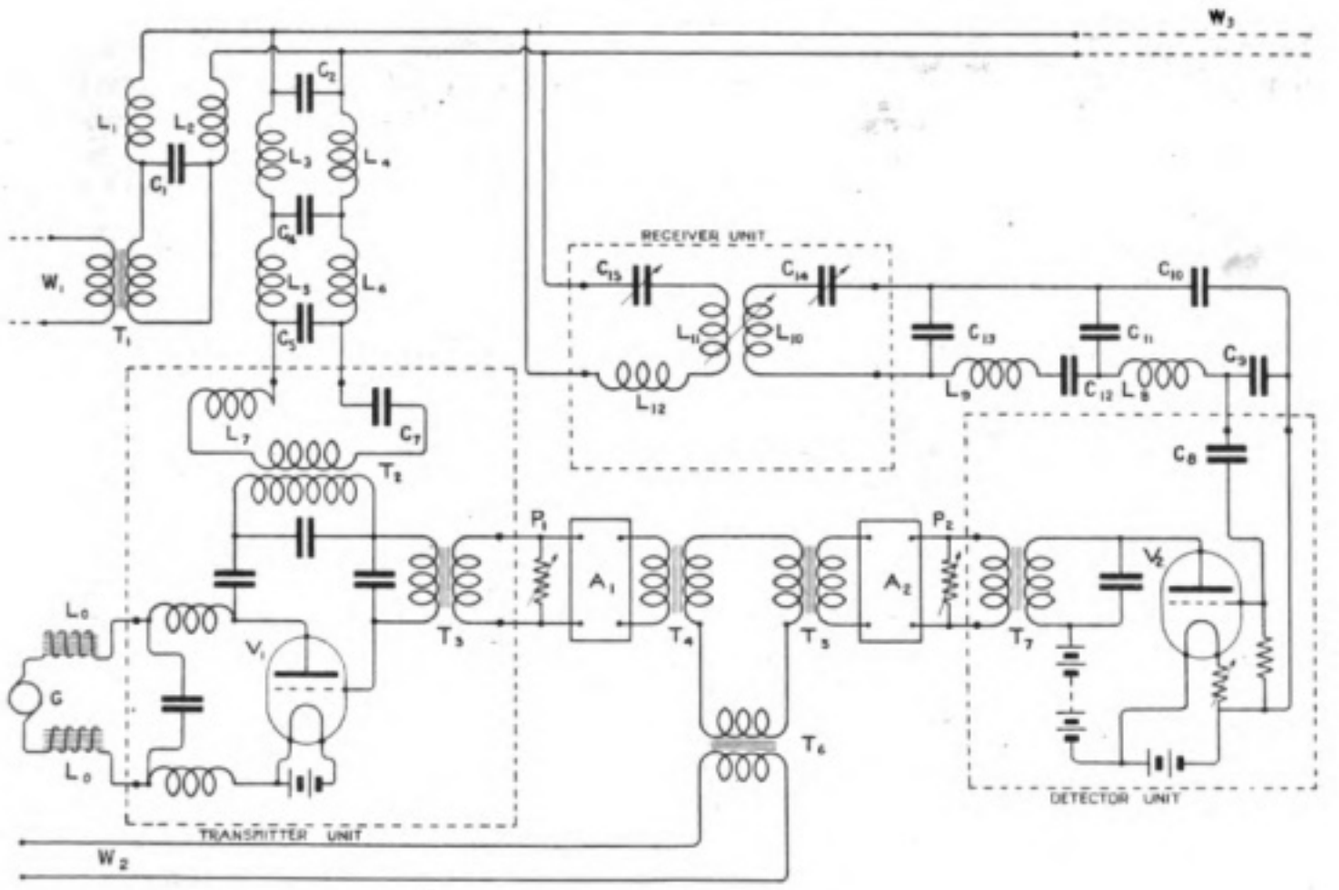


Fig. 3.

L_1 C_2 and L_2 L_3 C_3, and is made different from the frequency of the currents sent out by the distant transmitter, which are to affect the receiver circuits L_6 C_5 and the detecting valve V_2. The transmitting microphone M serves to modulate the intensity of the oscillations set up by V_1, and it will readily be seen from the diagram that the arrangement of the transmitter closely corresponds with an ordinary radiotelephone transmitter, while the receiver is an ordinary type of single-valve detecting circuit.

In practical working it is desirable that not only the circuit operating by the usual telephonic methods, but also the high-frequency circuit shall be arranged for connection to the telephone exchange switchboards, so that ordinary telephone subscribers may, with their usual instruments, be able to speak over either the ordinary or the high-frequency circuit without any difference in operating procedure. Such arrangements have been perfected in Germany, which country at the present time possesses probably the most extensive installations in existence working upon this method and has developed working high-frequency telephone exchanges as adjuncts to the ordinary telephone exchanges. One way in which such a circuit may be arranged is indicated in Fig. 3, which shows the main outlines of the arrangements used in the German high-frequency exchanges. W_3 represents the outgoing lines to the distant exchange. The lines W_1 are joined to the switchboard of the ordinary local exchange as are also the lines W_2 which connect with the high-frequency circuits. The remainder of the apparatus shown in this figure is located in the special high-frequency exchange, under the supervision of special attendants.

In his case, the apparatus shown to the left hand comprises the transmitter, that on the right the receiver, while in the centre

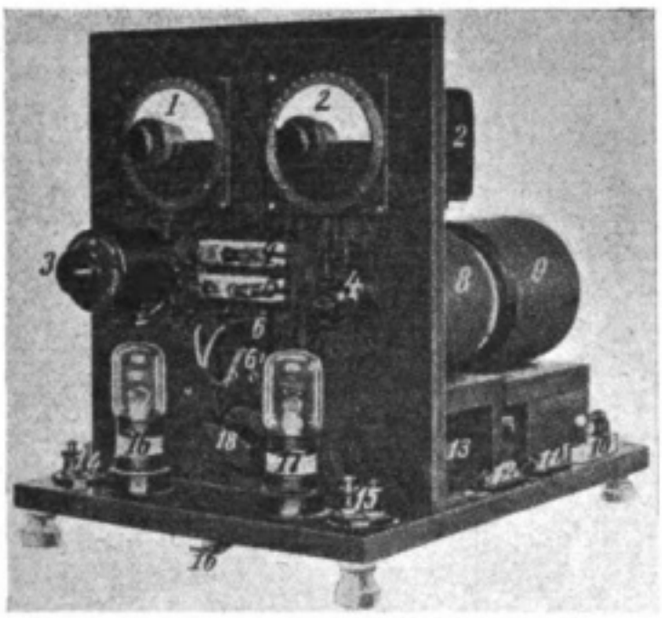


Fig. 4. Receiver and Detector Units used in German High-Frequency Exchanges.

1 and 2 = Tuning condensers—corresponding to C_{15} and C_{14} in Fig. 3.
3 = Intensity adjusting resistance (P_2).
4 and 5 = Valve filament protective resistances.
6 = Short-circuiting switch for inductance L_{12}.
8 and 9 = Receiver coupling coils (L_{11} L_{10}).
10, 11, 12 = Condensers.
13 = Transformer (T_7).
14 and 15 = Terminals of incoming and outgoing lines.
16 and 17 = Receiving valves, two used in parallel (shown as V_2 in Fig. 3).
18 = Shunt condenser in parallel with HT battery.

is the linking apparatus for coupling the two together and to the exchange lines W_2. The transmitter, which consists of the oscillation generating valve V_1, fed from the high voltage generator G, has its plate circuit coupled through T_2 to the filtering circuit C_2 L_3 L_4 C_4 L_5 C_5 L_6, and thence to the outgoing lines W_3. The grid circuit of the oscillating valve (or valves, since several may be used in parallel when required for signalling over longer ranges) is coupled through T_3 to the amplifier A_1, and thence through T_4 and T_6 to the exchange lines W_2. The incoming speech currents from W_2 thus modulate the strength of the high-frequency current, passing out to the lines W_3 from V_1. The choke coils L_1 L_2, in conjunction with the shunt condenser C_1, serve to prevent these high-frequency currents from passing through the ordinary telephone instrument directly connected to W_1.

The Receiver Unit, which is also shunted across the outgoing lines, contains the tuned circuits and couplings L_{11} L_{12} C_{15}, and L_{10} C_{14}, while the Detector Unit contains the detecting valve V_2, with its grid condenser C_8 and leak, its output transformer T_7, and the necessary batteries, etc., as shown. The receiver and detector units are united by the filtering circuits C_9 C_{10} L_8 C_{11} C_{12} L_9 C_{13}, which are designed to prevent disturbance of the receiving apparatus by the local transmitter operating upon a slightly different frequency, just as the filtering circuits at the transmitter prevent the circulation of the receiving frequency currents through the circuits of the transmitting valve.

The output circuit of the detector unit is completed through the amplifier A_2 and the

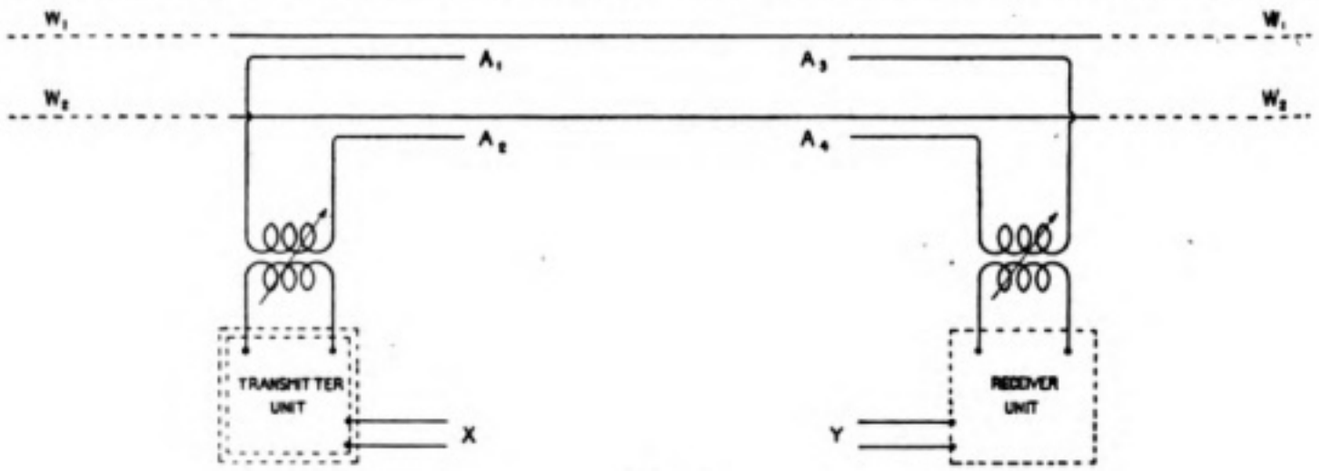


Fig. 5.

transformers T_5 T_6 to the exchange lines W_2. The adjustable resistances P_1 P_2, joined across the transmitting and receiving amplifiers as shown, serve to adjust the intensities of the outgoing and incoming impulses.

Fig. 4 illustrates one form of receiving apparatus used for this high-frequency telephony.

In addition to wired wireless transmission over ordinary telephone and telegraph lines, the same type of apparatus may be applied to effect communication over high-tension overhead power distribution networks between the central and sub-stations. If the telephonic apparatus were directly connected to these lines there would be serious danger of shocks from the operators using the telephone apparatus, but it has been found possible to dispense with the direct connections and substitute therefor two separate "aerial" wires, stretched out for a short distance along the poles supporting the high-tension wires, Fig. 5. At each station two sets of such "aerials" A_1 A_2 and A_3 A_4 are employed, one set being used for transmission and the second for reception, as indicated. The transmitter control circuit X and the receiver output circuit Y may be coupled together and to a common telephone instrument by a method similar to that shown in Fig. 3.

A "TURNER" VALVE RELAY

By J. E. Harrison.

As the writer was much impressed by the "Automatic Call Device," described at a meeting of the Wireless Society of London, on April 30th, 1920, and subsequently in *The Wireless World*, Vol. VIII, No. 5 (May 29th, 1920), an experimental relay was constructed, details of which are given below.

Some of the present-day amateurs, who are not yet expert telegraphists, may find a piece of apparatus of this description very useful for recording incoming signals which are transmitted at a speed in excess of their limits of reception.

It has been found that signals from most European stations can be recorded in London using a single valve receiver and one note magnifier in conjunction with the relay. The electrical details for construction were obtained through the medium of the "Questions and Answers" column of *The Wireless World*, Vol. VIII, No. 12, page 435. As will be seen from the diagram, the "relay" consists of a polarised P.O. relay, intervalve transformer, valve, oscillatory circuit with reaction coil, potentiometer and filament rheostat. The latter is not shown in the diagram accompanying the article as originally published, but is a useful adjunct as regards economy of filament current and for obtaining

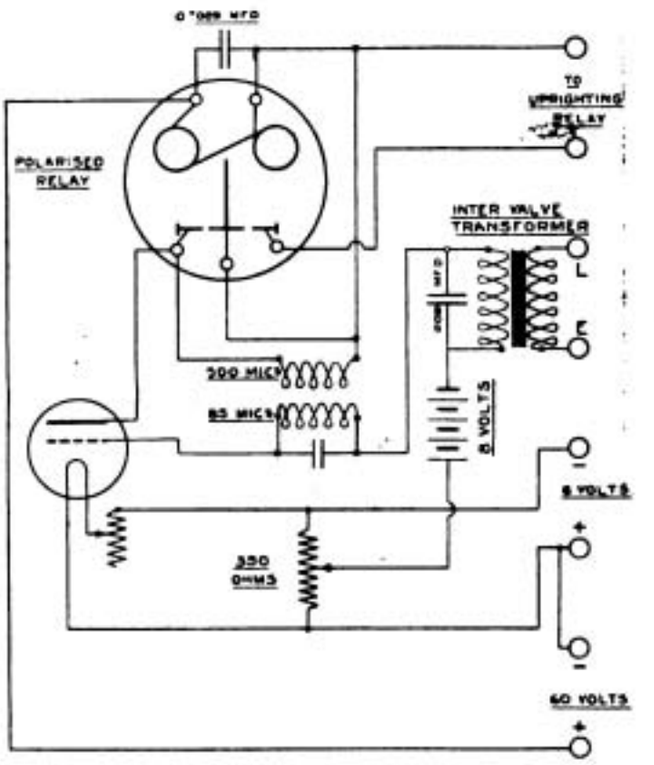


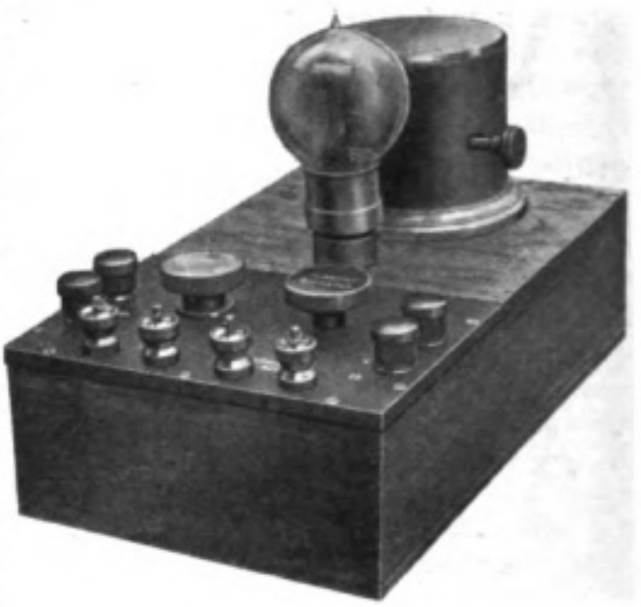
Diagram of Connections.

a fine adjustment. The valve (a Mullard "R") is rather critical on filament current adjustment.

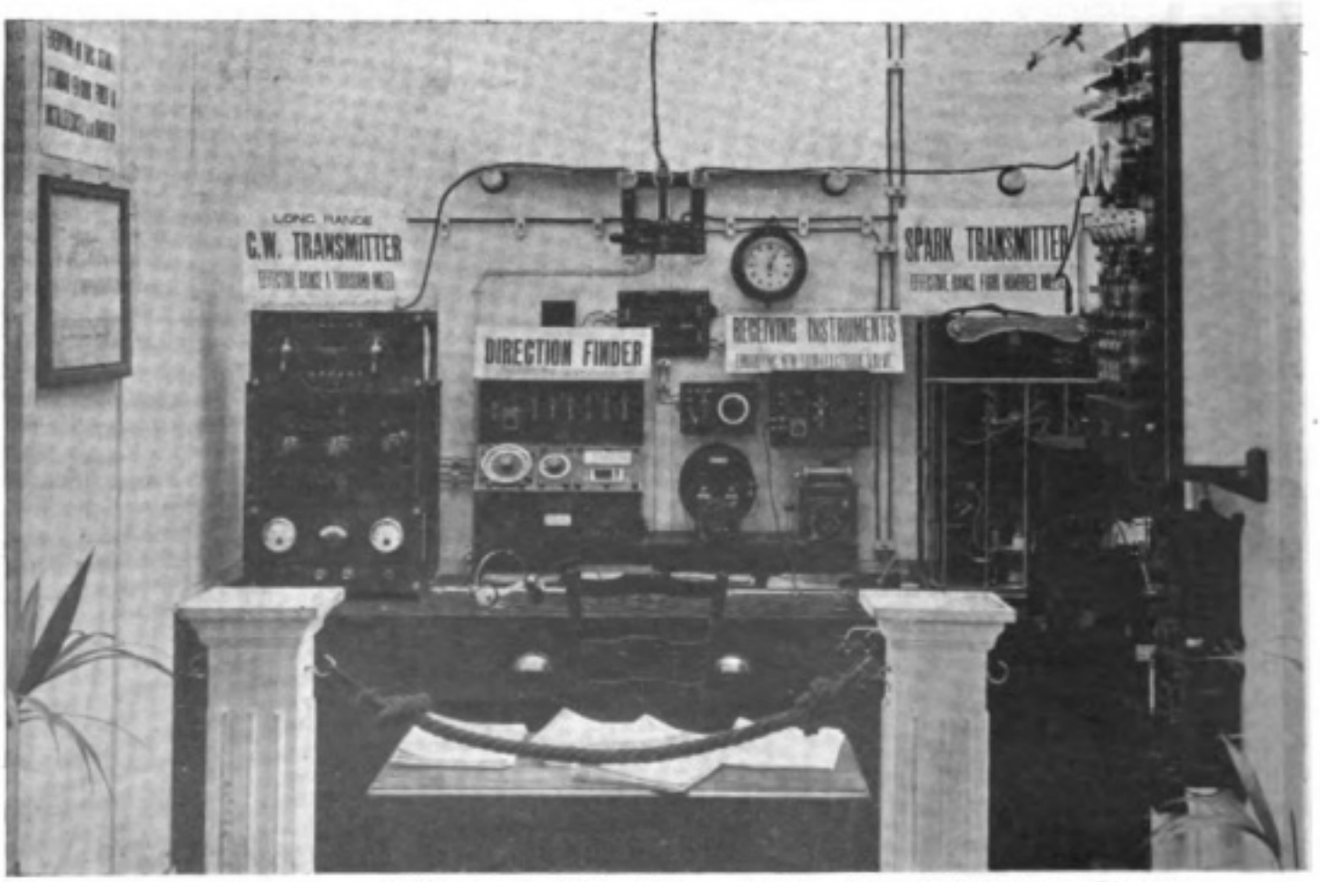
The relay is an old P.O. polarised relay rewound with 44 S.W.G. wire enamelled, 10,000 turns per bobbin, approximate total resistance, 1,600 ohms. It responds well with ·5 milliampere up to 40 words per minute. The intervalve transformer consists of a primary (3,500 turns) and a secondary (18,000 turns), 47 S.W.G. S.S.C., wound on a "Stalloy" core. Two basket coils were wound with 26 S.W.G. D.S.C. and 34 S.W.G. D.S.C., having values of 85 and 500 mhys. respectively. A potentiometer of 350 ohms. resistance is incorporated and the condensers are composed of copper foil and mica.

The 8-volt battery included in the set is contained in the base and consists of two nominally $4\frac{1}{2}$-volt flash-lamp batteries in series. The case is constructed of $\frac{1}{4}''$ oiled teak, $10'' \times 6'' \times 2\frac{3}{4}''$, with an ebonite terminal panel, $6'' \times 4'' \times \frac{1}{4}''$.

The full description of the action of the relay is given in Vol. VIII, No. 5, *The Wireless World*. The accompanying photograph shows the general appearance of the relay.



The Complete Instrument.



Marconi Apparatus exhibited at the Shipbuilding and Electrical Exhibition in Glasgow.

THE TRANS-ATLANTIC AMATEUR TESTS.

PRESENT ARRANGEMENTS.

As previously announced in this magazine and in the daily press, arrangements have been made in the United States for the transmission of wireless signals by certain amateur stations for the purpose of obtaining communication with amateurs on this side of the Atlantic. The organisation in America is in the hands of the *Everyday Engineering Magazine*, and amateurs entering the contest are required to limit their transmitter input to 1 kW (measured at the source of power supply), transmission being effected on a 200-metre wavelength. In order to prevent overlapping, a definite schedule will be adhered to, and under present arrangements transmission will take place at 3.15 a.m. G.M.T. on February 2nd, 4th and 6th.

In England the arrangements are in the hands of Mr. Philip R. Coursey, B.Sc., Assistant Editor of the "Radio Review," and wireless amateurs who wish to take part in the tests are asked to communicate with him at 12 and 13, Henrietta Street, W.C.2.

PRIZES.

In order to encourage amateurs to put their best efforts into the reception of the American signals, the following firms have generously offered the prizes detailed below :—

Messrs. Burnham & Company.—A three-valve amplifier to the most successful amateur. Should no competitor succeed in receiving the signals, the prize will be awarded for the best description, published in *The Wireless World*, of apparatus used in the attempt.

The Dubilier Condenser Co., Ltd.—Condensers to the value of £10 to the most successful competitor. Precise details of the condensers awarded will depend upon the choice of the winner.

Messrs. H. P. R. Wireless, Ltd.—The H.P.R. Universal Receiver, having a wavelength range of 400 30,000 metres, to be awarded to the winner of the competition if he succeeds in picking up the signals on one of the new short-wave receivers now manufactured by that firm.

Messrs. Halliwell & Good, Ltd.—Goods selected from their catalogue to the value of £30, provided that at least one piece of essential apparatus used has been supplied by them.

The Marconi Scientific Instrument Co., Ltd. A first, second and third prize of a selection of apparatus to the value of £25, £15 and £5 respectively, and, in addition, six consolation prizes of Marconi "V24" valves.

IMPORTANT NOTICE.

At the time of going to press final details of the arrangements and schedule of times have not yet arrived from the United States. In view of the fact that the next issue of *The Wireless World* will not be published until after the tests have been conducted, further particulars will be sent by post to those who have enrolled their names with Mr. Coursey.

Should amateurs be successful in their reception of the American signals, it is essential that they send to Mr. Coursey—

(1) Complete timed log of all signals received with estimated relative strengths ;

(2) Full particulars, circuit diagrams and, if possible, photographs of the apparatus used ;

(3) Precise location of the receiving station, with particulars of surrounding country (presence of trees, hills, rivers, coast-line, etc.)

Full particulars of the successful station or stations will be published in a forthcoming issue of *The Wireless World*.

NOTES AND NEWS

Public Wireless Service to France.—A new public telegraph service between England and France was opened Saturday morning, January 8th. High-speed duplex wireless transmission will be employed, and it is hoped that this additional means of communication between England and the Continent will afford considerable relief to the present congestion. The service will be conducted by Marconi's Wireless Telegraph Company, Ltd., and the Compagnie Generale de Telegraphie sans fil, these companies operating under licences from the British and French Governments. The current telegraph rates between the two countries will apply.

Telegrams to France, intended for transmission by this new service, may be handed in at all times at the Marconi Company's London offices, Fenchurch Street and Marconi House, Strand. On and after January 12th, they will also be accepted at any postal telegraph office within the United Kingdom. Messages so tendered, however, must be marked "*Via* Marconi."

For this service the latest high-speed automatic apparatus, such as was used between Geneva and London during the sitting of the Assembly of the League of Nations, will be employed. By this means will be secured the three essentials of speed, accuracy and secrecy.

Eiffel Tower's New Year Greeting.—One of our readers, Mr. Kenneth S. Payne, has sent us the Eiffel Tower's New Year's Eve message, copied by him at his station. The message reads:

A tous les amis de la radio le vieux poste de la tour Eiffel présente ses meilleurs voeux de bonne et heureuse année et forme les voeux les plus fervents pour que celle qui s'ouvre soit féconde en progrés radiotélégraphiques.

[*To every friend of wireless, old radio station Eiffel Tower offers its best wishes of good and happy New Year and frames most fervent wishes so that opening year will be fecund on radio improvements.*]

Amateur Radio Calls.—The call **2JJ** belongs to Mr. C. Wortley's station at 4, Riversdale Road, Egremont, Wallasey. 180 metres spark, C.W. and telephony; 1,000 metres, C.W. and telephony. Hours of working, 7.30 to 9.30 p.m. G.M.T. Power, 10 watts.

The call **2JF** is Mr. C. G. Williams' station at 22, Scholar Street, Sefton Park, Liverpool. 18. metres spark, C.W. and telephony; 1,00 metres, C.W. and telephony. Hours of working, 7.30 to 9.30 p.m. G.M.T. Power, 10 watts.

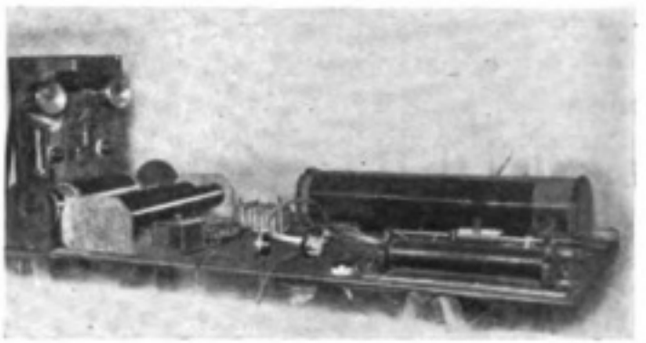
The call signs **2BN** and **2BQ** belong, we understand, to the L. & N.W. Railway, at Crewe and Euston respectively. A good deal of telephony has been done by these stations recently.

Another call, **2FH**, belongs to Mr. T. I. Rogers' station, 2, Park Hill, Moseley, Birmingham.

Lafayette Wireless Station.—On December 18th the French Government formally received the great Lafayette Wireless Station at Croix d'Hines, near Bordeaux, which was built by the United States Navy during the war. The station, which has a radius of 7,000 miles, was actually given to France some time ago, but the formal presentation by Admiral Magruder, on behalf of the American Ambassador, took place on the 18th of last month.

The station consists of a central dispatching section, with eight receiving towers over 800ft high, arranged over an area of 100 acres, and it will be able to communicate directly with the most distant French Colonies as soon as colonial stations are erected.

An Amateur Station.



The above photograph shows the single valve receiving set belonging to Mr. R. W. Jackson, Causeway, Great Baddow, Essex.

The Physical Society of London and the Optical Society.—The eleventh annual exhibition of electrical, optical, and other physical apparatus, was held on January 5th and 6th, at the Imperial College of Science, South Kensington.

Matters of wireless interest included a demonstration of "Some of the Uses of a Thermionic Valve," by Professor C. L. Fortescue and Dr. Bryan.

A number of firms manufacturing wireless apparatus were exhibiting, including Marconi's Wireless Telegraph Co., Ltd., The M.O. Valve Co., Ltd., H. Tinsley & Co., Ltd., Cambridge and Paul Instrument Co., Ltd., Creed & Co., Ltd., and H. W. Sullivan and the Radio Communication Co., Ltd.

A CORRECTION.

We regret that in our issue for January 8th an error arose, in the paging of the articles, which must have caused confusion to a number of readers.

On page 723 the article entitled "A Morse Practice Set," was made to finish with the sentence "the other pole of the battery O was connected to the metal of the holder."

Also, the matter on page 725 appears as a continuation of page 724, Actually, the first column and the first eleven lines of the second column are a continuation of the article "A Morse Practice Set," the remaining matter in the second column, page 725, beginning "The amateur will probably save himself much trouble," and ending "so that the local oscillations may be induced into the tuning circuit," is the conclusion of the article "The Construction of Amateur Wireless Apparatus," from page 724.

WIRELESS VALVE CIRCUITS AS APPLIED TO THE MEASUREMENTS OF PHYSICAL QUANTITIES *

By R. WHIDDINGTON, M.A., D.Sc., Professor of Physics, in the Univerity of Leeds.

A SHORT time ago your President, Mr. A. Campbell Swinton, delivered an address entitled "Some Wireless Wonders," being a most entertaining account of the recent progress and present state of wireless telegraphy. As you are well aware, the lecture just referred to brought out in a very clear manner the fundamental importance of that extraordinary device we call the thermionic valve—or triode.

It is my aim this evening to explain to you how a valve, in association with the now well-known wireless oscillating circuit, can be made to perform hitherto impossible feats of delicate measurement in the physical laboratory. As our time is short I propose to limit myself to only one of the investigations I have been conducting recently—its application to the measurement of minute distances.

The principle involved will appear in a most simple light to an audience so well versed in valve practice.

Fig. 1 shows, diagrammatically, the essentials of the apparatus.

On the left of the diagram is a valve, V, provided with the usual filament and anode batteries, grid and anode inductances, B, and variable air condenser, A.

On the right-hand side is shown an exactly similar arrangement in heterodyne with its fellow, provided with a telephone, T, and a condenser of a special design, A′.

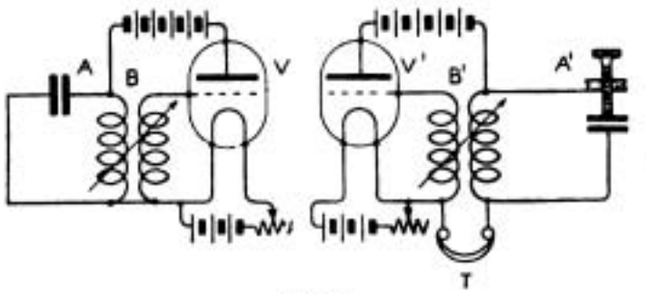


Fig. 1

It is this condenser which forms the basis of the arrangement, for it consists of a small pair of parallel metal plates of equal size, so arranged that one is permanently fixed and the other is capable of controlled motion in a direction at right angles to its own plane.

In the diagram this motion is shown as governed by a screw, although in practice other methods were used, as will be explained below.

Let us now investigate what will happen if the distance between these plates, A′, be changed slightly.

Clearly a change in capacity of the plates, and, therefore, of frequency of the associated circuit will result. Expressed symbolically, N, the initial frequency of the circuit is given by the usual approximate formula,

$$N=\frac{1}{2\pi\sqrt{LC}} \quad - - - - - - - (1)$$

where we have neglected the influence of the valve, the circuit resistances, and the mutual induction between the coils— L being the inductance of the anode coil and C the capacity of the pair of plates.

But if these plates are initially a distance x apart, the capacity is approximately given by $C=\frac{A}{4\pi X}$ when A is the area of either.

Substituting in the above expression for the frequency we obtain

$$N=\left(\frac{X}{\pi LA}\right)^{\frac{1}{2}} \quad - - - - - - (2)$$

which gives us the dependence of N on x.

Differentiating with respect to x we see that

* *A Paper read before The Wireless Society of London, at the Royal Society of Arts, on Tuesday, Dec. 21st, 1920*

$$\frac{dN}{dx} = \frac{1}{2(\pi LAx)^{\frac{1}{2}}}$$

$$= \frac{N}{2x} \quad - - - - - - - - - (3)$$

which shows us exactly how the frequency changes with x. In order that $\frac{dN}{dx}$ may be large $\frac{N}{x}$ must be large also, the most sensitive arrangement being attained when $\frac{N}{x}$ is greatest.*

We will now insert likely values of N and x in equation (3) in order to obtain a clearer perception of its import.

If $N = 10^6$ (corresponding to about 300 metres wavelength) and $x = \frac{1}{1000}$ inch,

$$\frac{dN}{dx} = \frac{10^9}{2} \text{ or } \delta x = \delta N \times 2 \times 10^{-9} \text{ ins.}$$

If we now suppose that in practice we are able to determine a change in frequency (δN) of so little as unity we see that a change in distance (δx) between the plates of only 2×10^{-9} inches produces an observable change in frequency of unity.

Theoretically, therefore, we might hope to be able to produce an observable frequency change when the distance between the plates alters by so little as 2×10^{-9} inches, or $\frac{1}{500000000}$ inch.

Laboratory Arrangement

The actual laboratory arrangement of apparatus is shown in Fig. 2.

The pair of parallel plates is housed in the box on the extreme left of the bench; on the right-hand side of this is another box containing the high-frequency coils, with the valves mounted just above.

The loud-speaking telephone, T,† is seen on the wall behind.

Very large constant batteries were used and care was taken to shield every sensitive

* $\frac{N}{x}$ diminishes continuously as x increases proportionately to $x^{-\frac{1}{2}}$

† A 3-stage note amplifier was used in conjunction with this telephone to make the note sufficiently loud.

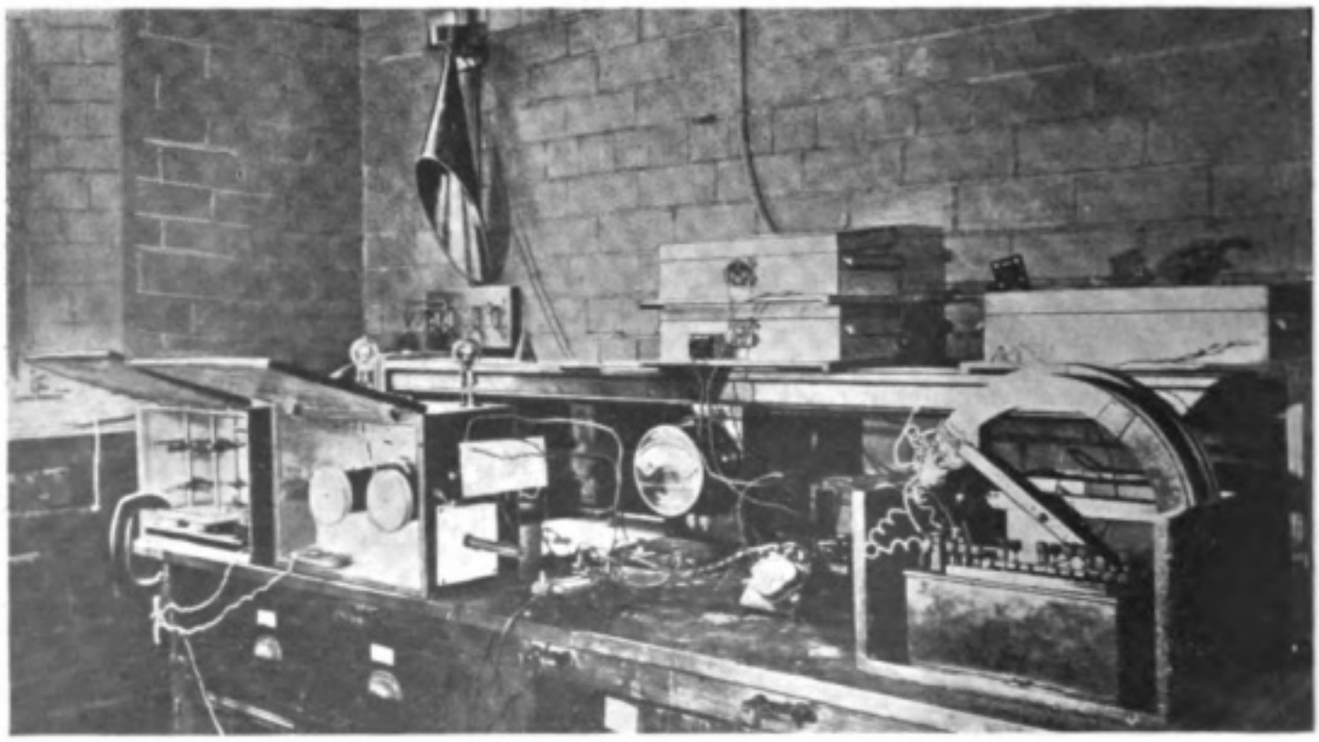


Fig. 2

part of the apparatus from temperature and electrostatic effects.*

It is now necessary to digress for a moment to explain a special arrangement which was found highly desirable if such a small change in frequency as unity was to be satisfactorily observed. We will take numerical examples first to clear the ground.

Our right-hand circuit in Fig. 1 has, initially, a million frequency; supposing the left-hand one to be oscillating at 995,000, we shall have a musical beat-note of 5,000 issuing from the telephone. A change of one in a million in the right-hand circuit will now appear as a change of 1 in 5,000 in the telephone. But, although by this frequency lever we have an advantage of $\frac{1,000,000}{5,000} = 200$ it is very unlikely that the resulting change in pitch would be recognizable by the ear.

Even if the beat-note be reduced to $(1,000,000 - 999,000) = 1,000$ such a small change is still only a change of 1 in 1,000 and probably too small to be detected as a change in pitch.

We must approach the two high-frequency circuits still more closely. If we could adjust them until their frequency difference was only 10 or less than a change of unity could easily be detected.†

A very serious practical difficulty here presents itself. When the two circuits are so closely tuned there is great danger of one forcing the other into step with the result that no beats can be heard at all. This phenomenon is a familiar one to those accustomed to continuous-wave circuits; it is not possible to get a beat-note of low musical pitch between two circuits unless they are extremely loosely coupled.

Again, when this latter condition is realised the intensity of the beat may be too small to be audible.

I have been able to get over this difficulty by setting up a third oscillating circuit (on the extreme right of the bench shown in Fig. 2), made up of very large inductances and capacity so as to give an audible oscillation of about 1,000 frequency.

This audible note is heard in the telephone, simultaneously with the heterodyne beat-note, and is used as a standard to which the latter is nearly adjusted. By this means we can get loud slow beats between these two musical notes, and observe the change in frequency (δN) between them.

It is, of course, very necessary to be sure that the frequency of this auxiliary musical circuit can be taken as constant over the time of any one observation, and a number of experiments have been carried out to confirm the theoretical expectation that fair constancy may be assumed.

Theory shows us that when every complicating factor in a valve oscillating circuit is considered the simple formula for the period of oscillation, $T\left(=\frac{1}{N}\right)$ is no longer $2\pi\sqrt{LC}$ but becomes

$$\frac{4\pi L}{\sqrt{\frac{4L}{C}\left(1+\frac{R}{P}\right)-\left\{R+\frac{1}{CP}(L+KM)\right\}^2}}$$

in which we may take briefly :—

R = resistance in anode circuit.
P = resistance of valve.
M = mutual inductance between grid and anode coil.
K = amplification factor of the valve.

We see, therefore, that a change in any one of

* Fluctuations believed to be due to barometric changes have been observed, but are difficult to eliminate.

† An experiment illustrating the sensitiveness of the slow-beat method was here shown. Two musical note-valve circuits were set up, each having air-core inductances arranged with a minimum of mutual inductance. Each produced separately a high musical note in a loud speaking telephone. When sounding together beats were heard which could be set to any speed by varying one of the condensers. These beats were shown on the screen by the motion of the needle of a small highly-damped galvanometer which flicked over at each beat.

A small iron screwdriver, placed some inches away from the coils, altered the inductance sufficiently to make a very large alteration in the number of beats, but when one of the circuits was used by itself not the slightest change in pitch could be detected by the ear alone.

these quantities will produce a change in the frequency. By using large batteries and keeping the circuit at a constant temperature, however, we can successfully maintain them steady over moderately long periods of time.

There remains a difficulty yet to be mentioned in connection with C. This capacity is the sum of two individual capacities, that of the valve and the condenser, used in the associated circuit. The latter may be maintained sufficiently constant, but the valve is subject to small changes in capacity of various origins, some of which are more or less accidental and difficult to control. It is possible, however, by suitably choosing the valve and, more important still by making the external capacity very much larger than the valve capacity to eliminate to a great extent these small changes.*

We are now in a position to proceed with the experimental verification of formula (3) on page 740.

The parallel plates were mounted on a rigid geometrical slide, as shown in Fig. 3, and small bending moments applied to the bar by putting weights into the scale-pan.

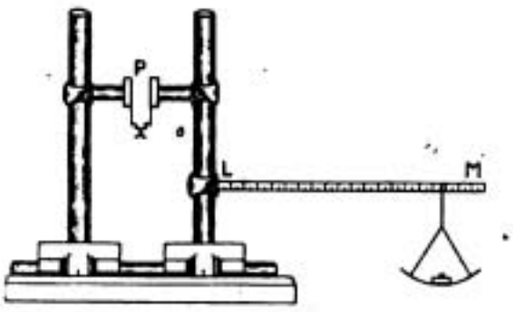


Fig. 8.

This pan was made of light paper and was capable of sliding along the quartz rod LM, which was clamped at L to a vertical steel pillar $\frac{1}{2}$ inch in diameter. Preliminary experiments, using an engineer's micrometer, showed that the centre of the left-hand plate moved through a millionth of an inch (10^{-6} inch) when a load of 0·14 gram. was added to the pan at 10 inches from L. Since smaller weights produced proportionately smaller displacements, according to Hooke's Law the displacement produced by any weight could be computed. It was found that when the apparatus as a whole was working properly a weight of 1 milligram at 5 inches from L produced an easily detected change in the slow beats.

This weight corresponded to a displacement of the plate of about $\frac{1}{200000000}$ inch, which is of the same order of sensitiveness as that predicted by equation (3). A sufficiently close agreement, in view of the fact that no special pains were taken to ensure that the plates were accurately parallel and $\frac{1}{1000}$ inch apart—in fact, the distance x was almost certainly much greater than this.

The interesting fact emerges that it is possible to detect a distance so small as $\frac{1}{200000000}$ inch with apparatus that can be fairly manageable. It is quite safe to say that prior to the advent of the valve no apparatus capable of directly indicating so minute a distance had been evolved, the nearest approach being the optical interferometer, with a sensitiveness some 50 to 100 times less.

DISCUSSION.

The President : I am sure we are all delighted with Professor Whiddington's explanation of his very wonderful researches. I remember that when Sir Joseph Whitworth invented a machine for measuring it was supposed to measure to the 1/1,000,000th of an inch, but I believe, as a matter of fact, that it never measured much less than 1/100,000th of an inch. That was considered a marvel in its way, but now we have a machine that will measure 1/200,000,000th of an inch, and even measure the size of the atom, which is one of those things which has come about from that very wonderful instrument, the thermionic valve. I do not know if this Paper is exactly a Paper that calls for discussion, but I am sure Professor Whiddington would be very pleased to answer any questions or to listen to anything any member has to say on the subject. I will, therefore, ask if any member would like to put any question, or to make any contribution to a discussion on this very interesting subject.

Mr. G. G. Blake : There are two points which occur to me arising out of the Paper. I was at a

* Tables of measurement were shown indicating how a valve circuit, having a large capacity in the oscillating circuit, could be maintained at an oscillation frequency of 1,000 to within 8 parts in a million over a period of several days. The filament was not flowing continuously—an important point.

lecture given by Dr. Eccles at the Royal Institution a little while ago, when he showed heterodyne experiments. A bottle of ether vapour was held near the condenser when he was getting beat notes, and the effect was to entirely upset the balance and produce another note, showing how very very sensitive it was and how one could measure the difference between various dielectrics by this method. I wonder whether some of the stray influences of which Professor Whiddington speaks, might not be due to changes in the gases in the room. Another point which has occurred to me is this. Dr. Eccles showed a rather interesting experiment between the plates of a condenser and the plates of a gold leaf electroscope. When he held a charged rod near the electroscope he showed that a very slight difference in the position of the leaves of the electroscope to the plates of the condenser altered the capacity and gave a different note. It occurs to me that perhaps such a method might be applied to Professor Whiddington's apparatus for the measurement of very high voltages. and I should like to hear what Professor Whiddington has to say on that point.

Mr. Smith Rose: I should like, first of all, to congratulate Professor Whiddington upon the very ingenious arrangement that he has for applying the valve to the measurement of and change in very small distances. I had the pleasure of witnessing a demonstration of it in Professor Whiddington's laboratory recently, and it impressed me with the tremendous advance that has been made in recent years in the measurement of small distances. To the average engineer, used to the distances measured by the ordinary micrometers, which at the best give measurements of 10,000ths of an inch, the figures given by Professor Whiddington must be staggering. It was thirty years ago that Sir Joseph Whitworth designed a machine for measuring to 1/1,000,000th of an inch, but I do not think the original machine measured anything like that. However, the demand for gauges for munition work during the war compelled the National Physical Laboratory to make a considerable advance in the measurement of distances, and we developed there apparatus for measuring changes of distance up to 1/1,000,000th of an inch, and suitable gauges were made for measurements of that order, and they found quite an extensive application in industry in dealing with gauges for ordinary engineering work. But to proceed from that to changes of the order of distance that Professor Whiddington has spoken of to-night is a tremendous jump. That jump has been made at one stride, and I am sure Professor Whiddington deserves congratulation. There is one point in connection with maintaining constant the frequency given out by the oscillating valve circuits. In the measurements which we have made at the National Physical Laboratory we have found it rather difficult to maintain the oscillating valve constant, when giving an audio frequency note to within one in a million. We have observed changes that take place, regular changes, in a valve oscillating at a frequency of 1,000 cycles per second. The changes come regularly at the end of about one in a million every half-hour, and if you observe the changes in frequency for the first hour or two you can leave the valve oscillating on its own quite freely, practically up to 100 hours, and be able to tell at the end of that time what frequency it will have. The change which Professor Whiddington has noted, I think, was 8 parts in 1,000,000 for 3 days, but, unless I have misunderstood him, that is just the relative change between the two valves which are oscillating. The two valves may be changed simultaneously, and if they are changed in the same way no change in the beat-note will be observed, and I should be glad if Professor Whiddington would clear up that point

Mr. P. R. Coursey: In connection with the formula shown on the screen for the sensitiveness, $N/2x$, the sensitiveness increases with increase of the frequency, and I should like to ask to what limits Professor Whiddington has gone in the direction of increasing the frequency beyond 10^6? I believe it is possible to get a frequency 20 or 30 times as great, if not more, than that of the oscillating valve used in this apparatus, if proper precautions are taken, but possibly the difficulties would be too great. Another point which occurred to me is that Professor Whi dington has shown to-night the effect of bringing iron near the coils in the audio-frequency circuits. Similar electrostatic effects take place with high frequency circuits, and I should like to ask if Professor Whiddington has had any trouble arising from that cause, and whether some of the changes which he has mentioned may not be due to electrostatic effects? I was interested to notice that the apparatus was screened in a metal box, but with high frequency circuits it is difficult to entirely screen out electrostatic effects.

Mr. Basil Binyon: Professor Whiddington has made some very modest claims for the practical application of this wonderful arrangement, and I look forward to seeing all kinds of developments arising out of it. I must confess with some surprise that after the wonderful accounts one used to read of the manner in which machines for ruling diffraction lines had to be put into pits, and all the other precautions for keeping absolutely constant the temperature, that the troubles which Professor Whiddington has experienced in that direction were not greater than they seem to have been. I should imagine for such very small changes of distance that the heat of the body many yards away from the apparatus would produce an instant effect, and I should not have been at all surprised if he had told us that he had to dig a great pit below the University at Leeds to carry out the work. There is one little side issue which struck me, and that was his slow-beat measurements, it was really very beautiful to notice the regularity. I believe some time ago the late Mr. Russell Clarke proposed to produce an electrical clock which was to operate on this slow oscillation period and have a most wonderful constancy, and I cannot help believing that there may be some very remarkable future for electrical timepieces operating on a beat method of low frequency oscillations, perhaps with a valve or something of that kind, which might give an extraordinary constancy. I only suggest it because I am afraid I have not thought about it, but one could

not help being impressed with the idea in merely watching the needle of the galvanometer working on the screen to-night.

Mr. Frank Hope-Jones : I also was fascinated by the beautiful experiment with the slow beat which Professor Whiddington showed us, and was reminded of the very same incident that the last speaker has referred to. I can tell Mr. Basil Binyon that the late Mr. Russell Clarke achieved quite a measure of success with that method. I provided him with some step-by-step time counters, and for some months he obtained a very respectable degree of accuracy. I am only sorry that the war and his untimely death appear to have stopped all those experiments, but it is well worthy of going further into. As to the degree of accuracy, I suppose it is too much to hope that it can really rival the accuracy of the marine chronometer or properly compensated pendulum under constant pressure, but the late Mr. Russell Clarke achieved quite a respectable degree of accuracy notwithstanding. I think we all desire to express to Professor Whiddington our thanks for such an excellent lecture as he has given us to-night.

Dr. J. Erskine-Murray : May I express my and our congratulations to Professor Whiddington on the remarkable new tone he has provided us with. The whole of scientific work will be very much more rapid because of the measurements which he has now made possible. I remember my friend, Dr. P. E. Shaw, of the Nottingham University, working for years in a cellar, with artificial light at all times of the day and night, on this same subject, but he only succeeded in measuring about 1/1,000,000th of an inch by a long series of levers and electrical contacts. I do not think he ever got very much further, but now we have a method of measuring up to 1/200,000,000th of an inch, which is a very different thing, and moreover, we have a very much simpler and more easily regulated apparatus. The one thing which struck me about Professor Whiddington's method is that it looks as though it might be a sensitive way of measuring magnetic flux and a rapid way of getting the magnetic properties of various materials, and no doubt lots of other things will open up as we go on with it.

Mr. Smith Rose : There are one or two other applications of this method which have not been mentioned. One is the minimum extension of substances which have very small coefficients of expansion, such as quartz and the alloy indra. Such substances, having small coefficients of expansion, are very difficult to measure by the ordinary methods, but by this method it should be possible to measure the change in length much more accurately. Another direction in which it might be of use is to measure terrestrial disturbances and earthquakes. I have not any idea of the apparatus used for recording earthquakes, but this arrangement strikes me as a very sensitive one, which, if we could have some method of recording frequency, would make a very admirable arrangement for that purpose. Another point is that if one tries to imagine what the surfaces of the plates of a condenser are like at a distance of the order of 1/200,000,000th of an inch, the results one would see would be certainly staggering. With 1/1,000,000th of an inch it is very difficult to get the surfaces of gauges machined accurately and true, but if you could imagine the plates of a condenser through such a distance as the author has mentioned, I think they would look something like the mountains of Switzerland. They would not be exactly flat, although Professor Whiddington said he had adjusted the plates approximately parallel. If one looks at the matter in that light the results to be obtained are distinctly interesting. Another point is, how far this method really takes us in the measurement of distances. I think it is fundamentally novel. One can never see an atom or an electron, however powerful the microscope. One can never see anything much smaller than the wavelength of light, and yet, according to the figures which Professor Whiddington has put on the screen, he is showing us distances which are of the order of 1/2,000th of the length of the shortest wavelength of light. That, again, is a result which is rather staggering when one realises it.

Mr. Morgan : I should like to ask the last speaker whether he has any knowledge of the methods of the Johannsen gauges, because they advertise that they can make them within limits of 1/30,000,000th of an inch. I was speaking to one of their engineers some time ago, and he told me that the process is a secret one, and I wonder whether they use this method at all.

Mr. Smith Rose : We have used a considerable number of Johannsen gauges. They are about the best gauges constructed in the world, and it was only recently, when we were unable to obtain a supply from Johannsen (they are a Swedish firm), that we set to work to make them ourselves at the National Physical Laboratory, and I think we have made gauges satisfactory in all respects, within the limits that can be measured. I do not think it is for me to criticise the claims of the firm of Johannsen, but I should accept the figure of 1/30,000,000th of an inch with some diffidence.

Professor Whiddington : I wish to crave your indulgence in replying to the many questions that have been asked. I am delighted that there has been such a lively discussion, but I am afraid if I were to answer all these questions in detail it would take at least another hour, or possibly more. But I will try my best to answer the main points. The first question was with regard to Dr. Eccles and the influence of ether on the capacity. That is, of course, undoubted. That was the principle which underlay the effect of barometric height which I mentioned. Barometric height produces the same effect on the capacity of the plates as the introduction of a foreign gas. Of course, that is a very great difficulty, but in my apparatus the whole thing is boxed up, and there is no question of any other gas getting in, and the only effect, I think, was that of barometric pressure. Mr. Smith Rose has opened up a tremendous field for argument. The constancy of a valve circuit I am now investigating in detail. I have got an assistant in my laboratory working on the constancy of musical note circuits, using a special absolute method of determination, and I hope to

run these changes to earth. Nevertheless, for the short time which I require to make these experiments, for the few minutes necessary, I think I can assume absolute constancy of the musical note circuit. Mr. Smith Rose's suggestion that the coefficient of expansion of materials might be measured by this method is certainly a good one. I used it quite accidentally. I first set up the apparatus, and found, if I got anywhere near the valves, the radiations from my body were sufficient to change the order of the note. In fact, it gave a most extraordinarily delicate method of determining the coefficient of expansion. As a matter of fact, the Fuel Research Department of the University of Leeds is contemplating using it for determining the coefficient of expansion of refractory quartz materials. Mr. Smith Rose's further remark about the surface of the plate being like the mountains of Switzerland is perfectly true, but it does not matter, because the plates are sufficiently far away from each other, and I think I can make the legitimate assumption that they are plane. A third speaker asked what the limits of frequency are that I work to. I am quite satisfied with the results I am obtaining to-day, using a frequency of 1,000,000. I have used a shorter wavelength, but found that the difficulties of controlling the apparatus increased with increase of frequency, and so I am continuing with my 1,000,000 for the present. Mr. Basil Binyon's remarks as to the heat effects on the plate are more or less covered by remarks I have already made. With regard to the late Mr. Russell Clarke's experiments on electrical clocks, I am afraid I rather agree with Mr. Hope-Jones that there is not a great deal of promise in that direction. Dr. Erskine-Murray's remarks about the lever method of determining very short distances I found very interesting. There is no reason whatever why the lever method should not be added to this arrangement. It is a practical method, and if you go into magnifications of 1,000,000 you can measure 1/2,000,000ths of an inch with great ease. The last speaker mentioned the possibility of using the arrangement for the determination of magnetic permeabilities. I have experiments on these lines going on, and we hope, amongst other things, to determine whether the electron is magnetic.

The President: I am sure you will all wish to accord Professor Whiddington a very hearty vote of thanks for the very excellent lecture and the beautiful demonstration that he has given us this evening, particularly when we have to take into account the fact that Professor Whiddington lives at Leeds and has brought up his apparatus specially from Leeds for the purpose of showing it to us. I ask you to accord him a hearty vote of thanks in the ordinary way.

The vote of thanks was accorded with acclamation.

Professor Whiddington: I omitted to say that I am indebted to Messrs. F. O Read & Co. for the use of some batteries, without which the experiments would have been quite impossible.

WIRELESS SOCIETY OF LONDON

ANNUAL GENERAL MEETING

Held after the above Paper had been read.

The President: We now have to resolve ourselves into a business meeting, and I will ask the Hon. Secretary to read the Annual Report that has been prepared by the Committee.

Annual Report.

This Report covers the first twelve months since the Society resumed its activities after the war. The year has been distinguished by a large accession to the membership, by the affiliation of a number of provincial wireless societies, and by the establishment of an annual conference.

This first conference was held at the Royal Society of Arts on the 27th February, 1920, under the Chairmanship of Sir Charles Bright, most of the fifteen societies then affiliated being represented. Commander F. G. Loring, R.N., a Vice-President of the Society, attended on behalf of the Post Office, and communicated an important announcement of the friendly attitude of the Government to wireless amateurs, at the same time indicating the directions in which greater freedom would be permitted.

More than thirty provincial and suburban wireless societies have now been affiliated.

The following papers have been read during the year under review :—

1919.

Nov. 26th. "A System for the Reception of Continuous Waves." By Mr. J. Scott-Taggart, M.C.

Dec. 19th. "Transmission of Electro-Magnetic Waves about the Earth." By Dr. J. Erskine-Murray, F.R.S.E.

1920.

Jan. 29th. "A Portable Set and some Properties of Continuous Wave Circuits." By Mr. R. C. Clinker.

Feb. 27th. "Presidential Address," "Some Wireless Wonders." By Mr. A. A. Campbell-Swinton, F.R.S.

Mar. 27th. "Harmonics in Continuous Wave Transmission" By Capt. L. A. T. Broadwood.

April 30th. "An Automatic Call Device." By Major Basil Binyon, O.B.E.

May 21st. "Some Methods of Eliminating Atmospherics in Wireless Reception." By Mr. Philip Coursey, B.Sc.

June 29th. "A small Wireless Telephone Transmitting Set." By Mr. G. G. Blake; and "Loop Aerials," by Admiral Sir Henry Jackson, G.C.B., F.R.S.

Sept. 30th. "Some Personal Experiences in connection with the Construction of a Six-Valve H.F. Resistance Amplifier." By Mr. Maurice Child.

Oct. 29th. Discussion on "The most Efficient Methods of Reception of Short Waves," opened by Mr. P. Coursey, B.Sc.

All these Papers, with reports of the discussions arising from them, have been published in the official organ of the Society—*The Wireless World*.

The above meetings were held in the lecture halls of the Royal Society of Arts and the Institution of Civil Engineers, to whom the thanks of the Society are due.

The stringent nature of the Post Office Regulations applying to the issue of Transmitting Licences, have made heavy demands upon the services of our Advisory Committee, who have carefully investigated the qualifications of applicants and have made recommendations in suitable cases.

Brigadier-General Sir Capel Holden, K.C.B., F.R.S., and Mr. E. H. Shaugnessy, O.B.E., have been elected Vice-Presidents.

At the beginning of the period covered by this Report the membership of the Society was 259, and is now 316.

The President: If anybody would like to discuss the Report it is, of course, open to them to do so. Time is getting on, however, and if nobody has anything important to say I will put it to the meeting that this Report be adopted.

The Report was adopted without discussion.

The President: I will now call upon Mr. Fogarty, the Hon. Treasurer, to give a statement with regard to the financial position of the Society.

Mr. L. F. Fogarty: I do not know whether, in view of the time being late, you will wish me to read the whole of the balance sheet. Fortunately, there are not very many figures attached to it. I have very much pleasure in reporting that the Society's finances are at present in a satisfactory condition The income for the past year has been approximately double that of the preceding year, so that, although the expenses have increased, there is available a satisfactory cash balance to meet the working expenses for next year. The increased income is accounted for by the large increase in membership, and the increased expenses are due to the cost of printing the Society's Proceedings and the distribution of these, and notices, at present postal rates. The accounts have been audited and a cash statement prepared by the Hon. Auditor, Mr. John Ockleshaw, F.C.A., and I desire to thank him for the great help he has given me.

The figures of the balance sheet, on the receipts side, show a balance brought forward from last year of £25 2s. 9d., subscriptions received £349 6s., and sale of publications 19s. 9d., making a total of £375 8s. 6d. The expenditure account shows printing and distributing Proceedings, £76 17s. 4d.; printing and stationery, £35 5s. 3d.; printing books of rules, £24 15s.; hire of lecture hall, £29 7s.; typewriting machine, £15 15s.; repairs to instruments, £1 18s. 6d.; Post Office Licence, 10s. 6d.; postages and petty expenses, £68 19s. 11d.; press cuttings, £3 3s.; making a total of £256 12s. 6d. and leaving a cash balance of £118 17s.

The President: I take it that the meeting will pass the Treasurer's Report. The accounts have been duly audited by a chartered accountant, to whom we are much obliged, as he does the work for nothing, and I will ask you to pass the accounts.

The motion was agreed to.

The President: I will now call upon Mr. Hope-Jones, the Chairman of the Society, to deal with the alterations in the rules of the Society, of which notice has been given, and also with the question of the election of the new President and the new Council.

Mr. Frank Hope-Jones, M.I.E.E.: You will recollect that in October last year we had our last annual general meeting, the first that was called after the war, and on that occasion you were good enough to confirm the Committee and officers in their office, and re-elected them for the year 1920. We did so really in spite of one of the rules of our constitution, which, if we had strictly interpreted it, would have rendered some of us ineligible for re-election. We decided, however, that the years of the war should be considered as a *dies non*, but to-night we, the officers of the Society, and the Committee, who have managed your affairs during the past twelve months, should

WIRELESS SOCIETY OF LONDON CASH STATEMENT.

October, 1919—October, 1920.

Dr. RECEIPTS.	£	s.	d.
Balance	25	2	9
Sundry Subscriptions	349	6	0
Sale of Printed Proceedings		19	9
	£375	8	6

Cr. EXPENDITURE.	£	s.	d.
Printing and Distributing Proceedings	76	17	4
Printing and Stationery	35	5	3
Printing Books of Rules	24	15	0
Hire of Lecture Hall	29	7	0
Purchase of Typewriting Machine	15	15	0
Repairs to Instruments	1	18	6
Post Office Licence		10	6
Postages and Sundry Petty Expenses	68	19	11
Press Cuttings	3	3	0
Cash Balance	118	17	0
	£375	8	6

vacate office automatically, according to the rules. It is a curious fact that your Committee woke up to, a month or two ago, that only three of our Committee are eligible for re-election according to the rules, and the rest of your officers are ineligible for re-election at all. That was not considered wise, because there are some officers of the Society who are really very valuable, such officers, for instance, as the Secretary and the Treasurer. I think those of you who have had anything to do with the conduct of societies may guess, but you do not actually know, the enormous amount of work involved, and the recently appointed members of the Committee, in accepting office, have made a definite stipulation that they would not take office if they were going to be robbed of the help and services of those who really know the details of the work of the Society, and could help them to carry on with continuity of policy. With such considerations in our mind, you will understand why it is that we suggest an alteration to the rules. Rule 33—I mention this first because it is first in number—states that there shall be six elective members of the Council, but we now propose that this number shall be eight. The membership of the Society is growing considerably, and on that ground, and also, perhaps, in sympathy with the democratic spirit of the age, we want more elective members: we want to feel that the members of the Society, the rank and file, are represented on the Committee. It is, therefore, proposed that we have eight elective members instead of six.

Then rule 34, which used to bar officers from taking office for more than a year, it is proposed shall read as follows:—

> "The officers shall be elected at the Annual General Meeting in December, to hold office for one year from the 1st January following, and shall be eligible for re-election. The members of the Committee, other than officers, shall be elected at the same time for one year, provided that no such member of the Committee shall serve for more than three consecutive years."

These alterations of rules have been very carefully thought out by the Committee at two meetings in succession, and notice in due form has been given, under date 6th December, to every member of the Society. An alteration in our constitution can only be made at an Annual General Meeting such as this, or at a Special General Meeting called for the purpose. The Secretary has received no notice of any alternative suggestion to these rules, and that, I think, is an indication that it is your intention to pass them to-night. I will ask the President, therefore, to put the alterations of these rules to the vote.

The President: I think Mr. Hope-Jones has explained the purport of these rules. We found there was going to be no continuity of policy under the rules as they existed, and it would never have done for the Society to lose all its officers and start afresh, as it were, and so, after quite a considerable amount of discussion and thought, we came to the conclusion that the alterations in the rules, which Mr. Hope-Jones has read out to you, should be made, I ask you therefore to vote upon them. Notice of these alterations has been circulated, and there is no suggestion of any opposition or of any alteration, and I now put the alterations to the meeting.

The alterations were agreed to unanimously.

Mr. Hope-Jones: That being so, ladies and gentlemen, the meeting is now free to elect, or rather, to confirm. the proposed election, whichever way we like to put it, of the officers and council for the coming year. I will read them. I should say that it was our duty, as the Committee of the Society, to put into your hands a fortnight before this meeting a list of nominations for these various offices and for the Council. It is also, according to the rules in order that any member may submit alternative names for the same offices, but no such alternative names have been sent in, and I will. therefore, read you the list of nominations put forward by the Council.

It is proposed that the President shall be Major J. Erskine-Murray, D.Sc., F.R.S.E.

The Committee have done me the honour to ask me to retain my office as Chairman. I presume largely for the sake of that one little quality of knowledge of the past history of the Society, and as some security for continuation of policy

As Acting Vice-Presidents, we have Admiral of the Fleet, Sir Henry J. Jackson, G.C.B., K.C.V.O., F.R.S., and Mr. Rene H. Klein, L.S.C., M.I.R.E.

As Vice-Chairman we have Mr. Basil Binyon, C.B.E., B.A., A.M.I.E.E., and Mr. G. P. Mair, A.M.Inst.C.E., M.I.Mech.E.

As members of the Committee, those who have already served are Mr. G. G. Blake, A.M.I.E.E., Mr. Maurice Child, Mr. P. R. Coursey, B.Sc., A.M.I.E.E., and Mr. J. Scott-Taggart, M.C., A.M.I.E.E., and as new members we have suggested for election Major N. H. Hamilton, D.S.C., A.M.I.Mech.E., Mr. J. Joseph, M.I.E.E., and Mr. W. H. Shortt, A.M.Inst.C.E.

Our Secretary, Mr. Leslie McMichael, and our Treasurer, Mr. L. F. Fogarty, are also nominated for re-election.

The position is that the number of nominations is the same as the number of vacancies, and as there are no alternative names I take it that these gentlemen will be elected.

The President: I declare that these gentlemen are all duly elected, by virtue of the fact that nobody else has been nominated in their stead, and, consequently, it will not be necessary to have a ballot.

The meeting agreed.

The President: Before I leave this chair there are two formal matters of business that I wish to do. I wish to declare that those gentlemen who were put up for ballot as new members of the Society this evening have been duly elected, and I have also to announce that Mr. H. H. Thompson, Mr. Dunham and Lieut. Burbury have been transferred from the class of Associate to that of full Membership.

Now, I just want to say a few words in parting from the position as first President of this Society, which I do with regret. I am sure it is to the interests of the Society that I should do so, because I have been there quite long enough. It is seven years since this Society was started, but, of course,

during a large portion of that period it was not in operation. I would like to say how much I feel indebted to those with whom I have been associated in the management of the Society. There is my friend, Mr. Hope-Jones, who has been a source of wise counsel and great tact upon all occasions. There is Mr. Klein, who, I believe, was the originator of the Society, and was the first Hon. Secretary. He also has been a gentleman with whom it has been a pleasure to be associated. Then there is Mr. McMichael, our present Hon. Secretary, and I do not know that you all realise what a very onerous business it is to be hon. secretary of a Society of this kind. He has a great deal of work to do, and I am sure we ought to be very much obliged to him for the amount of time and ability which he puts into the job. Then there is Mr. Fogarty, who has been looking after the finances of the Society from the beginning, with the result that I think I heard him say a short time ago that we were £100 to the good, which, I am sure, is a very satisfactory state of affairs for a small society of this kind. Further, I should like to thank all the other members, both past and present, of the Committee. It has really been a great pleasure to be associated with the Society. Perhaps it is because it is largely an amateur society. We have no business matters at the back of our heads, we are not trying to make money, but trying merely to advance the science, and, to some extent, to amuse ourselves with interesting scientific matters; but anyway, whatever the reason, the relations on the Committee, between myself and the other members of the Committee, have always been most amicable. We have never had any disputation of any description, and I can assure you that it has been one of the most pleasurable episodes of my life to have been the first President of the Wireless Society of London. I think, perhaps, there was some little doubt as to whether we should be able, successfully, to revive the Society after it had fallen into disuse during the war, but I think we have now got over all difficulties, and I believe the Society is on the road to a prosperous and useful career, and I look forward to its long life. I will now retire from the chair, and I will ask our new President, Dr. Erskine-Murray, to fill my place. I would like to emphasise how very pleased I am to be succeeded by Dr. Erskine-Murray, who has been one of the longest members of the Society. I know that he was originally a pupil of Lord Kelvin, and not very long after ceasing his college career he became associated with Mr. Marconi in some of his quite early experiments. Dr. Erskine-Murray has been connected with wireless telegraphy I do not know for how many years, and he is a very early worker in the field, and, as you all know, during the war, and for a long time before, he has been one of the masters of the subject. In fact, he has written one of the best books that there is on wireless telegraphy, and I think it is about time he published a new edition. (Laughter). Certainly at the time it came out it was one of the best books on the subject, and I am sure the Society is very much to be congratulated upon having such a master of the science to be its next President. I now ask Dr. Erskine-Murray to take the chair, although I do not know that he will have anything to do except to declare that this meeting is at an end.

Dr. Erskine-Murray: I think that my only duty is to declare that the meeting is at an end, but I should like, on behalf of myself and the rest of the Committee who have been elected by you to-night, to thank you for the confidence that you repose in us; I hope that we shall justify it in carrying on the Society during the next year, for which we are elected, keeping up its traditions of the past, and, if possible, adding something more to the lustre for the future.

The meeting then terminated.

WIRELESS CLUB REPORTS

The Wireless Society of London.

A full report is given elsewhere in this issue of the lecture delivered by Professor Whiddington, of Leeds University, on "Wireless Valve Circuits applied to the Measurement of Physical Quantities" to the above Society on December 21st, at the Royal Society of Arts. The lecture was followed by the Annual General Meeting, which is also reported elsewhere in this issue.

The annual conference with Wireless Societies affiliated with the Wireless Society of London will, in all probability, take place late in February, the exact date will be announced as soon as it is known.

A new edition of the rules and list of members of the Society is now in the hands of the printers, and will shortly be available for issue.

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Society was held at 8.30 p.m. on November 25th, Mr. D. F. Underwood in the chair.

The evening opened with a very interesting lecture, delivered by Mr. C. H. Bingham, on the 1½ K.W. S.F.R. set.

This was followed by a brief account, given by Mr. O. G Sandford, of his experiences at the recent meeting of the Wireless Society of London, during the course of which the Creed System was demonstrated.

There was a collection of members' apparatus on view, including a Mark III Short-Wave Tuner, which had recently been converted into a valve receiver.

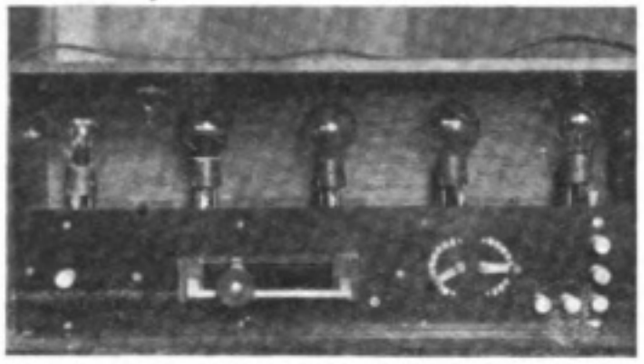
Full details as to membership will be forwarded to any interested gentleman, upon application to the Hon. Secretary, Mr. D. F. Underwood, 69, Southdown Avenue, Brighton.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At a meeting of the above Association on

December 29th, Mr. Foord, a member, exhibited a five-valve amplifier, which he had constructed to the designs of Major Binyon in a recent number of *The Wireless World*. He had put a great amount of skilled labour into the instrument as will be seen by the enclosed photograph, but its performance was not up to his expectations. Some of the club experts and consultants then weighed the matter up and came to the conclusion that the transformers were at fault, being too long, too thin and too tightly coupled. Mr. Foord, nothing daunted, procured some ebonite tube, 3" in diameter and wound about 1¼" of No. 40 wire in two sections on it. Treating this primary as the outside he made a variometer coil secondary, to revolve inside it, and tuned both windings dead to 200 metres with the aid of a standard wavemeter, procured from Messrs. Mitchells, of Rye Lane.



Mr. Foord's Five-Valve Amplifier.

The fact that he has had to make four of these variometers speaks volumes for his determination to hear something from our American amateur cousins, and is a specimen of the enthusiasm which rules in the Peckham Wireless Society.

At the meeting on January 5th, considerable discussion took place as to the form and disposal of the Club Aerial at the Central Hall Headquarters. It was decided to proceed with a plan suggested by the secretary. Mr. Knight, the Chairman of the Association, then followed with a lengthy and interesting description of the Brown telephone relay, a dismantled specimen of which he exhibited to give point to his remarks. So lucid was he that we all felt that we could make one ourselves, till a closer inspection showed what beautiful work these instruments contain.

East Kent Wireless Society.

(Affiliated with the Wireless Society of London.)

Owing to the Christmas holidays, the usual monthly meeting of the Society was held at the Oddfellows' Institute, on Wednesday, January 5th, instead of Wednesday, December 29th, Commander Norfolk, R.N., in the chair.

The minutes of the previous meeting were read and confirmed.

Five new members were elected, bringing our total to 50.

It was decided that the Society should hold an exhibition of wireless apparatus, during the last week in June.

To conclude the meeting, Major Martin gave a very interesting lecture on Wireless Transmission.

It is proposed to form branches of the Society at Folkestone, Canterbury and Ashford. The Hon. Secretary will, therefore, be very pleased to hear from enthusiasts who would be willing to help him in the formation of these branches.

Hon. Secretary, H. Alec. S. Gothard, 8, Longford Terrace, Folkestone.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

The fifty-fifth meeting of the Club was held at Shaftesbury Hall, Bowes Park, on Wednesday, December 29th, the President, Mr. A. G. Arthur being in the chair. Owing to the unavoidable absence of the Hon. Secretary the minutes of the previous meeting were taken as read, and before proceeding to the more serious business of the evening, the Chairman entertained the members by reading an amusing account of the "Alleged Early History of the Club." If this "History" is to be believed, the founding of the Club goes back to the Middle Ages!

Mr. Midworth had kindly brought up a fine example of a loose-coupler which he had just completed, finished in the manner which members are now accustomed to see in Mr. Midworth's work, and this being connected to the aerial, signals were received from several stations, many of the members listening in.

Coventry Wireless Club.

Several new members of the Coventry Wireless Club were enrolled at a meeting at the Croft Works, Priory Street, on Tuesday, December 14th, Mr. E. E. Stewart presiding.

The committee reported that no progress had yet been made in finding suitable premises, and the secretary (Mr. R. Leibin) kindly offered the use of the Croft Works to those engaged in making their own apparatus, providing they were conversant in the use of machinery. He also intimated that material and instruments could be purchased through the Exact Manufacturing Company.

Mr. Gillett invited members to inspect and experiment with apparatus at his house, and it was arranged that the next meeting should be held there on January 5th. The Chairman promised to read a paper, and give a demonstration of the simplest forms of receiver, etc., up to multi-valve amplifiers and magnifiers, in a short series of lectures, for the benefit of the less advanced members.

A class of instruction in Morse receiving and sending has been in progress for some time at Mr. Stewart's house, Ash Green, Exhall. This class has been enlarged, and arrangements have been made to hold it weekly at the club premises, under the direction of Mr. Porter, who was a wireless operator in the navy during the war.

Blue prints of suitable circuits have been made by Mr. Stewart and placed at the disposal of the members. He also invited them to experiment with his apparatus at his house.

GERMAN WIRELESS IN BAGHDAD

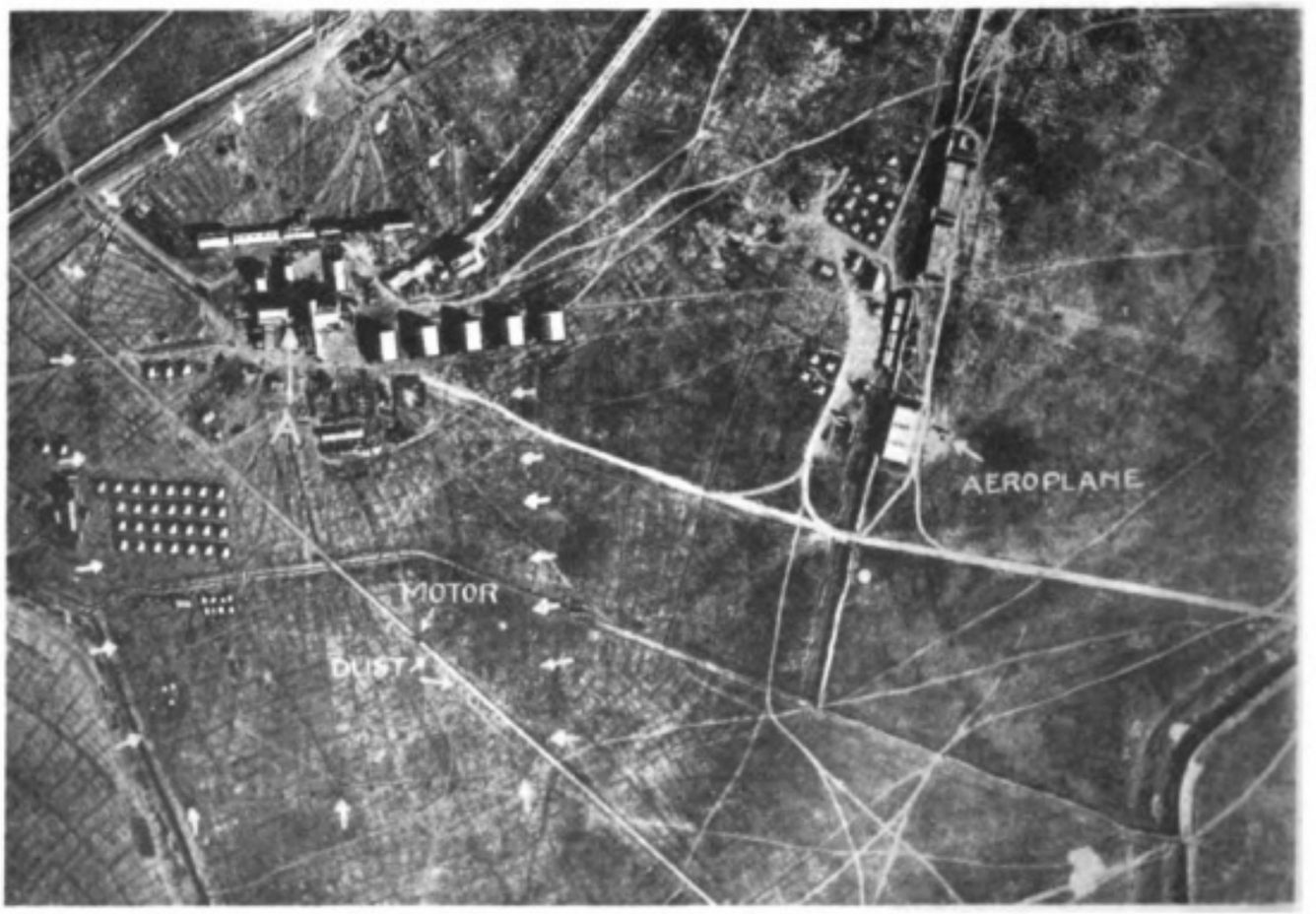
By C. H. E. Ridpath.

ONE of the sights that greeted the British troops on entering Baghdad in March, 1917, was the wreckage of the German wireless station, intended for communication with Berlin, and, presumably, with the German colonies. Just before our entry into the city the Germans effectively demolished the mast and destroyed all apparatus with explosives.

It has been said that the aerial was of the umbrella type, but on the other hand it can be seen from the photograph that the earth system must have had a directional effect.

Viewed from the ground this system was very hard to trace, but it is interesting to see how the photograph, taken at 4,000 feet, clearly indicates the general lay-out of the system. The mast was situated on the roof of the building at A. The earth consisted of about 100 lengths of buried wire radiating from this point, their outer ends being connected to copper plates. The photograph shows the shallow trenches and cavities caused by the operation of unearthing, and the fact that the soil would not, of course, be replaced quite level, the result is much exaggerated by the relief effect. The copper plates, also interconnected, formed three sides of a square, the fourth side being a semi-circle, having a length of 410 yards, a breadth of 270 yards; the total length of wire buried must have approximated to 10 miles.

Berlin lies N.W. of Baghdad and it is interesting to note that the round end of this system was found to point north-west.



PAGES FOR BEGINNERS

Under this heading we publish COMPLETE *instructional articles, forming a series specially designed and written for beginners in wireless work. Hardly any mathematics will be introduced, and we hope to present the fundamental facts of wireless in such a manner as will prove attractive to a much wider range of students than that for which this series is primarily intended.*

CONTINUOUS WAVE RECEPTION.

THE difficulties encountered in the reception of undamped waves are chiefly those in connection with rendering the signal audible to the human ear. We have already noted in the case of spark signals (*i.e.*, damped oscillations) that each train of waves composing the Morse signal is rectified into an uni-directional rush of current, which results in a click being heard in the telephones at the commencement of each wave train.

Thus, if a "dot" signal were composed of, say, ten trains of damped waves, there would be ten clicks produced in the telephones, which would merge into a short buzz. But, on the other hand, a "dot" signal, if sent in continuous wave trains, would at the most produce two clicks—one at the beginning and the other at the end of the train.

Fig. 1 will indicate the difference between transmission by continuous wave and damped waves.

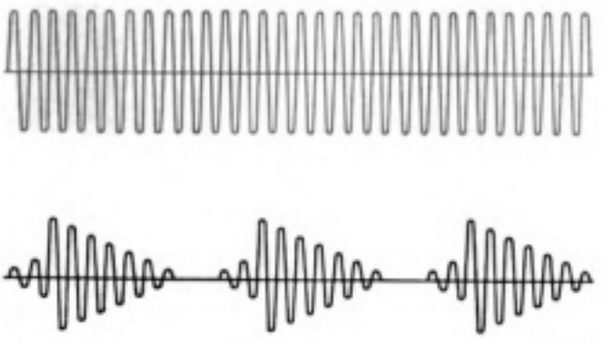


Fig. 1.

The first point for consideration is by what means the continuous wave train can be made to produce the same effect as a spark signal. If we could arrange to interrupt the wave train at regular intervals, the signal would then appear as in Fig. 2, and the effect would then be similar to that of a spark train.

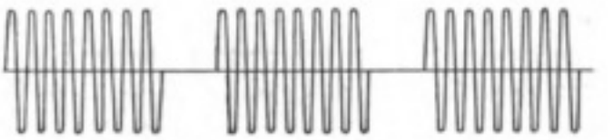


Fig. 2.

This "breaking up" could be accomplished by means of a buzzer in the telephone circuit, which would make and break the circuit regularly and quickly. This method is seldom used, however, owing to certain disadvantages which occur in practice.

Another method by which continuous waves can be made to give the necessary effect s that known as "beat" reception, and consists in combining the received oscillation with a train of oscillations of a different frequency.

To understand this, let us first consider the effect of adding two alternating current curves of the same frequency, but differing in phase.

If the alternations are exactly opposite in phase, *i.e.*, if one is a maximum when the other is a minimum, the total effect of the two currents will be zero; while if the two curves are exactly in step, they will combine to produce another current curve of amplitude equal to the sum of the amplitudes of their components.

A simple method of finding the total effect

of two current curves is to plot them on a suitable sheet of squared paper, and add up the ordinates at intervals, plotting the result to form a third curve, which then represents the sum of the two components. (Fig. 3). (*Compare also Fig. 4 of the preceding article in this series*).

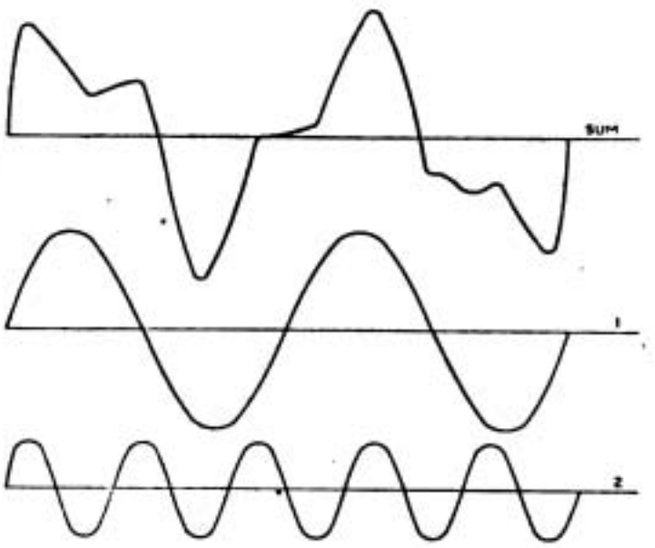


Fig. 3.

If the two curves differ in frequency, it simply means that the relation of one curve to the other is continually changing. The resultant curve can be plotted in exactly the same manner.

Now, applying this to the case of continuous wave trains, let us suppose that the frequency of the incoming train is 100,000 per second. If we superimpose on these oscillations another train of waves having a frequency of, say, 99,000, the two oscillatory currents will combine to produce the effect shown in Fig. 4. Hence, in the receiver we shall have oscillatory currents rising and falling in amplitude in a regular manner. This fluctuation of the amplitude will produce a similar effect in the telephones to that given by the spark signals. This effect is known as the production of beats.

The number of beats per second is known as the *beat frequency*. The beat frequency must not be confused with the oscillation frequency. The beat frequency is always equal to the *difference* of the two component frequencies. (In the case above, for example, 100,000 − 99,000 = 1,000 per second.)

Now the note in the telephones will depend for its pitch on the frequency of the beats. The greater the difference between the frequency of the incoming oscillations and those superimposed on them, the greater the frequency of the beat, and, consequently, the higher the note heard in the telephones.

We thus see that the pitch of this note can be altered by varying either the frequency of the incoming oscillations, or the frequency of those generated locally. Assuming that the frequency of the signals remains constant, the operator can vary the note in the telephones to his liking by altering the frequency of the continuous waves generated.

Looking at it from the other point of view, assuming that the frequency of the generated oscillations remains constant, it is easily seen that two trains of waves of slightly differing frequency, each received on the same aerial, will produce two notes in the telephones differing in pitch. It is thus possible to distinguish between two stations transmitting

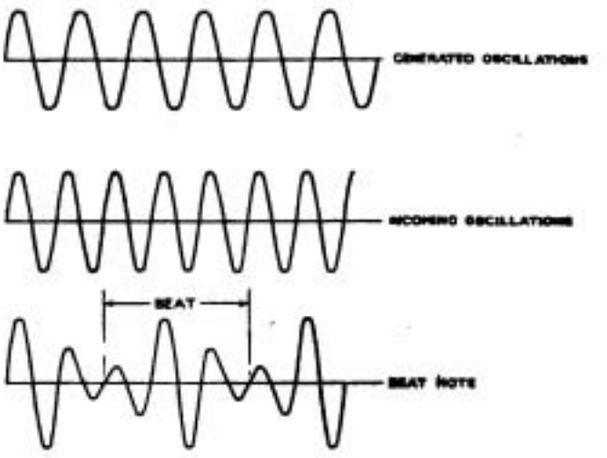


Fig. 4.

simultaneously, although their wavelengths may only differ very slightly.

Assuming that the receiving operator wishes to cut one station out of his receiver, he has only to alter the frequency of the continuous waves generated so that the oscillation frequency equals the frequency of

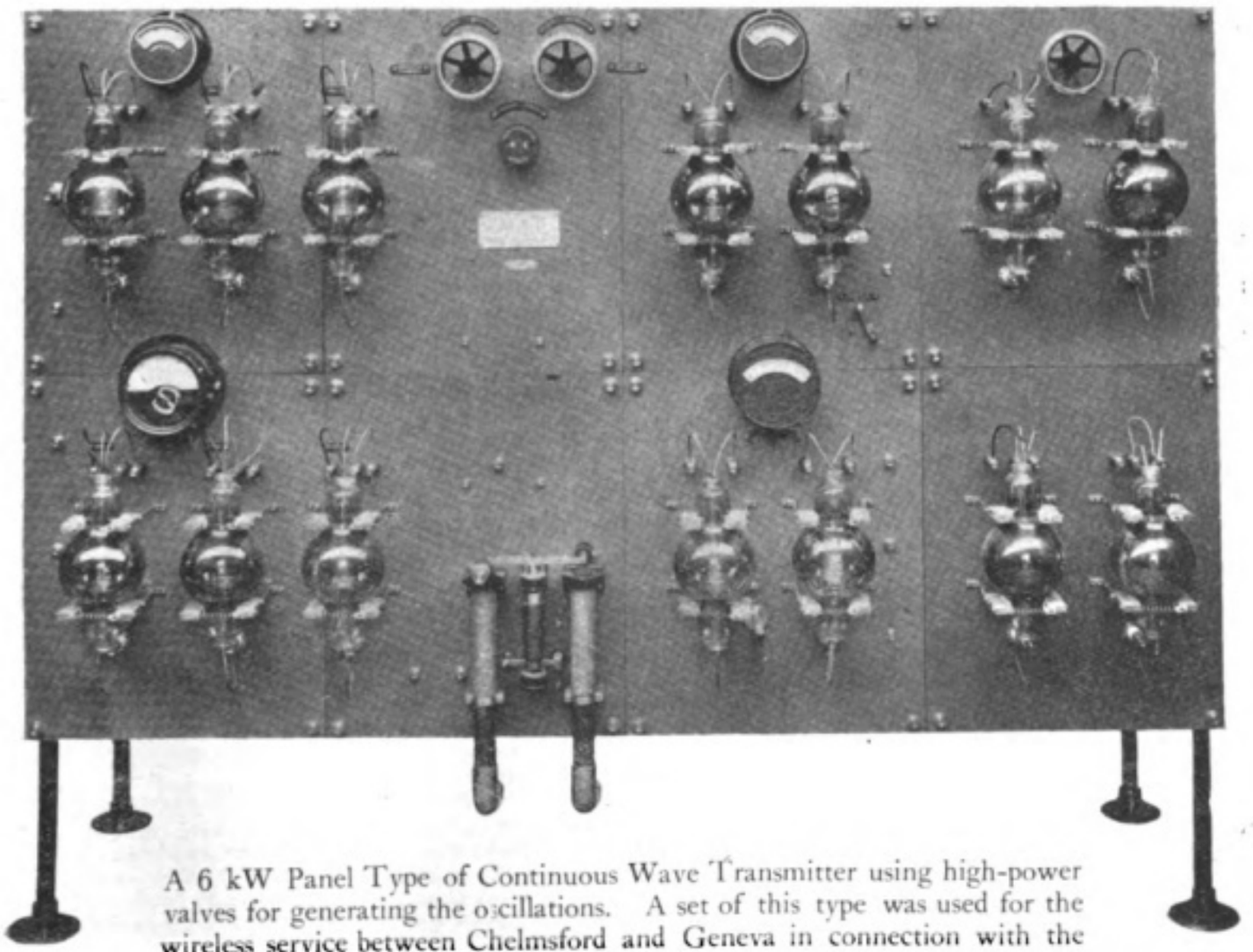
one or the other of the incoming signals to render it inaudible, when the other station is heard without interference.

This illustrates one of the important advantages in connection with beat reception —its selectivity. A further advantage of beat reception is, of course, that a good proportion of the current producing the signal is provided in the receiving station, thus increasing the efficiency of reception considerably.

In conclusion, we may note another interesting application of beat reception. If we have an arrangement of inductance and capacity, of which it is desired to know the wavelength, we can determine this by means of a continuous wave generator coupled to the circuit. If the circuit of unknown wavelength is set oscillating, and the wavelength of the generating set is varied, a beat note will be heard in the telephones, corresponding to the difference in frequency between the two sets.

Continuous wave oscillating sets are made up in this way for use as wavemeters

A 6 kW VALVE TRANSMITTER.



A 6 kW Panel Type of Continuous Wave Transmitter using high-power valves for generating the oscillations. A set of this type was used for the wireless service between Chelmsford and Geneva in connection with the League of Nations Conference. It can be used for C.W. Telegraphy or for Telephony.

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.**

F.W.D. (Crediton) *asks two questions about an aerial system, and (3) If telephone insulators can be used for the support of the wires. (4) If metal-covered telephone wire is suitable for part of the aerial. (5) If a crystal and valve set is better than one having one valve alone.*

(1) Either should be fairly satisfactory. Connect the down-lead to either the middle or the end of the horizontal wire, even at the expense of wasting a few feet of length, if not possible otherwise.

(2) No.

(3) Fairly.

(4) We do not know exactly what type of wire you mean, but no metal-sheathed wire is satisfactory in an aerial.

(5) Yes, if fairly well designed. See page 65, April 17th issue, for a fairly good one.

(*Four* questions, please.)

P.P. (York) *asks the size and quantity of wire for winding the secondary of a telephone transformer for a pair of telephones of 350 ohms resistance.*

3 oz. of No. 34 or 36 should be satisfactory.

R.A. (Wicklow) *calls attention to the widely divergent windings given here and elsewhere for L.F. transformers. He asks (1) Which is the more important—ratio of transformation or resistance value. (2) Which is the better—one given R.W.H. on page 535, or one on page 444, vol. 7, having windings of 300 and 1,500 ohms of No. 44.*

There is certainly a great variety of windings that have been used more or less satisfactorily.

(1) The principle to use in designing a transformer for an amateur set is, broadly, to fix a suitable transformation ratio, which is usually between 1—2 and 1—4. Having done this, arrange to have as many turns on each winding as reasonably possible.

(2) The one quoted to R.W.H., which, by the way, will have much less resistance than you suggest, owing to the weight of the insulation, which you have neglected.

D.H.B.M. (Leicester) *asks re the receiver described on page 477 (1) How many sheets of foil 6 × 4·5 cms., with glass dielectric 0·1 cms. thick, are needed for a grid-condenser, and its capacity. (2) If a grid leak will improve results. (3) If so, will 2 megohms do. (4) What size reaction coil to use, and how far it should slide away from the primary winding. (5) If set will work on C.W., spark, and telephony.*

(1) About half a sheet on each side, capacity about ·00005 mfds.

(2) Yes.

(3) Yes.

(4) Make coil as in article referred to: about 2".

(5) Yes.

(*Four* questions, please.)

G.B.E. (Enfield) *sends a diagram of a somewhat unusual valve set, and asks (1) Why the addition of a blocking condenser across the telephones stops oscillation. (2) How to stop a howl when receiving telephony.*

(1) With your arrangement, which oscillates by virtue of the capacity reaction, the introduction of a condenser across the telephones is virtually adding a large one in parallel with the plate-filament condenser. The resultant capacity is quite likely to be unsuitable for the production of oscillations.

(2) The howling is due to local oscillation. You have already told us of one way (*vide* question 1) of stopping this. Why, then, do you not try this way of getting over the difficulty? If this is not satisfactory, try one of the more normal valve circuits given in our columns; we do not like the type of circuit you show, particularly for spark, or what is practically equivalent—telephony.

H.C. (Cambridge).—We do not understand how you intend to use these inductances—without this information it is meaningless to say that they reach 30,000 ms. If they give this wavelength when used as an A.T.I. with a P.M.G. aerial, they will probably have to be closely coupled. If you give us particulars regarding sizes and windings of these coils, we may be able to help you. We recommend you not to attempt a longer wavelength than 15,000 ms.

P.S. (Lowestoft).—(1) The noise in your receiver is probably due to a bad battery, a poor valve, A.T., or a bad connection.

(2) The C.W. note should be quite steady unless the adjustments of the set are altered. The causes of unsteadiness would be the same as in (1).

(3) To hear telephony without the C.W. beat-note, weakens the reaction until your receiver no longer oscillates.

(4) The arrangement of the set is quite correct.

W.E.P. (Appledore) *asks (1) If a Mark 3 Short Wave Tuner can be adapted to receive C.W. and telephony, and if so, how. (2) What would be the maximum wavelength obtainable by increasing inductance in each circuit. (3) For dimensions of suitable coils for the above. (4) What is interrupted C.W.*

(1) It will receive telephony, and with suitable alterations and additions will also receive C.W.

(2) About 3,500 ms.

(3) See recent replies. An article on this subject is appearing as soon as space permits.

(4) Trains of C.W., interrupted at audio-frequency by some device on the transmitter.

A.L. (Soham) *sends 10 questions disguised under four headings. The following are the first four, with replies:—(1) What qualifications, if any, are necessary to obtain a* P.M.G. *licence for reception of wireless signals. (2) What is the maximum length and height of a twin-aerial. (3) What is the best type of headgear for a single-valve receiver. (4) If the use of* L.R. *telephones with a transformer is much less efficient than* H.R. *telephones in a crystal set.*

(1) A licence is necessary for the installation of a receiving set, for particulars of which apply to the Secretary, G.P.O.

(2) The length of each wire may be 70ft., including the lead-in. The height may be anything possible subject to this.

(3) Telephones of about 150 ohms. total resistance, in conjunction with a telephone transformer.

(4) Not at all, if the telephone transformer is fairly well designed.

SYNCHRONOUS (Cardiff) *sends sketch of a circuit (Fig. 1) and asks (1) If this circuit would be suitable for receiving* C.W. *and spark. (2) Is reaction coil too large. (3) What range of wavelength should he get. (4) Could the condensers be changed round, and if so, would the wavelength range be increased. (5) If his aerial as shown in a sketch would be suitable.*

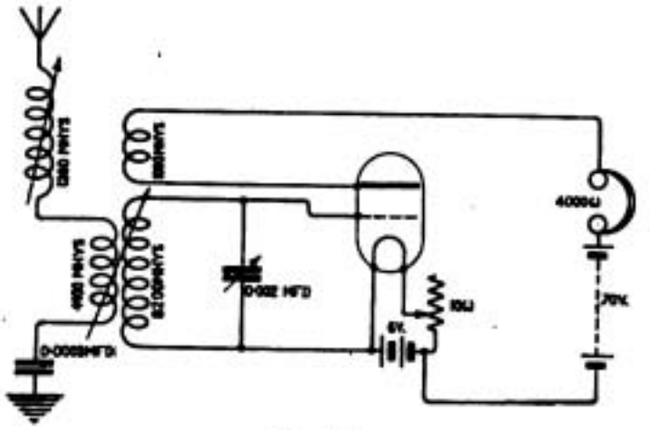


Fig. 1.

(1) Yes.

(2) No.

(3) The aerial circuit tunes to about 1,000 m. with your aerial, and the closed circuit to about 6,000 ms.

(4) Interchange of condensers would be desirable, except that a variable condenser is more convenient for a tuned circuit.

(5) The aerial is so poor as to be almost useless, especially as the two wires are only 18 ins. apart.

Four questions, please. *(See rules.)*

L.A.W. (London) *asks (1) If a telephone transformer with a ratio 1—1 is feasible. (2) If there is any definite value for the ratio of inductance to capacity in valve receiving circuits. (3) In the type 71 3-valve amplifier, what is the use of the condenser between the negative terminal of the filament battery and one side of the secondary of the telephone transformer, and also of the lead from the input terminal B to the change over switch. (4) What issues of "The Wireless World" contained Lieut. Bertram Hoyle's detailed articles on the design of wireless stations.*

(1) Yes, but not efficient.

(2) No; the self capacities of coils and the stray fields of the whole apparatus set a limit to the magnitude of this ratio.

(3) The condenser constitutes a capacity earth to the secondary thereby preventing effects due to the operators body *via* the telephones.

(4) "An Outline of the Design of a Wireless Station," see *Wireless World*, March, April, May, June and July, 1917.

DORMANS (East Grinstead).—(1) Yes. (2) For experimental purposes only. (3) 2BQ—Crewe; 2BS—unknown to us; 2BN—Euston.

F.L.D. (Manchester).—1, 3 and 4 of present volume, 8d., post free.

T.R.M. (Birmingham).—See reply to **A.R. (Lancashire)**, December 11th issue.

G.W.P. (Knutsford) *asks (1) For a diagram for adding a second valve to a receiver, sketch of which he sends. (2) Maximum wavelength of his set. (3) Reason for set not oscillating on short wavelengths. (4) If we recommend any other valve than that which he is using.*

(1) The position of A.T.C. is wrong, and should be altered in accordance with Fig. 2.

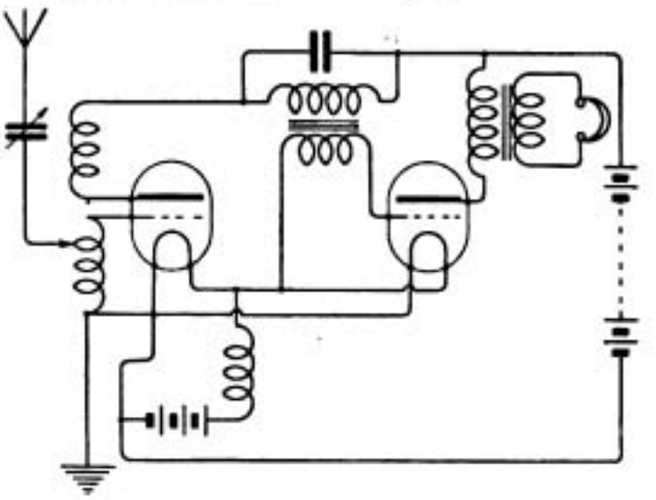


Fig. 2.

(2) About 20,000 ms.

(3) Possibly wrong connection of A.T.C. or too low L.T. volts.

(4) Your present valve should be quite satisfactory.

G.P. (Leicester) *sends diagram of a crystal set, and asks (1) If a tubular condenser, 2" in diameter, 12" long, with ¼" between the tubes, would be sufficient. (2) A suitable resistance for the telephones (3) The distance the set would receive. (4) If any arrangement would improve.*

(1) You do not say the nature of the dielectric. The condenser could be used, but is probably lower in capacity than desirable.

(2) 4,000-8,000 ohms.

(3) We cannot say.

(4) Connections are quite wrong as shown. Arrange as in Fig. 3.

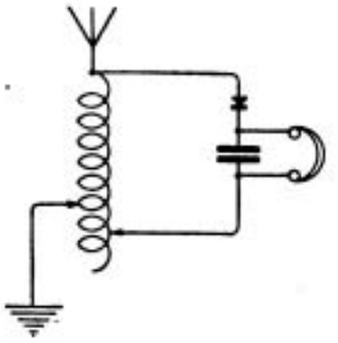


Fig. 3.

BILLY (Horncastle).—Your circuit should be as shown in Fig. 4, or with a condenser in series with the A.T.I., in the case of a single slide inductance. You have at present no apparent

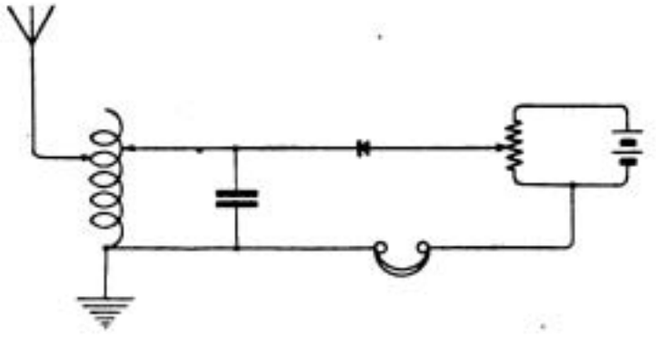


Fig. 4.

means of tuning your aerial. The noises you mention may be due to bad earth or bad contact in the apparatus. The signals are probably some test call. You do not state wavelength, so we cannot help you.

G.L. (Manchester):—(1) It depends on the extent to which your aerial is surrounded by houses. Aerial is of good general type.

(2) Circuit O.K.

(3) It seems quite satisfactory.

(4) All information *re*-Chelmsford's telephony transmissions may be obtained from any of the wireless clubs in Manchester, which clubs we keep advised to the best of our ability

1.2.3. (Walkden) *asks* (1) *What is the difference between* V24, Q, *and* R *valves; do the latter two require a greater* H.T. *battery.* (2) *What is included in the* 100 *ft. of wire allowed by the* P.M.G. *aerial.* (3) *For reference to an article on valve receivers.* (4) *A suitable elementary book on valves.*

(1) The essential differences lie chiefly in the proportions of the electrodes and their disposition in the tubes; suitable plate voltages are V24 (24 volts), R (75 volts), Q (200 volts).

(2) 100 ft. is the total length of wire, including the down-lead.

(3) See page 64, April 17th issue.

(4) Bangay's "Oscillation Valve" should be very satisfactory.

BEGINNER (Chiddingfold) *sends sketch of a proposed receiving set, and asks* (1) *Are the connections correct.* (2) *What size former and gauge wire is required for a wavelength of* 180-3,000 *ms.* (3) *Size and depth of earth-plate.*

(1) Yes.

(2) About 10" × 6", wound with No. 22 wire.

(3) As large and as deep as possible; not less than 2 or 3 sq. ft. buried 2 or 3 ft deep.

SPARKS (Clapham) *sends a sample of wire, and asks if we can state material and gauge.*

Gauge No. 22; it is probably of Eureka, or similar material. The resistance is 12 ohms per yard.

A.C. (Walthamstow) *asks* (1) *If we could give him dimensions of formers and gauges of wire for a loose-coupler to reach* 800 *miles.* (2) *If he could dispense with variable condensers by using blocking condensers; if so, what capacities should he use.* (3) *If we think that the wireless set described in the issue of December,* 1919, *would receive over* 800 *miles.* (4) *If he could receive a station no matter how far away so long as his apparatus is tuned to the correct wavelength.*

(1) We do not understand. See (4) below.

(2) You can use fixed condensers and vary them in steps, employing a variometer for fine tuning. We cannot give dimensions as you do not give the wavelength.

(3) It depends on the strength of the transmitting station.

(4) No; signals fall off roughly as the cube of the distance. You seem somewhat hazy about first principles: the dimensions of your apparatus depend on the wavelength and not on the distance. We advise you to study Bangay's Elementary Principles of Wireless Telegraphy.

F.S. (Hellingly) *sends description and sketch of apparatus, and asks* (1) *If it will give good results.* (2) *Range of wavelengths.* (3) *If his* G.P.O. *receiver could be re-wound for this set.* (4) *If* ¼ *lb. of No.* 28 *wire could be added to the set to improve it.*

(1) Preferably, connect as in reply to **G.P. (Leicester).** No. 28 wire is rather too thin for a good A.T.I. Waxed paper is not a good enough dielectric for a satisfactory tuned circuit condenser: also total capacity (probably about ·007 mfds.) will be too high.

(2) About 2,000 ms.

(3) Yes, re-wind with about No. 47 wire, using as much as you can get on the formers.

(4) Wind on a former of about 4" diameter, and add in series with the loading coil.

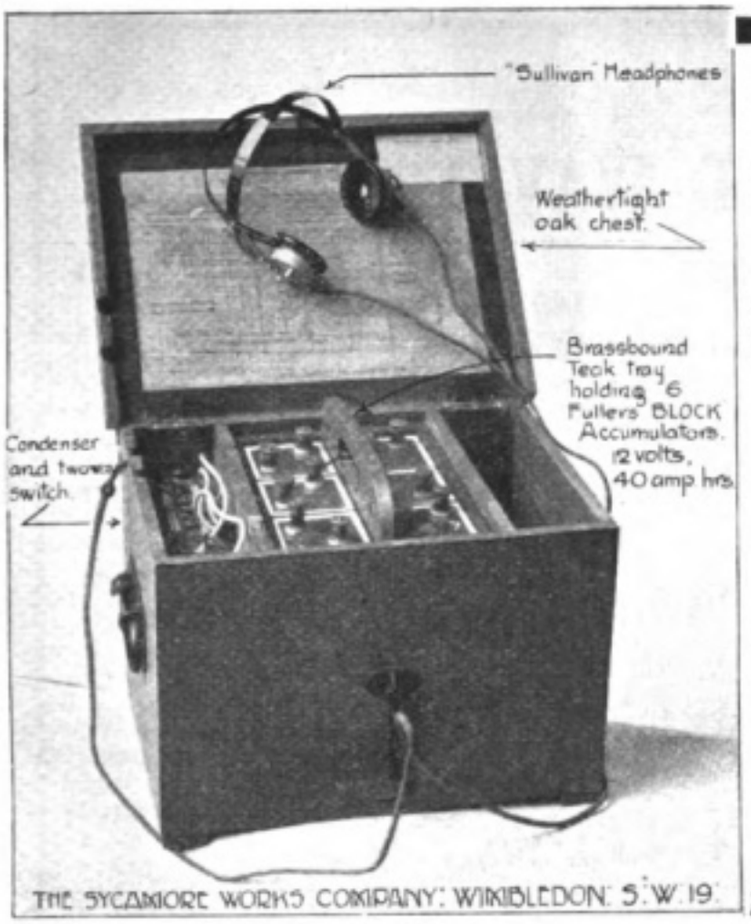
R.C. (Belfast) *gives a diagram of a circuit for criticism, and asks* (1) *Probable range of wavelength.* (2) *Suitable capacities of aerial circuit condenser and blocking condenser.* (3) *Potentiometer resistance.*

Your detector circuit is very inefficiently connected. It should be as in Fig. 10, page 502, with the addition of a blocking condenser shunted across the telephones.

(1) To 5,000 ms.

(2) A.T.C. ·01 mfds.: blocking condenser, ·002 mfds.

(3) About 200 ohms.



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QUESTIONS AND ANSWERS

J.B. (Taunton) *sends sketch of receiver given on page 65 of the April 17th issue, and asks (1) If his connections are correct. (2) For criticisms. (3) The range of the set. (4) If an L.F. amplifier can be added.*

(1) Your set appears to be an involved copy of the diagram on page 65, which is quite correct.

(2) This is quite a good receiver.

(3) Maximum wavelength is about 3,000 ms.

(4) Yes, by means of a step-up transformer in place of the telephones.

PATIENCE (Southampton) *sends sketch and description of a receiver which does not work, and asks for advice.*

The receiver is all right except for the potentiometer, which is shown in parallel with the crystal, as in Fig. 1, page 529. This Fig. is incorrect, the error having inadvertently escaped detection in the proof sheet. The connections of the potentiometer should evidently be as in Fig. 2, page 498, and many other recent examples.

F.H.K. (Coventry) *asks (1) Is transmission allowed by the* P.M.G. *(2) If so, under what conditions. (3) How to make a milliammeter, suitable for measuring aerial current.*

(1) and (2) Yes, under restrictions varying in each case owing to local circumstances, etc. Apply to the Secretary, G.P.O., for further information.

(3) The construction of a satisfactory milliammeter is beyond the powers of the average amateur, and the instructions necessary would take more space than we can spare. See descriptions of hot wire instruments in most electrical text-books.

A.E.B. (Surbiton) *sends a list of gear, and asks (1) how to arrange for* C.W. *and spark up to 30,000 ms. (2) Will the above apparatus, with one valve, be sensitive enough for trans-Atlantic tests. (3) Are basket coils the best method of coupling. (4) The best circuit he can arrange with his available apparatus for reception of speech.*

(1) The proportions of your parts are not very suitable. It is far better to fix what you want to do and then collect suitable components, than to collect a "job lot" of components more or less unsuited to each other and expect them to make a good set of a type they were probably never intended for. Try the circuit in Fig. 3, page 629, of the current volume, using A.T.C. in series for short wave.

(2) It is exceedingly unlikely that it will.

(3) They are quite satisfactory.

(4) Use circuit as above, with reaction coupling sufficiently weak to stop local oscillation.

PANSY (Biddulph Park).—(1) Yes.

(2) No.

(3) The power necessary for a receiver depends on the type; if a crystal is used, practically none is required; for a valve set, however, roughly 4 watts per valve is required.

(4) A cycle set of the type you suggest would have to be of multivalve type, and judging from your letter, would be beyond your powers to design and construct at present. We should recommend you to study Bangay's Elementary Principles, and then try some less ambitious type of set to commence with.

W.J.T. (Norbiton) *asks (1) If he can increase the capacity of an air condenser by filling it with oil, and if so, what oil to use. (2) Does* FL *still send press at 1500 C.M.T. on 3200 metres musical spark. (3) Are slab inductances very efficient, and is the self-capacity large compared with other coils.*

(1) Provided it is mechanically possible, *i.e.*, that the container does not leak, this can probably be done satisfactorily. Any good, heavy dry mineral oil will do. S.I.C. will be about 2.

(2) No, see January 8th issue.

(3) Quite efficient; the self-capacity is small.

A.G.S. (Hallsham) *describes the reception of Eiffel Tower with a Mark III. short wave tuner by slipping a piece of paper under No. 19 stud of the A.T.I. and listening in on the standby side.*

If you trace out the connections you will find that this arrangement inserts your telephone receivers in series with the crystal in the earth lead. The inductance of the telephone windings serves to load up the aerial circuits to the long wavelengths, but the high resistance renders the tuning extremely flat. The arrangement is best with a leaky aerial but is vastly inferior to the results possible with proper tuning.

SPARKS (Consett) *sends sketches of a set and aerial, and asks (1) Sizes of coils and condensers for a wavelength of 8,500 ms. (2) Capacity of aerial, and its natural wavelength. (3) Inductances of the following coils: (a) 27·5 cms. × 9 cms., No. 26 wire; (b) 9·5 cms. × 9·5 cms., 18 turns per cm; (c) 13 cms. × 8 cms., 9 turns per cm.*

(1) Your set will not be efficient on such long wavelengths with such a small aerial (30′ twin). Put A.T.C. in parallel with A.T.I., or the latter will be too big for convenience. If you make a H.F. intervalve transformer suitable for 8,000 ms., it will be very little use for short waves. A.T.C.—·002 mfds. Tuned circuit condenser = ·0005 mfds A.T.I.—30 cms. × 20 cms., of No. 24. Tuned circuit inductance 25 cms. × 16 cms., of No. 30. Reaction coil, 12 cms. × 8 cms., of No. 30; coil coupling to this, somewhat smaller, also of No. 30.

(2) Probably about ·0001 mfds. About 40 ms.

(3) (*a*) 7,800 mhys.; (*b*) 1,750 mhys.; (*c*) 520 mhys.

QUERIE (Newcastle) *sends a scheme for the addition of a valve to a Mark III. receiver, to be used in conjunction with the original crystal. He asks (1) If the proposal is practicable. (2) If the second winding is close enough to the primary for reaction purposes. (3) If we can recommend a better method.*

(1) Yes. For good results you will probably want more inductance in the grid circuit than given by the original coil. This can, of course, be arranged, as the circuit may be tuned by the A.T.C.

(2) Probably, especially if you increase the inductance as suggested.

(3) No.

A. de B. (Floresse) *asks (1) Who in England manufactures Kelvin's siphon recorder. (2) What is the sensitivity in milliamps of this instrument.*

(1) We believe this recorder is made by Muirhead & Co., Elmers End, and also probably by most firms specialising in the manufacture of telegraph apparatus.

(2) Its figure of merit will depend on the windings used, but it should work on under a milliamp if

suitably wound. The makers will be able to quote you exact figures.

C.F. (Cricklewood) (1) *Asks for information as to where he can obtain a rectifier suitable for charging accumulators from* 110 *volts* A.C. (2) *For instructions for making a telephone transformer.* (3) *For instructions for an intervalve transformer.*

(1) A convenient type, known as the Tungar rectifier, is handled by the B.T.H. Co., Rugby, who will supply you with particulars.

(2) See issue of March last.

(3) You do not specify what type you require. For a L.F. transformer, see reply to **R.A. (Wicklow)** and various other recent answers.

H.K.N. (Newbury) *asks* (1) *Of two circuits shown which will be the most efficient.* (2) *Over what range of wavelengths will each circuit respond.* (3) *What alterations are necessary to use V24 valves, and will the circuits be as sensitive.* (4) *What approximate increase in sensitiveness would the addition of one more valve make.*

(1) We distinctly prefer No. 1—an ordinary resistance amplifier with capacity reaction.

(2) All wavelengths from about 1,500 ms. upwards—there is, of course, no hard-and-fast rule lower limit.

(3) The only necessary alteration is the reduction of the H.T. volts to about 24.

(4) It should approximately double the strength of signals.

C.L. (South Norwood) *asks various questions on the use of a Mark III. receiver with a valve and a frame aerial.*

You do not say how you propose to arrange your set. You might possibly manage it for short waves with the coils you mention, which would, however, be much too small to reach 6,000 ms. The receiver is not of convenient type for adaptation to frame aerial working, and would be highly insensitive used in this way, with a single valve and small frame. The frame should be placed vertically, and arranged to rotate about a vertical axis so that its edge can be pointed to the station required. Any type of coil could be used for loading. Whether the set could be used for C.W. depends on the nature of the alterations made to this set. See also recent replies, and an article appearing on this receiver.

EXPERIMENT (Glasgow) *sends a sketch of a single valve set, about which he asks various questions.*

The set is of quite a normal type one of the simplest valve sets used. It should give quite good results. We cannot give dimensions of windings accurately, as you do not state aerial arrangements. For 6,000 ms. A.T.I. might be 10" × 6", of No. 24. Jigger primary, 6" × 4", of No. 24. Secondary (reaction coil), 5" · 3", of No 28· A.T.C., in parallel with A.T.I., ·001 mfds.

W.D.J. (Liverpool) (1) There is no simple rule for converting Brown & Sharp wire gauges into British standard sizes. You do not state the sizes you want the equivalents of, but for your purpose you will probably find similar numbers in each system sufficiently near to use.

(2) We are afraid medical electricity is somewhat out of our line. The apparatus you mention, when not purely "quack," probably operates by a simple low tension D.C. discharge, at the voltage of the battery supplied. The current will be very small.

V.G. (Halifax) *asks for particulars of a valve set to receive the usual commercial stations on an indoor aerial, inverted L, twin wire, spaced* 6', 15' *long, erected in a false roof under slates.*

We think you would find a frame aerial much preferable to an aerial of the type you suggest. There are so many circuits possible that we can only refer you to any of the multivalve sets, using not less than 3 valves, illustrated in these columns or in the body of the magazine.

H.V.R. (Eton College) *sends a sketch of a receiver, and asks* (1) *If a condenser would give good results, and, if so, what capacity it should have, and where it should be placed.* (2) *If a loading coil in the aerial circuit would improve results.* (3) *If there is any objection to his aerial passing through a tree, provided that it does not touch the branches.* (4) *If the short wave tuning coil described in the issue of October 2nd would be of use with this set, and, if so, how it should be inserted.*

We believe the circuit suggested is quite novel; it is, at all events, quite unfamiliar to us. The results with it will be very poor. We are unable to follow how the valve is intended to function, and strongly advise you to try a more normal type of circuit.

(1) This will depend on the type of circuit employed.

(2) Most probably.

(3) No—provided that you do not get damage from wind.

(4) No.

C.E.T. (Middlesbrough) *encloses sketch of his proposed receiving set, and asks* (1) *Wavelength* (*a*) *as shown,* (*b*) *with A.T.I.* 10" × 6" × 24 *G.* (2) *The capacity of the condensers C1 and C2.* (3) *The size and number of sheets of tinfoil for the telephone condenser.* (4) *As he cannot erect a longer aerial, would we recommend a single or double, say* 4' *apart.*

(1) Probably about 1,500 ms. without A.T.I. and 2,500 with.

(2) *C1* could be ·0003 mfds. and *C2* ·0006 mfds. The tube condensers you mention will have too small a capacity (about ·0005 mfds.) owing to the thickness of the dielectric.

(3) About 1 dozen sheets, 3" × -", and one sheet of waxed paper, dielectric will do

(4) Double, by all means, if you cannot increase the length, which you should make every effort to do.

K.G. (Manchester) *asks, with reference to the French L1 amplifier* (1) *What is its optimum wavelength.* (2) *If we know whether it is mentioned in the T.S.F. text-book.*

(1) Wavelength range from 1,500-20,000 ms. Optimum not stated, but probably about 10,000 ms.

(2) We do not know. We have seen a good pamphlet issued by the makers, to whom you might apply.

ENTHUSIAST (Leighton Buzzard) *encloses a sketch of a receiver circuit, and asks* (1) *Sizes of coil and wire in the coupling coils to receive 4,000 ms.* (2) *Is the circuit correct and to the best advantage.* (3) (*a*) *The capacity of the fixed condenser, and* (*b*) *what advantage, if any, would it be to have a variable condenser in the detector circuit.* (4) *Is the aerial passable.*

(1) The primary should be 5" long and 4" diameter wound with 22 S.W.G. The secondary 8" long and 5" diameter, wound with 28 S.W.G. The closed circuit condenser ·0095 mfds.

(2) The aerial circuit is correct; the closed circuit and detector circuit is wrong. See the back numbers of *The Wireless World* for a diagram; Fig. 10, page 502, of the 2/10/20 issue gives the simplest two-circuit receiver. The closed circuit condenser, situated as shown, is absolutely essential.

(3) (*a*) ·003 mfds. (*b*) No advantage as situated. See answer to (1).

(4) Yes.

J.B.B. (Helston) *describes two circuits, one a single valve receiver and the other a low frequency amplifier. He states that under certain circumstances he gets no signals. He asks* (1) *Why this is.* (2) *With reference to the Mark III. S.W. tuner, for a wiring diagram to convert this for use with a valve.*

(1) In the case of failure the plate circuit of your first valve is broken. By inserting telephones the plate circuit is completed, and the potential across them is transmitted to the amplifier. You should use an intervalve transformer.

(2) An article on this subject will shortly appear. See note by the Editor in the 27/11/20 issue.

F.W.R. (Croydon) *sends a sketch of a crystal receiver, and asks* (1) *If the coils are wound with too fine wire; No. 28 for A.T.I., and No. 35 for the tuned circuit inductance.* (2) *If an additional aerial tuning inductance would improve matters.* (3) *What gauge wire to use to wind it.* (4) *If a potentiometer is necessary with silicon.*

(1) Somewhat; better No. 24 for A.T.I., and No. 28 for jigger use.

(2) Certainly, make it at least as big as the jigger primary; preferably bigger.

(3) No. 24.

(4) It is not essential, but will probably improve results. In any case, the potentiometer is shown wrongly connected; see Fig. (1), page 662 of December 11th issue.

ELECTRON (Derby) *asks* (1) *The probable maximum aerial current in milliamperes in a 10 watt valve transmitter set.* (2) *What relation is there between the plate current and the aerial current.* (3) *With such a set, do we recommend control by microphone in the earth lead or the use of a second control valve.* (4) *For particulars of a choke coil suitable for such a set, if this is necessary.*

(1) It is difficult to say at all accurately; probably about 250 milliamps.

(2) Beyond the fact that the plate current generally increases with the aerial current (and even this is not always true) there is no simple connection.

(3) We do not think that with so small a set the possibly increased efficiency of a control by a second valve will balance the disadvantage of the extra complication. A microphone in the earth lead is possible but we should prefer microphone grid control of the transmitting valve.

(4) We are afraid we cannot answer this question without knowing the type of circuit you propose to use.

F.H. (Leeds) *encloses diagrams of two circuits for criticism, and asks* (1) *What wavelength they will receive.* (2) *The approximate capacity of certain condensers.* (3) *If C.W. reception is possible on either set.* (4) *If the dimensions for a loose coupler are correct.*

(1) The aerial circuit of A will tune to 4,000 ms. roughly.

(2) The aerial circuit of B will tune to 5,200 ms, roughly. You do not state the thickness of the glass dielectric of your condensers, so we cannot calculate their capacity nor the wavelength of your closed circuit in B.

(3) No.

(4) Satisfactory.

T.G.L. (Birmingham) *asks* (1) *What is a loop aerial.* (2) *Does a loop aerial require an earth.* (3) *What is a Fuller Telephone.* (4) *Can a Fuller Telephone be used for wireless purposes.*

(1) See page 112 of the May 15th issue, and articles in the two succeeding issues.

(2) No.

(3) An arrangement for transmission of signals along a line by D.C. pulses interrupted at audio frequency by a ticker mechanism at the receiver end.

(4) The Fuller Telephone receiver could probably be adapted satisfactorily for C.W. reception.

AETHER (Burton Joyce) *sends a sketch of a three-valve amplifier, and asks* (1) *Is a reaction coil necessary in order to receive C.W. with this type of amplifier.* (2) *If necessary, where should he insert it.* (3) *If the set can be worked with fewer valves than three, by plugging through from an earlier valve direct to the telephone transformer.*

(1) Set shown is an L.F. amplifier. You will need reaction in your receiver previous to this.

(2) It should be fairly easy to arrange for detection on the first valve of the amplifier, putting a reaction coil in the plate circuit, with a condenser across the transformer winding in this circuit.

(3) Yes. One way would be as follows: Insulate the plate terminal of the last valve in use from the connection on its socket with which it normally makes contact, and connect it to the plate terminal on the socket of the third valve, removing the valves not in use from their sockets.

R.A.I. (Grimsby) *asks for a diagram of a highly sensitive crystal receiver for reception of spark, C.W. and telephony.* (2) *The capacity of the condensers.* (3) *The connections to a proposed circuit for buzzer tests.* (4) *The length and gauge of resistance wire for a potentiometer for crystal circuit.*

(1) We regret that we do not know of any crystal receiver that will receive C.W. You will find many crystal circuits given in recent issues, *e.g.*, Fig. 10, page 502.

(2) The tuned circuit condenser should be about ·001 mfds. for long wavelengths.

(3) Connect the buzzer and cells across one slab of the A.T.I., not altering any other connections.

(4) About 100 ft. of No. 36 Eureka.

J.R.B. (Canterbury) *asks for a wiring diagram for a Morse Inker.*

We do not think you will get enough current from a two-valve receiver to work a normally wound relay, except possibly from very strong signals.

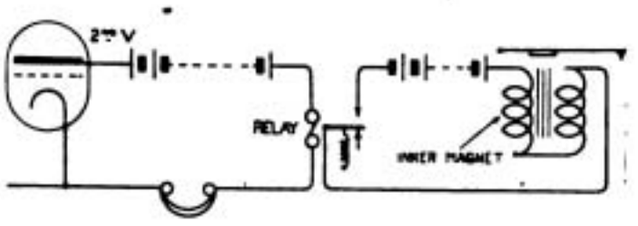

Fig. 1.

Connections should be as in Fig. 1. No potentiometer is necessary.

M.D.M. (Cricklewood) *asks* (1) *For information regarding ratio of turns of tuning inductance to turns of reactance coil in valve circuits.* (2) *With reference to a method for measuring the resistance of leaks by means of a sensitive galvanometer and battery of known voltage, if Ohm's law holds good for this method.* (3) *If 240 volts D.C. from the mains is sufficient plate voltage for C.W. and telephony transmission.* (4) *What amount of current will the "R" type French valve pass.*

(1) The question is one of great complexity, as more reactance turns are required when the tuned circuit has a large H.F. resistance. In some cases many more turns of reactance than of inductance are required. Multilayer coils enable more coupling to be obtained with fewer turns, but in general the H.F. resistance of these coils is greater.

(2) Yes.

(3) Yes.

(4) 10-15 milliamps.

RADIO (Norwich) *has a selection of apparatus in his possession, which he wishes to make into a receiver. He asks* (1) *For a diagram of connections for the above.* (2) *For suggested additions.* (3) *For wavelength range with a frame aerial.* (4) *For dimensions of frame aerial.*

(1) Diagram given in Fig. 2. You can use some

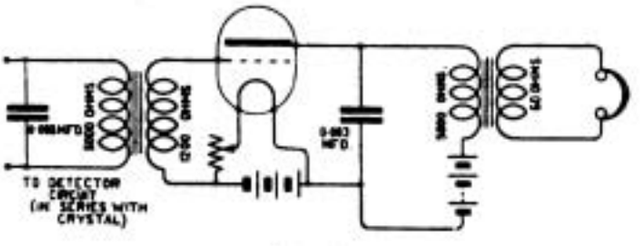

Fig. 2.

of your spare slab inductances to load up your closed circuit.

(2) Grid condenser duplicate of your present one Grid leak, 2-3 megohms. Blocking condenser across telephones and H.T., ·003 mfds. Reaction coil in series with blocking condenser and telephones on "earth" side of H.T. battery, coupled to closed circuit. Size to be found by experiment.

(3) The set as it stands will not give good results with frame aerial, as the valve only rectifies.

(4) See articles on frame aerials in the issues of May 29th, and June 12th last—particularly the latter.

G.A.H. (Farnborough) *asks* (1) *for a criticism of a receiver circuit.* (2) *If an intervalve transformer, 2,000 ohms. primary, 20,000 ohms. secondary, could be used in his circuit, with a crystal detector and valve amplifier.* (3) *For suggestions as to improvements for wireless telephony reception.* (4) *To what purpose he can put two ordinary Bell telephone receivers.*

(1) The circuit appears to be correct, but we do not understand why you employ 8 pancake coils in your plate circuit, apparently not coupled to anything. If you are not using reaction omit these altogether, otherwise use the least possible inductance to give the required reaction.

(2) The above circuit is a valve-detecting circuit. Consequently, a crystal detector is not required. Your transformer could be used for a L.F. amplifier, with primary in place of telephones.

(3) We cannot think of any improvements except that stated above.

(4) Use with telephone transformers as described in the issue of March, 1920, in place of your present high resistance telephones. You will find them somewhat insensitive.

Messrs. Mitchell's, of Peckham, have asked us to announce the names of the winners of their "WIT" competition, as per their advertisement in our issue of December 25th. The winners are Messrs. H. B. Hydes (Liverpool), W. P. Slater (Doncaster) and F. Scots (London, N.10), to each of whom a valve has been despatched. Consolation prizes of a copy of "Science and Invention" and "Radio News" were awarded also to Messrs. E. T. Manley (Wimbledon Park), C. W. Hirst (Acton) and H. P. Ford (Beeston). There were 289 entries for the competition.

SHARE MARKET REPORT.

Business in the Wireless Group has shown a slight improvement during the last fortnight. Prices as we go to press, January 13th, are:—

Marconi Ordinary	....	£2 - 5 - 0
,, Preference	....	£2 - 2 - 6
,, Inter. Marine	....	£1 - 4 - 4
,, Canadian	....	7 - 6