The WIRELESS WORLD

VOL. VIII. No. 10, NEW SERIES] 7th AUGUST, 1920 [FORTNIGHTLY

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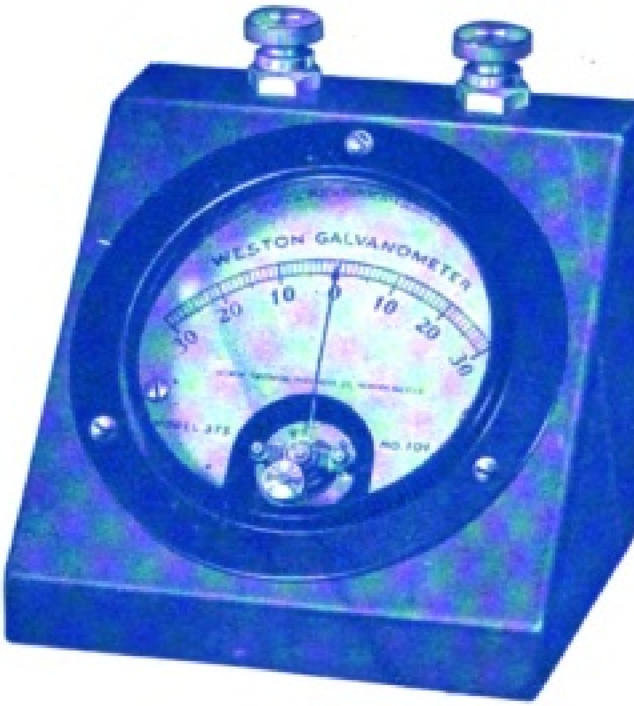

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 10. AUGUST 7TH, 1920 FORTNIGHTLY

SPARKS AND SPARK GAPS

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

IN the previous article it was indicated that the character of the discharge and the form of the oscillatory current were influenced to some extent by the construction given to the spark gap across which the discharge was made to take place. This feature may now be examined in somewhat greater detail.

The simplest of all spark gaps is that formed of two metal spheres or balls mounted on insulating supports a short distance from one another, and preferably provided with means for readily adjusting the length of the gap between them. When a series of spark discharges is passed across such a gap, the metal of the electrodes becomes heated and their surface badly pitted and worn. This damaging of the surface of the electrodes alters the effective length of the gap when that is short, while the uneven nature of the surface destroys the regularity of the discharge. Such a gap will not therefore function steadily for long periods unless the power of the discharge is very small so that the spark balls do not get appreciably heated.

The heating of the electrode surface implies that some of the metal of those surfaces becomes evaporated, and is carried into the discharge in the form of conducting vapour. When this is the case an arc discharge can traverse the gap while at the same time some of its power of setting up oscillations is lost. This condition, therefore, should be avoided. The reason for the reduction of the oscillations is not hard to find. We have seen in the previous article that, with a pure spark discharge the current across the gap is carried mostly by electrons, but also to some extent by ions of the gas between the electrodes (the production of the latter being brought about by electronic bombardment of the gas molecules). The electrons in particular being of very small mass are easily able to follow the fluctuations of potential of the electrodes, and cannot in fact leave the surface of the metal (when it is cold) until the electric stress reaches the breakdown value. This means that after the cessation of one spark the gap resistance rapidly rises again, so that the condenser is enabled to be charged up to its full voltage before the next spark passes.

When, however, the material of the electrodes becomes heated the electrodes are enabled to emit electrons at lower voltages, the higher the temperature the lower being the voltage at which electrons can leave the metal (at a bright red heat a potential of only a few volts is sufficient to draw a considerable electron current from most metals, as, for example, in the case of the filament of the Fleming valve). In addition to this effect, it is evident that when the metal is strongly treated, as at the sparking point, some metallic vapour will be evaporated which, by remaining in the gap, will maintain the conducting state for a longer period than would otherwise be the case. As a matter of fact experiments have shown that the time of de-ionisation of a spark gap is dependent for this reason upon the material of the electrodes. For example, the de-ionisation time for zinc electrodes in air is about 0·001 sec.*, and hence it will not be practically possible to pass discharges across these gaps at less intervals than the time required for the de-ionisation and the return to the non-conducting state.

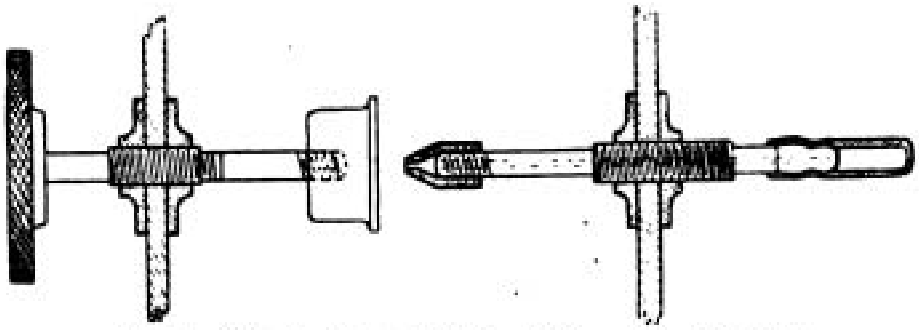


Fig. 1. Shaw's Quenched Spark Gap with Air Blast.

Evidently, then, if we forcibly blow away this cloud of ions and metallic vapour from the gap space—as, for example, by means of an air blast between the electrodes—we can reduce the de-ionisation time and increase the stability of the discharge and the regular operation of the gap. The air blast will evidently also be of assistance in the same direction by providing a more rapid cooling of the electrodes and preventing them from becoming overheated. Even so, however, it will not be possible to obtain a very rapid sparking rate should such be desired, as the de-ionisation time cannot be very much reduced by this means.

It has been found by experiment, however, that if the speed of the air blast through the gap is made very high—as may be done by increasing the pressure of the air applied to the jet—a quite pronounced change takes place in the character of the discharge. No longer does each spark consist of a train of perhaps ten or a dozen or more oscillations, but it comprises but one or two. The spark under these conditions is said to be "quenched." In the extreme case the train of oscillations may be reduced until but one semi-alternation is left, when the discharge is really no longer oscillatory, and we have the conditions corresponding to those of an "aperiodic discharge." Such a unidirectional or aperiodic discharge possesses the valuable property of impulsing a secondary circuit, which may be coupled to the oscillation circuit connected to the spark gap, or in other words it can give such a secondary circuit an electrical blow or shock, which serves to set the secondary oscillating with its own natural frequency. In consequence, this phenomenon is usually termed "impulse excitation" or "shock excitation" of the secondary circuit.

Many types of quenched spark gap have been developed with the idea of obtaining the most perfect quenching of the discharge, and consequent good impulsing of the secondary circuit—which, in practical working, is usually the aerial circuit, so that the free oscillations set up therein may radiate their energy as useful electromagnetic waves. One of the most important conditions to be satisfied is evidently that of cooling the electrodes efficiently. To this end they may be water-cooled, as in the case of the Lepel and similar quenched spark gaps. The gap length must evidently be very short, or the cooling of the electrodes will not be effective in quenching out the discharge by preventing the maintenance of the ionised state in the gas in the gap space.

The quenching properties of short spark gaps were first discovered by Max Wien, and are the basic properties underlying all the various forms.*

Perhaps the best known form is the Tele-

*Physikalische Zeitschrift, 12, p. 652 (1911).

*See for example, M. Wien, *Physikalische Zeitschrift*, 7, p. 871 (1906) also 9, p. 51 (1908).

funken type of quenched spark gap, one example of which is illustrated in Fig. 2. The electrodes of these gaps are customarily of silver-plated copper, while the flanges serve for cooling purposes. To hinder the evaporation of the metal of the electrodes they may with advantage be made of a metal with a high melting-point, such for example as Tungsten, and when using electrodes of this material it is possible to operate the gap in open air and still retain its quenching properties. This feature renders such a gap very suitable for small or portable sets of low power. The gap electrodes should preferably be in the form of small flat discs of the metal, mounted with their adjacent faces parallel and a fraction of a millimetre apart.

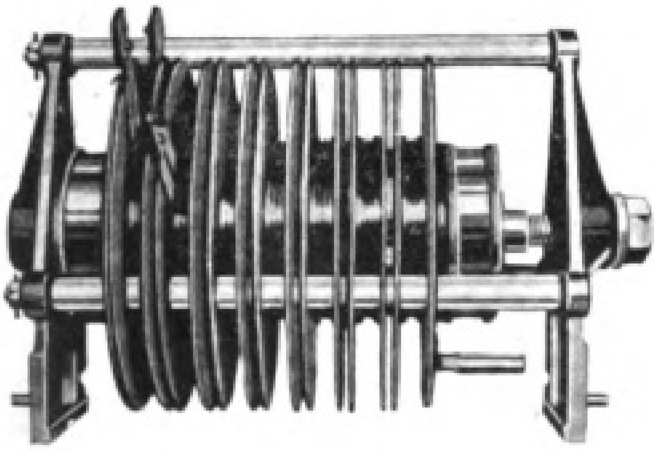


Fig. 2. A form of Telefunken Quenched Spark Gap.

The use of a gas other than air between the spark gap electrodes is frequently an advantage in securing efficient quenching action. Hydrogen or hydrocarbon gases or vapours are good. In the Lepel gap mentioned above a slight hydrocarbon atmosphere is obtained by the gradual decomposition of the paper separator ring between the plates by the heat of the sparks. These gases have also been applied to other gaps with good results, but a consideration of the properties of such gaps, particularly with regard to the generation of C.W., must be left to a later article.

A very important class of spark gap which must, however, be mentioned here, is that of the various kinds of rotary spark gaps, in which there is some relative motion between the electrodes of the gap. In its simplest essentials the type of gap comprises some form of disc, either made entirely of insulating materials or insulated from the driving shaft upon which it is mounted, and provided with a number of metallic projections from its surface, which serve for the sparking electrodes. The whole disc is mounted so that these projections pass near to fixed electrodes, so that the spark discharges can pass from the fixed to the moving electrodes.

The great features of these gaps are the excellent cooling obtained by the air blast set up by the disc's rotation, and the fact that each successive spark takes place to a fresh electrode surface. The electrical conditions of the spark gap, therefore, remain very constant, as all ionised gases are blown away, while in addition the spark frequency may be given that of a good musical note—a feature of considerable utility in practical working. A typical form is illustrated in Fig. 3, but there are many other possible varieties.

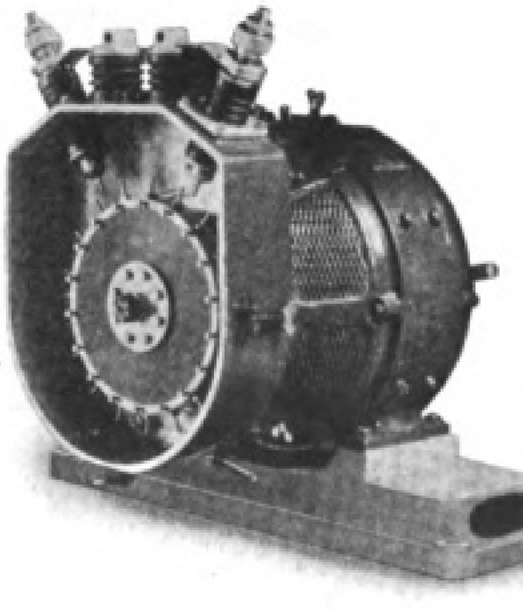
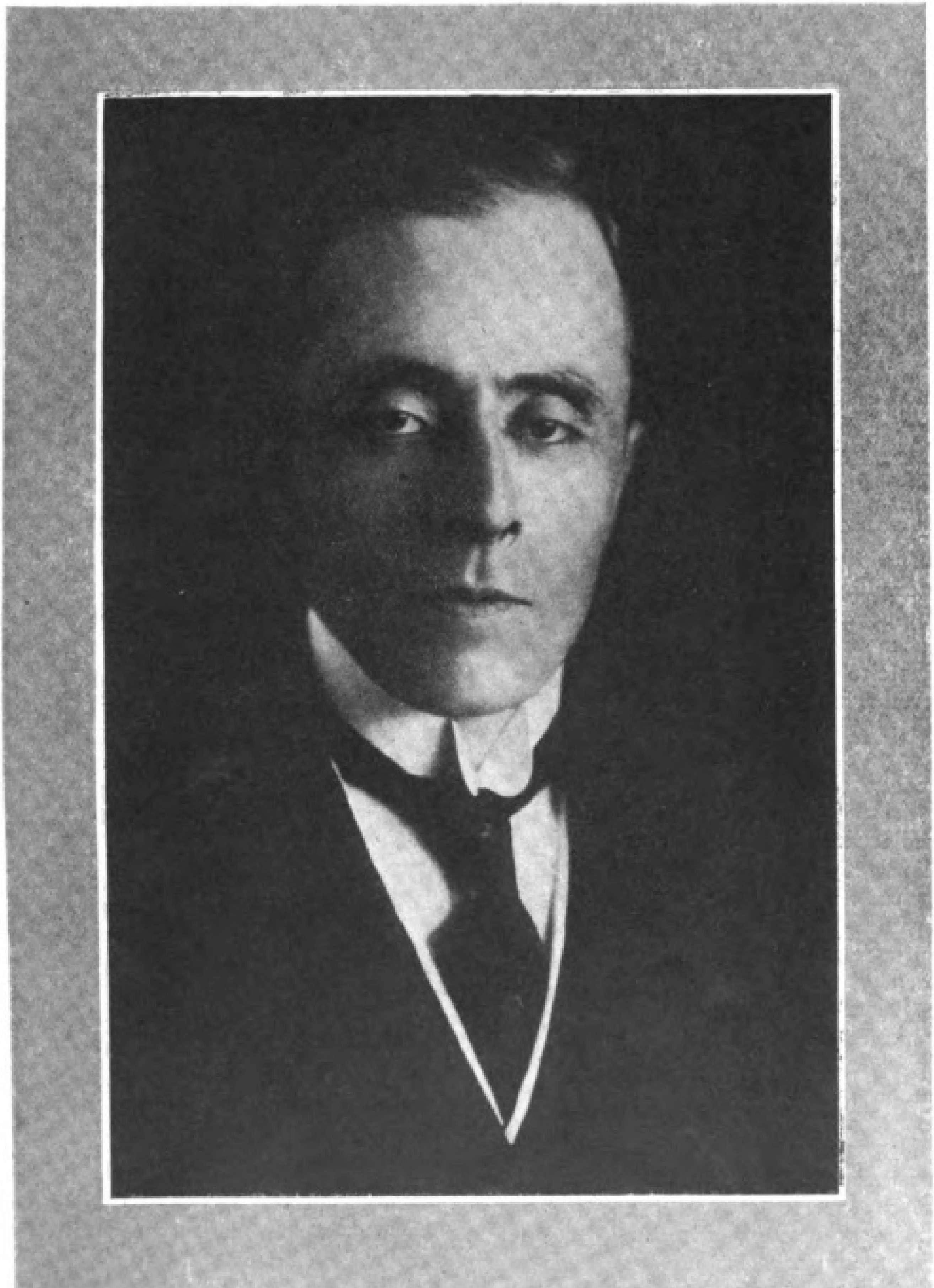


Fig. 3. One form of Rotary Spark Gap as used by Marconi's W. T. Co.

Such special forms as the smooth disc spark gap, for example, must be left for subsequent treatment, together with the quenching action of the rotary gaps at long wavelengths, and their application to continuous wave working.



E. T. FISK, ESQ.

Personalities in the Wireless World

THE subject of our photograph, Mr. Ernest Thomas Fisk, M.I.Radio E., was born at Sunbury-on-Thames on August 8th, 1886. On completion of his education at Primary and High Schools he devoted himself to the study of Physics, Mathematics and Commercial Subjects. In 1905 Mr. Fisk, attracted by wireless telegraphy, joined the English Marconi Company for the purpose of familiarising himself with wireless engineering and operating, subsequently being engaged in the engineering branch of the American Marconi Company in the erection of stations on ship and shore. In 1909 he undertook a special mission to the Arctic Icefields, and demonstrated there the possibilities of wireless communication with the Newfoundland Sealing Fleet. Returning to New York, and later to England, he was then engaged in the latter country at Marconi Headquarters.

In 1910 he visited the Antipodes in the R.M.S. *Otranto*, and demonstrated the use of the Marconi apparatus for the Orient Mail Line of steamers. During this visit he also rendered technical service to the Marconi Company's Agent in Australia.

In the year 1911 he again visited Australia, establishing branches for the Marconi Company in both Australia and New Zealand, where he conducted highly technical patent actions. In 1913 he accepted the position of General Manager, with a seat on the Board of Directors, of the Amalgamated Wireless (Australasia), Limited, this being formed for the purchase and operation of Marconi patents in Australia and New Zealand. He established the manufacture of wireless telegraph apparatus in Australia, training both the executive and technical personnel.

In 1916 he re-visited England, where he devoted some considerable period to the investigation of the latest developments in wireless telegraphy and its war-time uses. Shortly after his return to Australia he accepted the position of Managing Director of the Amalgamated Wireless (Australasia), Ltd.

While in England he undertook to test the possibility of direct wireless communication between England and Australia. In 1916 he commenced his experiments in Sydney, and early in 1918 he succeeded in receiving the first direct wireless messages from this country to Australia. The Marconi Trans-Atlantic Station in Wales was the transmitting station and reception was conducted at an experimental station at Wahroonga, Sydney, with apparatus designed and constructed by Mr. Fisk and his assistants. The first public demonstration of wireless telephony was given by the subject of our biography before the Royal Society of New South Wales.

He reorganised manufacturing work, manufactured and supplied from Sydney all wireless telegraph equipment for British ships built in Hong Kong, Japan and other neighbouring countries; he also supplied all the wireless requirements of Australasian Mercantile Marine during the war. Mr. Fisk now controls a large staff engaged in the erection of wireless stations, in addition to being Managing Director of the Australectric Company, an important electrical engineering and manufacturing concern. He is the founder and initiator of *Sea, Land and Air*, the first journal in the Southern Hemisphere to deal with aviation and wireless. This journal is now the official organ of the Australian Aero Club (affiliated with the Royal Aero Club of Great Britain) and is also the official journal of the Wireless Institute of Australia and New Zealand. He also established the Australian branch of the Wireless Press.

Mr. Fisk is a member of the Institute of Radio Engineers, a Member of the Electrical Association of Australia and President of the Wireless Institute of Australia (New South Wales Section).

STRAYS AND THEIR ORIGIN

By Cantab.

IT has long been known that a wireless receiving station responds not only to artificially produced electric waves, but also to certain naturally occurring electro-magnetic stimuli. The intensity of these natural waves is sometimes so large as to affect the receiver more powerfully than do the message-bearing waves. Thus, from the operator's point of view, these natural disturbances, called variously strays, or atmospherics, are particularly undesirable, though to the experimenter with non-utilitarian aims they present a fascinating field of study.

In the ordinary method of receiving signals each natural electro-magnetic impulse or stray makes itself evident as a click or sudden noise in the telephone receiver. A wireless man, pondering on this subject for the first time, would naturally conclude that each atmospheric click is the result of a single spark discharge in some natural oscillatory circuit, the receiver reproducing the resulting damped train in the same way as each train in an ordinary artificially produced spark signal is reproduced. Such a conclusion is now generally accepted, the actual spark train being supposed to originate from a lightning flash which may occur many thousands of miles from the actual receiver.

Until quite recently our knowledge of the magnitude and electrical sign of lightning flashes was of the scantiest. However, Mr. C. T. R. Wilson, of Cambridge, has recently completed some researches on this subject, which bear directly on the question of natural electro-magnetic disturbances. Mr. Wilson has shown that before an ordinary lightning flash passes between a cloud and earth, the electrical system is quite comparable to that of a simple Hertzian oscillator. (*See* The Wireless World, May 1st, 1920, pp. 73–75.)

A charge of electricity + Q situated in the atmosphere may be regarded as having an electrical image of charge − Q in the conducting earth. (Fig. 1*a*.)

When the electric intensity between the charges + Q and − Q is sufficient to break down the insulation of the air between them a spark passes and the electric field is suddenly destroyed. The analogy between this discharge and that of a Hertzian oscillator charged to a sufficiently high potential to spark between the knobs KK is at once evident. (*See* Fig. 1*b*.)

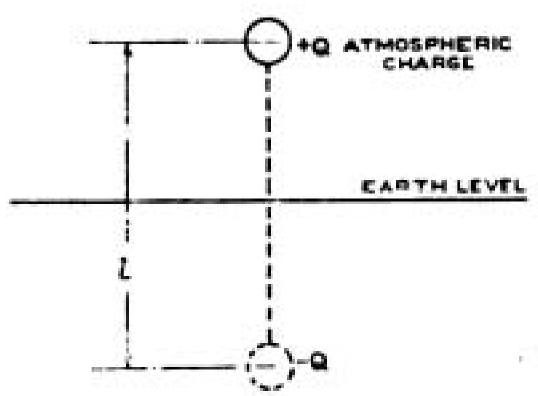


Fig. 1(*a*).

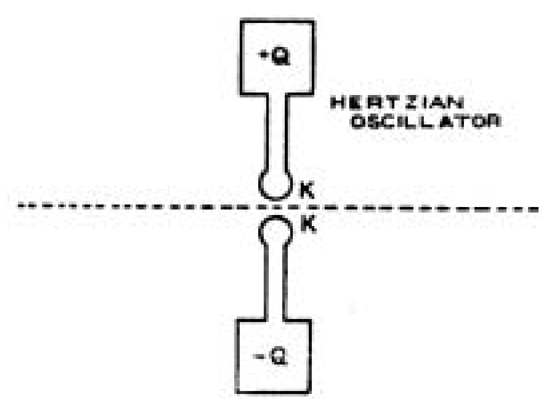


Fig. 1(*b*).

The calculation of the wavelength of the radiation emitted by a system, such as that of Fig. 1 (*a*), or 1 (*b*), is a very complicated and difficult matter. However, approximate values are available for the case of two spheres possessing equal and opposite charges and joined by a fine wire. In such a case it has been shown that the possible fundamental wavelength is equal to twice the original distance between the electric charges. Thus, as C. T. R. Wilson has shown that the value of *l* (*see* Fig. 1 (*a*)) for lightning flashes is of the order of 15,000 metres one might assume that the wavelength of the radiation from such a disturbance is of the order of 30,000 metres.

Supporting such a figure is the fact that the signal intensity of a stray is usually greater for a long wave receiver than for one tuned to shorter wavelengths. But the fact that the tuning is so very " broad " indicates that the impulses cannot be regarded as consisting of a single frequency.

Now, the greater the damping of a train of waves affecting an aerial, the greater is the range of receiver frequencies for which a marked response is obtained. Thus we are led to conclude that the electro-magnetic train emanating from a lightning stroke is very strongly damped, and there is reason to believe that in most cases the disturbance is aperiodic. Such a disturbance, of course, would produce a train of oscillations in an antenna by a process of shock excitation, the actual oscillation in the receiving aerial being that natural to the aerial circuit itself.

Twenty years ago it was not possible to say whether the discharges producing an effect in a given station originated within a hundred or within a thousand miles. In the year 1911 Eccles and Airey published the results of their experiments on the identification of isolated strays simultaneously at Newcastle and London. As 70 per cent. of the strays received at one station could be identified with those received at the other, the intensity being practically the same, it can be concluded that, so far as English stations are concerned, the origin of the disturbance is thousands of miles away.

The number of strays heard at a given station varies considerably during the day, there being a well-marked diurnal variation. Thus at night-time the strays are more frequent than during the day, and there are distinct lulls just after sunset and just before sunrise. Professor Eccles has shown that these variations can be interpreted in terms of the diurnal variation of the ionization in the upper and middle layers of the atmosphere. But a good deal of work on this subject requires to be done. For example, answers are required to the following questions: Is it possible to decide for any particular stray whether it is the result of a damped oscillation or a mere aperiodic surge of electricity ? Can some apparatus for automatic registering of stray intensity be devised ? Why do the bulk of strays originate from a source practically due south, as is shown by careful experiments with directional apparatus?

There are many problems for the experimental and theoretical physicists, but to test any theories evolved, a large mass of records of stray reception would be required. These records, if collated with the records of the atmospheric condition prevailing near the receiving station, would be especially valuable. And here the wireless amateur will find plenty of scope for his enthusiasm and activity.

The members of the numerous wireless clubs could take up such a question as this, feeling that they were taking part in a most important piece of research, and thus helping to extend the confines of human knowledge.

QUESTIONS AND ANSWERS

Owing to the popularity of the columns under this heading, a number of answers are unavoidably held over from every issue. Our readers may rest assured, however, that every effort is being made to give early publication to replies. If readers would only search our columns in recent issues before submitting their questions, we are sure many of their difficulties would be resolved at once, and we should be helped to bring the section up-to-date, thus increasing its utility.

NOTES AND NEWS

Australian Amateurs.—The Federal Government of Australia has decided to modify to some extent the restriction placed on the use of wireless telegraphy during the war. Licenses will be issued for a period of one year and may then be renewed; applicants must prove themselves to be natural born British subjects resident in Australia and must also prove their competence to conduct experiments in a scientific manner. We understand that these licenses will cover both reception and transmission, for it is stated that the licensee must undertake not to use his installation when it is apparent that naval or military signalling is proceeding.

Wireless and the Church.—With the bride at the church and the bridegroom in a man-o'-war about 1,000 miles away, the marriage of Miss Mabel Ebert of Detroit, to Mr. J. R. Wakeman, was conducted by wireless at the First Presbyterian Church, Detroit. The ship's chaplain aboard the man-o'-war read the ritual as received by the ship's wireless installation, while Miss Ebert and her friends were assembled at the church. The Rev. C. E. Moir telephoned the bride's answers to a telegraph office, to be transmitted to the Great Lakes naval training station and from thence to be passed on by wireless to the bridegroom's vessel, the U.S.S. *Birmingham*.

FL Meteorological Bulletin.—We are informed by a reader in Belgium that some slight alteration is made in FL's 5 p.m. weather report in that information regarding Station No. 20 is sometimes transmitted in place of reports regarding Station No. 12. Our reader elicits the information that Station No. 20 is Cape Sicié, near Toulon.

PCGG.—We have been notified by the owners of this station, so well-known to amateurs, that the following programme will be adhered to during the summer months:—Transmissions will take place each Thursday on a wavelength of 1,000 metres between 6.40 p.m. and 9.40 p.m. G.M.T.

A small band, comprising piano, violin, and cello, will take the place of the usual gramophone records, and amateurs are requested to "listen in" and to write to Messrs. Nederlandsche Radio Institute, Beukstraat, 8—10, Den Haag, apprising them of their success. Endeavours to answer all letters by wireless telephony will then be made each Thursday at 9 p.m. G.M.T.

King Alfonso and Wireless Telephony.—His Majesty the King of Spain paid a visit to Marconi House on July 17th and heard there a demonstration of Wireless Telephony.

Vocal and instrumental selections were transmitted from Chelmsford, being received on a frame aerial and a Marconi Type 55a receiver. Success attended the demonstration throughout, and His Majesty expressed his great pleasure and appreciation.

Aircraft Wireless Section.—With reference to an article appearing under this heading, in our issue of December, 1919, describing the transmitter known officially in the Admiralty and Royal Air Force as "54a," we are advised that this transmitter comprises the auto-transformer arrangement of Fig. 8 of Patent No. 13755 of 1913; the patent of Mr. Wm. Hamilton Wilson, M.I.E.E.

Wireless Telephony and the Japanese Navy.—The Japanese Navy will no longer depend upon wireless telegraphy for its communication in that the perfection of wireless telephony has caused the Ministry of the Navy to recognise this latter system before all others. Already has wireless telephony been installed on vessels of a unit of the First Squadron and the remainder of the fleet is to be similarly installed.

The Vlug Aerial System.—According to the *Vaderland* a new system of wireless aerials has been experimented with at Scheveningen, which is the invention of M. Vlug, a Nederlander. The aerial is made up of wires loosely buried in the ground and is said to be highly sensitive. Comparison has been made between this system and the large antenna at Scheveningen, by which it was proved that signals were louder on being received through ordinary aerials, but that atmospherical interference was much greater than when using the Vlug system.

New Wireless Station for Ecuador.—A wireless station has been erected at Quito by the Société Française Radio Electrique for the Government of Ecuador. Similar stations are also being erected at Guayaqual and Esmeraldas. These stations are of 10 k.w.

French Wireless Telegraph and Telephone Stations.—A wireless station has been opened at Maubeuge and affords a special service on a wave length of 1,200 metres. It will later be incorporated in the Paris-London system with 1,400 metres wavelength. The call sign of Maubeuge is AV.

As from May 25th the squall-warnings previously sent on 1,850 metre wavelengths are now transmitted on 1,400 metre wavelengths. The stations issuing the warnings are Lebourget (ZM), Strassburg (C3), Bourges (YE), Amiens (YB), Tours (YG), Toulouse (YF).

Institute of Electrical Engineers.—The Annual Conversazione of this Institute was held last month, demonstrations of wireless telegraphy and telephony being given before a large audience. According to a contemporary, one is led to believe that in spite of the fact that each demonstration was preceded by a short explanation it was obvious that a few only realised what was going on about them.

Institute of Civil Engineers.—This Institute held its Annual Conversazione at Great George Street during last month, when, in addition to a musical programme, demonstrations of the Marconi calling-up device were also given.

Storm Forecasts at Electrical Power Stations.—We learn from our contemporary *La Nature* that the large generating stations are adopting a method of storm warning by means of apparatus similar to that used in Wireless Telegraphy.

At this period of the year when the average demand for light is small, a sudden increase requiring the rapid bringing into operation of extra boilers, subjects such stations to sudden jerks which can only be warded off by the use of accumulators ready to take the extra load.

In full understanding of the advantage the storm warnings would give, the New York Edison Company endeavoured in the past to organise a meteorological service in conjunction with the Meteorological Office of each town; the results obtained therefrom though not successful in themselves—in that no distinction was recorded between storms threatening the Company's station and those beyond its area—were mainly responsible for the present storm detector which has been giving excellent results for several years. The system now in use is based upon a detector of the coherer type in circuit with an electric bell, and so arranged that the hammer of the bell, in addition to serving its usual purpose, also serves as a "tapper" for the coherer. By this means, at the approach of any electrical perturbation such as storms, the bell is made to ring at intervals of 5 to 15 minutes, the storm then being anything between 100 to 150 kilometres away, or from 2 to 7 hours from the station.

On the storm approaching nearer, the bell is made to sound every minute or half minute until, half an hour before the storm actually reaches the town, the bell is worked continuously. By this time the necessary precautions to meet the additional load of extra lighting have been taken, thus eliminating the possibility of overloading the station with the sudden demand put upon it.

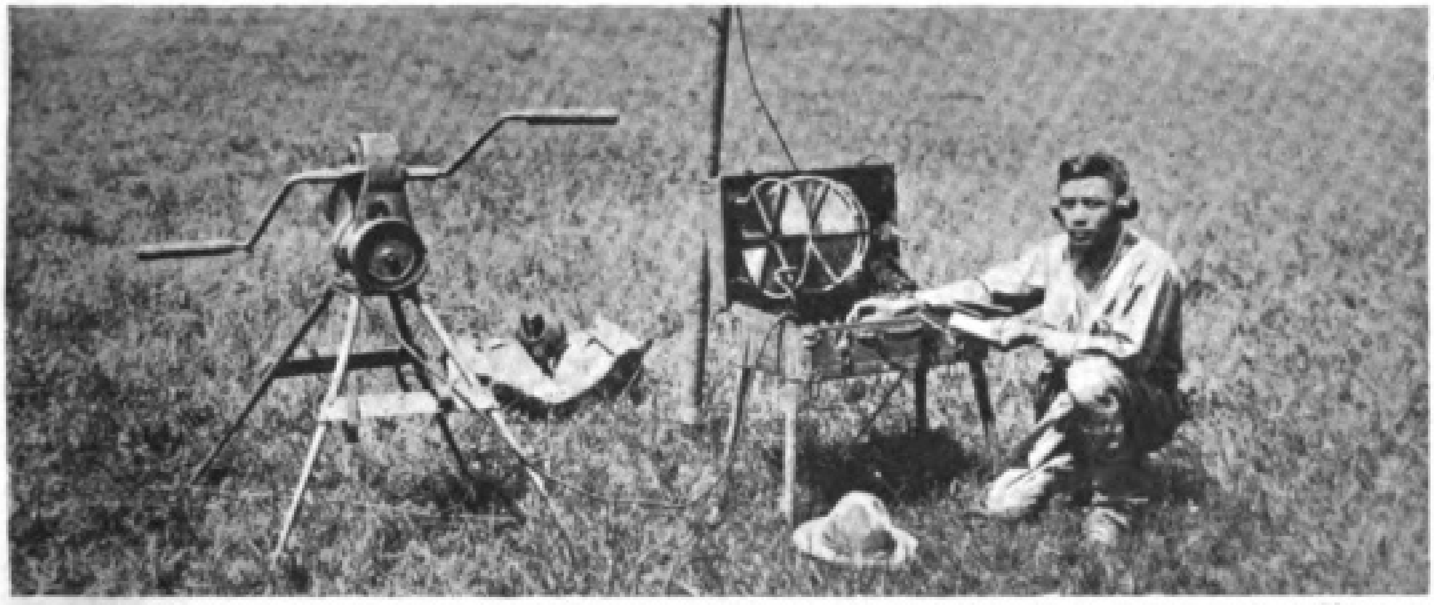
Wireless Telegraphy in Finland.—A system of Wireless Telegraphy for Press messages is shortly to be established between Helsingfor and Copenhagen. Though the Danish arrangements are now complete, the Finnish Military Authorities have not yet given their consent to the use of the Finnish Wireless Stations.

National Physical Laboratory.—The Annual Report of this institution for the year 1919 has just been published. Making one of the most interesting reports of the year, it contains *inter alia* details of facts relative to methods of modern warfare. The report gives much that will interest the wireless student with regard to valves, and gives notification of the publication of valuable information on the subject. There is also in the report a most interesting account of the methods adopted for the trapping of submarines in nets; in addition to diagrams, prints from cinematograph films are given to illustrate their use.

OXE Press.—We are informed by a Danish reader that the wireless station at Lyngby (near Copenhagen) transmits press to CQ at 11 a.m. G.M.T. on a wavelength of 4,100 metres C.W. and Meteorological reports at 7.50 a.m., 1.50 p.m., and 6.50 p.m. G.M.T. on 5,000 metres C.W.

Between the hours of 9 a.m. and 1 p.m., and 9 p.m. and 1 a.m. G.M.T., this station works with Stonehaven on 3,400 metres.

Mr. Alan A. Campbell-Swinton has been elected Chairman of the Council of the Royal Society of Arts, for the ensuing year.



Sergeant Belimbin, 1st Philippine Field Signal Battalion, United States Army, who has become a crack radio operator after less than a year's training. Photo: Photopress

The Imperial Press Conference.—Delegates from the Empire Press Union to the Imperial Press Conference, to be held at Ottawa, sailed for Halifax, N.S., on July 20th, aboard the C.P.O.S. *Victorian.* An extensive and important programme of wireless telephone demonstrations covering the whole voyage has been arranged by Marconi's Wireless Telegraph Company, Ltd., which, up to the time of writing, is being carried out successfully. The *Victorian* is equipped with a 3 K.W. wireless telephone transmitter, and similar installations rated at 6 K.W. have been set up at Poldhu, Cornwall, and Signal Hill, Newfoundland. In addition to receiving a number of news messages from Chelmsford, Poldhu, Horsea and Newcastle, N.S., and the publication on board each day of a special newspaper (*The North Atlantic Times*), the *Victorian* will give wireless telephone concerts to other ships. In a later issue, when it will be possible to review the whole of the *Victorian's* wireless work, we shall give our readers fuller details and some photographs.

ABSOLUTE DIRECTION FINDING WITH A LOOP AERIAL

THE use of a simple frame aerial as a direction finder suffers from the disadvantage, as is well known, that it does not give the absolute direction of the transmitting station but merely indicates the plane in which it lies so that there are two alternative directions possible. If it is known in a general way on which side of the receiving station the transmitter is situated this ambiguity does not introduce any trouble in determining the direction of the station, but if the whereabouts of the transmitter is quite unknown such indefiniteness, by which two possible and opposite directions are indicated, may sometimes lead to difficulties.

A simple arrangement to overcome such hindrances has recently been patented by F. A. Kolster.* It consists of an ordinary frame aerial in the centre of which is mounted a sheet of wire gauze. This gauze B should be connected to the centre turn of the frame aerial winding A, Fig. 1. The condenser C serves to tune the frame aerial to the incoming signals in the ordinary manner, and when the switch S_2 is in its upper contacts the receiving valve V is joined directly across the tuning condenser C as when the frame aerial is used for ordinary reception. When the switch S_1 is open it can be so used. When the switch S_1 is placed on one of its contacts the coil L is joined between the frame aerial and the gauze as a whole and the earth E, so that the capacity of the wires of the frame and of the metal gauze acts as an ordinary elevated aerial which may be tuned to the frequency of the incoming signals by means of the coil L. When switch S_2 is placed on the lower contacts the receiving valve V is joined directly across this coil L and the arrangement may then be used as a simple "stand-by" receiver for picking up signals quickly from all directions. By combining the two effects, that is to say, by leaving S_2 on the upper contacts and placing S_1 on either right or left hand stud, the result is to obtain an aerial system which receives best from one direction only, and therefore when the switches are in this position the absolute direction of any given transmitting station may easily be determined. The direction of maximum signal strength may be reversed by putting S_1 on the other stud. Once the absolute direction of the station has been determined approximately in this manner the switch S_1 may be opened, and the direction determined more accurately using the frame aerial only and working in its minimum position, as is customarily done in D.F. reception. When the valve V, shown in the figure, is used as a simple detecting valve, the telephones (not shown) should, of course, be joined in the plate circuit in the usual manner, and either a grid condenser and leak may be inserted in the filament circuit or the valve may be adjusted to work on the lower bend of its characteristic by suitable adjustment of the filament current and plate circuit voltages.

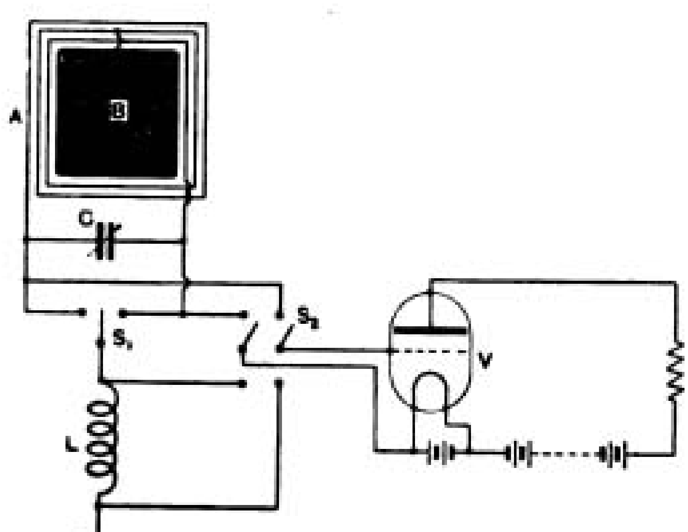


Fig. 1.

* British Patent 138318.

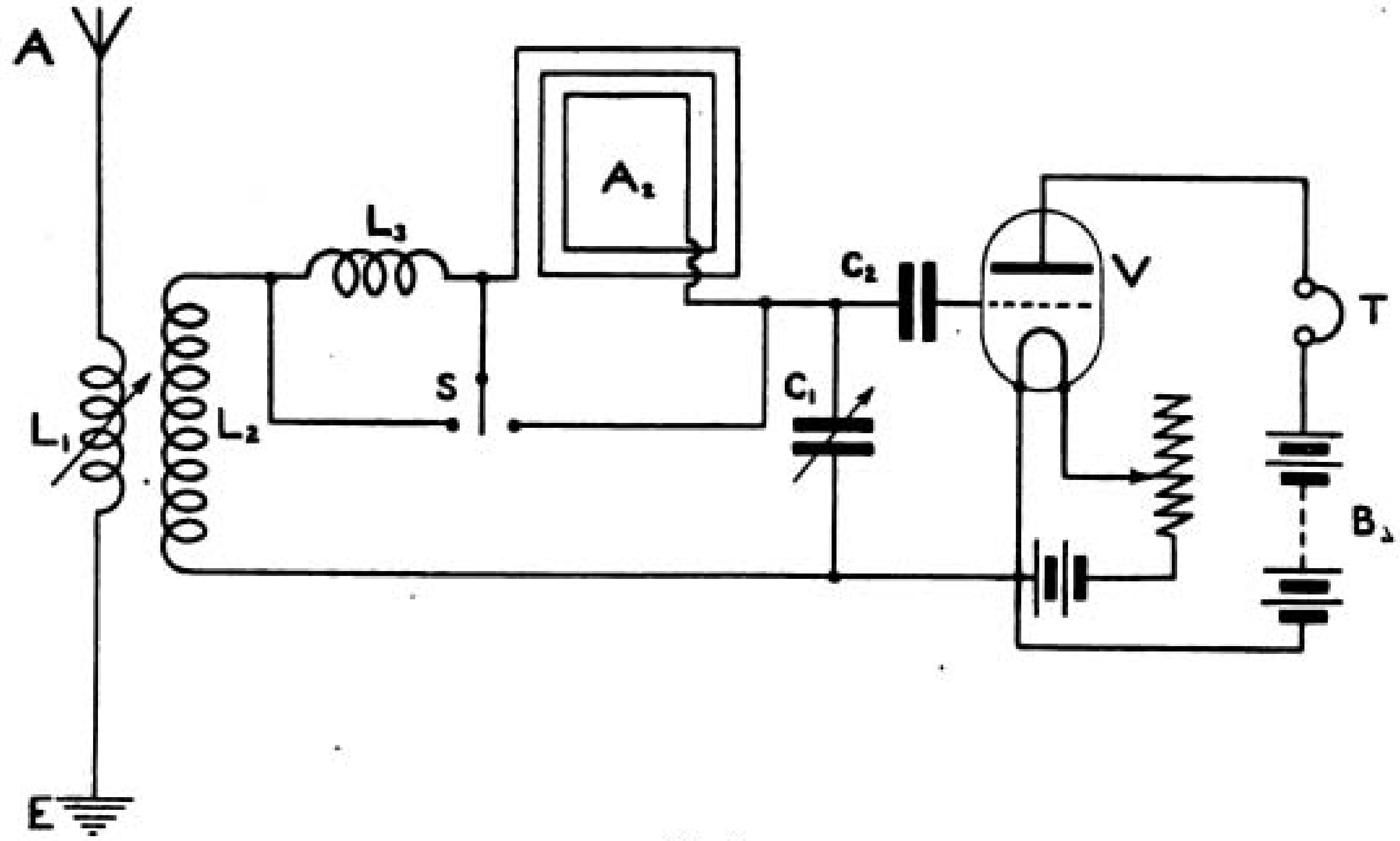


Fig. 2.

Alternatively an amplifier may be joined across the resistance shown in the plate circuit of V.

A small aerial consisting of a few parallel wires stretched horizontally a few inches above the upper side of the loop may evidently be used to replace the gauze in the above arrangement.

In the "Radio compass" as used by the U.S. Navy another method of combining an ordinary elevated aerial with a frame aerial receiver is employed. This also enables the absolute direction of a transmitting station to be determined. The arrangement is indicated in Fig. 2, in which A represents an ordinary elevated aerial, which for convenience should be rather small, so that the signal strength given by it is of the same order of magnitude as that heard on the frame, and A_2 is a frame aerial consisting of a few turns of wire wound round a square frame. This frame aerial is joined into the secondary circuit of an ordinary inductively coupled receiver connected to the usual aerial A. V represents any usual form of valve or other detector. The inductance coil L_3 should be made of equal value to that of the frame A_2 so that when the switch S is placed on either contact that is to say, with either the coil L_3 or the frame aerial A_2 in circuit, the tuning of the receiving circuit L_2 C_1 remains unchanged. If the inductance L_3 is made variable this condition can very quickly be found by experiment.

To use the apparatus, signals are first picked up on the elevated aerial A with the frame aerial cut out of circuit by the switch S_1 and the secondary circuit L_2 C_1 of the receiving tuner, carefully tuned up to the signals. The frame A_2 may then be inserted into the circuit by the switch S and the absolute direction determined approximately, as given by the position of the frame for loudest signals. In order to determine this direction more accurately the ordinary aerial A should then be cut out of the circuit and the directional line of the incoming waves determined exactly, using the sharper minimum positions of the receiving loop.

With any of the above arrangements the absolute direction of the incoming waves may be determined without sacrificing the accuracy of the loop aerial D.F. receiver used in the position of minimum signals as in the ordinary method of such reception.—P.R.C.

HIGH VOLTAGE SUPPLY FOR VALVES

HIS license arrived and his aerial and circuits set up to his satisfaction, the chief fly in the ointment of the amateur wireless man—and the professional, too, very often—is that necessary but expensive high tension battery. Besides being expensive, not only on account of the preliminary outlay but because it requires to be renewed at astoundingly frequent intervals, it is often the cause of more trouble than one would imagine—at least, until one has had considerable experience. Being one of the most fruitful causes of the absence or weakness of signals, and human nature being what it is, the H.T. battery is generally the last resort of the " fault " seeker—until he has learned how wickedly a battery of dry cells can behave. No better dictum could be offered to the amateur wireless worker than : " When in doubt suspect your H.T. battery, after making sure that your filament voltage is not falling."

The chief sources of high voltage at the disposal of the experimenter are the public mains, accumulators and dry cell batteries. A number of other sources have been either suggested or tried, for instance, thermopiles, small motor generators and so forth, but experience of these has not led to their general adoption.

As regards the use of the lighting mains, the method is quite practicable, though there is the primary drawback that, I suppose, not one in a hundred amateurs has the blessing of " juice " in his house in this year of 1920 ; if he has, it is often A.C., and needs rectifying ; the secondary disadvantage is that somewhat elaborate " smoothing out " means may have to be employed in order to deal with the ripples in the supply.

As the use of the mains has been dealt with so thoroughly in the WIRELESS WORLD, Vol. 7, Nos. 81, 82 and 83, we will not consider it here ; yet in this connection would draw the attention of readers to the useful potentiometer described in the Paper read by Mr. G. G. Blake, A.M.I.E.E., before the Wireless Society of London, published in our issue of July 24th, page 319.

I come next to the question of accumulators, and I may say at once that I do not recommend them for the purpose of valve H.T. supply. To obtain only 30 volts one needs at least 15 cells ; I leave the reader to compute roughly the preliminary outlay which this would entail. Then there is the constant charging which is required—an unmitigated nuisance, if the user is unable to do it at home. Modern valves do not take a large amount of current, but when one has to convey a bank of accumulators to a garage for charging, and take them home again, remaining meantime without any H.T. whatever, the disadvantages of storage batteries loom large.

Small accumulators require very skilful handling if they are to have long life (I would sooner keep fifty large ones in order than two small ones), and when left to the tender mercies of the gentleman in the cycle shop, with his asthmatic gas engine and five-shilling voltmeter, are not likely to prove a profitable investment.

Wet batteries would be, I imagine, either a nuisance or a great expense, and subject to polarisation troubles, evaporation, " creeping " and other common complaints of the species. True, I have never tried them ; I should not think of doing so if I could get dry cells. Several readers have sent me descriptions of cheap H.T. batteries, which will be published as soon as space can be found, when I hope the methods will be tried out by those interested.

My own experience leads me to recommend dry cells, good ones of large capacity. During the war, whilst keeping half-a-dozen circuits going, I had, perforce, to give this question of H.T. much attention. For a long time we used batteries composed of 4 v. " flash lamp " batteries, but although these went well for a time, they seemed to deteriorate quickly, and, which is worse, one bad cell appeared to infect its sound neighbours. Anyhow, somebody was always busy with voltmeter and soldering iron, and a lot of time was used up over seven or eight 200 v. banks of these batteries.

At last I obtained a sufficient quantity of large batteries, cylindrical in shape and about 8″ × 3″. These were composed of two cells, placed one on top of the other, and the combination gave a good 3 volts. These I connected by low resistance leads (copper strip is good for this purpose), soldering all joints instead of using the screw terminals supplied. They were insulated from the table by stout brown paper impregnated with paraffin wax, and from each other by an air space. Over the whole battery was fastened waxed paper. These batteries occupied three or four times the usual space allotted to the H.T. unit, and were, no doubt, expensive; but they lasted out a year of work, being used continuously day and night, and gave no trouble whatever.

It is a good plan to have a 50-volt lamp with suitably long leads, and to "flash" this occasionally across some 17 or 18 of the individual units. Should the "flash" be at any time not up to standard brilliancy, further investigation can be carried out with a voltmeter. If, however, a good type of battery is installed, your H.T. troubles should be at an end until the whole battery has run down.

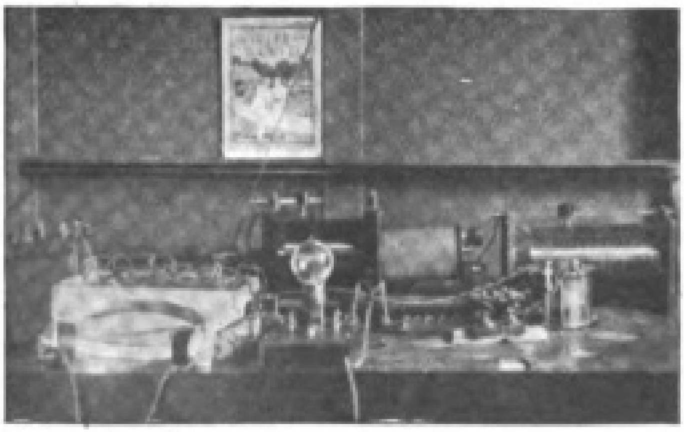
For a battery of 40 volts, 14 or 15 of these units should be installed, and will prove far less expensive in the long run than the cheaper but less stable "flash lamp" batteries.

The following hints, drawn from experience, may be of use. If there is a "frying" sound in the telephones, it may be an indication of deterioration in one of the H.T cells. Test the battery in detail. Do not leave a partially bad cell in circuit with good ones; it will act like a decayed tooth and must be extracted. Make sure none of the units is reversed; these little accidents *will* happen, and one reversed cell can damage a whole battery.

Always use the minimum voltage required; too high a voltage may cause weak signals as effectually as too little: besides, the practice is wasteful. The aim of the scientific radio worker should be readable, not deafening, signals. The boast, that "Eiffel Tower can be heard all over the house," should no longer be a proud one, for in these days of valve-receivers—well, as the lamented Sylvanus Thompson used genially to say, "What one fool can do, another can."—E.B.

THE PROOF OF THE PUDDING

A reader has kindly sent us this photograph of his set, which he designed according to the instructions given in our issue of April 17th. He finds that it works well up to his expectations, and he has been very successful in receiving wireless telephone messages and music. We shall always be pleased to receive similar reports from those of our readers who are following in practice our Constructional Articles.



WIRELESS CLUB REPORTS

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting of the Wireless and Experimental Association at 18, Peckham Road, on July 14th, the members again expressed their appreciation of the Chelmsford wireless concert of the previous evening, remarking on the fidelity of the tone of the oboe, but reserving their opinion as to the suitability of the "Lost Chord" as an unaccompanied solo for that instrument. The Secretary reported that he had by request arranged an interview for the next evening with an anonymous gentleman who was collecting evidence for his local M.P. on the subject of the incidence of the present restrictions and arming him for dealing with the Wireless Bill when it appears before the House. The Secretary was confirmed in affording all possible assistance and the members present made many helpful suggestions. Mr. Voigt then read a paper dealing with losses in inductances and other component parts of wireless plant. He also showed and described an ingenious little switch for connecting head gear telephones in series or parallel. He had found carborundum gave 3,000 to 8,000 ohms, and French galena 9,000 to 15,000. Mr. Kloots, senior, promised a lantern lecture on valves for July 29th. The Editor of the *Wireless World* was thanked for his timely advice of the Chelmsford concerts. On July 21st, under the chairmanship of Mr. C. Saunders, we spent a quiet and instructive evening. Mr. Voigt, on his last appearance before returning to his work in France, favoured the meeting with more details of his French Galena crystal set with a two-valve amplifier. If all he told us was true, the house will be considerably quieter when all his wireless apparatus is packed up and put away. Several members recounted their experiences of the exchange of speech between Chelmsford, the *Victorian* and Poldhu. Croydon, our near neighbour is also very voluble, we almost said garrulous, but not nearly so musical as of yore. When shall we hear again "O God our help in ages past," followed on the next Sunday by the "Bandolero"?

Somebody collecting opinions of amateurs and others on the incidence of Wireless Control was surprised to find that only one person, and he a manufacturer of wireless apparatus, was in favour of an absolutely free aether. The otherwise unanimous opinion was that control was necessary, but the present severe restrictions in the matter of aerials and modifications of receiving circuits might be considerably lightened. The writer's opinion is that the authorities might profitably make more use of the various wireless associations to sweep their own doorsteps, so to speak. They would keep their own members in order and report infractions of the amenities of the aether in the case of others who did not owe them obedience. Besides, the added responsibility would have a steadying effect and considerably add to the status of the societies. Hon. Sec., G. Sutton, Melford House, Melford Road, East Dulwich.

Glasgow and District Radio Club.

(Affiliated with the Wireless Society of London.)

The Secretary of this Club begs to announce that new members are now being enrolled. The annual subscription is 10s. and intending members should communicate with the Hon. Secretary and Treasurer. Mr. R. Carlisle, 40, Walton Street, Shawlands, Glasgow.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of this Club was held at Shaftesbury Hall, Bowes Park, on July 14th, the President being in the Chair. During the summer months the meetings have been of a more informal nature, partly owing to so many members being away on holiday; opportunity has been taken of this to make use of the Club's receiving set, and on this occasion the results were very good.

Full particulars of the Club may be obtained from the Hon. Secretary, E. M. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21.

Southport Wireless Experimental Society.

(Affiliated with the Wireless Society of London.)

Buzzer practice and renovations have taken up most of the time spent in the new Club-room at 74a, Kensington Road, Southport, since our last report. At a special meeting held on July 15th the President reported that a free installation of electric light and also an aerial had been promised. Several members promised apparatus as soon as the P.M.G.'s license was obtained. The chairman spoke regarding the unsatisfactory secretarial work, and it was unanimously agreed to accept the resignation of the present secretary. Mr. H. Sutton was elected Secretary, and Mr. H. Brown, 71, Norwood Crescent, Southport, the Treasurer. General discussion took place, many of the members reporting their success in catching the telephonic communications from Chelmsford, Hounslow and Didsbury. Atmospherics have been persistently bad for a month past.—Hon. Secretary, Mr. H. Sutton, 62, Marshside Road, Southport.

The Wireless Society of Hull and District.

At a recent meeting of this Club it was decided to adopt the above title in place of "The Hull and District Wireless Society." The following officers were elected:—President, G. H. Strong, M.Inst.N.A., etc.; Acting Vice-Presidents, Hy. Strong, A.M.Inst.N.A., etc., and C. Dyson; Hon. Secretary and Treasurer, H. Nightscales; Committee Members, Messrs. C. De Fraine, J. Jephcott, C. Cookson, A.M.I.M.E., etc., and W. Dowson. Membership of the Society is open to all persons resident in Hull and District who are interested in the advancement of wireless telegraphy and allied subjects. To be eligible for full membership, candidates must have attained the age of 18 years. Persons of not less than 12 years may, however, join as students.

The annual subscription has been fixed at 10s. for members and 6s. for students, payable in advance but subscriptions of 2s. 6d. in the case of full members and 1s. 6d. in the case of students may be paid quarterly in advance. The entrance fee for both members and students is 1s. Meetings will be held monthly as from May to September, and fortnightly from October to April. It is hoped to provide an interesting syllabus of lectures, demonstrations and discussions during the winter sessions. The next meeting will be held on Thursday, August 12th, at 7.30 p.m. in the Metropole (Marlborough Room) when a discussion will take place on the subject of "The Crystal Detector; is it now obsolete for amateur wireless receiving stations?"

A meeting of the Committee will take place on the same evening at 7 p.m.

The Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull, will be pleased to receive the names of intending members, and supply any further information.

Stockport Wireless Society.

A well-attended meeting was held at the Foresters' Hall, on July 2nd, and several interesting features arose.

Major Swart's very efficient portable valve set was exhibited, and constructional details were discussed. A discussion arising on the subject of self-capacity in inductances, Mr. J. Brown, B.Sc., gave us some very interesting information and theories as to the relative efficiency of tubular, honeycomb, and layer-wound coils. His experiments with the latter tend to show that, wound scientifically, they are perfectly efficient—contrary to the generally accepted belief.

July 9th.—Work is progressing towards the completion of the Society's receiving station. A resolution was passed that we file an application for a 10-watt transmitting permit.

Several members brought specimens of receiving apparatus, which were handed round and discussed. A schedule was prepared of the papers to be submitted by various members at forthcoming meetings. Intending members are invited to apply to the Hon. Secretary, Mr. Z. E. Faure, 3, Banks Lane, Stockport, or to attend at the Foresters' Hall, Churchgate, Stockport, any Friday evening at 7.45.

Walsall Amateur Radio Club.

The Secretary of this Club begs to draw the attention of readers to the following:—Meetings are held at the Brotherhood Institute, Church Hill, on Wednesday evenings at 8 p.m. The subscription for full members payable in advance is 7s. 6d. per annum, or 4s. half year, or 2s. 6d. per quarter. An entrance fee of 5s. is charged for full members. For associate members the subscription is 3s. 6d. per annum, or 2s. half year, or 1s. 3d. per quarter, with an entrance fee of 2s. 6d. The Club hopes to have its license within a few days, when receiving apparatus will be erected; Morse and buzzer instruments have already been installed for the use of those members wishing to become proficient in reading telegraphy. A visit to the Walsall Electrical Supply Station and sub-stations is to take place at an early date. Interested readers and intending members please communicate with the Hon. Secretary, Mr. E. W. Bridgewater, 46, Caldmore Road, Walsall.

Amateur Clubs.—It may interest our readers to know that there are in the United Kingdom forty-one Clubs, formed for the purpose of studying and practising Wireless Telegraphy and Telephony. Of these Clubs, twenty are affiliated with the Wireless Society of London. As far as we are able to gather from our records, the total number of Amateur Club members in the United Kingdom is approximately, 1,500; but since the honorary secretaries of many Clubs have not apprised us of further membership, our figures must necessarily be short of the actual total.

We take this opportunity of pointing out that a number of Clubs have become lax in the matter of sending in reports of their meetings, and, in so doing, are helping to defeat the amateur cause. There are, as shown above, forty-one Clubs for whom we could publish reports each month, yet, as enthusiastic as the members of those Clubs profess to be, never have we been called upon to publish a number of reports so high as forty-one.

The publicity of these columns is open to all Clubs, formed and forming, and, speaking from the book of experience, nothing succeeds *without* publicity; no Club can grow without support. Let each Club send in its report; let each Club make known its movements to other Clubs; let all Clubs make their existence known, and so advance the amateur cause. There are still wanted to form Wireless Clubs at Bournemouth, Spalding, Doncaster, Exeter, Grimsby, Aberdeen, Rugby and Glasgow. Those interested should communicate with Mr. T. H. Dyke, Hill Garage, Bournemouth; Mr. W. G. A. Daniels, Pinchbeck Road, G.N.R. Crossing, Spalding; Mr. A. H. Wasley, Glenholme, Ravensworth Road, Doncaster; Mr. H. E. Alcock, 1, Prospect Villas, Heavitree, Exeter; Mr. C. Hewins, 42, St. Augustine Avenue, Grimsby; Mr. W. W. Inder, Crown Mansions, 41, Union Street, Aberdeen; Mr. A. T. Cave, 3, Charlotte Street, Rugby; Mr. W. Mitchell, 237, North Street, Charing Cross, Glasgow.

AIRCRAFT WIRELESS TELEPHONE APPARATUS

A few remarks on the specialised design of wireless apparatus for use in Commercial Aircraft.

IN considering the design of wireless apparatus for the aeroplane of to-day, certain essential features have to be catered for ; thus, for an aeroplane flying on an overland and oversea route, both telephony and telegraphy will be required, the former to provide a service for communication with wireless telephone Aerodrome Stations, and the latter for calling up ships in case of distress or forced landing in the sea. Again, the modern commercial aeroplane, although it has developed greatly in size and passenger carrying capacity, does not cater for carrying a specialised wireless operator. As a rule on large aircraft a pilot and mechanic or navigator are carried, either of whom may be required to use the instrument. Pilot's and mechanic's cockpits are not very roomy compartments and therefore it has become standard practice to employ "remote control," that is to say the main portion of the wireless apparatus comprising the valves, oscillatory circuits, inductances, condensers, speech control circuits and receiver amplifiers are fitted in one or two boxes which can be suspended in any convenient part of the main fuselage of the machine ; these circuits being controlled by a small unit consisting of a send-receive switch and tuning arrangements which may be fitted on the dashboard of the machine or in any other convenient position.

An essential feature to observe is to reduce the weight and bulk of the apparatus to a minimum. The biggest item in this respect is usually the low tension accumulators necessary for providing the filament current for transmitting and receiving. One of the problems in this connection is that it is very desirable from the point of view of reliability to employ very robust transmitting valves, which means thick filaments necessitating the employment of big capacity accumulators. Also, with the development of high frequency amplification it becomes desirable and practicable to use anything up to five receiving valves without complications arising. One of the best methods of overcoming this difficulty is as follows.

It is usual to employ a generator driven by a small propeller or windmill to provide high tension energy for transmitting. The usual commercial air-driven generator is provided with two windings on its armature, one a high tension winding and the other a low tension winding. The high tension winding provides energy for transmitting at a high voltage, usually in the neighbourhood of 1,500 volts. The low tension winding is employed for exciting the field circuit of the generator, and the obvious solution is to employ the low tension winding for the purpose of lighting the valve filaments in addition to exciting the field circuit. In adopting this principle the designer is faced with two difficulties. The first is to obtain a constant output at varying air-speeds, and the second—the most serious one—is to prevent commutator noises from being induced into the receiving circuits. Neither of these difficulties is unsurmountable, however, and by a little care in the initial design it is possible by increasing the weight of the generator by 2 or 3 pounds to eliminate almost entirely the 20 or 30 pounds weight of accumulators which would have to be carried in the ordinary way. As regards regulation, there are various methods by means of which this may be accomplished. A very perfect degree of regulation can be obtained by employing the Tirrell system, in which a small relay is employed, with a vibrating armature controlled by the strength of the field current, which cuts in and out a resistance in series with the field circuit.

As regards the second difficulty, that of commutator noise, this trouble can be greatly reduced by care in the essential design of the generator itself. It can be reduced still further by keeping a small battery floating across the low tension mains. An additional precaution should be taken by the careful screening of the receiver amplifier circuits and their associated cables and wires. This system has the added advantage for commercial flying, that the small accumulator always remains charged, and if the aeroplane lands at a remote aerodrome where no charging facilities exist it will be able to proceed on its flight with the wireless installation always in a serviceable condition.

Another advance which will be made in the future will be the supplying of high tension energy for reception as well as for transmission, from the air-driven generator, thus eliminating the dry cell high tension battery; thereby still further reducing weight and bulk and increasing the all-round reliability of the apparatus.

One of the problems to be tackled, is due to the great variation in the size, speed and other characteristics which exist in the various types of aeroplane in use to-day. Thus the same apparatus fitted to a small two-seater has to give the same results regarding range, wavelength and accuracy, as that fitted in a machine of very much greater electrical capacity. It is therefore necessary to provide some means of readily making a fine adjustment of the transmitted wavelength in order to compensate for differences in the capacity of each different type of aeroplane. This, although only a small point, is a very important one, in that ground stations employed to communicate with aircraft are fixed-wave stations which also handle traffic between one another; it is most necessary, therefore, that each aeroplane should be exactly adjusted to the wavelength of the ground station.

Another variable feature is that of engine noise and its effect on speech transmission. Microphones for use in aeroplanes are of a heavily damped variety designed so as to pick up the minimum of extraneous noise while delivering a particularly clear speech quality when spoken into fairly loudly. At the same time a microphone heavily damped to suit a particularly noisy machine will cause a certain amount of loss in speech control because of its relative insensitiveness. It would not therefore be very efficient to employ this particular microphone in a machine which was relatively slow and silent, and therefore it is probable that the wireless telephone apparatus of the future will be provided with adjustably damped microphones which can be suited to give the maximum speech control for any particular degree of engine noise.

The most important point of all, however, in the consideration of aircraft wireless design is that of reliability. This is bound up with two features, the first being mechanical strength and ability of the various parts and connections to withstand vibration, and the second is the stability of the wireless circuits themselves. In this connection, it is interesting to note that from the several alternative methods of obtaining speech control which are known at the present time, the choke control system has been standardised, mainly because it requires no critical adjustment in its operation. Then again, in the receiving circuits, reliability has been increased to a very great degree by the introduction of high frequency magnification in conjunction with highly damped inter-valve transformers. Such a circuit arrangement is stable to a degree and by increasing the number of high frequency magnifications, any degree of sensitiveness can be obtained. This arrangement compares very favourably with the older reaction system, where great amplification was obtained with a small number of valves, by feeding back the high frequency oscillations in the aerial circuit. This latter system, although simple to design and produce, was unreliable owing to the critical nature of this reaction adjustment. It is points such as these that the aircraft wireless designer has to balance up, the net result being a compromise between the reduction of weight and bulk and the increase of reliability and ease of operation.

The most important point to watch and one which is vital to the whole system is that of speech distortion. Provided care be taken in the initial design of the microphone and speech control circuits, there is nothing to worry about in the transmission from the aeroplane to the ground. But received speech to be readily understood in the aero-'plane must be very perfect, and great care must be taken in the design of the receiver amplifier. From the point of view of reducing speech distortion to the minimum it is better practice to use high frequency magnifications than to use low frequency magnifications.

The ease with which speech may be received under noisy conditions also depends largely on the design of the head receivers themselves. Telephones of small diameter and with thin diaphragms are more likely to distort loud speech than those of bigger diameter and with thicker diaphragms. Also the actual shape of the telephones themselves has an important bearing on the tone of the received speech.

One of the secondary difficulties which designers have to face and yet which is one of the most important points to be cared for, is the interference heard in the receiving sets, caused by electrical disturbances from the ignition system of the aero engines. This is one of the limiting factors which determine the degree of magnification which can be obtained from the receiving apparatus, and as such, it plays a very important part in the whole scheme of things. Where a high degree of magnification is necessary the greatest care must be taken in the electrical screening of all parts, not only of the wireless set itself, but of the entire ignition system of the engine. There is probably no more elusive trouble to eliminate in the whole system than bad "magneto noise" which is only too readily obtained in certain types of aircraft.

Another little point in the design of telephone apparatus, small in its way, but yet interesting in its application, is that of "side tone." This means the ability of the speaker to hear his own voice when he is talking, and has to be provided for in aircraft installations because the engine noise is so great that one cannot hear what one is saying. It has been found that where side tone is not provided for, this inability to hear what one is saying causes the speaker to shout, and so to spoil the articulation of the transmitted speech. Special circuit arrangements are therefore always provided by means of which this can be accomplished.

The foregoing remarks by no means cover all the ground; a separate article might be written on any of the points which have been enumerated, but perhaps they will serve to indicate some of the lines which are guiding the design of modern aircraft wireless systems.

AMATEUR CLUBMEN!

Though these pages contain so much of amateur interest, still more interesting would they be made by the publication of photographs of stations, club laboratories, and club groups. Illustrations of this nature are particularly desired. All negatives or prints will be returned after publication.

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.*

HIGH FREQUENCY ALTERNATORS.

THE high-frequency alternator as its name implies, is a machine for directly converting mechanical energy into high frequency oscillating electrical energy. The advantage of such a machine is obvious; we can supply the transmitting aerial with continuous waves by simply connecting it to the terminal of the alternator. It is thus possible to dispense with the spark gap and condensers of the primary oscillatory circuit, the only external apparatus needed being a tapping key for interrupting the trains of waves transmitted.

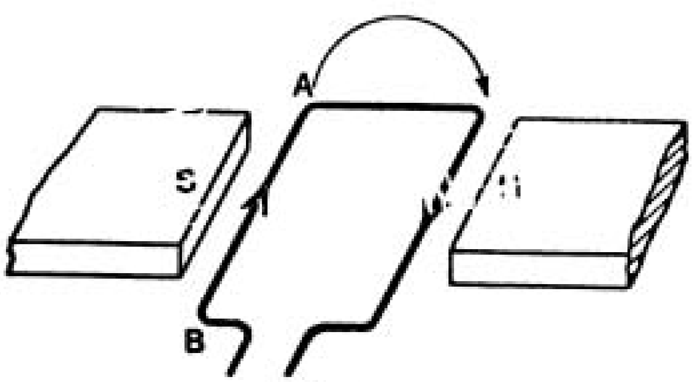


Fig. 1a.

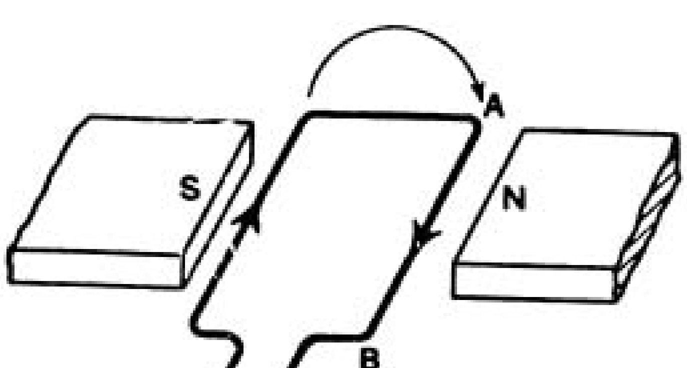


Fig. 1b.

The difficulties in the design and construction of these alternators are, however, considerable. The frequency necessary for wireless telegraphy is seldom less than 50,000 cycles per second, which places a machine of commercial value quite out of the question. This will be more readily understood on considering the factors upon which the frequency of an alternating current depends.

Take the simplest form of alternating current generator—a single loop of wire, rotating between the poles of an electromagnet. Fig. 1 (*a*). If this loop were rotated with a uniform speed of one revolution per second, the current induced in the coil would change its direction once every second. The side of the coil AB, which is opposite a south pole at one instant, would have a current induced in it in the direction shown by the arrow. On reaching the north pole, the direction of flow of the current would be reversed, as shown by the Fig. 1 (*b*).

Clearly, if we were to increase the rate at which the coil cut the poles, we should increase the number of reversals per second, *i.e.*, the frequency.

The frequency therefore is directly proportional to the speed in revolutions per second.

Now, if we keep the speed constant, and increase the number of poles, we shall also increase the frequency.

If we added another pair of poles to the original machine, the coil would then pass two north and south poles per revolution, and thus the number of reversals of the current would be doubled.

It should be noticed that the frequency in no way depends on the number of turns composing the coil, but solely on the speed at which the coil rotates, and the number of poles surrounding it.

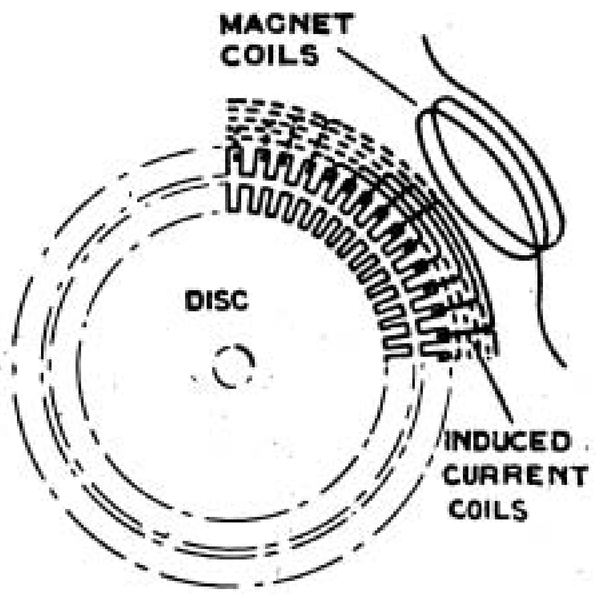


Fig. 2.

The expression for the frequency of any alternating current generator can therefore be written as follows :—

$$F = \frac{N \times p.}{60 \times 2}$$

where N is the speed in revolutions per minute (a more usual figure than revs. per second) and p is the number of poles.

As an example let us take the following :—

What is the speed of an alternator having eight poles and supplying current at 50 cycles per second ?

Substituting in the formula, we get

$$50 = \frac{N}{60} \times \frac{8}{2}$$

or $N = \frac{50 \times 60}{4} = 750$ revolutions per minute.

Now let us calculate the speed of an alternator required to give current at 50,000 cycles per second.

Fixing a fairly large figure for the number of poles, say 50, we find that the speed would have to be

$$\frac{50{,}000 \times 2 \times 60}{50} = 120{,}000 \text{ revs. per minute.}$$

This speed is obviously impracticable because of the enormous centrifugal force exerted on the metal around the circumference of the rotating part. Therefore it becomes necessary to still further increase the number of poles.

A machine having 400 poles and rotating at 3,000 revolutions per minute would give a frequency of 10,000 cycles per second, which is about the limiting size which can be obtained with ordinary types of alternators.

In order to generate current at higher frequencies than 10,000 various special forms of machine have been constructed. In one type, both the exciting magnets and the conductors are rotated, in opposite directions. Thus, if each part was rotating at 3,000 revolutions per minute, the effect would be the same as if the coils were stationary, and the poles were rotating at 6,000 revolutions.

An entirely different type of machine is known as the "Inductor" alternator. In the Inductor type, both the field magnets and the coils are fixed, and the rotating part consists of a number of steel laminations or plates, having a great number of teeth cut in their rim. (Fig. 2.)

As the revolving teeth sweep past the field magnets and coils, the magnitude of the lines of force is continually changing. This has the effect of inducing an alternating current in the coils, at a frequency depending on the speed and number of teeth in the revolving disc.

It can be understood that it is simpler to construct an high frequency alternator of this type, since the steel disc carries no wire, and can be made to carry a great number of teeth. In an improved type of alternator constructed by Alexanderson, the disc had 400 teeth and rotated at over 10,000 revolutions per minute. The frequency of the current generated by these machines can be made as high as 100,000 cycles per second.

In the Goldschmidt type of high frequency alternator, the frequency is, so to speak, continually "stepped up" until the required number of cycles per second is obtained. The full theory of the Goldschmidt alternator is beyond the scope of this article, but a brief sketch of its action can be given.

The field magnets of the machine are excited from direct current as in the ordinary type of machine. The rotating coils have therefore an alternating current induced in them, the frequency of which depends on the speed and the number of poles. This alternating current creates an alternating magnetic field which varies in intensity with the strength of current producing it. The result of this varying magnetic field is to induce in the fixed magnet coils themselves an alternating current having twice the frequency of that in the rotating coils. This alternating

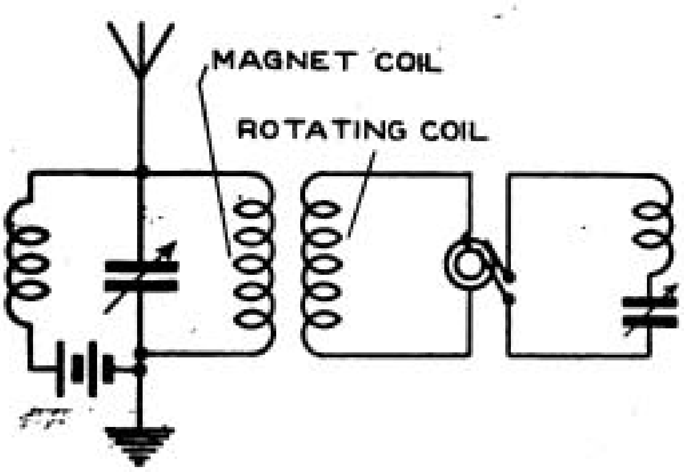


Fig. 3.

current in turn induces a second alternating current in the rotating coils with a frequency three times that of the original frequency. There is thus a continual increase of frequency between the magnet and the rotating coils, and with a tuned aerial circuit, these high frequency currents can be radiated. The rotating coils are usually connected to a condenser of such a capacity as to be in tune

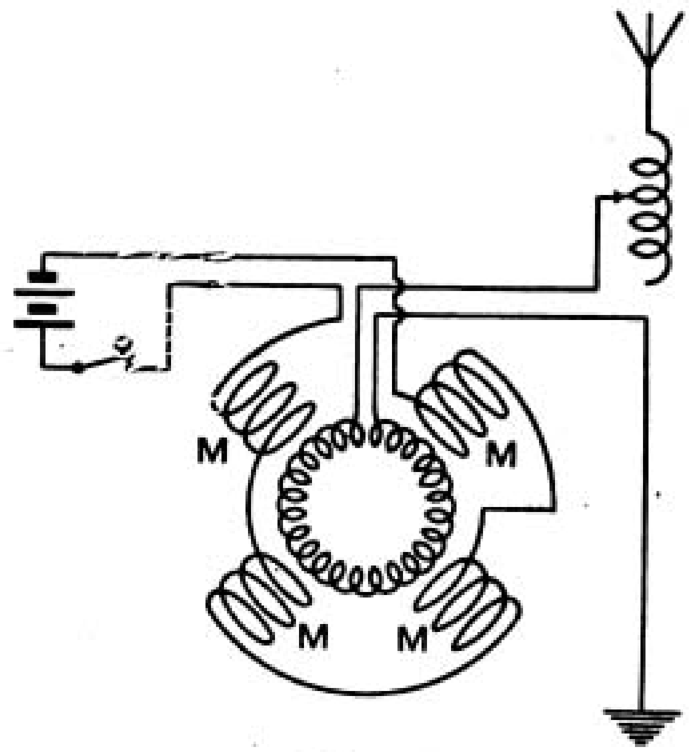


Fig. 4.

with the frequency of the original induced current. A diagram of the Goldschmidt alternator is given in Fig. 3. A small choking coil is connected in series with the field magnets in order to prevent the oscillatory current passing through the battery. It should be remembered that with every change in frequency there is a corresponding loss of energy in the machine, and thus the percentage of radiated energy compared with that supplied, is small.

The waves radiated by the high frequency alternator are continuous, provided that the speed is kept constant. In order to interrupt the wave trains to form signals of the Morse code, a tapping key is connected either directly in the aerial circuit, or in series with the exciting field magnets. (Fig. 4)

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

How to make a Condenser (Part I.)

THE number of variable capacity condensers required in modern receivers adds considerably to the cost of the amateur's installation. Therefore a few hints and figures will be very useful to enable him to make up fixed and variable condensers for himself.

In receiver work the capacity of the condensers required, is small. For aerial tuning, with the small aerial the amateur is allowed to use, the series condenser need not exceed 0·001 mfd. Condensers used in secondary circuits should have a smaller capacity—of the order 0·0004 to 0·0006 mfd.—so that the greatest amount of inductance may be used for the "potential operated detectors," the crystal and valve. For wavemeters the capacity may be as large as possible to give the biggest wavelength change, with a given inductance, over the range of the condenser.

When constructing variable condensers it is important to remember that the minimum as well as the maximum values of capacity must be considered. The minimum capacity should be kept as low as possible. If the condenser has a high minimum capacity the change of wavelength from minimum to maximum capacity with a given inductance will be smaller than it would be with a low minimum capacity condenser, therefore a greater number of tappings would be required to cover a given wavelength range. Moreover the tuning of the circuit will not be so sharp.

It has been found in practice that very useful condensers may be made by utilising old glass photographic plates. Calculations and tests have been made with "quarter plate" plates cut in half, and with copper foil approximately $\frac{1}{64}''$ thick, shellaced on to the surface of the glass.

Mr. Bertram Hoyle gives a formula in his book* for calculating the capacity of condensers. It is

$$K = \frac{A\,k}{11 \cdot 31 \times 10^6 \times d} \text{ mfd.}$$

wherein

$A =$ total area in sq. cms. of working sides of plates connected to one terminal.
$d =$ distance between + and − plates in cms.
$k =$ Specific Inductive Capacity.

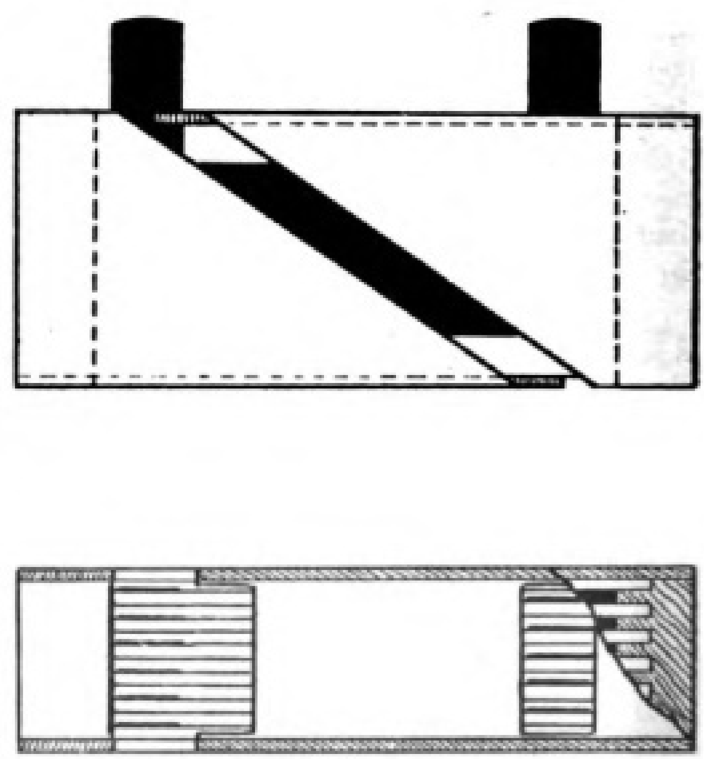


Fig. 1.

For test purposes a condenser was made up as follows :—Ten quarter plates cut to size 10·5 cms. × 5·5 cms. Thickness of each plate approximately 1 mm. Strips of copper foil 6 cms. × 4·5 cms. with a narrow connecting strip were shellaced one to each glass plate. When mounted and clamped

* "Useful Formula and Equations in Radio Telegraphy." (The Wireless Press, Ltd.)

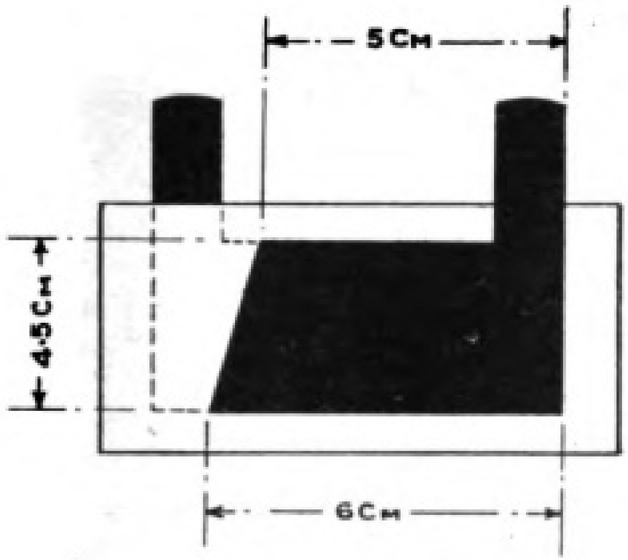


Fig. 2.

up there were 5 plates to each pole of the condenser. There were thus 9 working surfaces on each side of the condenser.

Substituting known values in the above equation, taking the value of k as 4 and the distance between + and — plates as 0·1 cm., we have

$$K = \frac{9 \times 6 \times 4{\cdot}5 \times 4}{11{\cdot}31 \times 10^6 \times 0{\cdot}1} = \frac{970}{1131 \times 10^3}$$

$$= 0{\cdot}00074 \text{ mfd}$$

The capacity measured was approximately 0·00068 mfd.

When calculating capacities a small allowance must be made for increase of the capacity due to fringing, although this is not so prominent in receiving as in transmitting condensers. From the foregoing it will be seen how it is possible to calculate and make fixed condensers with photographic plates.

It is also possible to make up a sliding variable condenser with plates and foil, of which a general idea is given in the Figs. 1 and 2. The glass plates should be 10·5 cms. ×5·5 cms. with the copper foils mounted centrally on each plate as shown. The foils should be 4·5 cms. wide and vary from 6 cms. to 5 cms. in length, as shown. The purpose of the sloping end is to obtain a slope to minimum capacity. When cutting the sloping ends on the foils half of them should be cut sloping down and the other half sloping up, and when assembling the condenser the plates should be placed in position with the foils sloping in alternate directions. The plates should be mounted in some form of stand, which, while allowing one set of plates to be drawn out, keeps the whole condenser rigid. A pointer may be fixed on to the sliding plates, to indicate on a centimetre scale, fixed to the base of the condenser. When the two sets of plates are together, the pointer should point to "6" on the scale, and as the movable plates are drawn out the pointer should move back along the scale, and should indicate "0" when the nearest points of the two sets of plates are about 1 cm. apart.

In Fig. 3 is shown the calibration curve of a variable condenser made up according to Figs. 1 and 2.

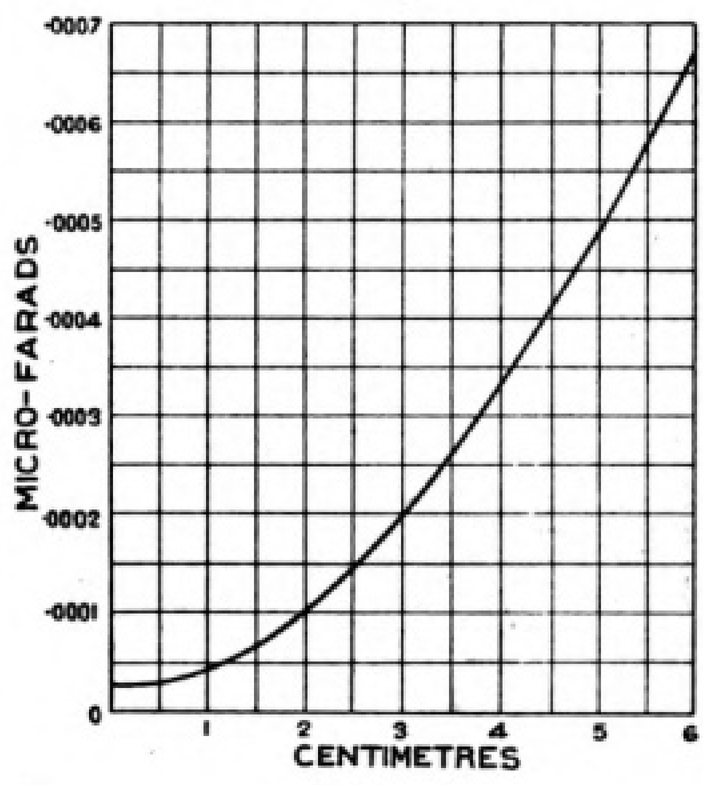


Fig. 3.

In the next article we shall continue this subject and deal with a 0·0015 mfd. variable air condenser.

WIRELESS TELEGRAPHY IN SAVAGE AFRICA.

By G. Montefinale.

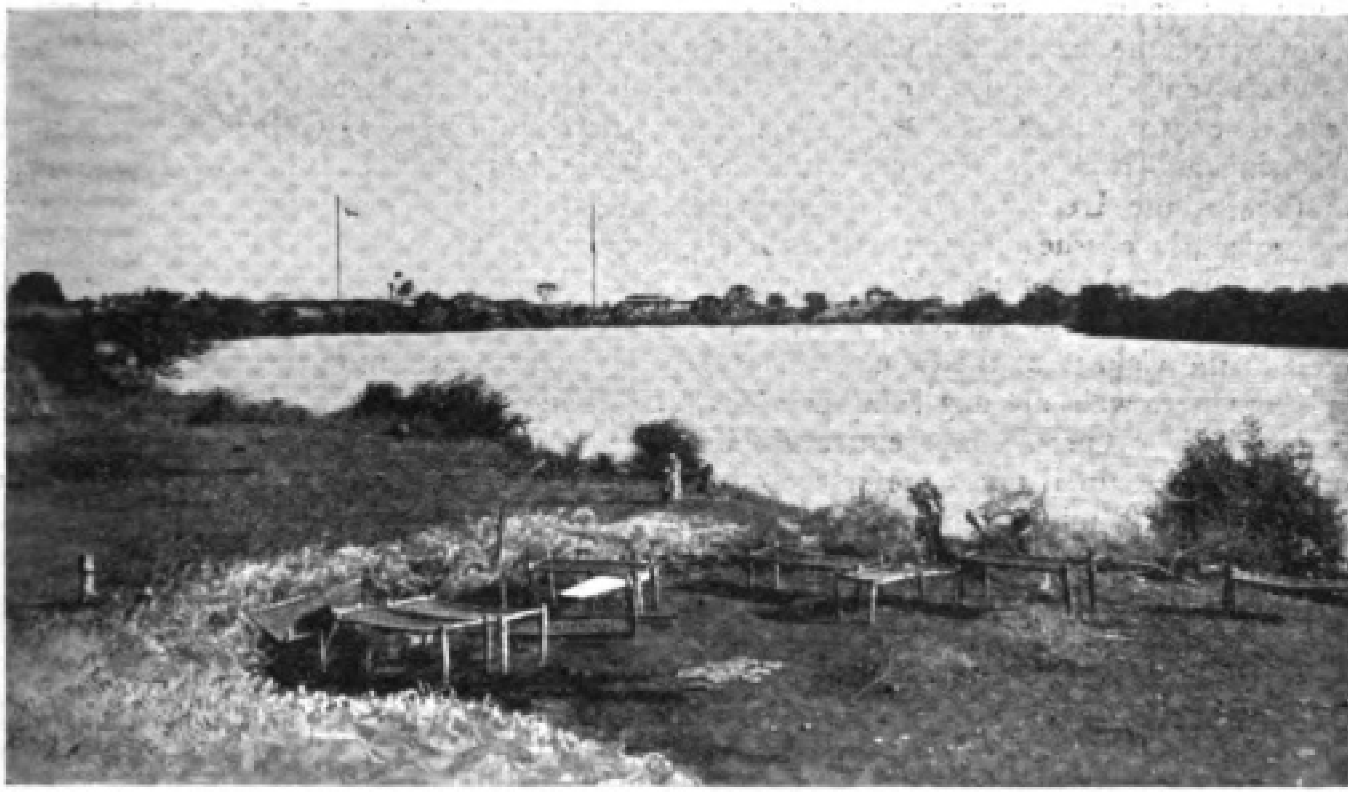
A GENERAL account of the development of Italian Somaliland and of the part wireless telegraphy has played therein was given by me in Vol. I, No. 12, of the *Wireless World*.

Since then other stations have been added to the extensive radiotelegraphic chain that Italy has spread over the territories of her East African settlements. Although several of those stations are now twelve years old, they still render most important services to the cause of civilisation in dark Africa, and especially in Somaliland where the only electric system of communication is Marconi telegraphy, which constitutes also the sole electric link with the Mother country.

Thanks to the *Telegrafo Marconi*, which is now very popular among the interior tribes, it was possible to maintain peace, and devotion to the occupiers, during the dynastic crisis that overturned Abyssinia and Harrar in 1914, with undesirable repercussions in some of the bordering colonies. It was a comparatively easy task to control the various Mussulman tribes peopling Northern and Southern Somaliland, amongst which the Turco-German propaganda was very strenuous.

Owing to the great distance from Italy and the necessity of maintaining in full efficiency the wireless telegraph stations of Italian Somaliland, a Director of Radiotelegraphic services has been instituted at Mogadiscio, the capital city of Benadir. The task is allotted to the officer superintending Radiotelegraphy and in those equatorial countries, deprived of all the necessities, is indeed a very difficult one for electrical work. The peculiar meteorological conditions and the presence in the atmosphere of moist sand and salt-dust result in a very rapid deterioration of metals. Accumulators, generators and valve receivers have but a

Landing wireless telegraph machinery at Mogadiscio when the Monsoon blows is not an easy matter.



Lugh, on the Giuba river, is the most northerly wireless station of Somaliland.

short life on the Equator and must be renewed with frequency, the apparatus having to be religiously preserved against all kinds of damage. The Italian mail steamer which leaves Genoa every month for the Red Sea and Indian Ocean harbours as far as Mozambique and Port Natal, transported the materials and also the radiotelegraphists appointed to the Colonial stations.

When the monsoon is not very strong the voyage is delightful as a respite from the torrid Red Sea zone and especially off Cape Guardafui where the massive promontory arises in the shape of a vigilant lion from the blue waves of the Indian Ocean.

Leaving the low yellow coast of the Mad Mullah and the territory of late Yusuf Ali, the strenuous Sultan of Obbia, one arrives in sight of the Benadir where the Italian occupation is revealed by the Marconi masts. The five little towns of Benadir are exceedingly picturesque, with their white Arabic houses shining in the sun, and the range of palm trees give to the sketch all the characteristic charm of oriental landscape.

Itala, Mogadiscio, Merca, Brava, Giumbo are the poetical names of the five anchorages, or *bender* as they are called in native language, which the Italian Navy occupied about 1900, after a treaty was signed with Said Bargash bin Said, Sultan of Zanzibar. The Italian flag now flies at the top of the wireless masts on most important occasions, and natives travelling in the plains, or trading on the coast, look at it with that same respect with which they regard the Marconi telegraph, or *sim* as they call it, which latter is believed to be a devilish invention of Shaitan.

Mogadiscio, like the other *bender* of the Somali coast, is a peaceful, sunny town, gracefully adorned by cocoanut palms, possessing good European houses and many Indian and Arabic mosques. These Mahometan mosques exist in great number in Somaliland, the people being one of the most religious and fanatical of East African tribes. At Mogadiscio all the wireless caravans were made and equipped, and from there started a long line of loaded camels for the far off stations of the Somali plains. The journey through the mysterious jungle is not without interest and emotions, and offers the utmost pleasure for sporting amateurs. Leaving the downs of the coast, the plain, covered by forests and plantations extends like a second ocean to the distant highlands of Abyssinia and Harrar. At a day's journey from the sea the Uebi Scebeli, or Leopard River, solemnly pursues its tortuous course, its yellow waters hiding thousands of crocodiles. The scenery is particularly full of interest in the vicinity of the nomad villages, the places where wells are dug being crowded with hundreds of people and entire flocks of cattle. The Somali tribes prefer the cool shade of gigantic baobabs for their meetings, in which Bolshevik matters are not yet discussed, but which are characterised as in Europe by interminable debates.

Bardera, Lugh, Iscia Baidoa, Bulo Burti, Oddur, Mahaddei Uen, Gheledi, Balad, etc., are the principal markets of the interior and they each possess a good, efficient wireless telegraph installation. The shepherds, travelling across the plains, utilise the radiotelegraphic masts much as sea navigators do lighthouses, and find in those structures, some of which are of the modern lattice type, sign posts of the most important centres of their country.

WIRELESS GADGETS AND FANCIES

By H. E. Adshead.

IF the reader is a very superior person he may not like this article, which is addressed to those taking up the home manufacture of apparatus, and who may not be acquainted with convenient tools, sizes and patterns.

For quickly making up and changing experimental circuits, an excellent scheme

(a) (b)

Fig. 1.

is to have an assortment of flexible conductors at each end of which is soldered a paper clip [Fig. 1 (*a*)]. That illustrated is Perry's "Double Lever" clip, and best serves the purpose as it opens easily and wide enough to pass over terminals. Such clips can be obtained coppered at about 2d. each. For more permanent connections it is better not to use the flexible strands with loose ends, but to solder to them a sheet brass tap, cut as in the figure. [Fig. 1 (*b*)]. Quite an easily-made filament resistance is made by soldering across the ends of some small contact studs a piece of fine high-resistance wire, S fashion (Fig. 2). Two or three inches of 38g. Constantin are sufficient, with about $\frac{1}{8}''$ between each stud, and though it may get hot, it will not harm.

Cut-out Contact Studs. In using a small portion of a large inductance, trouble is sometimes experienced from the electrical effect of the overhanging turns. For those who like construction work the stud design illustrated in Fig. 3 is suggested; the central portion being of some metallic material. It will be seen that on whichever stud the rotating arm rests, the contact is pressed open and the rest of the inductance cut out.

For temporary purposes adjustable condensers can be made from two test tubes sliding one in the other. On a visit to any chemical firm it will be noticed that these tubes vary in the blowing, and pairs can easily be picked out which will fit together. Cover each with foil, fitting a foil-covered cork with a central terminal to make contact with the inner tube. The outer tube can have a foil-lined paper tube pressed tightly on the end. For a pair of $\frac{3}{8}$″ tubes I have calculated the capacity to be 0·00003 mfd. per cm. of overlap.

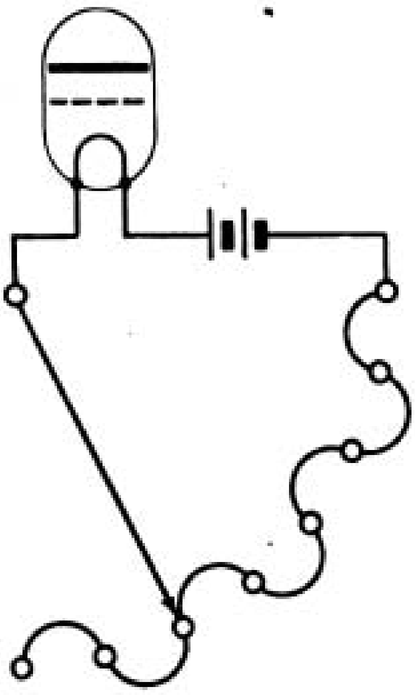


Fig. 2.

Milliammeter. Instead of buying a beautiful precision instrument, get a pocket compass about 1″ across, marked in degrees, and wind a 3″ coil of about 40 turns bunched together, and fix round the needle. Then borrow a milliammeter from one of the new rich, and graduate yours by plotting a curve of deflections on squared paper. The one I have gives 10°=3m.a ; 30°=12m.a ; 60°=42m.a ; 78°=100 m.a., and so on.

Potentiometer. If making this, make a good one with stud contacts and known resistances between the studs. Then it can be used as a resistance box in a Wheatstone bridge circuit with the galvanometer described above and the resistances of telephones, voltmeters, etc., can be estimated. Make it of two circles of studs, say of 13 each, with 4 ohms between each in the first circle and 50 ohms between those of the second. That will be 648 ohms total. The length of wire to give these values can be taken from a wire table and even if not quite accurate the box will be relatively in proportion, which, according to Einstein, is the best we can hope for.

Tikker. For the reception of C.W. without a valve, a tikker can be made from a buzzer. Remember that an electromagnet has two ends. Take away the yoke and one magnet coil and fit a similar contact breaker on that side. Then when the battery is switched on the contacts will buzz at the same rate and the new pair can be put in the telephone circuit. Make the contacts of silver from a cut-up coin (not British.—Ed.) and put a condenser across the buzzer contacts to stop the noise they will set up in the 'phones.

Sizes : B.A. *Taps and Dies.* Don't use Whitworth threads in your apparatus, but B.A. A useful size is 4B.A. for terminals and contact studs. 3B.A. and 5B.A. are also good, with the addition of 6B.A. and 8B.A. for small grub screws, etc. For satisfaction buy only American-made screwing tackle. It is advisable to buy a sensitive stand for the hand drill, as you will then ensure the holes being drilled and tapped true, and will not break the drills. The *Model Engineer* handbook No. 27 gives a complete list of threads and tapping sizes. Tapping drills for 3, 4, 5, 6, 8, B.A. Nos. 30, 34, 40, 44, 51 respectively. Clearance holes can be reamered out with a taper broach ; two, $\frac{5}{32}$″ and $\frac{3}{16}$″, are useful. Taps and dies ; S.W. Cards make $\frac{1}{8}$–$\frac{3}{8}$″ diameter adjustable. Thin sheet brass 0·012″ ; stouter for contact

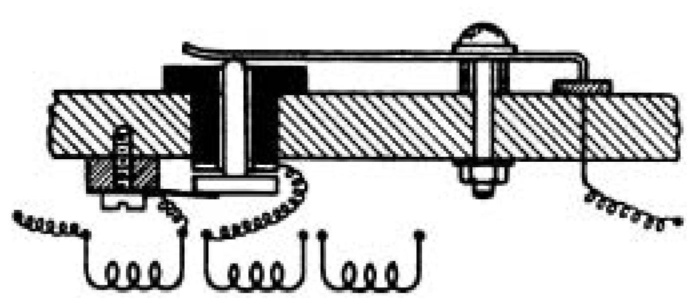


Fig. 3.

arms, etc., 0·016″. Flexible conductor, 14/36. Instead of buying brass screws by the dozen, a good tip is to buy a pound of mixed scrap screws. Sort these out into sizes and if you are fortunate you will have a collection to last a long time.

BOOK REVIEWS

OUR ATLANTIC ATTEMPT.

By H. G. Hawker, M.B.E., and K. Mackenzie Grieve, Lieut.-Commander A.F.C., R.N.

London: Methuen & Co., Ltd., pp. 128, 14 illustrations, 6 diagrams (3s. 6d. net).

THIS excellent little book, simply and interestingly written, not only fully describes the details and adventures of the Atlantic Flight, but also contains much appertaining to wireless which would interest our readers. Primarily intended to be a history of the famous flight, and a record of its many obstacles, there is also to be found in its pages reading which merits the attention of wireless enthusiasts.

In addition to much information concerning the overcoming of obvious difficulties met with in the installing of wireless in aircraft, Chapter IX. deals exclusively with Wireless Telegraphy, giving many interesting facts relative to the generation of power by air-driven machines. This chapter also embraces an elementary description of "direction finding," its values and its possibilities. Well written, with full page illustrations, this book will familiarise its readers with much that is not ordinarily known, both in aircraft, and Wireless as applied thereto.

RADIO ENGINEERING PRINCIPLES.

By Henri Lauer, B.S., and Harry L. Brown, B.E.E.

New York: Mcgraw Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Pp. xv.+300. 12 Plates. Price, 21s. net.

The different electrical phenomena which have been observed to take place in matter, such as the development of electricity by the friction of one body against another, have led to the assumption that electricity is present in material bodies, and may under certain conditions be clearly brought to evidence. How these assumptions came about and what are the theories based upon them, are set forth in this book.

The three-electrode valve, the device around which the present and future of wireless telegraphy would seem to centre, is fully dealt with, though certain of the observations given are not entirely accurate. Chapter VI and its subsequent chapters show the important part played by the valve in its application to wireless telegraphy, its uses as detector, amplifier, oscillator, and modulator being taken up in detail.

In order to give a clearer conception of what takes place under certain conditions the authors make frequent use of the electron theory to describe the development of the principles involved, thus serving the dual purpose of familiarising the student with the electron theory and also the principles of radio-telegraphy. The description of any particular system of apparatus is purposely avoided with the object of devoting the entire space of the book solely to the principles. The general means of utilising these principles in practical work is dealt with in some measure, but it is assumed that the student with the principles once understood will be able to apply them to any specific system of radio apparatus.

Chapter XI is devoted to the underlying principles of Directional Wireless and Loop Aerials, both of which are so largely used in aircraft work. Numerous diagrams are given in illustrating the descriptions and methods adopted.

Chapter XII gives a few of the various applications of Radio-telegraphy, dealing chiefly with its application to aeroplanes. The systems of antennæ described, though not altogether new, are of interest to the student. The development of wireless in submarine work, the possibilities and results obtained with the loop aerial as used in under-water craft are also touched upon in this chapter.

For the purpose for which the book is written, the assistance of operators and students who do not require their technical knowledge to be so highly developed as engineers engaged in research, the book may be commended.

QUESTIONS AND ANSWERS

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

C.G.W. (Balham) *asks* (1) *If much error will arise from calculating the capacity of an aerial merely as a wire, without regarding the capacity to earth.* (2) *If the following dimensions of coils will be suitable for a receiver with an aerial slightly smaller than P.M.G. maximum, tuned circuit capacity being* 0·0005 *mfds*:—

Extra inductance coil, 34 *cms. long by* 18 *cms. dia., wound No.* 24 *SWG.*

Primary of coupler, 18 *cms. long by* 14 *cms. dia., wound No.* 24 *SWG.*

Secondary of coupler, 16 *cms. long by* 11·5 *cms. dia., wound No.* 28 *SWG.*

(3) *If* 7/19 *stranded wire is used for the aerial, should diameter be taken as that of each strand, or that of the whole cable.* (4) *In winding the coils, is it necessary for them all to be wound in the same sense.*

(1) We do not know what formula you have used. The following take the effect of the ground into account. Compare with your previous results.

Vertical wire, height h cms., radius r cms., C in electrostatic units:—

$$C = 0{\cdot}43h \div \left[\log_{10}\left(\frac{h}{r}\right) - 0{\cdot}105\right]$$

Horizontal wire, height h cms., radius r cms.,

$$C = 0{\cdot}217 \div \log_{10}\left(\frac{2h}{r}\right)$$

Capacity in electrostatic units per centimetre length of wire.

(2) Yes.

(3) The whole cable.

(4) No.

G.S.H. (Glasgow) *asks* (1) *Why does the rotary converter speed up when there is a current lag.* (2) *Why do the choke coils choke back the high frequency current and yet allow the low frequency to pass through them.* (3) *Why is a double humped wave radiated with tight coupling.* (4) *How do the oscillatory circuit surges get to the guard-lamps.*

(1) The variation of speed with power factor of load depends on reactions inside the machine by which the armature currents vary the strength of the magnetic circuit. For a detailed explanation consult any fairly advanced book on dynamo electric machinery.

(2) Because the impedance a coil offers to the flow of a current through it is directly proportional to the frequency of the current.

(3) An adequate explanation would take more space than we can spare. Roughly speaking, when two circuits are tightly coupled there is a continual handing backwards and forwards of energy between them, and each circuit oscillates at a frequency which is somewhat different when it is handing back the energy from when it is receiving it again. These two frequencies cause the two humps of the tuning curve.

(4) The guard lamps are an additional precaution, chiefly to protect the machine from surges directly induced in it by the discharge, not from surges passing back through the chokes.

C.G.C.S. (Southsea) *asks* (1) *For a diagram of a simple valve circuit, giving little radiation and not using a potentiometer.* (2) *Whether following dimensions would be suitable for a small loose coupler: primary* 5-*in. by* 3½-*in., wound with No.* 32; *secondary* 4-*in. by* 3-*in., wound with No.* 44. (3) *If* 2,000 *ohm 'phones would be suitable for receiver in* (1,) *without a transformer.*

(1) The circuit shown in Fig. 1 should meet your requirements. This circuit would be improved by a grid potentiometer.

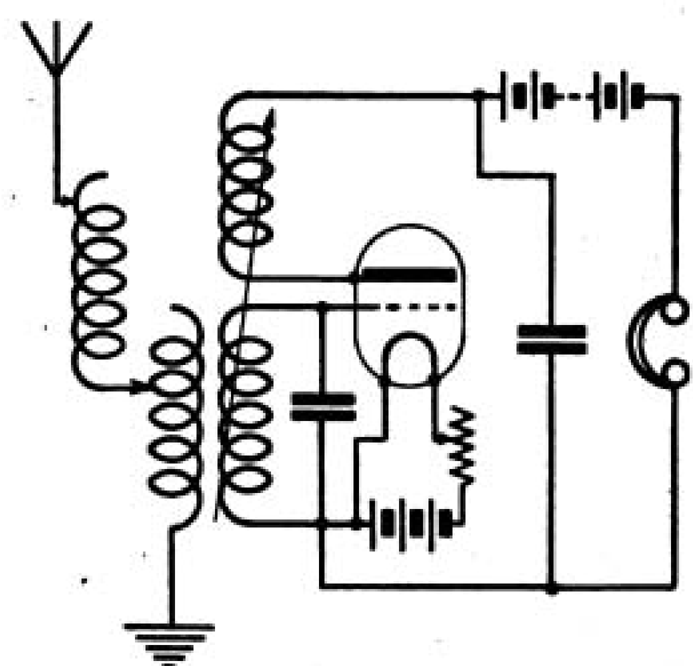


Fig. 1.

(2) No. 44 is too fine for the secondary. If you wind this coil with No. 36 and keep the remaining dimensions, as you suggest, the coupler should be quite satisfactory.

(3) Yes; higher resistance would be preferable, but 2,000 ohms should give quite good results.

B.S. (Leicester) *asks various questions on the construction of a telephone transformer.*

Consult the article on this subject in the March, 1920, issue. You will find all you require there. The only difference from the dimensions given is that your telephones being of 500 ohms resistance, the low resistance winding should be about 4 oz. of No. 36, instead of the 6 oz. of No. 30 specified.

E.R.W.F. (Southport) *sends a sketch of a double-note magnifier, and asks for comments.*

The type of magnifier shown is in no way specially good, but should give useful results. Without more information as to the dimensions of the components we cannot give much advice as to its improvement. You query whether you are using enough H.T. volts, but omit to state how much you *are* using!

E.W.W. (Wimbledon) *has telephone wires running parallel to his aerial and about 12 feet away. Under certain conditions he hears speech by induction and asks if this is usual. He sends a diagram of receiver and asks (2) If it should permit C.W. reception. (3) What is the difference in sound between C.W. and spark. (4) If he could amplify satisfactorily by means of another valve used as in a diagram sent.*

(1) Under the circumstances we think this is very natural.

(2) Yes.

(3) C.W. gives a clear musical note, varying in pitch with the tuning of the receiver.

(4) The circuit shown would not work. There are many possible forms of circuit. See past numbers of this magazine.

F.W.R. (Croydon) *sends a sketch of a crystal set and asks (1) For suitable capacity for tuning condenser. (2) For suitable capacity for blocking condenser.*

(1) 0·0005 mfds.

(2) Exactness in this condenser is not important. Best value will vary with the telephones used. Try about 0·001 mfds.

N.B.—Judging from queries received many amateurs appear to think this blocking condenser one of the most important items in the set. As a matter of fact, while improvements can be obtained by its skilful use, it is by no means important; and in crystal sets at any rate, it can generally be omitted without serious detriment to the results obtained.

J.McL. (Glasgow) *asks (1) Re reply to* **G.D.A.** *in May 15th issue if an A.T.C. is necessary, and if so, how to make one of fixed value. (2) Whether lightning is likely to burn out an ordinary knife switch. (3) For a sketch of an easily made radial switch.*

(1) An A.T.C. is not necessary, though if variable is a convenience for tuning. Rather than fit a fixed capacity we should recommend you to make the coil as shown, but of variable inductance by means of a slider or closely-spaced tappings.

(2) If the switch is kept clean there should be very little risk.

(3) It is difficult to do this without a more exact knowledge of your requirements. You might use a block of dry hard wood, with round headed brass screws for the contacts, and a flexible strip of brass for an arm, fitting the strip with an ebonite handle for manipulation. Ebonite would be better than hard wood, but would need more skill in working.

L.E.B. (Alton) *sends a sketch (Fig 2) of a proposed receiver to work over a range of 600 to 17,000 ms. He asks (1) For comments, and (2) For instructions re the inductance B.*

(1) The set as shown might very possibly work. You would probably get more certain results by doing away with the grid condenser D and leak. The value given (0·2 mfds) for condenser A is

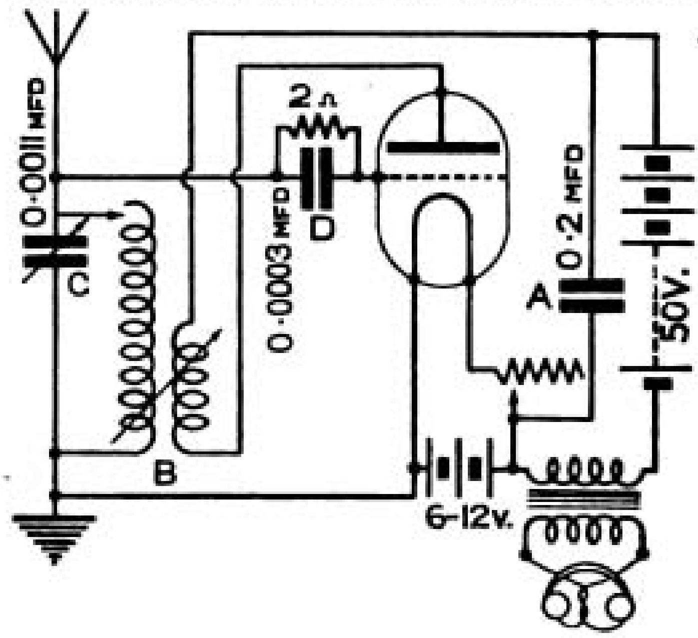


Fig. 2.

much bigger than necessary. 0·002 mfds would probably be big enough. Any hard valve requiring about the plate voltage you have at your disposal will do.

(2) You are very unlikely to make a set which will work well over such an extreme wavelength. If you try it, make the inductance about 1′ long by 6″ diameter, of No. 32. You will have to fix the reaction coil by trial, say 6″ × 5″ of No. 28 to begin with.

H.D. (Willesden) *asks (1) How to modify the windings of the amateur set described in the numbers for 17th April and 1st May to suit 40 ft. twin inverted L aerial 25 ft. from ground, A.T.I. former to be 5″ diameter, wound with No. 23. (2) If the set would be suitable for wireless telephony. (3) If an amateur can use a frame aerial.*

(1) Loose coupler can be as in article referred to. For the A.T.I., with 5″ former and No. 23 wire, make length about 15″.

(2) Set should receive telephony quite well. For this purpose keep the coupling weak.

(3) Yes, if he obtains the usual official permission.

L.F. (London, N.12) *sends diagram of a valve receiver and asks (1) The reason for an annoying click on passing from stud to stud of the tuning inductance (receiver is of grid tuned type), and (2) The reason why set will not oscillate at above 9,000 ms, or less than 1,000 ms. He appears to suspect the tuning inductance mentioned above.*

(1) As well as we can judge without more detailed information the click is probably due to your breaking the oscillating circuit on moving the switch. A stoppage of the oscillations will cause a variation of plate current and a click such as you describe. An obvious remedy is to design a better inductance switch. From your diagram we think it is likely you are using too many positive volts on the grid. A 16-volt grid battery is quite unnecessary.

(2) The reason probably lies in the unsuitability of the reactance coil for such wavelengths; and not in the tuning inductance at all. You cannot expect one size of reaction coil to give oscillations over an unlimited range of wavelengths. The best size for the reaction coil increases with the wavelength.

PHOSPHOR (Nottingham) *sends* (1) *sketches of a proposed aerial system for comment, and asks* (2) *What size and kind of wire to use.*

(1) To begin with, the suggested scheme involves the use of much more wire than you are allowed even without the EK section. Also an aerial bent back on itself as EFGH is always bad. (See other recent replies.) You should not have much trouble from the telephone wires situated as they are. We should recommend the EF section alone, or possibly the EF plus FG, though we do not think you will get much better results from the extra 20′ F to G. If possible raise E and F considerably.

(2) Any bare wire of copper, or phosphor bronze or silicon bronze, of sufficient size for mechanical strength will do. It may be single or stranded cable. About No. 14 should do if you use single wire.

H.H. (Harlesden) (1) *Wishes to make a wavemeter, as described in issue of 3rd April, but wishes to use variometer formers of an altogether different size and shape. He asks what winding to use to get the same wavelengths. He asks* (2) *Whether it is necessary to inform the P.M.G. of a change in his aerial from the twin to the single wire type.* (3) *At*

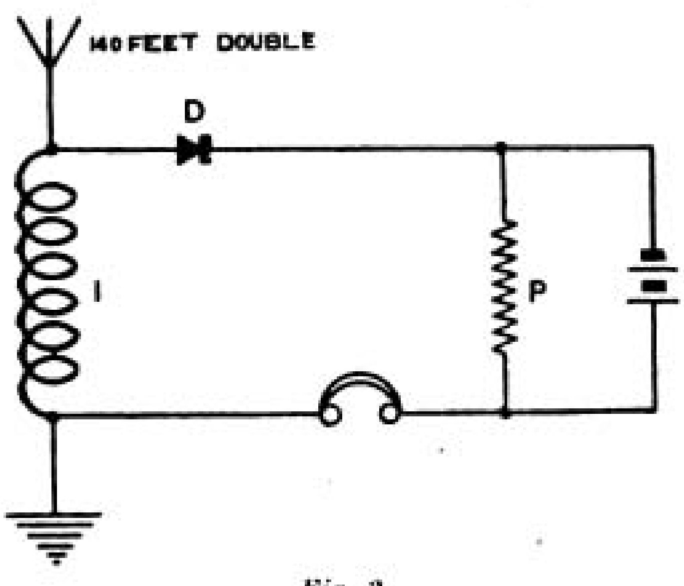


Fig. 3.

Whitsun he heard two stations, one high note and the other low and rather scratchy—wavelength 2,500—3,000 ms. He asks who they were.

(1) This question is quite out of our scope. Firstly, there would most likely be no windings suitable. Secondly, the work of calculation would take us much longer and give us more trouble than you would need to make the formers recommended. And thirdly, if we did make the calculations and they did lead to some result, the calculated result would not be accurate enough for use in the construction of a wavemeter.

(2) Yes.

(3) There are so many stations working that we cannot identify any special two with the little information you give. The low pitched note on 2,500—3,000 ms. may have been Eiffel Tower.

L.R.R. (Bishop's Stortford) *asks* (1) *Whether there is a Wireless Society at Bishop's Stortford or Highgate.* (2) *If it is possible to use a frame aerial*

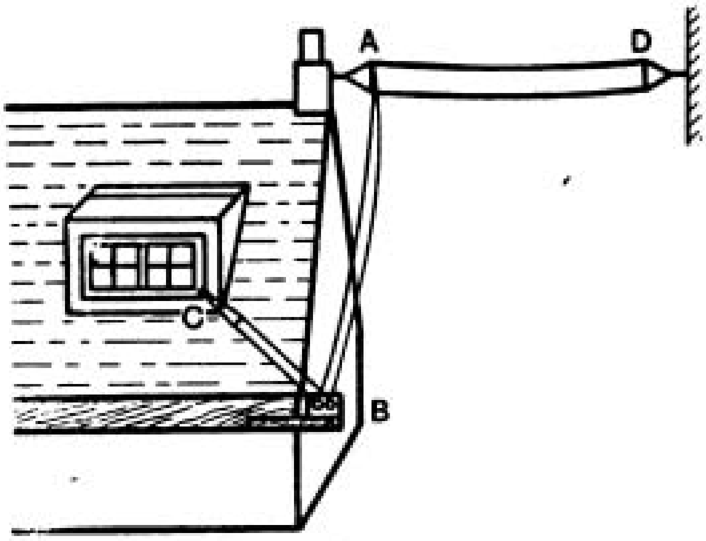


Fig. 4.

in conjunction with an outside aerial. (3) *For criticism of his aerial.*

(1) No.

(2) It could be done, but would probably not be worth while.

(3) The receiver should be all right as sketched. (Fig. 3).

(4) The aerial (Fig. 4) is not good. The sharp angle at B is bad. It would be better to take the leads straight from C to A. A long stretch as AB close to roof is undesirable. Practically the only part of your aerial which is doing any useful work is the section AD.

B.H.C. (Felsted) *has a 3-valve resistance amplifier which works O.K. He wishes, if possible, to substitute a sensitive relay for the telephones. (He suggests one sensitive to 6 microamps.) He asks if the scheme is feasible and for any information we can give him with regard to a suitable relay.*

We cannot trace the diagram you say you enclose, but if the circuit is a good one of fairly normal type, this should be quite possible. We do not recommend such extreme sensitivity in the relay as you suggest, you should be able to get at least 100 microamps in signals from strong stations. A P.O. type relay rewound to about 10,000 ohms, instead of the standard lower resistance winding should be suitable. Its construction would be difficult for an amateur. You might get results by fitting contacts to the pointer and stop of some form of sensitive galvanometer, such as the Weston.

E.F.D. (Portsmouth) *asks for advice in acquiring a receiving set. He wishes to know* (1) *The best way to set about getting a permit.* (2) *If he should buy a set or make his own.* (3) *If we recommend "——"s; or what is the best firm to deal with*

(1) Write to Secretary, G.P.O., London, for forms and information.

(2) This depends chiefly on (*a*) how much you

are prepared to spend and (*b*) whether you have any taste and ability for the work of making one. If you have unlimited resources you will get a good set with least trouble to yourself by buying one. On the other hand if you do not wish to spend much, you will find it cheaper, and not a difficult job, to make one for yourself.

(3) We never recommend any particular firm, for obvious reasons. Any of the firms advertising in this magazine should give you satisfaction.

C.A.L. (Cambridge) *sends sketch of a receiver which is giving trouble and asks for help. Receiver has picked up FL faintly with a silicon detector, but will give nothing—except buzzer signals, which are OK—with carborundum. Circuits can be tuned to 2,600 metres.*

There does not appear to be anything much the matter. Of course your aerial is rather small and low, so you cannot expect excellent results. Circuit should be all right as sketched. Possibly your carborundum crystal is a bad one. Have you tried reversing the crystal battery? Connecting the two parts of the tuning coil as you show should not have any bad effect. Is your earth connection good?

R.J. *asks* (1) *If there is any simple formula for calculating the tuning positions of a receiver for a given wavelength with a given aerial.* (2) *What should be the natural wavelength of an aerial sketched.* (3) *How can such natural wavelength be calculated.* (4) *Is an angle of 45° in an aerial too acute.* (5) *Why a sketched receiver does not give good results.* (6) *How much power would be required to transmit 20 miles with an aerial as shown above.*

(1) There is no simple formula universally applicable. It could generally be done by the choice from a large number of formulæ of certain ones applicable to the particular type of aerial and receiver under consideration. You will find many typical formulæ in Nottages' book on the measurement of Inductance and Capacity.

(2) About 600 ms.

(3) The natural wavelength is 4 to 5 times the length, depending on the shape of the aerial.

(4) Yes, it is undesirable.

(5) Chiefly because you have placed the telephones in parallel with the crystal instead of in series with it. Also you would probably get better results with more turns on your primary coil and fewer on the secondary.

(6) Depends on conditions and type of receiver. Overland and with crystal, say 100 watts: oversea, or with valves, less.

Constant (H.M.S. Revenge) *asks* (1) *Re Bangay, Oscillation Valve, paragraph 20, page 9, and paragraph 26, page 11, if in the latter paragraph the maximum frequency should be 4,000 cycles and not 2,000 as given: and* (2) *What is the formula for the capacity of a reservoir condenser, as referred to on page 11 paragraph 27.*

(1) No, 2,000 is correct. 2,000 cycles correspond to 4,000 actual maxima of voltage, each of which has to be discharged. There is a slip in the earlier paragraph. For a frequency of 100 cycles the number of current maxima will evidently be 200 per second, and not 100 as stated.

(2) The ordinary formula for the frequency of oscillation in a condenser circuit will give you this. :—

$$\textit{Frequency} = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

The value of frequency you require is that which makes $\frac{1}{4}$ of the period of oscillation equal to the time of discharge wanted.

Many thanks for your kind remarks about the *Wireless World.* Your suggestion has been partially carried out by the article on Research for the Wireless Amateur, published in the issue of May 15th, but we will see what more can be done.

J.N.C.B. (Preston) *asks* (1) *What capacity will be suitable for use with a jigger secondary of No. 29 wire on a 4" former, the coil being divided into three sections with 60, 140 and 340 turns respectively.* (2) *What would be the maximum wavelength attainable with this condenser.* (3) *If the aerial condenser in Fig. 1, page 65 of the April 17th "Wireless World" is necessary.*

(1) Condenser should be variable, with a maximum capacity of about 0·0005 mfds. If you choose a plate type you will be able to fix suitable dimensions from formulæ recently given in these columns.

(2) About 4,500 ms.

(3) With a small aerial an A.T.C. is seldom necessary. You can omit it if you wish, but its use will probably improve results on short wavelengths.

CRYSTEC (Beckenham) *sends sketch of a proposed receiver and asks* (1) *For comments.* (2) *If the aerial will be satisfactory—it is shown as a twin 20' long and 17' high.* (3) *If he should be able to get FL and MFT.* (4) *Could the telephone transformer be done without, as the resistance of the telephones is 2,000 ohms.*

(1) & (4) The circuit shown is fairly good. Condenser shown as 0·09 mfds, is much too big, this condenser should be about 0·0003 mfds. You might interchange condensers. Telephone transformer would be better omitted with telephones of 2,000 ohms.

(2) Aerial is very small. We are afraid you will need a larger one than this to get good results.

(3) FL possibly, if your tuning inductance is big enough. MFT—we are afraid not, with such a low and short aerial.

INDUCTANCE (Earl's Court) *asks* (1) *which is the more efficient, high frequency or low frequency amplification.* (2) *Whether a basket wound pancake type inductance is as efficient as a single layer cylindrical one.* (3) *If other compact methods of winding can be given, or are they "trade secrets."*

(1) For very weak signals H.F. amplification is the better: for stronger signals there is little to choose between them.

(2) Yes. It is more difficult to wind but saves space when wound.

(3) There are practically no other types but pancakes and single layer cylindricals used.

YEX (London, N.7) *sends a sketch (Fig. 5) of a valve attachment to a Marconi 31 type receiver, which he says gives poor magnification for waves less than 1,000 ms. He asks* (1) *Reason for this.* (2) *How he can make it more sensitive.* (3) *If there is anything new in the scheme of connections.*

(4) *If he can use valves of two different types together.*

(1) The reason may be that you have introduced too much capacity in parallel with the billi condenser: or it may be due to the direction action through the receiver on this circuit opposing the action on it through the valve.

(2) Keep the receiver coupling dead weak. Use a potentiometer in the grid circuit.

(3) The scheme is somewhat unusual, but contains nothing essentially new.

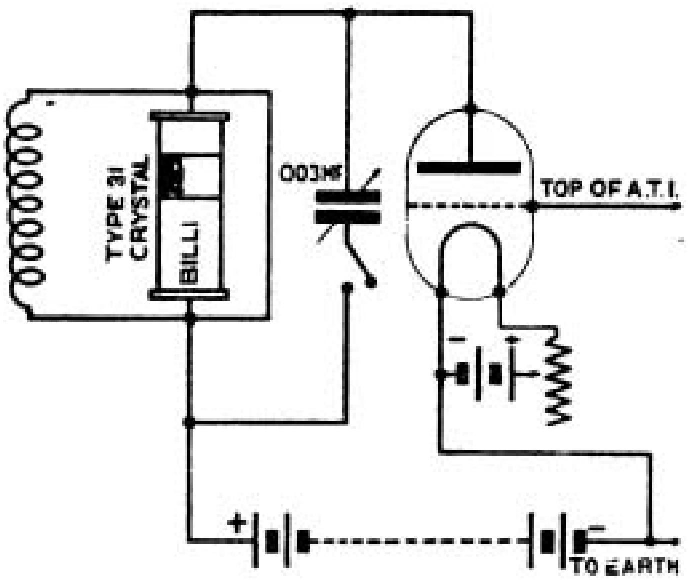


Fig. 5.

(4) This depends entirely on the type of circuit used and the characteristics of the valves.

G.W.D.S. (London) *asks* (1) *If he could use apparatus sketched, with a frame aerial and 3-valve amplifier.* (2) *For a dimensioned drawing of a 7-valve amplifier.* (3) *Would the P.M.G. permit use of apparatus of this description.* (4) *How to apply for a valve licence.*

(1) The set sketched is an elementary crystal receiver. It would be of little use as it stands, but if stripped the components might be built up with an amplifier for the purpose you suggest.

(2) We cannot do better than refer you to the articles on valve amplifiers in this magazine in the earlier numbers of this and the last volume.

(3) Yes, very probably.

(4) Apply to the Secretary of G.P.O., giving diagram of proposed set.

P.J.C. (Cumberland) *asks* (1) *For criticism of a circuit sketched.* (2) *How it could be improved by the addition of an assortment of valve apparatus.* (3) *What should be the approximate wavelength range.*

(1) Scrap the condenser marked E and put the telephones in series with crystal and not in parallel with it. The set should then work. To get a good range of wavelengths you should increase either the aerial inductances or the condenser F, considerably.

(2) There are such a large number of circuits possible, depending on how you wish the valves to function that we should recommend you to pick out some fairly normal circuit from the many given in the *Wireless World* from time to time. There is no special correct or best way of employing two valves in a circuit.

(3) With the suggested alteration to the aerial circuit your maximum should be about 5,000 ms. We cannot say much about the minimum without more definite information.

E.G. (Worthing) *wishes to make a 2-circuit crystal receiver for a range of 400—1,000 ms, tuned by the condensers. He asks for values for the inductances and condensers.*

We should combine A.T.I. and primary coupling coil. Make tuned circuit condenser equal to 0·0005 mfds at maximum. Make tuned circuit inductance equal to 1,000 mhys. We cannot predict aerial constants without data of your aerial. You might try aerial inductance about 2,000 mhys, and aerial condenser about 0·005 mfds at maximum.

L.J.H. (Islington) *sends sketch, Fig. 6, of a proposed frame aerial system, and asks* (1) *Whether the aerial will be efficient with 14 turns on a former 82 cms. in diameter.* (2) *What would be approximate range with a two-valve L.F. amplifier.* (3) *What will be the range of wavelengths that the circuit will receive.*

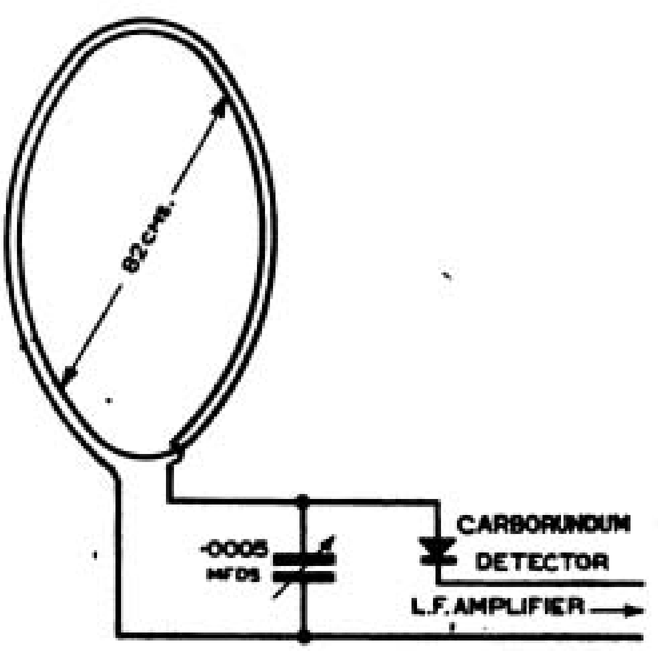


Fig. 6.

(1) Yes; but you would probably get better results with more turns.

(2) This is difficult to say. Possibly about the same as with a good ordinary aerial and crystal without an amplifier.

(3) We cannot say exactly, as you do not state size of wire or spacing between turns. Assuming No. 20, wound fairly close, wavelength should be about 900 ms. We should recommend more turns on the aerial former or an additional tuning inductance in the circuit.

W.A.H. (Erith) *sends description of his aerial and receiver and asks* (1) *What maximum wavelength he can reach.* (2) *Whether he will need a loading coil to receive FL, and if so, what size.* (3) *How he can make sure his circuits are in tune with each other and incoming signals.*

(1) and (2) We cannot answer either of these as, although you state the diameter of your coils and the wire they are wound with, you say nothing about their length.

(3) The best way is to vary the tuning of each circuit until signals are heard, and then adjust them each carefully until the signals obtained are strongest.

ENGINEER-IN-CHARGE (Preston) *asks* (1) *If a valve receiver will detect arc, spark, and C.W. signals, and also wireless telephony.* (2) *If we can recommend a suitable set for the purpose.* (3) *If a 10" coil ship emergency set is a spark transmitter.* (4) *If the Marconi Standard 1½ K.W. ship set is an arc transmitter.*

(1) Yes certainly, if suitably designed.

(2) Consult the lists of any of our advertisers. Any set listed will receive some signals; but in general the more you pay for a set the more sensitive it will be, and the greater will be its range of usefulness.

(3) Yes.

(4) No. A valve set of this size has recently been developed, but the well-known standard set is a spark transmitter, with a rotary discharger.

AERIAL (Golder's Green) *sends crystal circuit and asks* (1) *For comments.* (2) *How to introduce a potentiometer.* (3) *If a 3-wire 30 ft. aerial will be suitable for this set.* (4) *How many miles will it receive messages.*

(1) and (2) Circuit shown is quite hopeless. Suitable connections, including potentiometer are as Fig. 7.

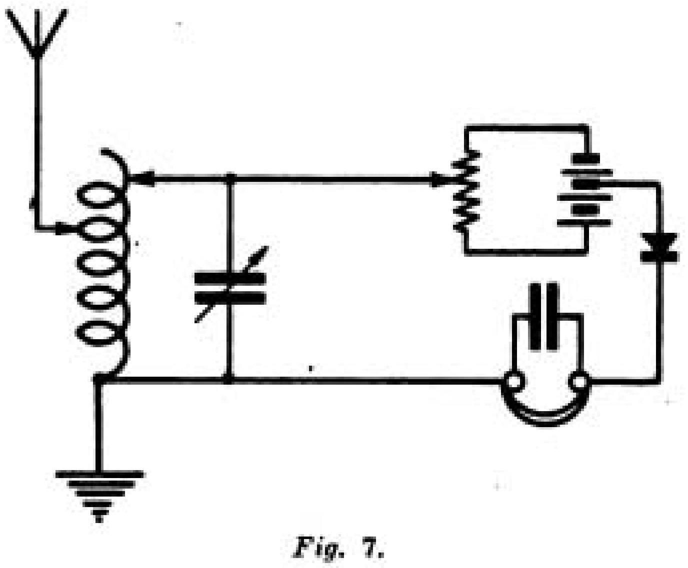


Fig. 7.

(3) Such an aerial is possible, but a longer 2-wire aerial would be much better.

(4) See answers to similar questions recently.

M. de W. (Brussels) *asks* (1) *For dimensions for a frame aerial suitable for reception on wavelengths from 8,000 to 20,000 ms.* (2) *What wire to use for the purpose.* (3) *What capacity tuning condenser to use with it.*

(1) Of many possible forms, Fig. 8 should be suitable. Dimensions need not be rigidly adhered to if inconvenient.

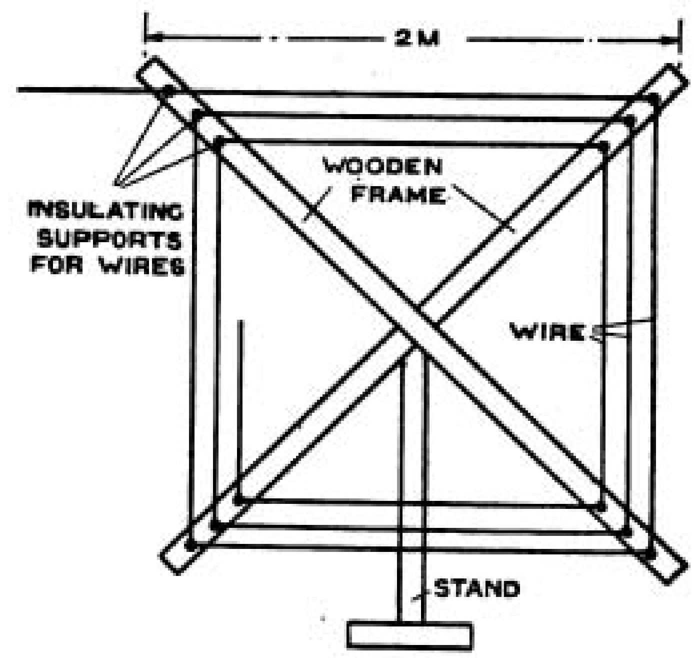


Fig. 8.

About 60 turns of wire should be used, spaced 1 cm. apart. See also article on frame aerials in issue June 12th.

(2) 7/24 insulated stranded cable would be very good; but single wire, say No. 16 bare or S.C.C., could be used if desired.

(3) Maximum might be 0·001 mfd or rather less. Circuit should be tuned up to required maximum wavelength by means of a suitable loading inductance.

P.S. (Lowestoft) *sends sketch of a proposed receiver, with description of aerial for comment.*

Receiver though of elementary type, is quite well proportioned, and should give satisfactory results. 2/50' wires are better than 4/25' for the aerial. They should be as far apart as possible; and if over a roof, should be elevated above it as much as possible.

SHARE MARKET REPORT.

Business in all the Wireless Stocks has been quiet. The market is steady though stagnant.

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

Marconi	Ordinary	3
„	Preference	2 11/16
„	Canadian	9/-
„	Marine	1 3/4
„	New Issue	3

The WIRELESS WORLD

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 11. AUGUST 21ST, 1920 FORTNIGHTLY

THE EARTH, AETHER AND WIRELESS

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

IN earlier articles a few of the theories relating to the aether have been briefly referred to in connection with the transmission of electromagnetic waves. The question has frequently arisen as to whether the hypothesis of the existence of the aether is either really necessary to explain physical phenomena, or justified in the light of existing knowledge. Recently the interest that has been aroused by Einstein's work on the Relativity Theory has once again brought this question into prominence and has prompted the statement by some physicists that there can be no such entity as the aether, and that its presence is no longer necessary to explain ordinary phenomena.

As we have seen, the success which attended the experimental verifications of Maxwell's theory of electromagnetic waves gave great support to the aether theory, and the existence of these waves is still one of the strongest arguments for the necessity of postulating some medium in which the strains constituting such waves may be set up and through which they may be propagated. Some additional evidence in support of the existence of the aether has recently been obtained and will be briefly referred to below. The various phenomena of light waves, in particular those of polarisation, interference, etc., are very difficult of explanation in terms of known concepts unless there is actually existent a true form of wave motion in some medium, but at the same time the very existence of these waves has brought out other facts which are almost equally difficult of explanation if we imagine the aether to be an immoveable and unvarying medium filling all space. For instance, consider the case when there is relative motion between the source of the wave disturbance, and the medium through which the wave is propagated. To make use of an acoustic analysis in order to fix one's ideas, imagine that we are listening to a sound coming from a moving source, such as a locomotive whistle, and that the observer and the medium through which the wave is propagated—the air—are both at rest. We are then all well aware that as the source approaches, the frequency of the sound—or its pitch—apparently arises, and that if the sound source is receding the pitch falls. As a matter of fact the wavelength of the sound from an approaching source is shortened by the amount by which the source has moved during the emission of one wave. Calling v the velocity of the sound source, and λ the normal wavelength of the sound emitted, then if V is the velocity of the sound in still air, the time required for the emission of one wave is λ/V. During this time the source will have moved through a distance $= v\lambda/V$ and therefore the apparent wavelength of the sound will now be $\lambda - v\lambda/V = \lambda(1 - v/V)$. In other words the apparent pitch of the note will be increased from n to $n\left(\frac{V}{V-v}\right)$

This is an effect primarily of the relative movement of the source and the observer, but it should also be evident that some similar effect might be expected if the medium through which the wave is propagated is moving relatively to the source. It will take a wave longer to reach a point a given distance from the source, if it is propagated in the opposite direction to the direction of motion of the medium than it will if it is in the same direction.

Since light and Hertzian waves are waves in the aether it is to be expected that somewhat similar alterations in frequency would occur in their case as with sound waves. As a matter of fact certain of such changes are observed, but their detection is in most cases a very much more difficult matter than with air waves, largely on account of their enormous velocity (186,200 miles per second) as compared with any speeds of movement customarily encountered with ordinary material bodies. The so-called "Doppler" effect is an example of one such result.

It might be expected, however, since the earth is rotating on its axis and also revolving round the sun, in addition to any movement through space that the solar system as a whole may possess, that there would be some relative movement between the bodies on the earth's surface and the aether in which everything is supposed to be immersed. Many experiments have been devised to endeavour to detect this movement, but very little success has been obtained. It has been suggested that this difficulty might be overcome by assuming that the surface of a moving body is always practically at rest with respect to the aether—or in other words that a body in motion always carries with it a certain quantity of aether so that there is no relative motion between its surface and the aether, much as the earth is known to carry its material atmosphere with it, the relative movement between the earth and free space being evidenced at the outside of the atmosphere rather than on the surface of the earth itself. This suggestion, however, carries with it many serious objections which render it difficult to reconcile with other observed phenomena.

Experiments have been carried out by Sir O. Lodge and others with a view of testing this point but no positive evidence was obtained.* Sir O. Lodge used two steel discs driven round at a high speed and endeavoured to determine whether the aether was carried round with them by means of the modified optical effects that such an aether movement might be expected to produce, but so far as it went the experiment failed to show any such movement.

The famous Michelson and Morley experiment was designed to investigate the motion of the earth relative to the (supposed) fixed aether, but this also gave a negative result. In broad outline this experiment consisted in sending two beams of light from one source along two paths at right angles to one another and reflecting them both back again to an observing telescope. If then the earth as a whole, and therefore the apparatus used, is moving through the aether it should take the beam of light longer to traverse and return along the path in line with the direction of motion, than it will along the path at right angles. Any difference in time taken could be determined by observations of the interference fringes obtained when the two beams were combined again in the observing telescope. By rotating the apparatus into different directions it was hoped to observe such difference of time and thus to determine the direction of movement and velocity of the earth through the aether. No difference was however observed. In order to account for this the very artificial hypothesis of the Lorentz contraction has been put forward. This is to the effect that the size of all material bodies changes according to their direction of motion through the aether. The amount of this contraction is assumed to be exactly sufficient to neutralise any observable effect of such motion, thus rendering it impossible to detect such motion

* "The Ether of Space," by Sir Oliver Lodge (London: *Harper and Bros.*).

by any known physical method. This hypothesis although temporarily removing the difficulty created by the results of the Michelson-Morley experiment brings in an idea that is so difficult to accept that the hypothesis has not by any means found universal favour. The generalised relativity theory smooths over these difficulties by posulating that absolute space and absolute time are both meaningless, and that no two events can be referred in any way to one another unless the relative motion of the observers is known. This implies that all our "standards" of length, time, etc., are merely functions of the relative motion of the observers using them, and that therefore it will be impossible to detect any changes taking place in them. The theory also at the same time renders the aether hypothesis less necessary in some respects, but the latter has however by no means been rejected entirely. For instance, in illuminating discussion on the Relativity Theory recently held at the Royal Society* both Mr. E. Cunningham and Dr. L. Silberstein expressed views to the effect that the aether hypothesis was not inconsistent with the Relativity Theory, and that by suitable transformation an explanation in terms of it could be given of the deflection of a ray of light passing near the sun—a phenomenon predicted by Einstein and confirmed by the observations made at the last solar eclipse expeditions in May of last year. It has also been stated by Prof. Lindemann that suitably interpreted the Relativity Theory appears to favour the undulatory nature of the transmission of radiation—and hence indirectly the existence of the aether.

The Michelson-Morley experiment depends upon a second order effect—*i.e.*, upon the square of the ratio of the earth's velocity to the velocity of light—which is a very minute quantity, but recently G. Sagnac has described some experiments using a rotating interferometer and making use of a first order effect of the aether movement.† Briefly the apparatus consisted of a special interferometer mounted on a massive platform which could be driven round by a motor in one direction or the other. A shift of the central interference fringes was observed in one direction or the other depending upon the direction of rotation and arising through the aether wind set up round the optical circuit by reason of its rotation. The observed magnitude of the shift of the fringes agreed well with the theoretically predicted value calculated from the known speed of rotation and assuming that the aether is an immoveable fluid transmitting the luminous waves with an unvarying velocity. The experiment is therefore taken as a proof of the existence of such an aether.

More recently the same investigator has examined the results of some early wireless tests that were carried out by Sir Henry Jackson in 1896‡ in which tests it was found that definite zones of silence existed at certain distances east and west of a ship transmitting station. At these places no signals could be received, although at greater distances they were again observed. Taking the test figures quoted by Sir H. Jackson, M. Sagnac has shown that the position of these zones of silence can be predicted if the earth's velocity through the aether of space is known, or conversely knowing the distances the earth's velocity can be found.§ The results calculated in this way give a velocity of 400 kms. per second, which is much larger than the earth's orbital velocity. Hence if this value is correct it points to a movement of the solar system as a whole through the aether of space at a velocity which is of the same order of magnitude as the astronomically observed speeds of movement relative to the earth of some of the largest stars, and again gives a confirmation of the existence of the aether.

*Reported in the *Proceedings of the Royal Society*, Section A, Vol. 97, pp. 66–79. March 1st, 1920.

† G. Sagnac, *Journal de Physique*, pp. 177-195, March, 1914.

‡ *Proceedings of the Royal Society*, 70, p. 254 (1902).

§ *Comptes Rendus de l'Academie des Sciences*, 170, pp. 800-803, March 29th, 1920.

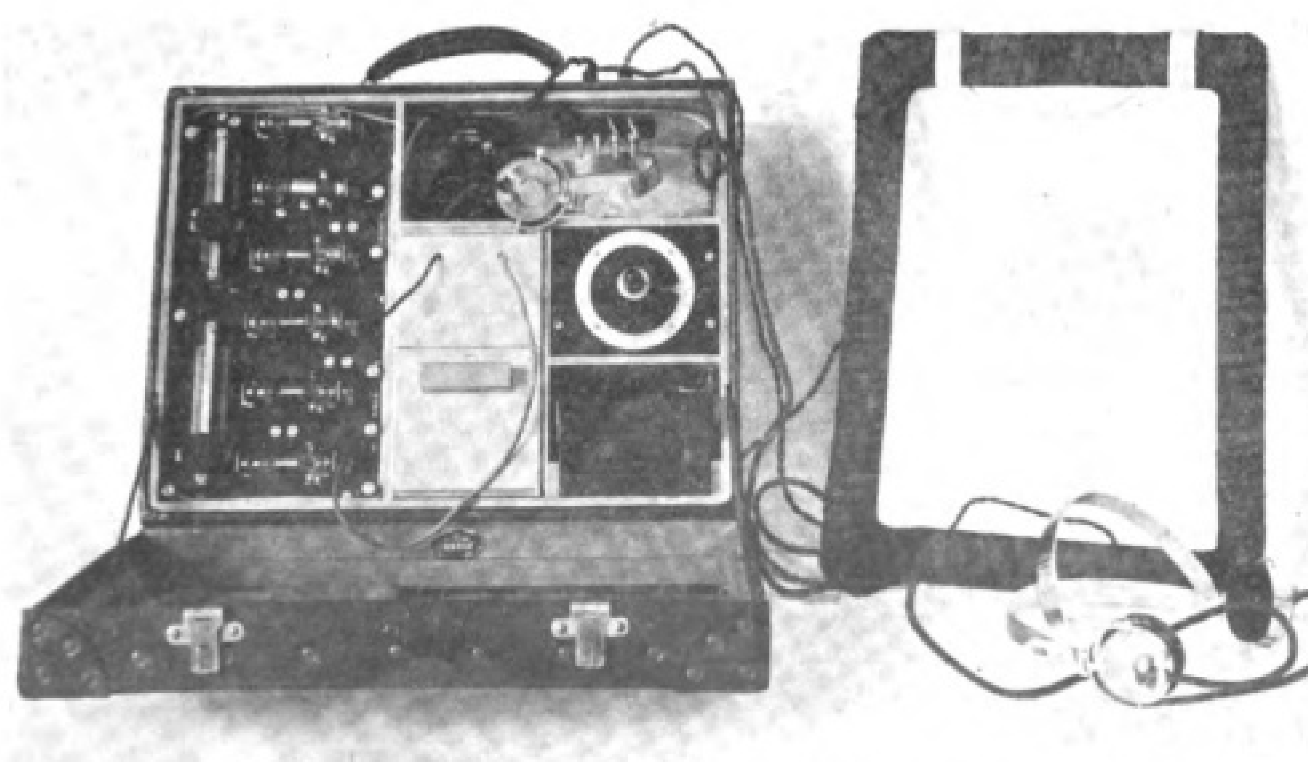
A NEW PORTABLE TELEPHONY SET

THE utility of the wireless telephone and the various purposes to which it may be applied were yet again brought before the notice of the general public on July 23rd.

A reporter on the staff of the *Daily Mail* left the offices of that paper for the outskirts of London, armed with a small despatch case containing a wireless telephony apparatus, and whilst walking on Hampstead Heath, intercepted a message from the Marconi Company's station at Chelmsford, originating from the News Editor of the *Daily Mail*, instructing him to attend at the scene of a fire. These instructions he carried out, thus emphasizing to the journalistic world the possibilities of the wireless telephone

The illustration we give shows the despatch case, opened to expose its set to view. The aerial used is a small "loop" 16½" × 13½" containing 50 turns of No. 20, and may be carried either on the back or chest of the person conducting the demonstration. The despatch case is of the usual type, 17½" × 8" × 13½", and with its contents weighs no more than the average week-end bag. The set is made up with a Marconi Marine Type No. 11 Amplifier, and reference to the illustration will show that there are six valves in all. The four bottom valves are of the "V24" pattern, being used to amplify in four stages the high frequency currents from the transformer. The valve next to the top, and fifth from the bottom, which is of the "Q" pattern, acts as a rectifier; whilst the topmost valve of all, a "V. 24" performs the functions of a "note magnifier," or, in other words, it magnifies the rectified signals in the telephone circuit.

Such an instrument as this is especially suitable for those clubs and experimental societies anticipating "field days" during the few remaining summer months, in that such a set has all the advantages of the bigger and less convenient installations, the matter of the aerial being a decided improvement upon anything hitherto experimented with.



The new "despatch-case" set, showing aerial which is carried under the coat.

NOTES AND NEWS

A Paper was read before the Portsmouth Municipal College Engineering Society, on June 18th, on "Wireless and its Applications," by G. H. Watson, A.M.I.R.E., Senior Lecturer, W/T. Dept., Municipal College.

The lecturer described various forms of Transmitters and Receivers, Selective Calling Devices, Direction Finding Apparatus, Wired Wave Multiplex Telephony, Wireless Telephony, and the action of the Thermionic Valve.

The lecture was illustrated with slides kindly lent by Marconi's Wireless Telegraph Co., Ltd. The interest that was manifested during the lecture can be gauged from the fact that about 40 questions were put forward during question time.

Wireless Telephony in South Africa.—The first wireless telephony demonstration in South Africa took place at Paarl during the month of June, within the precincts of the Rosebank Agricultural Show. The set was a Marconi YC2. telephone-telegraph set operated in conjunction with a similar set 30 miles away. By permission of the South African Aerial Transports, Ltd., a three-seater Avro was also fitted for the purpose of demonstrating the uses of wireless telephony in air.

It needs little imagination to picture the uses to which this science could be applied in such a country of vast wastes as South Africa. Estates and mines and scattered settlements, which it would be difficult to "wire up," could one and all be brought within the lines of communication by the simple application of the modest wireless telephone. Our photograph shows the tent containing the set exhibited at the Show, and into which visitors were permitted to speak and sing.

A New Dutch Radio Society. — The Nederlandsch Radio Genootschap was founded on the 29th of May, at Amsterdam, under the direction of Professor G. J. Elias as Chairman, and Dr. Balth van der Pol, Vice-Chairman. The Society aims to be the centre of scientific radio work in Holland. The address of the Society's offices is W. Barentzstraat, 8, Utrecht, the Secretary being Ir. H. Nordlohne.

A "One Lever" Automatic Telegraph Transmitter was demonstrated for the first time recently, by Mr. F. S. S. Wates, of the Automatic Telegraph Co., and was also exhibited at the Aero Exhibition, Olympia. The instrument which has many interesting features has been designed with a view to enabling aircraft pilots to transmit definite wireless messages without the necessity of carrying a telegraphist. The operation of the instrument is purely automatic, entailing no knowledge whatsoever of either electricity or the Morse code. The instrument is of box shape and weighs approximately 10 lbs. On the face of the box is a plate engraved with 60 messages in three columns. The pilot requiring to send a message inserts a plug in the hole corresponding to the message required to be transmitted, and pulls down a lever, to be found at the right-hand side of the box. By this movement a spring is wound up, which, in turn, drives a clockwork mechanism arranged to rotate a cylinder. A series of contacts on the latter transmit in Morse the call sign of the sending station, and the signal representing the message selected. The call sign as well as the 60 messages are all adjustable in arrangement, to suit requirements. The instrument which is intended for transmission only takes the place of the manipulating key, the remainder of the apparatus being the usual wireless equipment.

A Long-distance Wireless Station is shortly to be opened at Devizes. At the time of going to press tests are taking place, and the coming into commission of the new station will mark an important improvement in wireless communication from the shore to ships at sea. This station was originally partly constructed for the old Imperial scheme and was used as an intercepting station during the war. The station has now been converted by the Marconi Company into a transmitting station, and supplied with a 6 K.W. valve transmitter; it has been erected under contract with the Post Office, and is constructed for the purpose of communication on C.W. with ships at sea. Messages have been received by the Marconi Company informing them that good readable signals have been obtained on ocean liners at distances of 1,600 miles. The aerial is supported on two masts, 300 feet high, and the power plant is an oil-driven engine and dynamo, with a motor alternator for working the valve transmitter.

Belgian Amateurs. — Correspondence has reached us from Belgium to the effect that amateurs in that country are meeting with the same difficulties expressed by Norwegian amateurs in the *Wireless World* of July 24th. Though we sympathise with these unfortunate amateurs nothing remains but to wait for that day when the various Governments revise the present unsatisfactory laws governing experimental wireless.

Merchant Shipping (Wireless Telegraphy) Act.—As from the 1st September, 1920, the Board of Trade will apply certain modifications to the Rules and Regulations governing Wireless Telegraphy and the Mercantile Marine. The Act permits of the use of automatic apparatus, subject to the approval of the Board of Trade. For voyages exceeding 48 hours from port to port in vessels carrying 200 passengers or more, three operators, one of whom shall hold a First Grade Certificate, must be carried. For voyages exceeding 8 hours but not exceeding 48 hours from port to port, two operators must be carried. These Statutory Rules and Orders may be purchased through any bookseller. (Price 3d. net.)

H. W. Sullivan, the Electrical and Telegraph Engineering firm, has recently issued a book of 21 working diagrams for valve amplifying receiver circuits for wireless telegraphy and telephony. The book is well put together, containing much that is of interest to amateurs. Price 1s., obtainable from H. W. Sullivan, Winchester House, Old Broad Street, E.C.

German Radio-Telegraph Developments.—In order to supplement the ordinary telegraph system and to serve as a substitute in cases of breakdowns of the telegraphic communication, the German State Ministry of Posts and Telegraphs is establishing a State Wireless System.

A number of transmitting Receiving Stations are already in operation, at Berlin, Breslau, Darmstadt, Dortmund, Frankfurt a/M., Friedrichshafen, Hamburg, Hanover, Königsberg, Königswusterhausen, Konstanz, Leipzig, Stettin and Dantzig. In addition there are receiving stations at Brunswick, Breslau, Chemnitz, Kottbus, Darmstadt, Dortmund, Dresden, Dusseldorf, Duisburg, Elberfeld, Essen, Frankfurt a/M., Halberstadt, Hamburg, Hanover, Königsberg, Konstanz, Leipzig, Liegnitz, Magdeburg, Rostock, Stettin and Stuttgart. The State wireless system is being constantly extended. Bavaria and Wurtemberg will also be linked up in the system by the establishment of transmitting and receiving stations in Munich and Stuttgart. The Ministry has also established in Königsberg, East Prussia, two transmitting and two receiving wireless stations in order to render independent of the "Polish Corridor," the telegraphic communication of East Prussia with the remaining parts of the State. At the present time the main traffic passes between Königsberg and Stettin and between Königsberg and Berlin. Other developments are projected, and it would appear that the Government is determined to make its telegraphic service as independent and self-contained as possible.—(*Electrician*, July 23rd, 1920.)

European Inter-Communication.—The League of Nations was represented, together with various specialists from various States, at the Conference which has just completed its work in connection with the re-establishment of Postal, Telegraphic, and Wireless Communication in Europe.

A series of proposals was adopted and will be submitted to the Governments concerned, their objective being to promote an improvement as rapidly as possible in areas which are outside the ordinary scope of the Postal and Telegraphic Convention, but which are at the same time vital for quick and sure communication between different countries.

It was announced on the 21st July that the German Wireless Stations were in full and unrestricted operation again.

Wireless v. Cable.—During the breakdown of the Pacific Cable at Norfolk Island in February last, the wireless station at Suva, which was erected by the Marconi Company in 1911, for the Fiji Government, maintained communication with Awanui, New Zealand, during the ten days' interruption. The Suva station using only 2 K.W. was able to handle the usual traffic as well as all messages that were handed over by the Pacific Cable Board for transmission *via* Awanui Radio for Australia and New Zealand.

Wireless Communication for U.S. Railways.—In 1913 the Lackawana Railroad Co., U.S.A., began the installation of wireless telegraphy for the purpose of establishing communication between terminal stations and moving trains, and with the object of providing a means of communication between main stations, at those times when the regular telegraph lines might be out of action. When the U.S. Government for war purposes prohibited all private use of wireless, the Lackawana installations were dismantled. With the ban lifted, however, the Company again took up the work towards the end of last year, and is this time availing itself of the numerous improvements, developed as a result of war, to ensure undoubted success to its new undertaking.

Australian Wireless Licences.—We are given to understand that 900 wireless permits have been issued since the war, to universities, technical schools, and private individuals. These permits are now replaced by licences, and applications for further licences are still being received by the Commonwealth Government.

Thermionic Valves.—In the *Board of Trade Journal* for July 22nd, attention is called to the important part played by the thermionic valve-making industry in Great Britain. The development of valves for wireless telegraphy was enormously increased during the war, and it is believed that the quality of valves produced in Great Britain is now superior to that of any other country. It is said that a larger variety of standardised valves is produced in the United Kingdom than in any other country; high power valves for any purpose have been developed to such an extent that they are believed to be far in advance of those produced in any other country, and a higher standard of technical knowledge has been attained in the United Kingdom than abroad.

Obituary.—Professor John Perry, D.Sc., LL.D., F.R.S., Emeritus Professor of Mechanics, Royal College of Science, and general treasurer of the British Association, has recently died at the age of 70. Professor Perry is known widely as an eminent mathematician and as one who devoted most of his life to introducing mathematics as a practical science. Jointly with Professor Ayrton he brought out many electrical inventions. The names of Ayrton and Perry as pioneers of electrical instruments will never be forgotten.

British Association Meeting.—The 88th annual meeting of this Association is to be held at Cardiff from August 24th to August 28th inclusive. An extensive programme is being arranged and is nearing completion.

THE WIRELESS LOG OF H.M. AIRSHIP "R. 34."

Extracts from entries made during her historic Transatlantic flight.

NO matter what else may be likely to fade from the memories of those who spent last summer in England, no one can ever forget the state of tense excitement that existed throughout the country during those warm July days when the British Airship "R. 34," ploughed her way bravely across the Atlantic Ocean on her epoch-making flight to America. Although much justifiable praise was bestowed by the daily press on the crew of the "R. 34," at the time of her magnificent achievement, a great deal was necessarily omitted from the published reports of the adventure which would have afforded very interesting reading.

No one, of course, failed to appreciate the value of this wonderful feat from the point of view of its commercial and industrial importance, but few people were given the opportunity of fully realising the nature and extent of the scientific organisation which its successful performance involved.

It was generally admitted that the success of the flight depended mainly upon the weather factor, and this occasioned two important requirements: (1) An efficient system of meteorological investigation. (2) The equipment of the "R. 34" with a R.A.F. wireless receiver and a long range transmitting installation.

That these conditions were fulfilled with admirable efficiency is convincingly established by the interesting data which the Wireless Log of the "R. 34" contains.

For this reason, and also because of the valuable testimony it bears of the fine spirit of those who participated in this daring and romantic adventure, we are glad to be able to put before readers of the *Wireless World* the first published account of this unique document. The Wireless Log was compiled by Flying Officer R. Durrant, Wireless Officer of the "R. 34," and his assistants, to whom great credit is due for the remarkably efficient manner in which they conducted their important duties.

At exactly 1.42 a.m. on the morning of July 2nd last year, the "R. 34" left the aerodrome at East Fortune and crept into the sky. After sufficient time had elapsed for the attainment of suitable height, the wireless aerial was dropped and the "R. 34" passed the cryptic message to the big base wireless station at the aerodrome: "All O.K." Shortly after this, messages of good will and encouragement were received on board the airship from the Seaplane Carrier H.M.S. *Furious* and the Air Ministry. The Log contains the entries :—

July 2nd.

2.10 a.m.	From Air Ministry to "R. 34." "All success to your flight and good luck to all on board."
2.17 ,,	From H.M.S. *Furious* to "R. 34." "All good wishes from Captain and Flying Squadron."

Within about two hours from the time of starting, the airship passed over Rathlin Island on the Irish coast, and Major Scott, the Captain of the "R. 34," signalled his position to the aerodrome by wireless.

Shortly before 7 a.m. the Air Ministry Wireless Station (at that time erected on the top story of the Hotel Cecil) advised the "R. 34" that the long distance commercial wireless station at Clifden, on the coast of Galway, would send a code weather report at 7 a.m. Later, H.M.S. *Tiger* transmitted her position and local weather conditions to the airship *via* the wireless station at Ponta Delgada, and shortly after 9 a.m. a similar report was again forwarded by H.M.S. *Tiger* and H.M.S. *Furious via* Clifden station.

The following are the extracts from the Log :—

4.52 a.m.	To East Fortune: "Off Rathlin Island, N.E. Ireland. 4.50 a.m., G.M.T. Steering West. Going well. Scott 'R. 34.'"
6.55 ,,	From Air Ministry: "Code weather report will be sent by Clifden at 7 a.m."
7.0 ,,	Received Code weather report from Clifden.
7.48 ,,	From Ponta Delgada: "H.M.S. *Tiger*. Lat. 56°.15″ N. Long. 36°.20″ W. Barometer 30.33 falling slowly. Wind S.S.W. under 5 miles per hour. Thick fog bank. Visibility nil. Sea moderate."

7.55 a.m. Weather report received from Ponta Delgada.
8.10 „ From Air Ministry: "What is your position?"
8.23 „ To Air Ministry: "Position 55°.20" N. 10°.40" W. Course W. 40 knots."
9.10 „ From H.M.S. *Tiger via* Clifden: Position 56°.15" N. 36°.20" W. Barometer 30.33 falling slowly. Wind S.S.W. under 5 M.P.H. Thick fog bank. Visibility 5 miles. Sea moderate."
From H.M.S. *Furious via* Clifden. Position 60° N. 25° W. Barometer 1027.5 millibars, falling slowly. Wind N.W. Visibility 4 miles.
10.7 „ To East Fortune: "Going through thick fog. Everything well. Scott."
11.45 „ Weather report received from Ponta Delgada.

By the afternoon of the first day the "R. 34" had got into touch with H.M.S. *Renown*, H.M.S. *Queen Elizabeth*, and the Scilly Islands, and had performed the praiseworthy wireless feat of establishing communication with St. John's, Newfoundland! The Log continues:—

12.5 p.m. From the Scillies: "Can you hear me?"
12.7 „ To the Scillies: "Yes, your signals are quite strong."
12.23 „ From Air Ministry: "What is your position?"
12.27 „ To Air Ministry: "Position at noon was 55°.7" N. 14°.50" W. Course 270 true. Speed 32 knots. Thick fog. All's well."
1.25 „ Gave mid-day position to H.M.S. *Renown*.
2.15 „ Talked with East Fortune.
3.48 „ Received weather report from Ponta Delgada.
3.50 „ In touch with St. John's.
3.55 „ From St. John's: "Your signals are very weak."
4.0 „ Received weather report from St. John's.
4.18 „ From H.M.S. *Queen Elizabeth*: "Can you hear me?"
4.20 „ To H.M.S. *Queen Elizabeth*: "Yes, your signals are very loud."
4.35 „ Gave position to Air Ministry *via* H.M.S. *Queen Elizabeth*: "53°.50" N. 18° W. All's well."
5.0 „ Received weather report from Clifden.

From the moment when the "R. 34" had crossed the coast of Scotland in the early morning that day, the whole of New York was in a state of tense and speculative excitement in anticipation of her arrival on that side of the Atlantic. With characteristic enterprise American journalists spared no efforts in their attempts to feed their hungry public with the "real goods—steaming hot!" Before the "R. 34" had been 17 hours in the air the following signal from the International News Service was received on board:—

"Could you wireless one or two messages to *New York Times*? Reply few words giving impressions of voyage so far, and weather?"

In the early evening of the first day, whilst the "R. 34" was "steaming 30 knots at 2,000 feet," a small black object could be seen on the green watery desert beneath. This was the s.s. *Ballygally Head*, bound for Montreal from Belfast. One can imagine the two crews of these two wonderful inventions of man eyeing each other with a tense and silent interest as they pass through the dusk over the broad Atlantic.

6.42 p.m. "Here British Airship 'R. 34' from Scotland bound New York."
6.43 „ "Good! Good luck! old man! Here s.s. *Ballygally Head* from Belfast bound Montreal."

All through the night the airship was in constant touch with numerous ship and shore stations and weather reports were received at frequent intervals.

7.0 p.m. From Clifden: "Are you in communication with *Tiger* and *Renown*?"
7.20 „ To Air Ministry *via Renown*: "Yes. Receiving from *Tiger*."
8.20 „ In touch with Pembroke.
9.0 „ From Clifden: "Report at noon tomorrow the amount of fuel expended."
9.16 „ Still in touch with East Fortune.
9.30 „ Weather from *Renown*.
10.45 „ Weather report from St. John's.
11.46 „ Weather report from Ponta Delgada and Pembroke.

About "breakfast time" on the morning of July 3rd, extremely strong and disturbing atmospherics maintained a constant spluttering in the telephones.

The Log contains the following interesting entries:—

9.0 a.m. From Clifden: "Am requesting Glace Bay to pass all messages to you from us 30 minutes past odd hours."
9.30 „ Curious static charging receiver between cloud layers 2,000 to 4,000 feet.
9.45 „ Tuning for Glace Bay. Capacity added stops atmospherics. Heard Glace Bay for the first time. Signals fairly weak.

Shortly after noon signals from the *Aquitania*—which was then some considerable distance away—were received in the "R. 34's" wireless cabin, and later in the afternoon the airship spoke to various steamships plying across the Atlantic, and obtained useful information regarding local weather conditions.

3.42 p.m. Received from the Captain of the s.s. *Canada*: "We are bound for Liverpool. Position 51°.16" N. 39°.42" W. Moderate S.E. wind and sea. Weather clear. Barometer at 30.08. Rising.—Davis."

3.56 ,, To Air Ministry: "Our position at 3.55 p.m. is 52°.10" N. 40°.30" W. Petrol expended 1,546 gallons. Fuel left 3,354 gallons."

At this stage in the flight the Log contains a host of entries concerning the exchange of weather reports from numerous stations—St. John's, The Azores, Pembroke, Clifden and H.M.S. *Tiger*. The following extracts are of interest :—

3.42 p.m. To Clements Meteorological Officer, *via* St. John's: "Our position is 52°.25" N. 42°.35" W. Wind S.S.E Steaming 45 knots at 800 feet. Propose going north of centre. Please forward any information.—Lieut. Guy Harris, Meteorological Officer 'R. 34.'"

8.27 ,, To St. John's: "Please inform Admiral Kerr, Handley Page Aerodrome, that General Maitland is aboard."

July 4th.

1.29 a.m. From St. John's: "Handley Page probably leaving for New York at 10.30 p.m. to-day."

The "R. 34" had now been in the air for two whole days and the work of F. Officer Durrant and his assistants was rendered extremely difficult by the viciously persistent atmospherical disturbances which were experienced at this point. In spite of this, however, the good work went on and wireless traffic literally streamed in and out of the "R. 34." The remainder of the Log contains hundreds of interesting entries, from which the following are selected:—

3.0 a.m. From Clifden: "Inform Air Ministry immediately you sight St. John's."

5.0 ,, Atmospherics very bad Phones burn out. Rig up new pair.

6.0 ,, Impossible to read through atmospherics.

9.10 ,, Got Cape Race. 250 miles.

9.15 ,, Sending V's to Cape Race for D.F. Bearing.

9.20 ,, From Cape Race: "Your bearing at 9.15 a.m. was 36° E of true N."

9.35 a.m. From Canadian Pacific Railway: "Hearty greetings to the crew of the 'R. 34' on its initial trip across the Atlantic. Can you give us any story please ?—MacMillan, Manager of Telegraphs."

10.21 ,, To Toronto Weather Bureau: "Full reports requested of American coast."

12.18 p.m. From St. John's: "To General Maitland, officers and crew. On behalf of Newfoundland I greet you as you pass on your enterprising journey.—Harris, Governor."

12.25 ,, To Governor of Newfoundland: "Major Scott, officers and crew of the 'R. 34' send grateful thanks for kind message with which I beg to associate myself. —General Maitland."

12.35 ,, From the Senior Naval Officer at St. John's: "Request to be informed if you intend passing over St. John's, and, if so, at what time ?"

12.37 ,, To St. John's. "Yes, probably about 4 p.m. G.M.T."

1.5 ,, From Clifden: "Report fuel expended and number of engines in use."

1.20 ,, To Air Ministry *via* St. John's: "Expended 2,900 gallons of petrol. All engines running well. Position 49°.5" N. 50°.20" W at 1.17 p.m."

4.0 ,, From St. John's: "Local authorities informed of your position and intention of passing over St. John's. Can we be of any assistance. Congratulations and successful voyage. Martynside Aeroplane will attempt to join you."

4.10 ,, To St. John's: "Tell Mr. Raynham to beware of long aerials hanging from 'R. 34' when he gets near us."

4.15 ,, To St. John's: "Have sighted land through gap in clouds. Not sure of position. What height are the clouds ?"

4.22 ,, From St. John's: Clouds between 2,000 and 3,000 feet.

5.0 ,, Land seen through cabin window.

5.34 ,, Curious effect of signals dying away and gradually becoming stronger. (Due to hills.)

5.50 ,, Very long weather report from Barrington Passage.

6.40 ,, From New York *via* Cape Race: "Please state time of landing at New York."

6.45 ,, To New York *via* Cape Race: "Landing early Sunday morning."

7.45 ,, From General Seeley *via* Glace Bay: "Warmest congratulations to General Maitland and to all your gallant comrades. Best wishes for completion of voyage."

8.0 ,, To Air Ministry: "Position at 8 a.m. is 46°.56" W. 56°.14" W. Course W. Speed 45 knots. All's well."

8.30 ,, From Captain Miller of the s.s. *Metagama*: "Hearty congratulations. Your progress watched with much interest. All success."

9.4 p.m. From s.s. *Seal* bound for Australia: "Good luck. God speed."

11.0 „ Hear Cape Race speaking to Handley Page Aeroplane.

11.5 „ Intercepted from Cape Race to Handley Page: "Dempsey knocked Willard out in the third round!"

11.20 „ From Canso: "Your bearing from us is 62° E. of true N."

11.25 „ From Cape Race to Handley Page: "How are you getting on? Send V's for Bearing."

11.28 „ Intercepted from Handley Page to Glace Bay: "Going strong, 85 M.P.H."

11.52 „ From Handley Page: "Here Handley Page. Are you the Atlantic Airship?"

11.55 „ To Handley Page: "Yes, old man. Bound New York."

11.58 „ Handley Page signals break off suddenly.*

July 5th.

2.15 a.m. Atmospherics terrific. Still keep watch.

3.55 „ From Barrington Passage: "I have 700 words weather for you. Can I carry on or send it at intervals?"

4.0 „ To Barrington Passage: "Go right ahead."

5.58 „ To Canso: "At 1,500 feet. Hope to reach Halifax by dawn."

6.15 „ From Canso: "Your bearing is 81° E. of us. Handley Page has crashed."

6.18 „ To Canso: "Anyone hurt in H.P.?"

6.20 „ "No news yet, old man."

6.23 „ Try Wireless Telephony with Canso.

6.28 „ From Canso: "Good. Speech fine. 'That's the stuff to give 'em.'"

7.15 „ From Canso: "Are you on the sea side or land side of us?"

7.20 „ To Canso: "On the sea side of you."

7.50 „ To Barrington Passage: "Have passed over coast north of Trinity Bay, am proceeding to New York passing out over Fortune Bay."

8.52 „ To Navy, Halifax: "Meeting stormy headwind. If required could you supply destroyer to tow, please.—Scott, Commander, 'R. 34.'"

9.22 „ To Canso: "Request weather from St. John's, New Brunswick."

9.25 „ From Canso: "Will relay it on. It will have to go through three stations."

10.0 „ To Canso: "Hurry weather report and Halifax replies."

10.5 „ From Canso: "Doing my best, old man."

10.55 „ Send V's for position.

11.5 „ From Canso: "Your bearing at 11 a.m. is 245° from Canso and 60° from Chebucto."

11.15 „ From Halifax: "No destroyers here. Only tugs available."

11.20 „ From Canso: "Weather from St. John's, N.B.: Wind S.W. Clear sky. Clouds low."

*This is the approximate time that the ill-fated Handley-Page crashed.

1.5 p.m. To Air Ministry *via* Barrington Passage: "Flying across Nova Scotia. Stormy headway. Petrol beginning to get short, 1 p.m."

2.0 „ Atmospherics now terrific. Got shock through headphones and drew off sparks from aerial.

2.30 „ Second pair of phones burnt out.

2.40 „ Get in touch with Bar Harbour.

3.0 „ To Bar Harbour.: "To operators (aviation) Navy Department, Washington D.C. and to Commander, 2nd Naval District, Boston, Mass. Could destroyers proceed if required to southern end of Bay of Fundy and take H.M.A. 'R. 34' in tow?"

3.45 „ From U.S. Navy: "Arrangements have been made for destroyers to be South of Cape Cod. Arrangements are being made to temporarily land you at Montauk if it becomes essential. Keep us informed."

3.56 „ Weather from Bar Harbour: "Showers and local thunderstorms probably late to-night and Sunday along coast."

4.0 „ From U.S. Navy: "Destroyers *Bancroft* and *Stevens* left Boston to your assistance at 3.30 p.m."

5.0 „ From "O.U. 8": "Can I help?"

5.15 „ From "O.U. 8": "French sloop *Somme* proceeding now to southern end of Bay of Fundy. She will get there quicker than we can."

5.40 „ To Navy Department, Washington: "Position of 'R. 34' noon 75th Meridian time, Lat. 45°.20″ N. Long. 64° W. Course S.W. true. Speed 20 knots. Steaming down coast of New Brunswick and Maine. Petrol running short. Please have destroyer meet us early as possible."

8.0 „ Atmospherics terrific. Reading impossible.

9.0 „ Hauled up aerial. Approaching storm.

9.15 „ Ship swaying badly.

9.20 „ Tried to let out aerial, but it charged up quickly.

9.30 „ Ship caught edge of the storm.

10.35 „ Aerial out again.

10.36 „ From Destroyer *Bancroft*: "Course for Chatham. Will make flares."

10.50 „ Flares seen. Shone "Aldis Lamp" down.

10.55 „ From Destroyer: "You are directly above us."

July 6th.

12.10 a.m. To C.O., U.S.N.A. Chatham, Mass: "If through shortage petrol 'R. 34' wishes to land Chatham, can you supply 50,000 cubic feet hydrogen and 500 gallons petrol?"

1.30 „ From Destroyer: "Are you heading for Chatham?"

2.0 „ To C.O., U.S.N.A.S., Montauk, Long Island: "Can you land 'R. 34' and give us 300 gallons petrol? Will arrive over Montauk 8 o'clock this morning."

2.50 a.m. From Navy Department, Washington: "Advise 1st District immediately if you can land Montauk. If you can, facilities for landing have been provided."

3.0 ,, From Destroyer: "Will make flares again."

3.10 ,, To Destroyer: "You are still beneath us."

4.0 ,, From Navy, Washington: "Personnel and material waiting at Mineola for instructions from you. Advise if you desire base elsewhere. Keep me informed of your movements."

4.15 ,, To U.S. Navy: "Will land Montauk. Will report time later."

4.18 ,, From Destroyer: "Was our last rocket ahead or astern of you?"

4.19 ,, To Destroyer: "Astern."

5.30 ,, From Destroyer: "Have you sighted Chatham?"

5.35 ,, To Destroyer: "Not yet."

7.0 ,, From Navy, Washington: "Arrangements being made to temporarily land ship Montauk if it becomes essential. Advise landing Mineola. Keep us informed."

8.0 ,, Heavy jamming on 600 metres.

9.30 a.m. To Navy, Washington: "Will land Montauk and take in petrol."

9.50 ,, To Navy, Washington: "If when we reach Montauk we decide to go on, can you land us at Hazelhurst Fields?"

10.0 ,, From s.s. *City of Augusta* bound Boston: "You are over Block Island."

10.5 ,, To *City of Augusta*: "Keep out! You are interfering."

10.15 ,, From New York: "The American Flying Club cordially invite as guests of the A.F.C. the crew of the 'R. 34' during their stay in New York at the Hotel Commodore."

11.45 ,, To Hazelhurst Fields: "Have passed Montauk. Making a dash for Hazelhurst Fields. Expect to land 2 p.m. G.M.T."

11.48 ,, To Base: "Landing 1 p.m. G.M.T. Not 2 p.m. Barometer and Temperature, please?"

12.5 p.m. From Base: "Pressure 2979. Temperature 80°."

12.30 ,, Use Wireless Telephone with Base.

1.0 ,, From Base: "Lieutenant Hoyt, U.S.N., is on landing ground ready to land you. Major Fuller not here yet."

1.35 ,, Landed.

(Finish of Outward Journey.)

WIRELESS CONTROL

By A. Harley Reeves.

(Reprinted from *The English Mechanic*.)

ONE of the first uses to which it was suggested that Hertzian waves should be put was the control of mechanism at a distance. The most practical example of this was the steering of ships from the shore, which was accomplished in an experimental stage at an early date in the history of radiotelegraphy; in fact, the apparatus was so successful that its practical possibilities for war purposes, such as the control of torpedoes, were at once realised. According to reports a small self-propelled boat equipped with the installation was steered through a crowded harbour without the occurrence of any mishap.

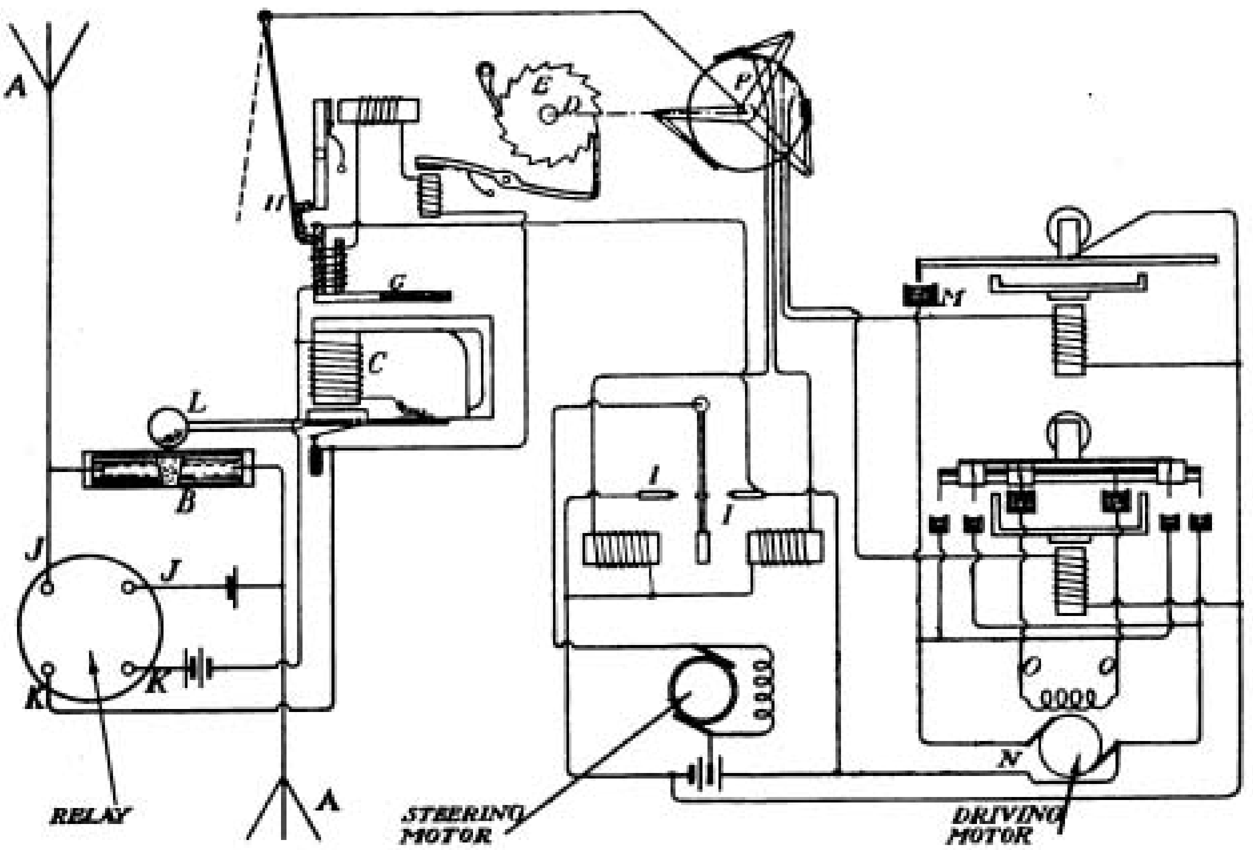
The principle of the apparatus used in this experimental model is very simple, more so than in that to be described later; but for short-distance work it has several disadvantages. The transmitting "controller" consisted of several independent oscillators, each of which emitted its own particular wavelength; there were an equal number of receiving systems, each tuned to respond to one, and one only, of the oscillators. Of course the same aerial could be used for all the oscillators, the wavelength being altered in the usual way by a variable condenser and helix. The receiving circuits were connected in turn, through relays to the steering mechanism and engine control. For instance, if it were desired that the boat should turn in one particular direction a particular receiving circuit would be energised by its corresponding oscillator. To reverse the engines, a second oscillating and receiving system would be brought into use. Thus a single aerial and inductance could be used; the detector and relay circuits were connected in turn to different points on the winding of this inductance. The system was rapid in its action, as a single dot of the required wavelength sufficed to operate each control on the boat ; but accurate tuning is difficult, almost impossible to obtain at short distances, especially when coherers are used ; the result of this is confusion in the controls, more than one receiving system becoming energised by a single wavelength emitted by the transmitter.

No doubt this could be overcome by modern methods of tuning especially by using the " heterodyne " system which makes use of the interference effect between a very high frequency local circuit and the received continuous wave train, which is of similar frequency. When tuned, the frequencies are so adjusted that the interference " beats " produced are of audible wavelength. The original continuous wave train is of much too high a frequency to be heard directly in the telephone receiver. When a slight departure from the correct wavelength is made by the transmitter, the pitch of the " beats " is altered considerably—often so much so as to be beyond the range of audibility. If the telephone were made on the tuning-fork principle, so that it responded to a particular frequency only, and the sound waves from this made to impinge on a microphone operating the steering mechanism, very accurate tuning for control purposes could be obtained.

The mechanism to be dealt with here was designed by me to work on a different principle. With this apparatus, no particular attention need be paid to tuning : in fact in the experimental model an ordinary filings coherer was used with no tuning devices whatever. The steering mechanism was actuated by a rapid train of dots from the transmitter, the number depending on the result required. *e.g.*, whether change of direction or stoppage of the engine.

A car driven by an electric motor was used instead of a boat ; but the essential principles involved are the same in each case. A vertical aerial was used, with the coherer at the mid-point of the wire ; the coherer was of the Marconi type, connected in series with a sensitive and quick-acting Weston relay of which the working current was 1-10th of an ampere. One of the chief difficulties at first was found to be the lagging and " stickiness " of the coherer system ; every attention had to be paid to make this part of the apparatus as quick acting as possible. The reason for this will be obvious when it is realised that a speed of five dots per second was achieved, which is difficult to obtain when using an ordinary filings model, decohered by a bell hammer. As usual the local circuit of the relay was connected in series with the decoherer ; the latter had a light armature and a short arm to give minimum inertia.

In parallel with the decoherer was an electro-magnet and armature, designed for quick action. At the end of the armature a piece of clock spring was attached, and its position adjusted until at every attraction its free end pushed an escapement wheel through an angle corresponding to one tooth on the latter—the wheel was prevented from turning backwards by a similar fixed piece of clock spring. After fifteen attractions—*i.e.*, after fifteen dots from the transmitter—the escapement wheel would have made one complete revolution. On the same axle as the escapement wheel a mechanism resembling a commutator was attached. It consisted of three brushes at 120° apart, in electrical connection, moving over the surface of an insulating disc, which contained five insulated metallic sectors 24° apart. With this arrangement one brush was always in contact with a sector ; when one brush had left the last, the second brush had just come into contact with the first sector. Four of the sectors were connected in turn to the various controlling mechanisms. The first of these steered the car to the left, the second steered it to the right, the third stopped or started the driving motor, the fourth reversed the motor, and the fifth was left blank, being the normal position of the brush. Starting from this normal position, if it were desired to steer to the right, two dots in rapid succession would be made by the transmitter ; this would start a small steering motor rotating until,



A. Antennæ.
B. Coherer.
C. Decoherer.
D. Controller Shaft.
E. Controller Wheel.
F. Brush Arms on Shaft of *E.*
G. Permanent Magnet.
H. Time-Control Pendulum.
I. Contact Screws.
J. Primary Circuit.
K. Local Circuit.
L. Bell Hammer.
M. Mercury Cups.
N. Armature
O. Field Winding

in a few seconds, the steering wheel had turned through the requisite angle by means of a gear train connected to the motor. Three more dots would then be sent, which would bring the brush to the normal position —the fifth sector. This operation would break the steering motor circuit, and the steering wheel would remain inclined at the angle desired. The other operations—of stopping and reversing—were carried out in the same way, five dots altogether being used to complete each movement.

With the apparatus as described, in moving say, to the fourth contact, three other contacts would be made in the process ; if this were not remedied the car would go first to the left, then to the right, and finally stop, which would be inconvenient if simply a reversal of the engine were required. To avoid this a "time-control" device was added. A second electro-magnet was placed in series with that just described. It consisted of two separate parallel bars of soft iron, the adjacent ends of which were in metallic contact with the poles of a permanent magnet. The windings and battery strength were so adjusted that the magnetisation produced by the current just neutralised that induced by the permanent magnet.

The result was a magnet which in its normal condition prevented a pendulum with an iron bob from falling to a vertical position ; but when its winding was energised it released the pendulum, which swung, and on returning was caught by the magnet. The time of swing was about one and a half seconds—ample to insure that all the dots should have ceased on the return of the pendulum. The end of the core, and the contact surface of the iron bob were silver-plated and polished ; the contact between them was put in series with the battery, supplying current to the controls.

At the first dot transmitted of the series the magnet released the pendulum, and broke the "General contact" before the brush had reached the first sector ; contact was only re-established on the return of the pendulum, when the brush was in its final position. It was found that the pendulum was inclined to lag. To remedy this, in an improved design the armature of an auxiliary electro-magnet, in series with the others, was made to propel the pendulum in its direction of fall, thus assisting gravity at the start.

Taking the controls in order, the first actuated an electro-magnet whose armature, when attracted, closed the circuit of the small auxiliary motor operating the steering wheel. The motor being of the permanent type was directly reversible. When the second contact was closed another magnet attracted the same armature in the opposite direction, and again closed the motor circuit but with the current reversed. A spiral spring kept the armature contact studs midway between the contacts when neither electro-magnet was energised. Let us suppose that it were desired to steer the car to the left round a quadrant of a circle, a single dot transmitted would cause the motor to rotate the steering-wheel in the required direction ; when the correct position had been reached, four more dots would fix the wheel, as the brush would then be on the blank contact. Just before completion of the right-angle turn two dots would rotate the wheel to the right ; when the course was again straight, three more would bring all controls to the neutral position.

We come next to the stop-start device at the third contact. In principle it consisted of a horizontal bar, pivoted at its mid-point, and having its mass centre above the point of support ; therefore when horizontal, its equilibrium was unstable. It was prevented from turning through more than about 30 degrees from the horizontal by means of studs ; it is then evident that if placed with either end touching a stud it would be stable in that position. When this position was realised on one particular side of the arm a bridge consisting of two connected contact screws fixed to the movable bar, completed the main motor circuit by dipping into two mercury cups, forming a part of the lead-wire circuit from battery to motor. Also, the bar was nearly touching a lever connected to an electro-magnet armature, which when attracted, jerked the bar upwards with a velocity sufficient to carry it over the "dead-point" at its horizontal position, and to make the bar come to rest with an end in contact with the other stud, thus breaking the main motor circuit by lifting the contact bridge. When in this last position the bar was ready to be jerked back again, as the lever which first struck it was one branch of a fork. It will thus be seen that a succession of impulses in this last electro-magnet winding, connected to the third contact would cause an alternate making and breaking of the main motor circuit. The function of the third contact, then, was to start the motor if it had stopped, or stop it if it were already running. The mechanism connected to the fourth contact on the "brush-dial" was similar, but in this case the arm acted as commutator, six mercury cups in all being required. A momentary closure of the circuit through this contact sufficed to reverse the direction of the current through the field-winding of the series motor used.

A simple mechanism was designed to simplify the transmission of the control signals. A circular disc had five thin metal sectors at equal intervals ; there were slight depressions in the disc surfaces between them. A metal brush-arm with an insulating handle, could be rotated over the sectors ; as it touched each one the transmitting induction coil circuit was closed. The spaces between the sectors were named in order as follows :—"Left," "right," "stop-start," "reverse," "return." Starting at "return," the normal position, all that was necessary was to move the pointer by hand, in a definite sense, indicated by an arrow, and neither too slowly nor too hurriedly, until it pointed to the result desired on the car—the correct number of dots would be sent automatically. As long as the speed of rotation was kept within the required limits the movement carried out by the car had to correspond to that indicated by the pointer, thus eliminating errors due to the wrong number of dots being sent

PHYSICAL FEATURES AND WIRELESS TRANSMISSION

By J. Williamson.

The following paper was awarded the first prize in our competition for commercial wireless operators, which was instituted during the publication of our last volume.

THE statement appears in the September, 1919, *Wireless World*, that the cause of "fading" is quite unknown, the suggestion being conveyed that it is probably a magnetic phenomenon. The following data, however, seem to point to a different solution.

On the night of 28th November, 1919, while approaching the Strait of Hormuz from the Persian Gulf, signals from Bombay Radio, who was working with ships on the 600 metres wave and 1,200 miles distant, were observed to fluctuate in a manner quite unusual for this station. Unfortunately, his transmission was not continuous, but the relative strengths, when studied in conjunction with a map of the vicinity, left little doubt but that the phenomenon was entirely due to the mountainous rock formation at the end of the 'Oman Peninsula. Hills obtruding into the course about 70 miles from the ship also had an adverse effect on the signal strength, but, although of about the same height, their influence appeared much less than that of these rocks only a few miles away. Details are given in the inset to Map 2.

A similar case was observed on listening to Malta's transmission whilst passing Gebel Galala, a mountain on the west side of the Gulf of Suez, between 7 and 9 p.m., on the 10th December, 1919, where the same cause of fading was apparent.

The question arises as to whether these examples represent the majority of cases of a like nature, or whether they belong to a class by themselves. The only answer I can offer is that afforded by Aden, which to the East-going operator is the most notorious station in this connection, and, so far as I know, has always been the same, and unaffected by time or season. Occasionally he starts his press strong and dies away towards the end, or he may be almost unreadable on commencing, increasing towards the middle and perhaps fading again before the end of his transmission, but always more or less gradually. Then in addition to changing thus in point of time, his fluctuations vary a good deal both in rate and degree of change.

That it is not a magnetic phenomenon seems indicated by the fact that other stations in the neighbourhood remain unaffected, though an instance of the exception proving the rule was apparent on my hearing—when in a position 700 miles round the South Arabian Coast—the French s.s. *Royruna* (call letters UAN) sending to Port Soudan and then working with another ship (UHV ?) Both these ships were fluctuating fairly rapidly between easy readability and inaudibility, but at different intervals, and both were in the Red Sea.

Now, Aden is surrounded, perhaps more than any other station, by mountains: between west and north-east the highest mountains in Arabia rise from five to ten thousand feet and are from 50 to 200 miles away—the signals from UAN and the ship with which he was working had to cross this same mountain range—whilst, outside of the Gulf of Aden, only a small sector eastward is quite clear, and in the Gulf itself are parts screened from the station by the rocks of Jebels Shamshan and Ihsan in close proximity. I had, unfortunately, not been taking systematic notes of Aden's fluctuations until this voyage, and it has so happened this time that, during the time the ship was in the unscreened area, his transmissions did not include press, or last long enough to prove the absence of fluctuation;

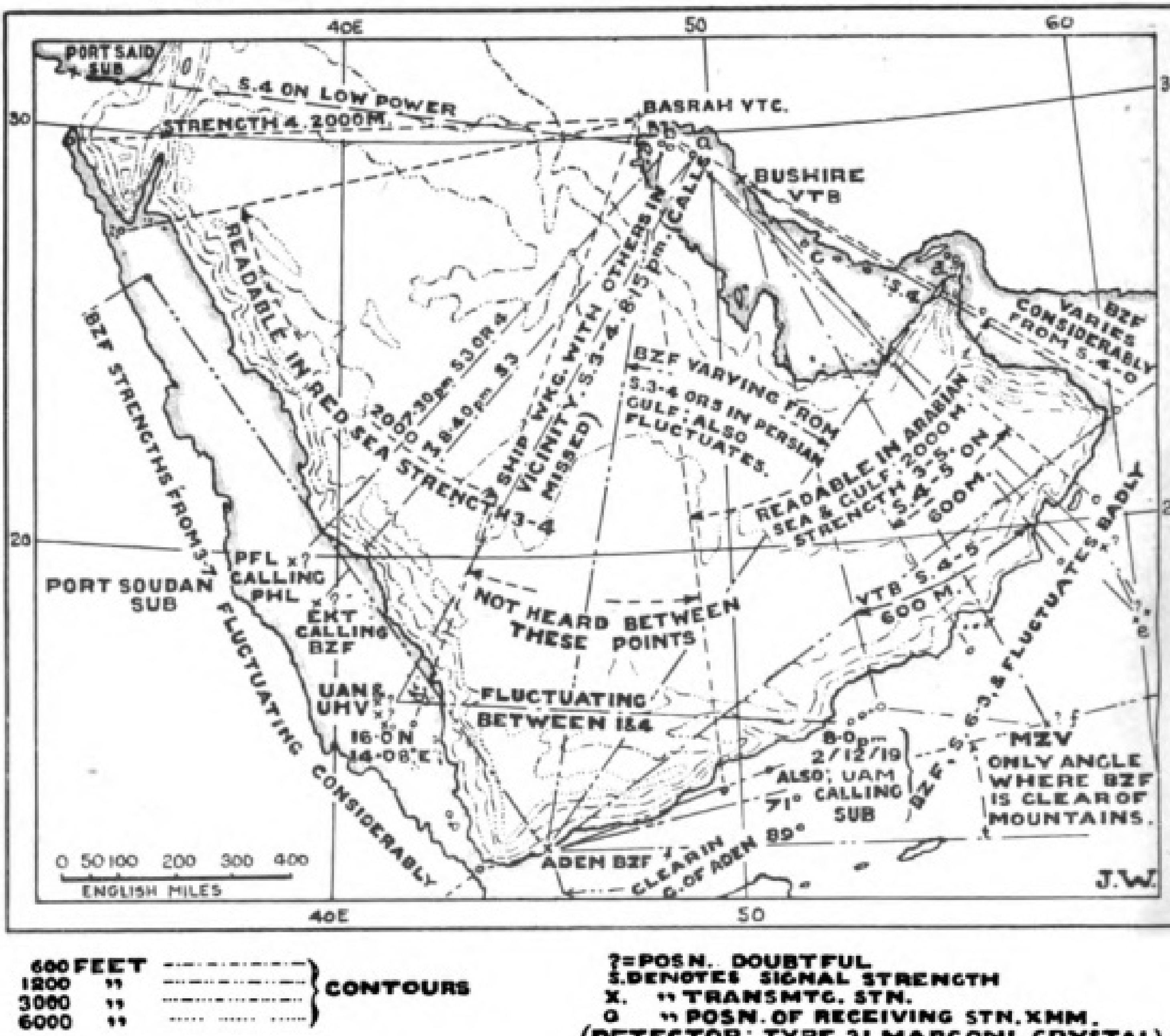


Fig. 1.

(*a*) 19/11/19. Also heard GBJF giving BZF—"QSL," 8.20 p.m. SUB wkg. KEMG, 8 p.m. SHQ calls CQ, 8.30; probably in Red Sea. XSO and VYN in Mediterranean.

(*b*) 26/11/19. FNK wkg. FNL and FJJ. Djibouti, 8.0 p.m. XJP calling SUB with msg., 8.50 p.m. (s.4).

(*c*) 27/11/19. 7.0 to 8.30 p.m. PFL, IMV, FML, GBFY and OZP working at intervals: s.3 to 4 and probably all in Red Sea.

(*d*) 28/11/19. 6.25 p.m.: MHT from Calcutta to Liverpool (s. 4) and BFX, bnd. Australia, pass Tr's. BAI wkg. MVV and GBLN.

(*e*) MZV, bound Karachi (s. 4), heard (by XMM in Persian Gulf), working with ZCI. MOJ and GGF, on Bombay run (s. between 3 and 4), 7.5 to 7.30 p.m., 19/11/19. Also: GBKM and ZCI, calling VWB (Bombay).

(*f*) MZV heard exchanging sigs. with VTB: give each other "QSA," 6.15 p.m. 2/12/19.

but none was noticed. There should be no difficulty in determining this point, however, and should the result show no greater changes in signal strength than those of other stations, when receiving Aden within his bearings of N. 71° E. and N. 89° E. (true), the inference will be obvious that the cause of fading, so far at least as the stations mentioned are concerned, lies in the physical obstacles between the transmitting and receiving ends conducting part of the transmitted charges to earth.

The rate and amplitude of fluctuation would therefore vary with the direction and speed at which the ship moved across or towards such a screen, in addition to their relative distances from the transmitting station, and the angles of the ground forming the screen.

Again, slight variations in the transmitting power, unnoticeable in ordinary circumstances, might possibly be sufficient to raise or lower the course of the intercepted part of the wave a sufficient height to affect the received strength perceptibly, if that course just cleared a land height. If this effect does take place, it would be the only one of those dealt with here which would be observable at a land station listening to others, so it might be of interest to find out if stations such as Basrah or Port Soudan experience Aden's fading and, if so, to what extent.

Should this theory account for most cases of this phenomenon, it would explain the lack of scientific data on the subject, as observations would be practically confined to communication between fixed points.

Dr. Eccles' article (*Wireless World*, 7, p. 331 and p. 400) also expresses doubt as to the height to which waves travel above the earth's surface, in which connection I might be able to give a few interesting facts, however erroneous my deductions from these may be.

Referring to Fig. 1 it will be seen that reception in the Persian Gulf of signals crossing Arabia during the period in which I have been taking notes, was strikingly better than anywhere else round Arabia, although also fairly good along the eastern and lower-lying half of the south-east coast. Ships 1,000 to 1,200 miles away in the Red Sea and Indian Ocean were quite readable in the Gulf, and that it was not a purely local "freak" is evidenced by my having read UAN at eight or nine hundred miles, as previously referred to, and the fact that reception was excellent when transmission was along the Red Sea and not from outside of it, except in the case of certain warships in the Mediterranean which were received far down the Red Sea, probably because their signals were coming down the Gulf of Suez rift valley.

Now why should ships' transmissions between the Persian Gulf and the other sides of Arabia be possible only in one direction, and communication generally from the Red and Arabian Seas towards the Gulf be so much better than *vice versa?* The map of Arabia, on which I have marked every instance or group of transmissions across the peninsula heard this voyage, shows that this is undoubtedly so, and also suggests this reason: that the waves travel high near the commencement but gradually drop nearer sea level as they approach the receiving station.

It will be seen that the land rises high on the Arabian west and south-east coasts and slopes fairly evenly down to the Persian Gulf; also that heights of 5,000 feet or more within the first few hundred miles from the sending station appear to be no obstacle, but evidently bar the way to that ship's receiving in the opposite direction. Then, I believe that UAN and UHV (?) were in such positions that their signals were following part of the course of a widening and deepening valley when picked up, though they had crossed the Red Sea coast mountains at a high level. Generally, ships on one side of the Strait of Bab-el-Mandeb are cut off from those on the other, even at much shorter range.

The only apparent exceptions are the land stations of Bushire and Basrah (VTB and VTC respectively) in the Gulf, but VTB and VTC on his low power, were only heard along that part of the coast where the mountains are lowest, and the latter on his 2,000 metres wave is the only high power station in the Persian Gulf area, which may account for his being heard in the Red Sea.

Turning to the sheet of section diagrams (Fig. 2) and to Fig. 3, where I have included other communications, noted in most cases because of their being over the average distance for reception of the various stations, in the more unusual long-distance cases, for the type of receiver, again the same feature is seen: that mountains in the first two or three hundred miles are of no account, but we find none of any height crossed near the receiving end. The same seems to apply to every case where the distance, with respect to the transmitting power, is out of the ordinary. I have also

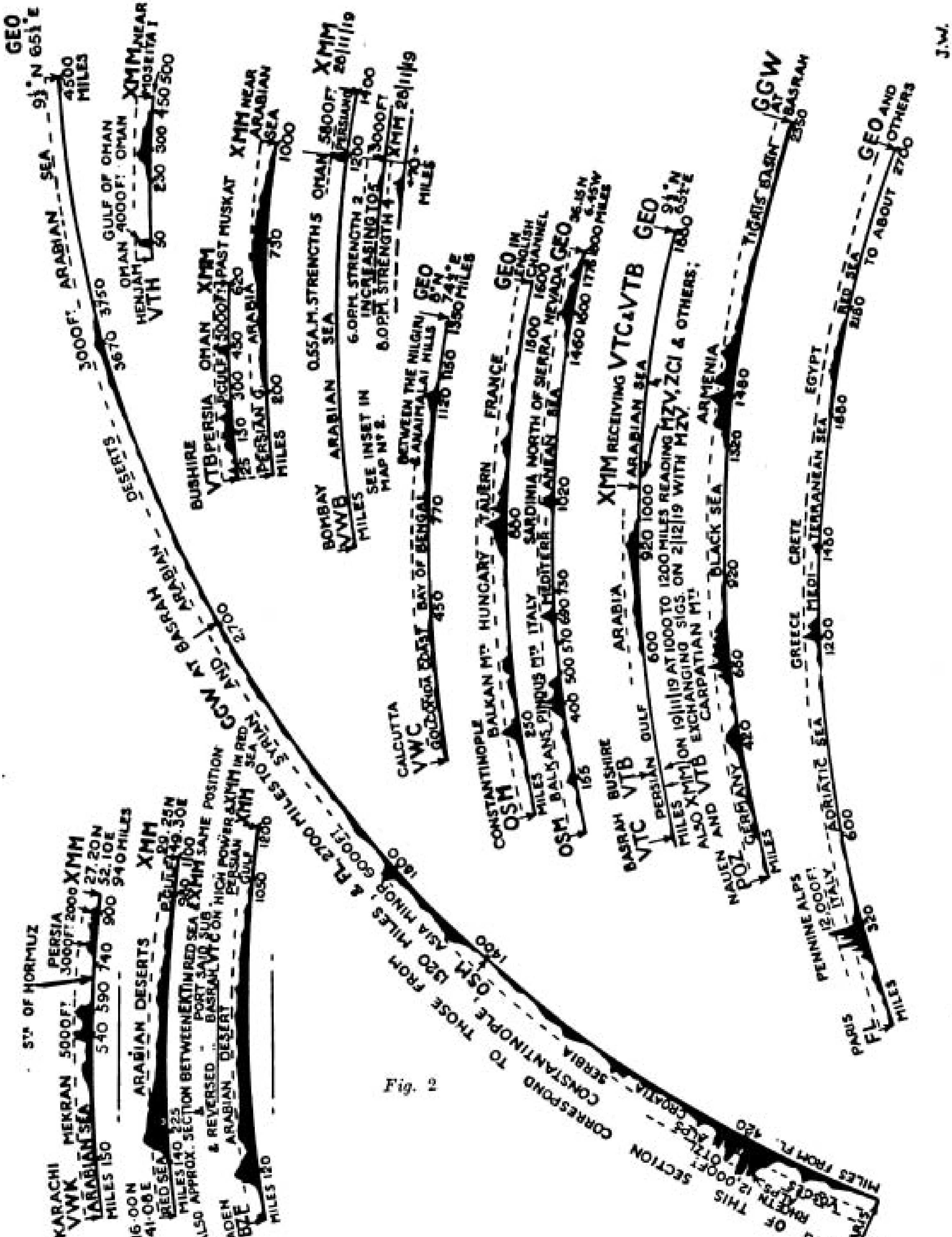

J.W.
GEO 9½° N 65½° E
ARABIAN SEA
DESERTS
GULF OF OMAN
VTH
XMM
VTB PERSIA
BUSHIRE
BOMBAY VWB
ARABIAN SEA
SEE INSET IN MAP No. 2.
CALCUTTA VWC
BAY OF BENGAL
CONSTANTINOPLE OSM
BALKAN MTS. HUNGARY
FRANCE
ITALY
GEO IN ENGLISH CHANNEL
XMM RECEIVING VTC & VTB
ARABIA
ARABIAN SEA
BLACK SEA
ARMENIA
NAUEN POZ GERMANY
GGW AT BASRAH
TIGRIS BASIN
GEO AND OTHERS
GREECE
CRETE
EGYPT
RED SEA
PENNINE ALPS
PARIS FL MILES
KARACHI VWK
MEKRAN
STR. OF HORMUZ
PERSIA
ARABIAN DESERTS
ADEN BZE
ARABIAN DESERT
GGW AND GEO AT BASRAH
SYRIAN
ASIA MINOR
SERBIA
CROATIA
PARTS OF THIS SECTION CORRESPOND TO THOSE FROM CONSTANTINOPLE
MILES FROM FL.

Fig. 2

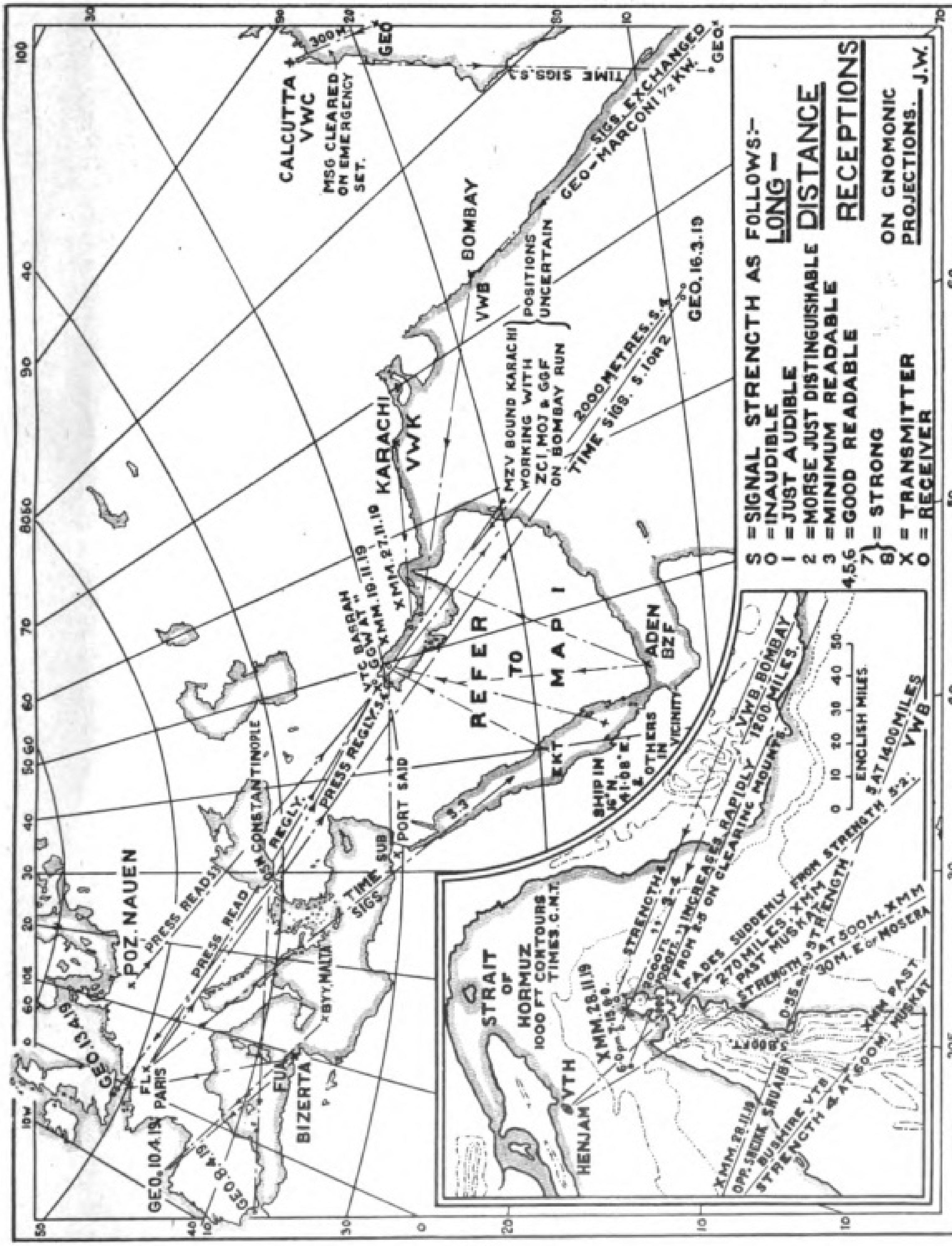

CALCUTTA
VWC
MSG CLEARED ON EMERGENCY SET.
TIME SIGS. S.3
SIGS. EXCHANGED
GEO—MARCONI ½ KW.
BOMBAY
VWB
POSITIONS UNCERTAIN
GEO. 16.3.19
2000 METRES S.4
TIME SIGS. S.1 or 2
KARACHI
VWK
MZV BOUND KARACHI WORKING WITH ZCI, MOJ & GGF ON BOMBAY RUN
XMM. 27.11.19
XMM. 18.11.19
REFER TO MAP I
ADEN
BZF
EKT
OTHERS IN VICINITY
PORT SAID
POZ. NAUEN
PRESS READ
CONSTANTINOPLE
PRESS REGLY.
TIME SIGS
SUB
MALTA
FUA
BIZERTA
PARIS
GEO. 13.4.19
GEO. 10.4.19
GEO. 8.4.19
S = SIGNAL STRENGTH AS FOLLOWS:—
0 = INAUDIBLE
1 = JUST AUDIBLE
2 = MORSE JUST DISTINGUISHABLE
3 = MINIMUM READABLE
4.5.6 = GOOD READABLE
7, 8 = STRONG
X = TRANSMITTER
O = RECEIVER
LONG-DISTANCE RECEPTIONS
ON GNOMONIC PROJECTIONS. J.W.
STRAIT OF HORMUZ
1000 FT CONTOURS
TIMES G.M.T.
HENJAM
VTH
XMM. 28.11.19
ENGLISH MILES
VWB. BOMBAY 1200 MILES.
S AT 1400 MILES
VWB

Fig. 3.

introduced a number of receptions from high power stations at long, but not unusual, range. On taking these into consideration, a difference will be noticed, in that mountains crossed without affecting signal strength, instead of being all near the sending station as before, approach to around mid-way between the stations but, if high, never far beyond that point. I am of opinion that low-power waves over ordinary distances adhere to the same rule. As one example, let us take the case of Henjam's transmission shown in Map 2 inset, and one of the section diagrams. When received at 270 miles his strength is reduced considerably by a 3,000-foot rock intervening, yet later on, when 500 miles off, and when his signals had to traverse a range of mountains 4,000 ft. high in the position corresponding to that of the lower mountain, his strength was all that might have been expected had the ground been flat. This, again, indicates a lower angle of transmission to a nearer position of the receiver, therefore a nearer approach to the symmetrical.

My conclusion—very tentative, of course—from the foregoing is that, so far as ordinary ranges are concerned the intercepted wave does not pass to a considerable height (probably not more than one or two miles) above sea level, but that the maximum height attained increases with the distance, while the course it takes may turn out to be a semi-parabolic curve, with the transmitting station as point of origin, and whose axis makes an angle with the earth's surface which decreases with distance, so that the less the range the

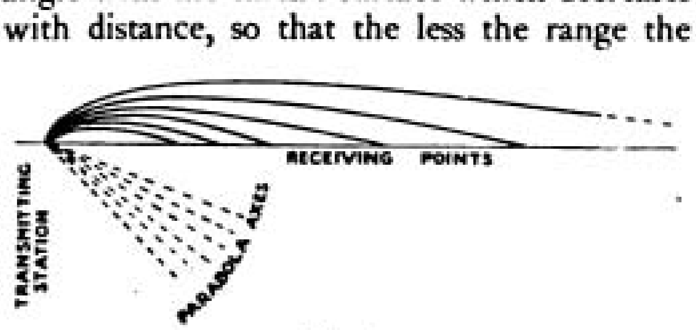


Fig. 4.

nearer the semi-parabola approaches to an arc. A decrease in power would appear to have the same effect as an increase in distance. Perhaps my meaning may be expressed more clearly by Fig. 4, in which height is exaggerated and the earth's surface shown as if flat.

Of course, with the earth's section being circular, the semi-parabola would resolve into a curve in the nature of an involute.

I must admit that the material on which my conjectures are based, while showing nothing adverse to them, is by no means complete, as I have only been taking systematic notes during the last few weeks. Then, at the time of writing, I have not the advantage of knowing exactly how far the study of the relation between physical features and wireless has progressed. Some of my facts may prove of interest, however, even should they establish nothing new.

POST-SCRIPT *(communicated later).*

As regards "fading," which I have found to be a much commoner phenomenon than I had supposed, every case noticed so far was quite explainable as, if not actually proved to be, an effect of land variations. The Aden contention may be regarded as proved, as, when listening to his transmissions—extending on one or two occasions to half-an-hour—while in the Gulf of Aden without land in the way there was no sign of his usual fluctuations, which seem to commence as soon as the ship passes out of this area.

Although my evidence for the second theory only consists in the multiplication of instances of long-distance transmission over land where the heights keep within a certain formation, and absence of these instances where other conditions supervene, I am continually finding such cases to support it.

Given fair atmospheric conditions, a ship in the Persian Gulf can, practically every night, read ships or other low-power stations that may be anywhere round the outside coasts of Arabia or Asia Minor as far as Batoum, and at distances of about 900 to 1,500 miles. Their signals are sometimes so strong that ships in the Gulf attempt to communicate with them, but never, to my knowledge, receive any answer. Other stations readable down the Gulf until the Persian coast mountains intervene, are: Eiffel Tower, Nauen, allied warships around the Bosphorus, and, occasionally, Malta on low power. In every case the land rises high towards the transmitting end and slopes more or less gradually down to the receiver.

In the reverse direction, I have not yet heard of any ship in the Persian Gulf being received at any distance outside of it, although Basrah and Bushire land stations can be heard on 600 metres when the receiving ship is opposite the parts of the Arabian coast where the mountains are lowest (*i.e.*, along part of the south-east coast, and the northern part of the Red Sea). Reception in the Red Sea is very much better when the waves have traversed a few hundred miles of its length, as when receiving Eiffel Tower and the warships mentioned: these have heard as far as Perim, at 3,550 and 2,150 miles respectively.

WIRELESS CLUB REPORTS

The Wireless Society of London.

The Committee of the Wireless Society of London are now making arrangements for Lectures and Papers to be read during the forthcoming session. It is expected that the next meeting of the Society will take place towards the end of September, the exact date to be announced later. Will members of the Society who have anything suitable to offer in the shape of a Paper or Lecture kindly communicate with the Hon. Secretary as soon as possible, giving full particulars. Particulars of membership and forms of application may be obtained from the undermentioned; applicants passed by the Committee for membership will be balloted for at the next General Meeting; subscriptions then due by new members would carry them through to October, 1921.—Hon. Secretary, Mr. Leslie McMichael, M.I.R.E., 32, Quex Road, West Hampstead, N.W. 6.

Wireless and Experimental Association.

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

At the Annual General Meeting of the Wireless and Experimental Association at 16, Peckham Road, on Wednesday evening, August 4th, the Secretary was able, on the first year's working since reconstitution subsequent to the war, to congratulate members on the fact that the Association has made for itself a place amongst the Wireless Societies of Great Britain; not by reason of the outstanding merits and qualifications of any one of its members, but by the general high level and good sound knowledge of the whole body.

Mr. William le Quex, the famous novelist, has consented to be the President, as he was of the pre-war organisation, and readers of the illustrated press will be aware of his attainments in this line. Other officers elected were Mr. A. W. Knight, chairman; Mr. C. Saunders, General Manager; Mr. G. Horwood, Assistant General Manager; Mr. C. A. Carroll, Treasurer; and Mr. Geo. Sutton, Hon. Secretary. Messrs. H. Kloots, Selden, Howard and Morris were elected to the Committee.

The Secretary has been empowered to enrol as corresponding members, at the nominal fee of 1s. per annum, any of its old members who cannot attend meetings regularly, but who desire to keep in touch with the Association, and resume their regular attendance when circumstances again favour such a course.

Our experts report receiving Arlington and other American stations on one valve, and the recent series of wireless concerts which followed the *Victorian* across the Atlantic have been a source of delight to all.

The Association met on One Tree Hill on Saturday, August 7th, for open air experiments by permission of the Postmaster-General and the Camberwell Boro' Council. One power buzzer transmitting station and three receiving stations were established and nearly a whole column of the *Evening News* was transmitted.

Even considered as buzzer practice it was far in advance of the usual Club way of doing things and as practical earth transmitting it was "the thing." We hope to repeat at an early date.

We hope that with the improvements in short wave small power wireless telephone apparatus, the authorities will be able to grant a little more liberty to the experimenting amateur.—Hon. Secretary, Mr. G. Sutton, Melford House, 18, Melford Road, East Dulwich.

The Cardiff and South Wales Wireless Society.

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

A meeting of this Society was held at headquarters (the Wireless Department of the City of Cardiff Technical College), at 6.30 p.m. on Thursday, July 22nd, 1920, the President, Captain W. A. Andrews, in the chair.

The minutes of the last meeting held on July 1st, were read and adopted.

A minutes secretary was appointed, in the person of Mr. E. J. Matthews (of the Marconi Company's staff), Cardiff. It was unanimously decided that Mr. N. M. Drysdale, Cardiff, be elected a Vice-President of the Society. The said gentleman being present, made suitable response and offered to give the Society a lecture at its next meeting, which offer we were pleased to accept.

The President then read a formal resignation of office, from Mr. A. E. Hay, the Hon. Secretary, wherein he stated that owing to pressure of business he feared both his business and the secretarial duties were suffering from lack of undivided attention.

After discussion, the meeting accepted Mr. Hay's resignation with regret, and paid tribute to his work in founding the Society and placing it on a firm foundation.

Several gentlemen present were voted to succeed Mr. Hay, but each regretted his inability to devote sufficient time to the office, whereupon it was decided to hold the matter in abeyance until a more representative meeting is obtained. The retiring Hon. Secretary then volunteered to remain in office until the end of September, and the meeting availed itself of the offer.

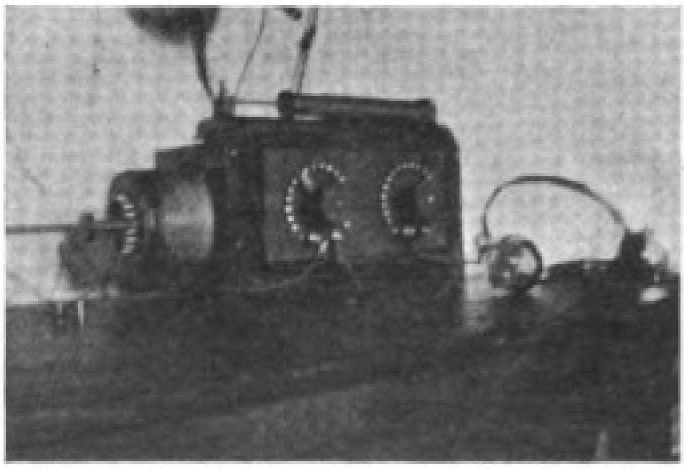
Routine business being at an end, there followed various discussions of purely technical interest, after which the meeting dispersed for Morse-inker tests, buzzer practice and "listening-in."

The next meeting is fixed for 6.30 p.m. at Headquarters on Thursday, September 9th, 1920, when it is hoped that the West Wales counties' members will attend in force. The agenda will be published later. The Society has already 84 members and new candidates for membership are invited to apply for particulars of the work and objects of the Society to the Hon. Secretary, Mr. A. E. Hay, at 6, Oxford Street, Mountain Ash, Glamorganshire.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

The Society continues to receive numerous applications for membership, especially in the case of corresponding members and the Advisory Committee are being kept quite busy with technical correspondents from our amateurs. It is anticipated that the committee will have to be augmented and the services of a typist requisitioned to deal with future correspondence. Just at present, the certificated members holding the P.M.G. licence are carrying out exhaustive experiments in the reception of Wireless Telephony, and quite a good report was received of the work in connection with this branch, during the long test on July 25th, by the Press Association.



Manchester Wireless Society. A Member's Set.

One exceptionally fine result was obtained on a set comprising a 12 ft. aerial, two small variometer coils (3 inches over all) and one valve, using 20 volts on the plate and 4 volts filament, a small variable condenser and a gas-pipe earth.

With this simple device three persons received every message transmitted and were able to write them down with ease. Reports of the experiments were sent to the Press Association and it is hoped that the points suggested will help to improve this most fascinating science.

We are by no means full of members, being still able to squeeze a few more in our little laboratory; it is requested, therefore, that those who wish to dabble with wireless, expert or novice, will communicate with the Hon. Secretary, who will forward all necessary information. Intending members should note that only half the subscription is due for this year.

The next lecture and practical demonstration will be given during September by one of our Vice-Presidents, Mr. Charles V. Morris, who is well known in the radio world.

Other attractions too numerous to mention, are in store for the members during the chilly winter months.

For receiving the telephony experiments from Chelmsford to Denmark, the Club receiving set has been used for the first time.

The set used was a single valve and aerial 12 ft. long, stretched across the room. Every item in the programme was clear and distinct and proves interesting by reason of the fact that only 24 volts plate-pressure and 4 volts filament on a 6-volt valve, were used.

The licence for the Club has just come to hand, and with it was included a transmitting licence and an extra receiving licence for a portable set. The Club intends to transmit to members at their homes and to a party of members with the portable set, every evening from 7 to 9 p.m.

The official call sign is 2 FZ (two FZ) so through the medium of the *Wireless World*, readers in the Manchester district will be able to recognise the Society's transmissions. Wavelength will be from 120 to 180 metres, which is rather low, but evidently the maximum length the Postmaster General can spare at present. However, we hope to improve on this in the near future, our ultimate ambition being direct communication with the Wireless Society of London and other institutions.

Hon. Secretary, Mr. Y.W. P. Evans, 7, Clitheroe Road, Longsight, Manchester.

Newcastle and District Amateur Wireless Association.

(Affiliated with the Wireless Society of London.)

Meetings are taking place regularly on Monday evenings. Several members who have private stations report the successful reception of the Chelmsford C.W. programmes, two reporting having heard them on crystal circuits. The Society is much indebted to the *Wireless World* for information as to the intended programmes of transmission and takes this opportunity of expressing thanks to the Editor. It is the opinion of many members that a large number of local enthusiasts who address queries often of a very elementary nature to the "Questions and Answers" columns of the *Wireless World*, should get into touch with their local Societies, where most of these questions would be satisfactorily answered. Most of the querists are not members of any Society; it is therefore up to them to join up and add their weight to the good of the amateur cause.—Hon. Secretary, Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

Edinburgh Wireless Club.

(Affiliated with the Wireless Society of London.)

In spite of the small number of members who attended meetings during last month, (owing to summer vacations), we have succeeded in erecting our aerial (temporary), installing the set, which is entirely home-made, and getting signals with one valve in circuit from various stations, including MPD, POZ and other high power stations.

Telephony signals were received yesterday about 4.45 p.m. (British summer time), but were not very distinct. Our membership is still smaller than it might be, and full particulars can be had from the Hon. Secretary, Mr. W. Winkler, 9, Ettrick Road, Edinburgh.

The Halifax Wireless Club.

(Affiliated with the Wireless Society of London.)

At this Club's last meeting, on July 26th, with about 25 members present, Mr. C. Oates gave a demonstration and lecture on vacuum tubes. Mr. Oates has had much experience in this line and all his experiments were both interesting and successful. Buzzer classes meet every week and are making good progress. The Club is shortly to be divided into "Elementary" and "Advanced" sections. The Club's transmitting license has not yet been granted by the P.M.G., but we are still "hoping."

Valuable experiments have been carried out by the members lately, with frame aerials, etc., and a deal of useful information obtained.

Membership now well over 50, and new members continually joining.—Hon. Secretary, Mr. L. Pemberton, Y.M.C.A., Clare Hall, Halifax.

Nottingham and District Wireless Society.

A successful meeting was held at the People's Hall, Nottingham, on Wednesday, July 21. A temporary committee and officers were elected, and a good deal of other business was dealt with.

The subscription for members of 21 years of age and over was fixed at 10s. per annum and for those under 21, 2s. 6d. per annum payable half-yearly.

Will all members note that subscriptions are now due, and should be paid to the treasurer at the next meeting or forwarded to the Secretary, Mr. J. H. Gill, 18, Fourth Avenue, Sherwood Rise, Nottingham.

Future meetings have been arranged on the following dates and the room booked for the purpose at the People's Hall, Nottingham.

Members should take particular notice of these dates as it is very probable that no further notice will be given:—September 8th, September 22nd, October 6th, October 20th, November 3rd, November 17th, December 1st, and December 15th.

Several promises have been given for interesting lectures and demonstrations.

All meetings will commence at 7.30 p.m.

The Chiswick, Acton, and District Amateur Wireless Association.

The above-named Club cordially invites all prospective members to its meetings held every Thursday at 7 p.m., at the Club's temporary room at 126, Cranbrook Road, Chiswick. It is hoped that soon we shall have a larger and permanent club-room, when the Club will then possess a receiving set. At present the Club is progressing favourably; time being passed by buzzer practice, discussions, lectures, etc.

The Club is under the Presidency of Mr. F. O. Read, and the Vice-Presidency of Prof. Pearl, B.A., whose combined efforts, together with the rest of the members, should make the Club a splendid union of amateurs of the district.

The Club also anticipates affiliation with the Wireless Society of London.

Particulars of membership, etc., may be obtained by post from the Hon. Secretary, Mr. C. Hirst, 58, Agnes Road, Acton, W.

Stoke-on-Trent Wireless Club.

Mr. Shaw, of the Stoke-on-Trent Wireless Club, has relinquished his office of Hon. Secretary in favour of Mr. S. Wilkinson, West View, Liverpool Road, Newcastle, Stoke-on-Trent. Other officers of the club are—President, Mr. F. E. Denger; Vice-Presidents, Messrs. E. Blake, A.M.I.E.E., and W. Yeoman, A.M.I.E.E.; Hon. Treasurer, Mr. A. H. Wilson.

Wireless Society for Blackpool.—It is proposed to form at Blackpool an amateur wireless Club and those who may be interested are requested to communicate with Mr. W. Turnbull, 14, Cambridge Road, Blackpool.

Amateur Clubs.—It may interest our readers to know that there are in the United Kingdom forty-one Clubs, formed for the purpose of studying and practising Wireless Telegraphy and Telephony. Of these Clubs, twenty are affiliated with the Wireless Society of London. As far as we are able to gather from our records, the total number of Amateur Club members in the United Kingdom is approximately, 1,500; but since the honorary secretaries of many Clubs have not apprised us of further membership, our figures must necessarily be short of the actual total.

We take this opportunity of pointing out that a number of Clubs have become lax in the matter of sending in reports of their meetings, and in so doing, are helping to defeat the amateur cause. There are, as shown above, forty-one Clubs for whom we could publish reports each month, yet as enthusiastic as the members of those Clubs are, never have we been asked to publish a number of reports so high.

The publicity of these columns is open to all Clubs, formed and forming, and, speaking from the book of experience, nothing succeeds *without* publicity. Let each Club send in its report; let each Club make known its movements to other Clubs; let all Clubs make their existence known, and so advance the amateur cause. There are still wanted to form Wireless Clubs at Bournemouth, Spalding, Doncaster, Exeter, Grimsby, Aberdeen, Rugby, Congleton and Glasgow. Those interested should communicate with Mr. T. H. Dyke, Hill Garage, Bournemouth; Mr. W. G. A. Daniels, Pinchbeck Road, G.N.R. Crossing, Spalding; Mr. A. H. Wasley, Glenholme, Ravensworth Road, Doncaster.

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.*

WIRELESS TELEGRAPHY DETECTORS.

IN a previous article on Receiving Circuits it was seen that some form of detector or rectifier was necessary before the waves of energy could be rendered audible to the operator. In this section we shall discuss the various forms of apparatus used for detecting the presence of electric oscillations, and the principles upon which their action depends.

Detectors can be classified into four groups, as under :—(1) Imperfect contacts. (2) Magnetic. (3) Thermal. (4) Electrolytic. Nearly all types of detector require some auxiliary circuit to show the presence of oscillations. They are usually connected directly in the aerial circuit, and across them is connected a battery and indicator which are operated by the detector under the influence of the aerial oscillatory current.

1. Imperfect contact detectors, as their name implies, consist essentially of two electrodes connected in the receiving circuit and so adjusted that there is a very slight electrical contact between them. In order to arrange this, it is usual to separate them by a few millimetres, and fill up the gap by a quantity of fine metal filings. In their normal state the filings are so loosely adherent to one another that they offer considerable resistance to the passage of an electric current.

When an electromotive force is applied to the electrodes the particles in the gap are changed and tend to arrange themselves in continuous chains. Their conductivity is thus increased, and a small current will flow. As the applied e.m.f. is increased the resistance gradually diminishes until at a certain point it decreases very suddenly. The filings become, so to speak, welded together. When the detector is connected in the circuit a small e.m.f. from a battery is applied and adjusted so that a very slight increase will bring about this rapid drop in resistance. The slight additional e.m.f. required is supplied by the incoming signal. In the early days of wireless telegraphy a detector of this type, invented by Marconi, was used. It consisted of two nickel electrodes sealed in an exhausted glass tube

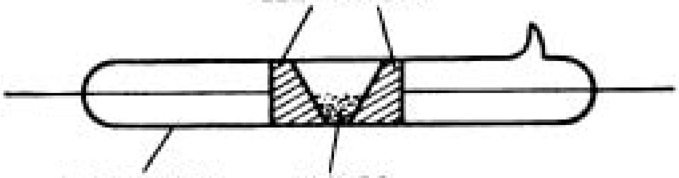


Fig. 1

The space between the electrodes was partly filled with a mixture of nickel and silver filings (Fig. 1). The detector was connected as shown in Fig. 2, and the incoming signals were recorded by a deflection of the pointer of the indicator.

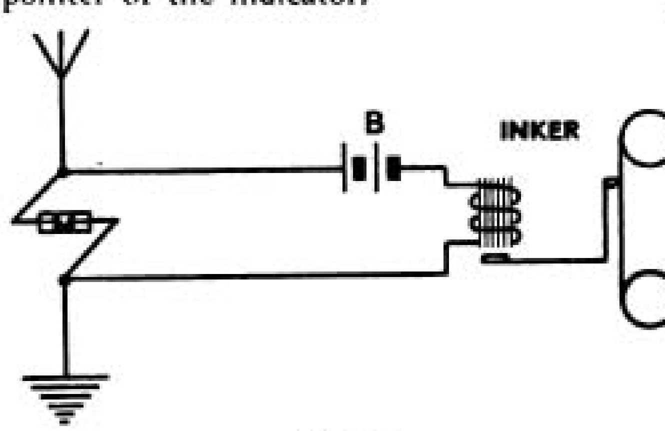


Fig. 2.

The drawback to this type of detector, however, was that the filings remained cohered after the oscillatory current had ceased to flow. It became necessary, therefore, to provide some mechanical means of shaking up the filings and preventing the tendency to stick together. This was accomplished by mounting a small hammer near the tube, which was actuated by the local battery, and which tapped the tube after each wave train had passed.

Another detector of this type was invented by Dr. Muirhead, and possessed the advantage that it did not require a mechanical device to reset it. In Muirhead's detector a small steel disc was rotated slowly over a pool of mercury. The height of the disc was so adjusted that it just grazed the surface of the mercury which was usually covered by a thin film of oil to prevent it adhering to the disc and forming a good electrical contact. As in the case of the filings coherer, the applied e.m.f. causes a sudden decrease of electrical resistance between the mercury and the disc and permits a current to flow through the indicating or recording device. When the additional e.m.f. supplied from the aerial ceases, the film of oil interposes between the electrodes and restores the detector to its previous condition of imperfect contact (Fig. 3).

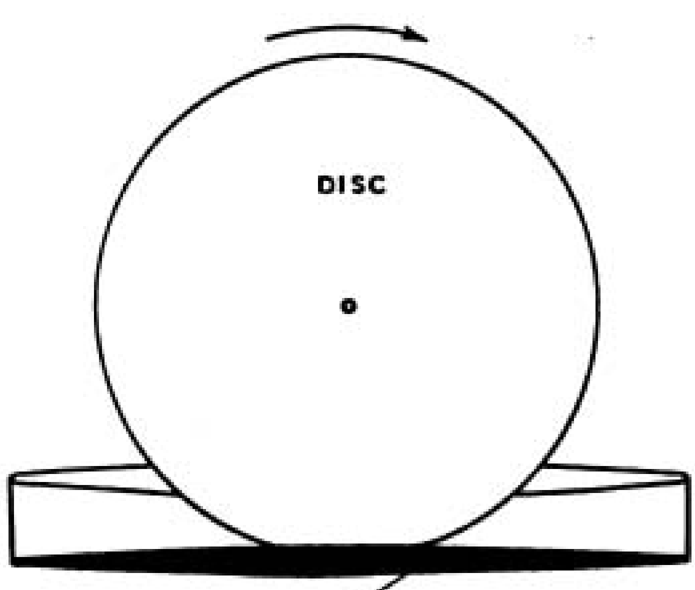


Fig. 3.

2. The magnetic detector depends for its action on the variation of magnetic force which is caused by an oscillatory current. If a piece of iron is placed near a permanent magnet it will have a certain magnetism induced in it. If, now, a coil of wire is wound over the iron, and an oscillatory current is caused to flow in it, the magnetic flux of the iron will be altered.

In Marconi's improved form of detector, an endless band of soft iron wire, B, is caused to rotate in front of the poles of a permanent magnet M (Fig. 4).

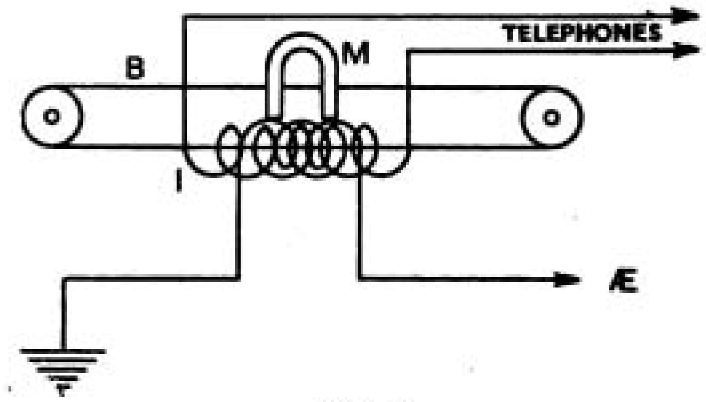


Fig. 4.

Over the band of iron wire is an insulating tube I, wound with two coils of wire, primary and secondary, after the manner of a transformer. The primary coil is connected to the aerial and earth, while the secondary coil is connected to a pair of telephones or other suitable detector.

Let us follow the course of a short length of the iron wire band as it travels round. As it comes opposite the poles of the magnet M, a certain magnetic flux will be induced in it, which will grow until it reaches its maximum value, when the portion of the wire is immediately opposite the pole. Suppose while the flux is increasing, an oscillatory current flows in the coil connected to the aerial. The effect will be a sudden increase in the magnetic flux.

Remember that in every case where a coil is under the influence of a magnetic field, any change in the lines of force cutting the coil will induce a current in it.

In this case, therefore, the sudden "jump" of the lines of force will induce a small momentary current in the secondary coil, which will cause a click to be heard in the telephones.

If the band were not rotated so as to bring a fresh piece of iron under the influence of the magnet, we should not get such a marked effect on the arrival of the next wave train. The effect due to the oscillatory current is most marked when the magnetic flux is increasing or decreasing, *i.e.*, when the band is approaching or receding from the permanent magnet. It will be understood that this type of detector is somewhat unwieldy and requires periodical attention to ensure that the driving mechanism is running.

3 Thermal detectors are more often used in quantitative work in wireless telegraphy, where the transmitter is not far from the receiver

In any wire carrying a current, the resistance of the wire will cause some of the electrical energy to be converted into heat, and the temperature of the wire will be raised. At the same time the resistance of the wire will increase. With fine wires, the passage of a very small current will cause them to get red hot and make a considerable difference in the resistance. The heating effect is the same whether the current is oscillatory or direct. If a detector of this type is connected in series with an indicator a decrease in the deflection will mark the passage of an oscillatory current.

In another type of thermal detector a small e.m.f. is generated by the heating of two wires of dissimilar material. Such an

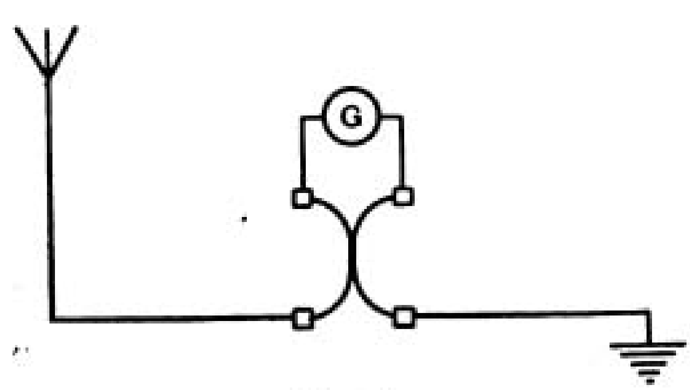


Fig. 5.

arrangement is known as a *thermo-junction*, and is illustrated in Fig. 5. The wires are usually of nickel and iron and are twisted at their centre. The ends are soldered to metal plates which are connected to the galvanometer or indicator, and the oscillatory circuit. The oscillatory current heats the junction of the wires and causes a small unidirectional current to flow in the indicating instrument. Such a device is not very sensitive to small abrupt oscillatory impulses, but is extensively used for detecting the presence of a steady oscillatory current. The wires are usually enclosed in a glass bulb which is then exhausted of air to minimise the effect of external heat.

4. The electrolytic detectors are similar in their action to the "imperfect contact" detectors. One type indeed is of very similar construction to the Marconi filings detector.

A glass tube contains two electrodes, which are immersed in a paste of water, lead filings and filings of some other metal. The applied e.m.f. causes the lead to be deposited on the metal filings, thus bridging the gap between the electrodes. The passage of an oscillatory current, however, destroys the bridge of lead, and increases the resistance of the detector. A corresponding *decrease* in the deflection of the indicator is observed. It will be noted that the action of the electrolytic detector is the reverse of that of the filings detector.

So far, no mention has been made of crystal detectors, the action of which was outlined in a previous article. The crystal detectors operate on the principle of rectifiers of oscillatory current, and do not require an auxiliary circuit to indicate the presence of signals. A small e.m.f. applied to the terminals of the crystal detector will increase its sensitivity up to a certain point. It has been thought by some that this indicates a thermo-electric action, but it will be sufficient for our purpose to consider the crystal solely as a rectifier of oscillatory current.

Of recent years the thermionic valve has replaced the crystal for the detection and rectification of oscillatory current, just as the crystal replaced the earlier and more cumbersome forms of detector.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

The Construction of Condensers (Part II.)

A VARIABLE AIR CONDENSER.

THE construction of an efficient variable air condenser requires some mechanical skill on the part of the amateur, but by carefully observing the following notes and the exercise of care and patience a very useful condenser may be made. Our description calls for a certain amount of accurate small lathe work, but a little ingenuity may enable those who do not possess a lathe partly to overcome this necessity.

A very useful condenser is one having a maximum capacity of 0·0015 mfd., which may be made to fit in a box 5″ × 4″ × 5″ deep. The box may be made of hard wood ¼″ thick, and its top should be made of ebonite or fibre ¼″ thick. On this ebonite top the whole of the condenser is mounted.

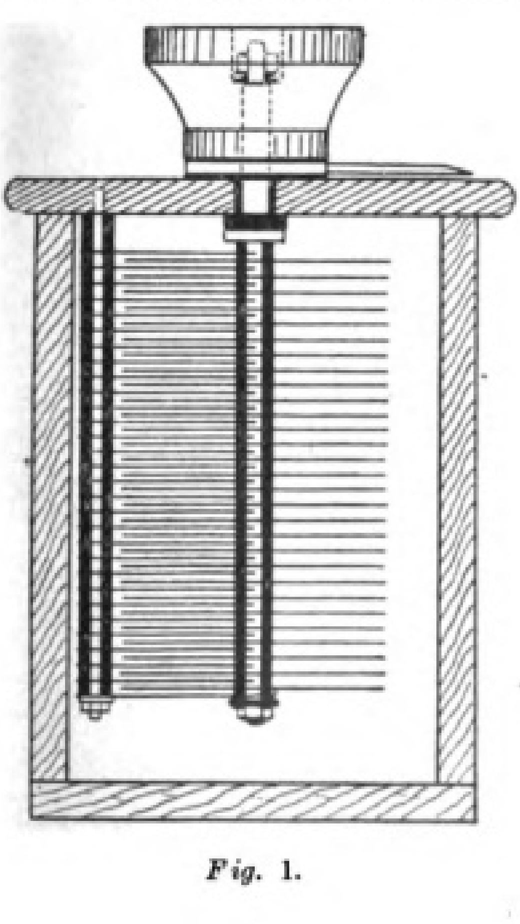
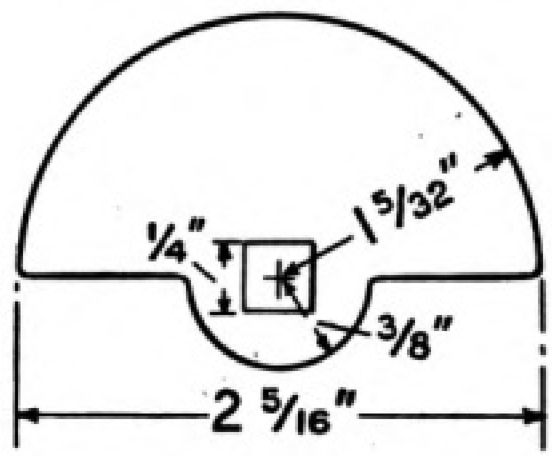


Fig. 1.

Fig. 1 gives a general view of the condenser.

For a 0·0015 mfd. capacity, 30 fixed and 29 moving vanes will be required. The vanes may be cut out of sheet copper, brass



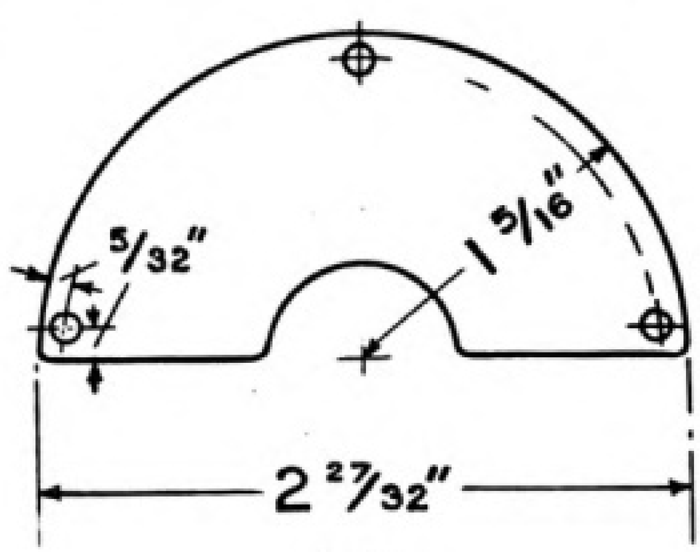


Fig. 2.

or zinc, which should be No. 20 S.W.G. (if a size other than 20 gauge is used the necessary corrections must be made to the lengths of the spindles). The square holes in the moving vanes are necessary so that the latter may be perfectly rigid on the spindle. Fig. 2 gives the shape and dimensions of the vanes.

The ebonite top should have the three holes for the fixed vane pillars accurately marked off, which should be done by placing one of the fixed vanes on the ebonite and marking off the holes with a scriber. Check the accuracy of this marking by trying several of the fixed vanes. Drill and tap these holes 4 B.A.

A hole is required in the centre of the top to allow the moving vane spindle to come through. This hole should be approximately ½" diameter, and should have a flanged bush fitted into it. The bush may be given a friction tight fit or may be fixed to the top with two screws. The flange of the bush will serve as a bearing surface for the handle, and by allowing the bush to be a little longer than the thickness of the top an inside bearing surface will be provided. The hole for the spindle should be $\frac{7}{32}$".

The three pillars for the fixed vanes should be brass rods $\frac{5}{32}$" thick, and approximately 4" long. They should be threaded 4 B.A. for about ½" at each end. The ends which screw into the ebonite top should be fitted with nuts so that the pillars may be locked tight.

A number of washers will be required for spacing the vanes. Those for the fixed vanes should be ¼" diameter and $\frac{72}{1000}$" thick, with a $\frac{5}{32}$" hole. Those for the moving vanes should be $\frac{9}{16}$" diameter and $\frac{72}{1000}$" thick, with a $\frac{5}{16}$" clearance hole through them. These washers should be accurately machined to the right thickness. Approximately 100 fixed and 33 moving vane washers will be required.

The central spindle should be made of ¼" square-section brass. Its overall length will be 4⅜" approximately. One end should be turned down to $\frac{7}{32}$" for a length of ⅞". A brass collar ½" diameter and about ¼" long should be turned up and fitted to this end of the spindle. This will act as a bearing surface and also as a support against which to mount the moving vanes. This collar should be pinned to the spindle. This end of the spindle should be fitted to the bush in the ebonite top so that there is no sideshake in the bearing.

The other end of this spindle should be machined—partly threaded a convenient size and partly turned plain for a bottom bearing. The square section upon which the moving vanes are mounted should be 3⅛" long. Another ebonite plate ⅛" thick, and shaped something like the fixed vanes should be made and bushed to take the bottom end of the moving vane spindle and act as a bearing. This plate should not be made of metal; if it is the condenser will be "shorted."

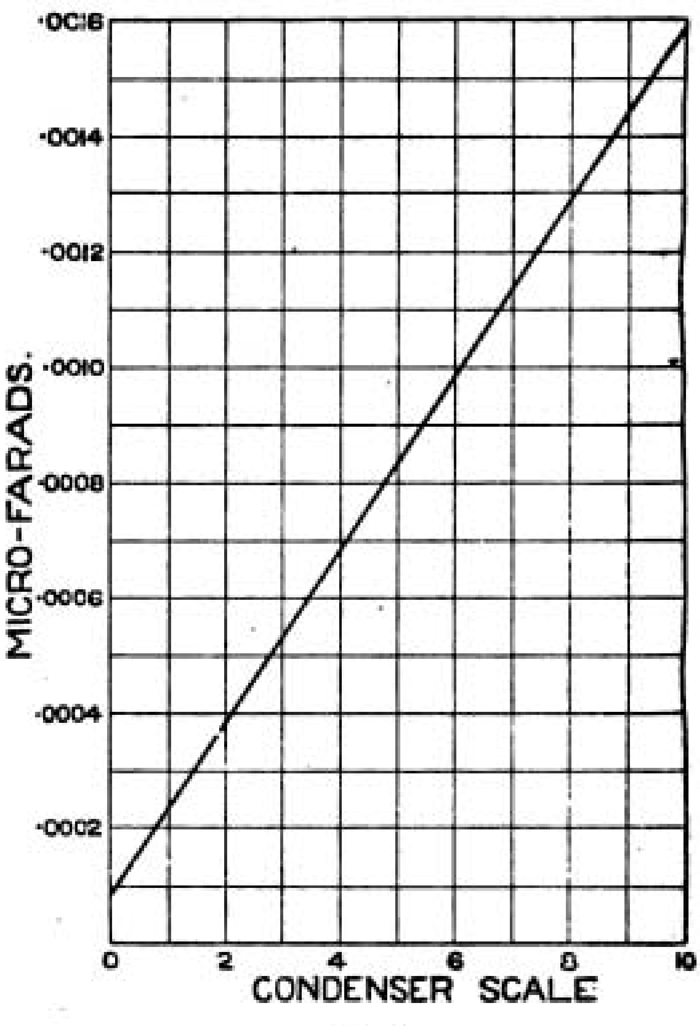


Fig. 3.

If the parts have all been made as stated, an attempt may be made to build up the condenser. First, mount all the moving vanes on the spindle, placing a plate against the collar, then a washer, then another plate, and so on, until all the moving vanes are mounted. The end of the spindle is threaded and a nut should be put on and tightened up so that the vanes are securely locked.

Spacing washers will be required on the three pillars before any of the fixed vanes are placed in position, and their actual length should be determined by placing the moving vane spindle in its position, and judging the correct length so that the first fixed and first moving vanes do not foul each other. After this all the fixed vanes may be mounted—first a vane, then a washer and another vane, etc. When this is complete, place the moving vane spindle in its position, and try the bottom bearing, and also see how the moving and fixed vanes are spaced.

Finally, mount the ebonite handle fitted with a brass pointer on to the spindle, fixing the handle by means of a nut and spring washer as shown in Fig. 1.

It will be advisable to fit a felt or thin leather washer between the ebonite handle and the bearing surface, to make the movement of the condenser easy.

Connections to the instrument may be made on one side to one of the three fixed vane pillars, and on the other—the moving vanes—a good rubbing contact should be made to the spindle on the brass collar at the top of the spindle.

The capacity curve of a condenser such as described, is shown in Fig. 3.

BOOK REVIEWS

MARCONI DICTIONARY.

Compiled by J. C. H. MACBETH.
London: The Marconi International Code Co., Ltd. Pp. ix+925. Price, 25s.

THE Marconi International Code Co., Ltd., has recently published a special type of dictionary which serves as an auxiliary to the Marconi International Code, making it more flexible, comprehensive, and precise. The book contains upwards of 3,000 technical words, used in connection with wireless telegraphy and telephony, in the form of a specially compiled glossary Other glossaries in this useful dictionary cover the principal terms used in Aviation and Motoring, compiled by Mr. Claude Graham-White and Mr. H. Walter Staner respectively.

Every word in the book is numbered and clearly defined whilst on page x. may be seen a method of securing secrecy in coding which is capable of extensive variation. Instructions given in the book show how the dictionary may, in addition to being used in conjunction with the Marconi International Code, be used as a verbatim code, reducing the cost of cables by some considerable amount. Students of wireless, as well as those professionally engaged in the art, would do well to keep this dictionary ready at hand as a guide and rapid reference to both English and Wireless language.

RADIO DIAGRAMS.

Published by The Consolidated Radio Call Book Co., Inc., of 41, Park Row, New York City.

The first numbers of these diagrams are apparently intended for the guidance of amateurs who are desirous of calibrating and measuring the capacity and inductance of their apparatus. Simply explained, each diagram is clearly drawn, allowing the student to follow its meaning with interest and understanding. The later numbers are designs of receiving apparatus for both spark and continuous waves, giving their internal connections and advantages. Still later publications of these diagrams give tables of measurement upon which the student may base his calculations.

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.**

H.B. (New Cross) *sends sketches of a receiver and a loose coupler with reaction coil. He asks (1) For windings for the latter instrument, to suit sizes given for the coils, which are to be pancakes Maximum wavelength to be about 10,000 metres. (2) If a condenser is necessary in the plate circuit of the valve. (3) If arrangement suggested will conform to G.P.O. requirements.*

(1) The loose coupler suggested is not at all suitable for the wavelength required. You might possibly get results with pancake coils if you used such values as the following:—Primary 8" diameter, full of No. 32. Secondary 12" diameter, full of No. 38. Reaction 6" diameter, full of No. 32.

(2) Presuming there is only an iron cored coil across the input terminals of your L.F. amplifier, you should put a condenser across this and preferably the H.T. battery as well.

(3) It should do so.

J.S.H. (Bristol) *sends diagram of a proposed receiver. He asks (1) Whether dimensions suggested are correct for a maximum of 15,000 ms. (2) If a glass plate condenser is suitable for an A.T.C. (3) Suitable dimensions for the coupler. (4) What will be the effect of trees at one end of the aerial.*

(1) 15,000 ms. is much too long a wavelength for successful work with a small aerial and crystal only. You do not state dimensions of A.T.I. former, but unless it is very big you will probably need nearer 3,000 than 600 turns of No. 24 to reach such a wavelength. If you wish such a wavelength you had better increase secondary tuning condenser to 0·0006, to save wire on jigger secondary.

(2) There is no objection to it, except the difficulty of making the condenser conveniently variable.

(3) Primary about 8" long by 6" diameter, of No. 32 wire. Secondary about 12" long by 8" long, of No. 34 wire.

(4) They will probably weaken signals coming through them.

L.F.T. (Exmouth) *asks (1) What length to make a tubular condenser for tuned circuit of a receiver, tubes being brass, 55 and 60 mms. wide. (2) If a variable resistance, as used for controlling model trains, could be used for regulating the current for a crystal detector. (3) He sends sketch of a condenser and asks if it will be large enough if he uses 4 sheets of zinc 2" × 4" for the plates. (4) He sends sketch of a receiver for comment.*

(1) Assuming the diameters given are inside and outside respectively, for a capacity of 0·0005 mfds., length should be about 75 cms.

(2) No, the resistance is much too low. In wireless reception you do not attempt to vary the current through the crystal by means of a resistance. What is required is to vary the potential applied to the crystal.

(3) The sketch sent does not tell us much. As it does not say what the dielectric is, how thick it is, or what the condenser is for, it is difficult to answer. But it probably will not be much use, unless the dielectric is, say, mica in thin sheets.

(4) Receiver sketched is fairly good. Coil E however, should contain more turns or arrangement should be made to include all E and part of A in the tuned circuit when required. Potentiometer is not properly connected in, but this may be a clerical error.

L.A.W. (London, W.C.2) *asks (1) If, in the formula given on page 508 of the "Wireless World" of December last, the wavelength is in metres if the other dimensions are in metres; and in feet if other dimensions are in feet. (2) If good results can be obtained with plate reaction coil when the oscillation transformer is directly coupled. (3) If we can give values for the condensers and inductances for certain wavelengths for the circuit on page 530 of the above issue.*

(1) Yes.

(2) This could be done if desired; inductive coupling is preferable, as it diminishes radiation of local oscillations.

(3) We have not access to special information on this circuit, and are therefore afraid we cannot give the data required. See also other recent replies dealing with this circuit.

A.E.B. (Surbiton) *sends sketch of a proposed circuit and asks our opinion (1) Of the circuit. (2) Of the variable condenser, which is the A.T.C. and formed in a glass tube 6" × 2" × 1/32". (3) Of the loose coupler, Primary 10" × 5" No. 24: Secondary 8" × 4", No. 24. (4) He also asks if he would benefit by adding an A.T.I. similar to the jigger primary. (No. 24 is the only wire he can get.)*

(1) We are afraid the whole arrangement of the closed circuit and detector is hopeless. Consult any crystal receiver diagram.

(2) The capacity will be too small for an A.T.C. It would even be rather small for the tuned circuit. You can conveniently do away with an A.T.C., and tune the aerial circuit by the inductance.

(3) Coupler should do, provided you are content with fairly short wavelengths only.

(4) This will probably not be wanted with your coupler as suggested; but it would increase your range of wavelengths if you also increase size of coupler secondary.

QUESTIONS AND ANSWERS

W.B. (Brixton) *sends two sketches of a closed primary circuit of a* $1\frac{1}{2}$ *K.W. set showing* (*a*) *H.T. leads to condenser and* (*b*) *H.T. leads to discharger. He asks* (1) *Which is correct: and if both are correct, which is preferable. He asks, referring to the regulating effect in a closed iron transformer due to the demagnetising effect of the secondary current allowing a greater flow of primary current* (2) *Why isn't the effect produced in an induction coil.* (3) *If it is, why isn't efficiency impaired by the reduction of magnetisation in core.* (4) *Why is an open core transformer used with a fixed discharger and a closed with a rotary discharger.* (5) *Could we inform him which shipping companies employ their own operators or where he could obtain this information.*

(1) Consideration of principles will show you that set could be worked with either arrangement. (*b*) Is somewhat preferable.

(2) There is a tendency to the effect but not large, chiefly because nearly all the well-known causes tending to efficiency in a coil tend to reduce this effect.

(3) It would not have this effect; because, as your own explanation of the effect with a closed core, points out, demagnetisation by the secondary current leads to an increase of primary current, building up the magnetisation to its old value.

(4) Probably the merits of rotary dischargers happened to be realised at the same period as those of closed iron transformers. There is also less risk of arcing and damaging the gear if an open circuit discharger is used with a fixed discharger, as this type will not take such a heavy overload as the other.

(5) A few collieries employ their own operators on their steamers. Apply direct to the various companies.

E.H.D. (Kennington) *asks* (1) *What a Tikker is.* (2) *If it would be possible to make one at home.* (3) *He also sends a description too lengthy to quote of two types of freaks he gets with his set. One is strengthening of signals on certain wavelengths by touching the insulated windings of the tuning coil and the other a double tuning effect with certain stations. He also expresses surprise at receiving telephony on a crystal.*

(1) The name Tikker is given to a device for rapidly breaking up C.W. signals so that they can be heard with an ordinary receiver.

(2) There are many possible forms. One that should be fairly easy to make is a rapidly revolving metal pulley with a roughened groove, and a springy wire making contact in the groove. This intermittent contact device should be used instead of the crystal.

(3) Both these freaks are far from uncommon. The first result is evidently due to a capacity to earth introduced by your hand. We cannot give a reason for the other without a detailed examination of your set. We have pointed out before that telephony though employing continuous oscillations as a vehicle for the speech, should be and is receivable on a crystal set.

R.C.S. (Chester) *wishes to modify set described in constructional articles now running, to work up to 10,000 ms. He asks* (1) *For dimensions of A.T.I.* (2) *For capacity of A.T.C.* (3) *Dimensions of loose coupler.* (4) *Dimensions of secondary condenser.*

Set modified in this way would not be satisfactory with such a small aerial to which amateurs are limited.

(1) We can only suggest very roughly. Try a former about 18″ × 9″ wound with No. 26.

(2) Can be dispensed with. If used, may be kept as stated in article.

(3) Primary say 6″ × 5″ No. 28; Secondary 10″ × 6″ No. 32.

(4) Keep as stated.

H.E.A. (Braintree) *asks* (1) *In applying formula* $\lambda = 1885\sqrt{CL}$, *what value is assumed for C.* (2) *In this formula does it follow that inductance for 15,000 ms. is 25 times that for 3,000 ms.* (3) *Correspondent thinks he has seen statement in this magazine that* $\lambda = 10 \times$ *length of wire in coil, and queries it. He asks* (4) *For A.T.I. to tune from 10,000 to 15,000 ms.* (5) *For a reaction coil to make this oscillate.* (6) *Sends sketch of receiver and asks if the fact that a certain disconnection improves signals proves there is something wrong.*

(1) The value of the capacity in the circuit. N.B. Formula only applies to circuits with localised capacity and inductance; and is therefore useless for an aerial, where, *e.g.*, the capacity is distributed.

(2) Yes, in any case to which the formula is applicable.

(3) We do not think such a statement has been made, except possibly for some special type coil. It is quite untrue.

(4) We cannot do this without information as to aerial, etc.

(5) We cannot do this without information as to set, etc. Possibly not; circuit is somewhat unusual and we cannot say distinctly without more detailed information. Effect may be similar to that obtained with the fairly well-known broken grid circuit.

J.E.S. (Guildford) *sends diagram of a circuit which receives spark but not C.W. and asks* (1) *How it can be altered to receive C.W.* (2) *If a reactance coil is needed, where should it be put, and what size should it be.* (3) *What station has call letters* F B

(1) Introduction of a reaction coil is all that is necessary.

(2) Connect it in plate circuit next to valve, and couple it to tuned circuit inductance. (A very little searching through back Numbers would have answered the questions, and done you much more good than getting the difficulty cleared up by us). For size, try a former 4″ × 3″, wound with No. 22. You must find the best value to suit your own set by trial.

(3) Possibly F T S, a French ship.

NOVICE (Taunton) *asks re set in constructional articles in recent numbers.* (1) *If small coil* (*Fig. 2, page 66*) *should slide right inside the large one or only up to it.* (2) *If the winding for the big coil* (*i.e., the 40 turn section should start at the end nearest the small coil, or furthest from it.* (3) *If coil slides inside how to make a neat connection from it to a terminal board.*

(1) It should slide inside.

(2) The end nearer to the small coil. This is the "open end" of the big coil, for reception of the small coil.

(3) By means of a piece of twin flex, soldered

to the ends of the windings, and also to the terminal on the board.

PROF. WIRELESS (Liverpool) *asks* (1) *If set described in constructional articles in last few issues would work with frame aerial.* (2) *Which would make best frame aerial, (a) 3 turns of bell wire round a room 10′ × 7′, or (b) a complicated arrangement under the eaves, sketch of which is sent.* (3) *If a pair of 4,000 ohm telephones could be used with a telephone transformer with 5 to 1 ratio and resistances 2,000 and 1,000 ohms, wound on a ½″ bobbin.* (4) *Reason why with a certain set and frame aerial, signals are as loud with frame connected as disconnected.*

(1) Results would probably be very poor.

(2) Probably (*a*). From sketch sent (*b*) does not appear to be a closed circuit at all.

(3) They could be, but you would get better results with the phones alone than you would by adding a quite unsuitable and unnecessary transformer.

(4) This result points to the frame aerial circuit being either wrongly arranged or badly out of tune.

E.W.L. (Saltley) *sends diagram of valve circuit and crystal receiver, both grid and plate circuits being tuned. He asks* (1) *Whether it is necessary for both grid and plate circuits to be tuned to the signals, or how much they may differ* (2) *Suitable value for grid circuit condenser with grid circuit inductance split into 5 sections as shown.* (3) *If this splitting up could be improved upon.*

(1) Certainly. With this type receiver both these circuits must be exactly tuned to the incoming signals.

(2) Make it variable from as small a value as convenient up to about 0·0005 mfds.

(3) Suggested scheme is all right, but we think you have made a clerical error in writing down dimensions. Fourth section should preferably have more turns than the third.

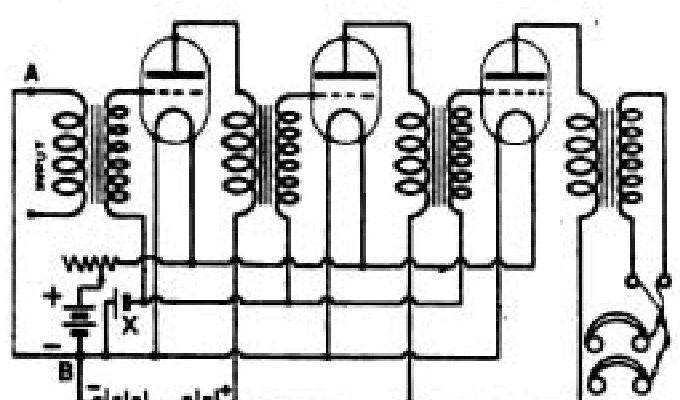


Fig. 1.

J.F.B. (Osterley) *sends a sketch of a* C Mk.3 *three-valve* L.F. *amplifier.* (*Fig.* 1.) *He asks following questions:* (1) *Should not lead* AB *be broken.* (2) *Should not negative of* H.T. *battery be joined to positive of* L.T. *battery, instead of connections shown* (3) *Could small battery* X. *for putting a small negative potential on the grids, be done without.* (4) *Could two 2,000 ohm telephones be used in parallel on the secondary side of the telephone transformer, or should he cut out the transformer and use* H.R. *phones.*

(1) Disconnection will not be necessary if you connect A to an earthed point of your receiver. If this is not convenient you should disconnect AB as you suggest.

(2) This is often immaterial. The arrangement in the sketch is usual, but your suggested alteration sometimes gives good results.

(3) Probably. Many successful amplifiers work without it. We cannot say exactly how the circuit shown will act in this respect without trying it. It depends chiefly on the characteristics of the valves.

(4) You do not give any information as to the windings of the transformer. The suggested arrangement will very likely work. Why not buy L.R. phones (say 120 ohms) and use with the transformer instead of H.R. without it. You can put two pairs of L.R. phones in series or parallel as you prefer.

F.A.W. (Catford) *asks for dimensions for a loose coupler to tune to 7,500 ms,* A.T.C. *being* 10·9 *jars, and tuned circuit condenser* 1·2 *jars at max.*

You do not say much about your aerial or aerial circuit. Assuming it is P.M.G. size, and you do not propose to use an A.T.I. we should suggest a primary 10″ long by 8″ diameter, wound with about No. 26. Secondary should be 8″ × 5″, wound with No. 28.

RADIO (Wolverhampton) *asks for capacity of two condensers. Plates are in each case semicircular, fixed plates are 3″ radius, and moving plates 2¾″. In condenser (a) There are 11 fixed and 10 moving plates. In condenser (b) there are 9 fixed and 8 moving plates. Each pair of fixed plates are ¼″ apart.*

Presuming that moving plates are spaced exactly mid way between the fixed plates capacities will be :—

(*a*) 0·00035 mfds.
(*b*) 0·00027 mfds.

If spacing is uneven capacities will be somewhat higher than these values.

A.M. (Clapton Common) *has heard of frame aerials but has only a vague idea of their nature and properties. He asks various questions.*

You will find the whole subject treated at considerable length in articles in issues of May 29th, and June 12th, from which you will be able to find out all you require.

EXPERIMENTER (Portsmouth) *sends a sketch of a proposed receiver, crystal detector, and* L.F. *amplifier, and asks* (1) *For dimensions for a loose coupler suitable for* 4,000 *ms.,* A.T.I. *being* 10,000 *mhys.* (2) *Capacity of* A.T.C. *and tuned circuit condenser.* (3) *What information to send* P.M.G. *in applying for a permit.*

We do not think the type of circuit suggested will be of any use; however, as an experimenter, this is your concern.

(1) Primary 8″ × 5″ wound with No. 26.
Secondary 7″ × 4″ wound with No. 32.

(2) A.T.C. might be 0·005 mfds. There is no necessity for two condensers in series in tuned circuit. Anyhow, total capacity should be not more than ·0005 mfds.

(3) Send a roughly dimensioned sketch, with proposed wavelength range.

QUESTIONS AND ANSWERS

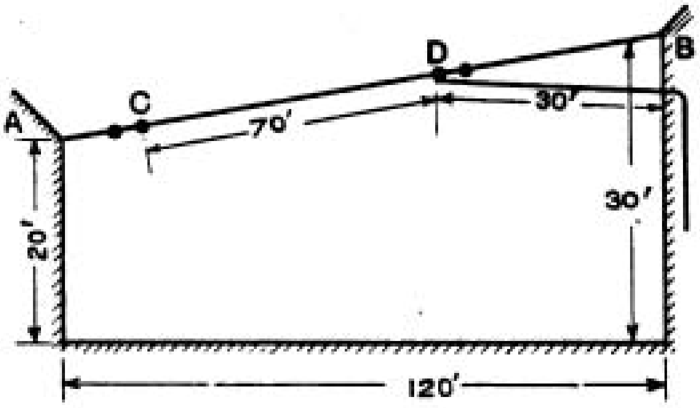


Fig. 2.

S.J. (Solihull) *sends sketches of proposed aerial (Fig. 2) and receiver (Fig. 3), and asks* (1) *If aerial arrangements 100′ nearly horizontal, average height 25′, will be satisfactory.* (2) *If earth to a water tank at top of house 20′ from receiver will be sufficiently good.* (3) *For comments on the receiver—2 circuit crystal set.* (4) *Capacity and inductance of aerial.* (5) *Inductance of A.T.I. 200 turns No. 22 on former 4″ × 10″.*

(1) and (2) These arrangements are fairly good, and appear the best you can do.

(3) Arrangement of set is quite good except for switching of coupler secondary. First range should make use of 45 turn section, not the 215 turn section as shown in your sketch. You will find probably more A.T.I. necessary to get the maximum wavelengths possible for your closed circuit.

(4) If diameter of wire is 0·5 cms. Inductance is 55 mhys. Capacity, 0·0002 mfds.

(5) Approximate 1,350 mhys.

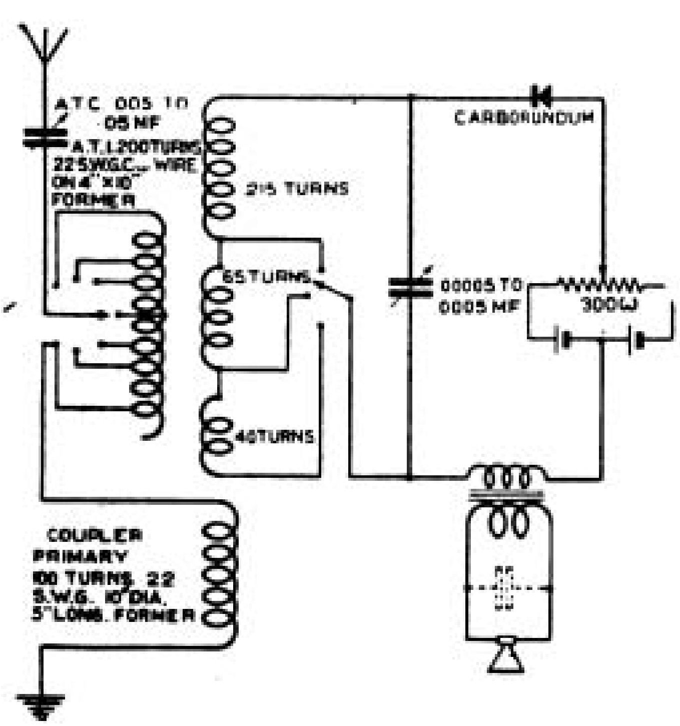


Fig 3.

B.J.A. (Wembley) *asks* (1) *How he can calculate the "wavelength capacity" of a loose coupler.* (2) *If altering the coupling between the coils alters the "wavelength capacity," i.e., the tuning.* (3) *Re the instructions in the March number for making a telephone transformer, he finds from a certain catalogue the resistance of 6 ozs. of No. 30 S.S.C. is about 33 ohms. What do we advise him to do.* (4) *Do you know of any radio amateurs residing at Wembley or near it.*

(1) We are afraid we do not understand this. If you mean the mutual capacity of the coils, there is no simple formula for calculating it, and is small enough in practice to be negligible for all ordinary purposes.

(2) Altering the coupling does alter the tuning somewhat, but more by altering the mutual inductance than the mutual capacity.

(3) The resistance varies in different makes of wire, chiefly by variation in the thickness, quality and weight of the insulation. We should recommend using 6 oz. as suggested, but you can increase this by an ounce or two if you wish, and may thereby get a slight improvement in result.

(4) No. Why not join the Wireless Society of London ?

W.A.M. (Inverarie) *sends description of a crystal set, which works fairly well, but only gets faint signals from* F L. *He asks* (1) *If a 100′ single wire aerial would be better than his present arrangement of 50′ twin horizontal with 40′ single lead in.* (2) *How he can get* F L *louder.* (3) *For details of* F L *press transmissions.* (4) *If a diagram of a tapped off coil is correct.* (5) *He has read in a contemporary that it is possible to make a crystal oscillate, and asks how to receive* C.W. *by this means with crystals only.*

(1) Results would probably not be much different.

(2) Try adding a potentiometer in the crystal circuit. You should not expect to get F L very strong with such a small aerial and crystal only.

(3) See page 284, issue for July 10th.

(4) Arrangement would be satisfactory if you included more of the wire—nearly all, in fact—in the circuit from aerial to earth when desired.

(5) We do not know of any satisfactory arrangement on these lines. C.W. can be received on crystals, *e.g.*, by means of local buzzer oscillations as discussed in this column some months ago, but such methods are merely "freaks" and have never been found of much practical use.

F.H.T. (Wimbledon) *asks* (1) *If a mica lamp chimney covered with foil and sliding over a metal cylinder could be used for an A.T.C., or if glass chimney would be better.* (2) *If telephone receivers, such as used for inter-departmental telephones, would be satisfactory with telephone transformer recently described in this magazine.* (3) *If condenser described above is no use, what do you recommend.*

(1) The mica chimney might possibly do, if the insulation were good enough. The so-called mica used for this purpose may be nearly anything, and is in practice not very good electrically. Moreover, you would have trouble with any metal used to keep it in shape and fasten it, as it would be necessary to fit it fairly tightly on the metal

cylinder. A glass chimney would give too low capacity to be much use.

(2) Yes, if the resistance were about right. It would be best to measure the resistance before making the transformer, and if necessary alter the primary winding to suit the telephone.

(3) A handy type for an amateur is described on page 539 of the December issue.

V.D.B. (Reading) *is getting poor results with crystal receiver, described in December issue, to which he has added a potentiometer. He asks (1) Whether a large tree about 80′ from aerial should affect signals much. (2) If a 1·5 jar vane condenser is suitable instead of condenser shown. (3) Whether winding inductance with No. 23 instead of No. 24 would make any difference to working of set. (4) If any other type of tuning coil would give better results.*

The set described should give quite good results.

(1) The tree may weaken signals somewhat, but the effect should not be serious.

(2) This type of condenser should be quite satisfactory.

(3) No; only effect will be to reduce maximum wavelength somewhat.

(4) No.

Possibly either your crystal is a bad one, or potentiometer should be reversed.

H.F.B. (Sidcup) *sends sketch of a crystal receiver similar to that on page 537, December, 1919, except for absence of condenser shown therein. Set does not give signals, correspondent presumably wants to know why, but does not ask anything. (2) He asks if silicon will do for the crystal.*

(1) Set appears quite correct as drawn. You do not state size of inductance; we take it that it is of size shown on page 537. If all contacts, etc., are good we can only suggest that you are using a bad crystal. Set would be better with condenser as shown.

(2) Yes. Any recognised crystal could be used.

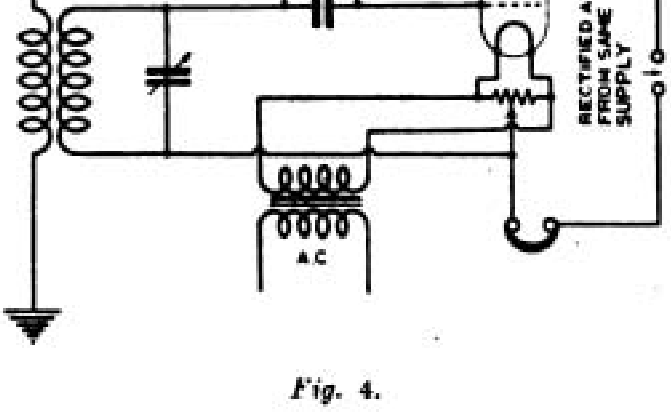


Fig. 4.

G.P.K. (Leeds) *sends proposition of a scheme (from the Electrical Experimenter, July, 1919) for working a valve receiver off an A.C. supply without trouble from humming. Sketch herewith explains this method.* (Fig. 4). *He asks for an opinion of this device. (2) He refers to reply to* **PETE** *recently, giving rough maximum wavelength for efficient reception with one valve and small aerial as 5,000 ms., and gives instances of good results up to double this figure with his own set.*

(1) Proposed scheme is interesting, and might work. We have not tried it, but from difficulty of balancing out A.C. induction in other types of circuit, we doubt if in practice it will be as easy as it looks. For instance, there is no way shown fo correcting the small differences of phase in the currents to be balanced out.

(2) You will notice reply to **PETE** was worded in a guarded manner. No definite limit can be given, for many reasons, but in giving an answer like this we have to consider the average amateur, of only average skill, with a fairly good set. It is no use misleading such a man by quoting him the best results which can be obtained under most favourable conditions with a specially sensitive set, skilfully used. (Your set is undoubtedly very sensitive). Has it occurred to you that commercial companies would hardly use the complicated aerial systems and multi-valve receivers that they do if all wavelengths could be efficiently received on 100 feet of wire and a single valve?

H.E.S. (Folkestone).—Many thanks for further letter. It is a pleasure to hear from men taking such an intelligent interest in their job. We are afraid that we cannot give any definite answer on the point; we have never heard the question raised before. Your results certainly point to its existence on your boat.

Re better radiation from aft end, as this is the higher end, it should give better results in forward direction of an L aerial: regard yours as two L's back to back.

Your second argument does seem to give a possible reason. How about the funnel gases we mentioned before?

By the way, in your sketch you show down lead not vertical, but do not say which is forward and which aft on boat. In this case, as in sketch, we should expect best results from direction A, as part ACD as aerial should be less efficient than B C D. Does this fit in with your results?

SHARE MARKET REPORT.

During the past few weeks business has been very quiet in the Share Market. The shares of the Wireless group have been quite inactive in sympathy with the general apathy prevailing in the other markets, no doubt due to the uncertainty of the political situation. The shares are now quoted ex div. and bonus.

Prices as we go to press, August 12th, are:—

Marconi	Ordinary - - -	$2\frac{1}{4}$
,,	Preference - - -	$2\frac{3}{8}$
,,	Marine - - - -	$1\frac{1}{16}$
,,	Canadian - - -	9s.