The WIRELESS WORLD

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 12. SEPTEMBER 4TH, 1920 FORTNIGHTLY

INDOOR AERIALS

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

IN these days of sensitive multivalve amplifiers the employment of aerials so reduced in size as to be capable of use in an ordinary room has now become a perfectly practical proposition. Even when a good crystal receiver is employed it is possible to get signals from high-power stations over not inconsiderable distances, using such insignificant aerials as bedsteads, or a bucket on a table, as was pointed out some time ago by Mr. Campbell Swinton, and by Dr. J. A. Fleming and others.* With a valve receiver, however, many other possibilities are open to consideration. Of these, by far the best known are the various patterns of frame or loop aerials. The factors governing the design of frame aerials for reception purposes has recently been discussed in this magazine,† and from the curves there given it becomes a comparatively simple matter to work out an arrangement that will give good results for any given set of conditions.

However, as regards the circuit with which the frame is used, more choice is open, and the exact circuit employed is almost immaterial. The experimenter may find a useful field for investigation in comparing the relative advantages of the various possibilities. If the design chart above referred to is employed to obtain the best arrangement of loop, it will generally be found possible to tune up the aerial to the optimum wavelength for which it is designed with a variable condenser not exceeding 0·001 mfd. in capacity. In general it is preferable to effect the tuning as far as possible with condensers only, rather than to add in series with the frame an external loading inductance coil. In other words, the inductance of the circuit should all be in the loop itself, and not be spread over other coils. For the simplest of all detecting circuits the terminals of the tuning condenser may be connected to grid and filament respectively of a valve detector, a grid condenser and leak being interposed in the usual manner. Such an arrangement, however, does not permit of the reception of continuous wave signals unless a separate heterodyne is provided in order to furnish the oscillations of slightly different frequency, which can form beats with the signal currents. Alternatively, however, some reaction may be arranged between the anode and grid circuits of the receiving valve so that it can set up its own local—or autodyne—oscillations to produce the desired beats. One of the most usually employed ways in which reaction may be obtained is by inserting a small coupling coil in the anode circuit of the valve, and coupling this with the frame aerial itself. This scheme was incorporated in the portable receiver described by Mr. R. C. Clinker before the Wireless Society of London,‡ while, more recently, Admiral Sir Henry Jackson has dealt with the

*See *Electrician*, 71, pp. 460, 510, 1025 and 1065 (1913).

† *Wireless World*, 8, pp. 152-155, and pp. 184-188 (1920).

‡ *Wireless World*, 7, pp. 712-721, March, 1920.

same subject from a slightly different standpoint.*

In any regenerative arrangement it is essential that a condenser be shunted across the telephones connected in the plate circuit of the valve, as otherwise their large inductance would effectively prevent the production of high frequency oscillations. It is often advantageous, also, to shunt this condenser across the H.T. battery as well.

Regenerative action, and the production of local high frequency oscillations by its means, may be obtained in any one of a number of ways, but space will not permit of a detailed consideration of them all. A very simple arrangement, however, and one that at the same time involves a minimum of adjustment, is de Forest's "Ultraudion" circuit, shown in Fig. 1. In this case the reaction coupling

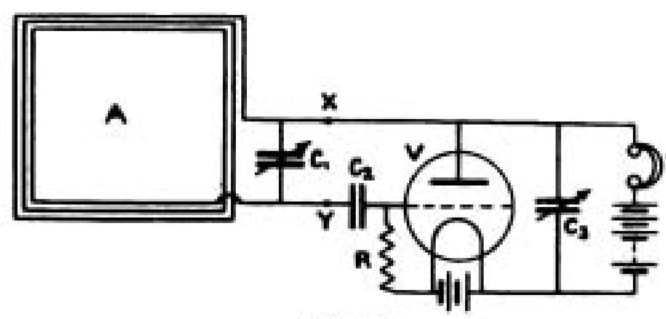


Fig. 1.

is provided by means of the condenser C_3, which really forms part of both the grid and the plate circuits, as may be seen by a careful inspection of the diagram. The frame aerial A is tuned by the variable condenser C_1 (of say, 0·001 mfd. capacity maximum) to the wavelength to be received, while C_2 represents the usual grid condenser—say of the order of 0·0004 mfd. The resistance R must be very high—in fact, with some grid condensers, if their insulation is not perfect, it may be dispensed with entirely. The best value for R is most conveniently found in practice by drawing a line with a soft graphite pencil between two terminals mounted on a piece of fibre or similar insulating material, and connected respectively to the grid and filament of the valve, and then thickening up the line until the best signals are obtained.† The condenser C_3 should be variable as indicated, and may conveniently be of about the same size as C_1. A very similar circuit, possessing almost the same properties, was described on page 530 of this magazine (*Wireless World*, 7, p. 530, December, 1919).

It should not be forgotten that a frame aerial may also be used for transmission purposes, and for short distance work and for experimental purposes it presents some advantages over the ordinary elevated aerial on account of its directive properties and consequent less liability to cause interference. The design data referred to above may also be used to give a general outline of the best size to be employed in this case to suit any given set of condition, as to wavelength and other factors. When using an aerial of this type for sending great care must be taken to choose a position for it where there will not be too much induction on to near-by metal work, wires, gaspipes, etc., or the radiation which at the best is not very strong will be very considerably reduced.

A diminutive form of an ordinary type of aerial may also be used entirely indoors. In the early days of the coherer and similar receivers, such "model" aerials, as we may term them, were often used for demonstration purposes, and at the present time with valve receivers not inconsiderable signalling ranges may be obtained by their use. A typical form of one of these early model aerials is indicated in Fig. 2, which illustrates a small demonstration set made up for use with a simple spark transmitter and a coherer receiver. In this case the aerial system consists of two squares of wire netting, the one placed on the ground serving as the counterpoise capacity, while the one raised up on the support serves as the antenna. For the purposes of ordinary receiving from commercial wireless stations it will be more satisfactory to replace the lower counterpoise by a direct earth connection made to a water main or other convenient

* *Wireless World*, 8, pp. 324-328, July 24th, 1920.

† A simple grid leak was described on pages 265-266 of the July 10th, 1920, issue of the *Wireless World*.

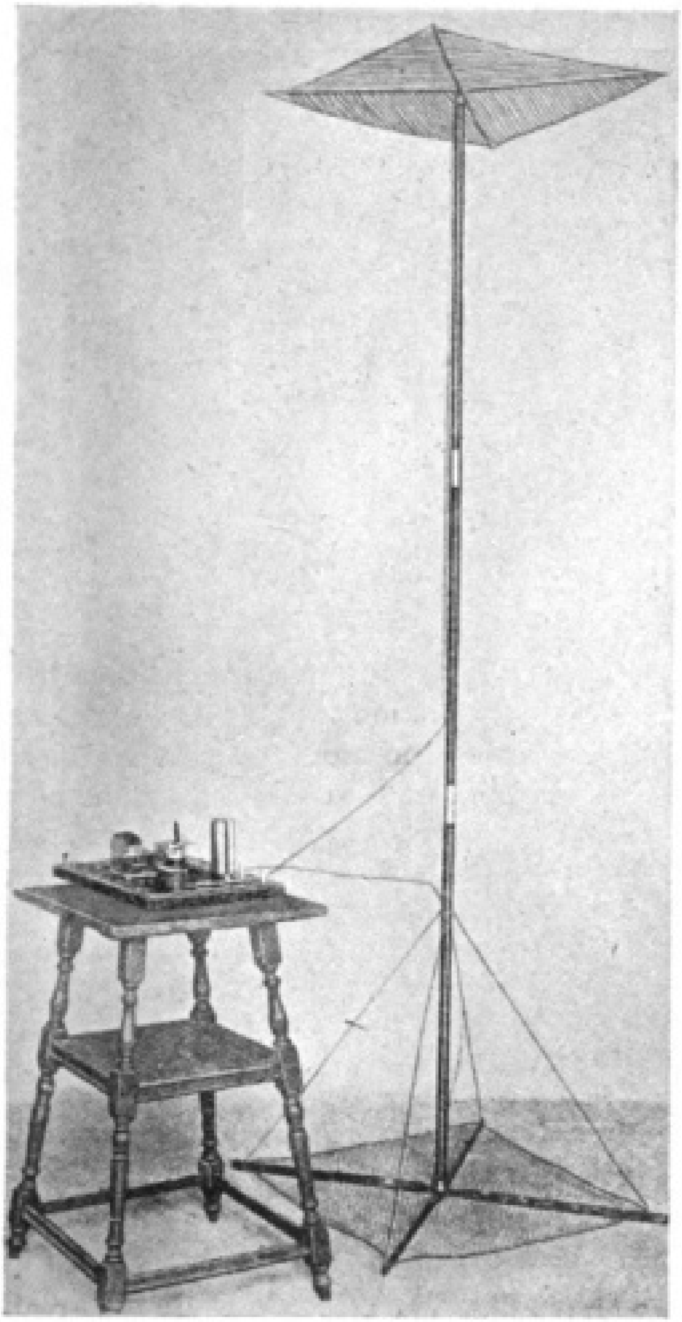


Fig. 2.

point—although some signals may be received without such an earth connection.

Besides an aerial of the type illustrated in Fig. 2, the model may, if desired, be made to resemble any of the ordinary well-known forms of outdoor aerials customarily employed in ordinary wireless signalling on a commercial scale. A very convenient form may be made up on either the inverted L (or ⌈ shape) or the T shape by stretching out a few lengths of horizontal wire across a room, or along a passage, and connecting them to the receiving instruments, an ordinary earth connection being employed for the other terminal as usual.

As a word of warning in connection with the use of such indoor aerials, the location for them should be carefully chosen if good results are to be obtained. For instance, one would not expect to get the most satisfactory results if the aerial is set up in a room immediately beneath a metal roof, or if it is closely adjacent to gas or water pipes, or to electric light wires. Similar remarks apply to the use of loop aerials for directional reception, as no reliable results are possible if the frame is too closely surrounded by metal work.

As regards connecting up such a small aerial, although it is undoubtedly best to tune up the aerial circuit of a receiver solely by means of loading inductances, yet in the case of these very small aerials such a method is hardly practicable, and as a rule it is most satisfactory to arrange a variable condenser in shunt to the loading inductance. The aerial and earth connections are joined across the loading inductance in the usual manner, and they are, therefore, in parallel with the variable condenser, as indicated in Fig. 3. The condenser

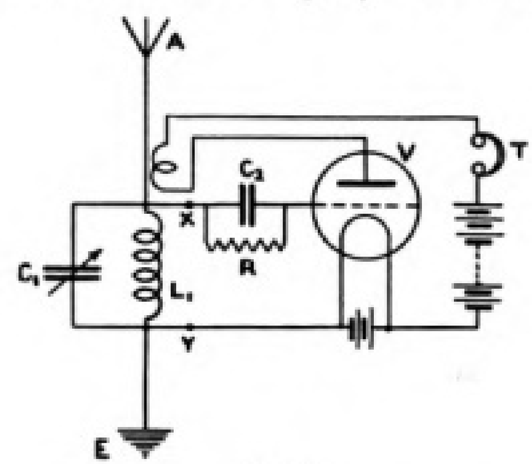
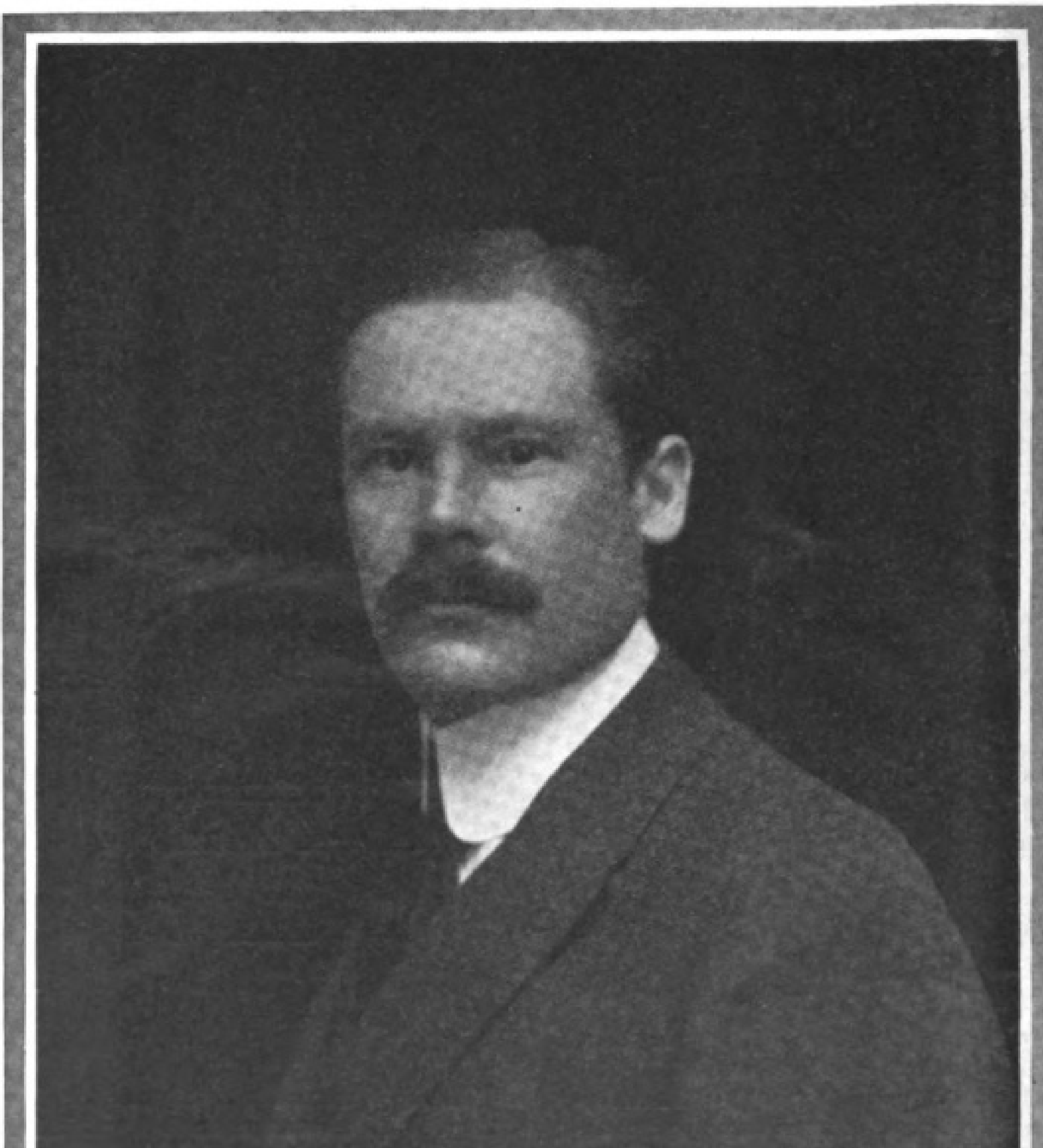


Fig. 3.

C_1 should, however, be small, and the inductance be given as large a value as practicable having regard to the wavelength to be received. In Fig. 3 an ordinary form of magnetic reaction coupling is shown, but this may be replaced as desired by any other arrangement, giving the desired degree of reaction or by the connection shown in Fig. 1, the points marked X and Y corresponding in the two diagrams. In this latter case the reaction coil L_2 should be omitted.

(To be continued.)



MR. ERNST FREDRIK WERNER ALEXANDERSON.

Personalities in the Wireless World

ERNST FREDRIK WERNER ALEXANDERSON was born at Upsala, Sweden, on January 28th, 1878. Educated at the High School and University of Lund, Sweden, and at the Royal Institute of Technology, Stockholm, he completed a post-graduate course at Berlin and entered the service of the C. and O. Electric Company in 1901. A year later he joined the General Electric Company, and still maintains his connection with that firm as consulting engineer. At the present time Mr. Alexanderson holds the very responsible position of Chief Engineer to the great Radio Corporation of America.

The subject of our biography, although one of the younger school of prominent workers in the field of radiotelegraphy, has already made outstanding contributions to the science of wireless engineering, and has ensured his place in the history and literature of that science. This is no mean achievement, considering the vast number of talented and energetic men, drawn from all nations, who are devoting their time to the perfecting of our present means of aetheric communication and to research in those branches of high-frequency work which have been opened up by past discoveries.

Mr. Alexanderson is, of course, best known to our readers as the inventor of what is generally called the Alexanderson High Frequency Alternator. The spark discharge method of generating oscillations for wireless telegraphy, although of proved value, and although it is still greatly in vogue, has certain disadvantages attaching to it which are not shared by the generators of undamped oscillations. The use of continuous waves, especially for long distance work, and, necessarily, for wireless telephony, is rapidly increasing, and engineers are therefore concerned with an efficient means of generating them. The Poulsen arc, the Marconi "Timed Spark" system, the Goldschmidt machine and the thermionic valve generator are all useful solutions of the problem, especially the latter, which is so widely used for the purpose of wireless telephony, but each has its own particular virtues and, maybe, its own little disadvantages. The Alexanderson alternator is of especial value for the purpose of high-power, high-speed, long-distance radio-telegraphy. Mr. E. J. Nally, the President of the Radio Corporation, says, "This machine is the concrete expression of an ideal which electrical engineers have held for many years, for it represents a perfected generator of high frequency oscillations constructed along the lines of the ordinary power house dynamo. The problems solved by Mr. Alexanderson were thought insurmountable."

In a future issue we shall describe the Alexanderson machine in detail. Suffice it for the moment to say that a 200 k.w. type was installed at the New Brunswick station, and proved so efficient in its performance that more than one wireless expert has travelled from Europe to the States in order to witness it.

It is not, perhaps, so generally known that Mr. Alexanderson originated the use of iron in the manufacture of high frequency circuits, and that he is the inventor of the "barrage" receiver, and a special form of antenna which consists of a normal long horizontal aerial to which are added a series of tuned downleads which act as separate antennæ fed in parallel from the horizontal conductors. It is claimed that this method greatly reduces the ground resistance of the whole aerial system.

Mr. Alexanderson is the holder of a number of patents, is a member of the American Institute of Electrical Engineers and a Fellow of the Institute of Radio Engineers, of which he is also the Vice-President for the current year.

WIRELESS TELEPHONY ON THE "VICTORIAN"

DELEGATES TO THE IMPERIAL PRESS CONFERENCE MAKE AN UNIQUE VOYAGE.

IN order to attend the Imperial Press Conference at Ottawa, on August 5th, the United Kingdom delegates sailed from England on July 20th by the s.s. *Victorian*, for Sydney, Nova Scotia.

The purpose of the Conference was to discuss the re-organisation of the Empire's press services and the establishment of a better means of allocating the world's news.

One of the chief subjects on the agenda of the Conference was that of the fuller utilisation of wireless telegraphy and telephony. With this in view and as a practical demonstration of what wireless is able to do, Marconi's Wireless Telegraph Company, Ltd., specially fitted the C.P.O.S. *Victorian* with a 3 k.w. wireless telephony apparatus in addition to her usual wireless telegraph installation.

The world's communications undoubtedly centre about wireless telegraphy and telephony, not only for the allocation of news but for commerce and industry. Already do we read of wireless gear being accepted as a part of the equipment of Forestry Departments, for it has justified its use in maintaining communication during forest fires when other communications have failed, and the time is not far distant when it will make known its utility in other spheres. The recent demonstration by which the wonderful voice of Dame Melba was heard in almost every European country is also indicative of its possibilities. A lecture or a political speech delivered in any town in this country could be heard and copied at every newspaper office in Europe; transmission of news would exceed its present rate, and the press become the "living moment" in print. Wireless is paramount in importance, and the sooner full recognition is given to its vast possibilities the sooner may we attain throughout the world that which the *Victorian* has already achieved in individual attempt.

Purposing to demonstrate to the delegates on board the possibilities of wireless telegraphy and telephony, the s.s. *Victorian* not only entertained her passengers throughout the voyage with concerts from the shore, but also permitted them speech with friends they had left behind and those they were soon to see.

With a view to meeting the special requirements of a Press delegation it was essential that they should be kept in touch with matters ashore. Therefore an ocean newspaper bearing the name of *The North Atlantic Times* was published on board twice a day, *i.e.*, morning and evening, giving news of current events and also a summary of the day's editorials. Material with which to produce such a paper was gathered from three Horsea programmes, the usual Poldhu programme and a special Poldhu message transmitted at 4 a.m.

A further consideration of the delegates' requirements and possible wishes was shown by the fact that, so long as the range permitted, Poldhu conducted conversation with the *Victorian*, being for the purpose fitted with a wireless telephony apparatus rated at 6 k.w.

The Marconi Station at Chelmsford, in addition to a morning press programme, also conducted a special afternoon programme of both music and press.

In order that the news received should not entirely originate from English sources or from stations on English soil, and in order to maintain similar communication on the Canadian side of the Atlantic, a temporary wireless telephony station, of the same rating as Poldhu, was erected at Signal Hill, Newfoundland. This station—situated on an island where, 20 years before, Senatore Marconi received his first signals in his endeavour to bridge the Atlantic—was engaged in transmitting to the *Victorian* at pre-arranged intervals; and on July 25th at 11 a.m.,

The Music Room of the Victorian *Ready for a Wireless Concert.*

over a distance of 650 miles, in the presence of the Prime Minister of Newfoundland, conversation was conducted between Lord Burnham (President of the Empire Press Union) on the *Victorian* and Mr. Squires, the Prime Minister, at Signal Hill. Among those present at the shore station was Sir Patrick McGrath (senior delegate to the Conference), who also held conversation with both Sir Roderick Jones (Managing Director of Reuter's), and Col. Parkinson of the *Ottawa Journal*; the latter gentleman crossed the Atlantic to Liverpool, as delegate from the Canadian Press, to welcome the delegates to Canada. Col. Parkinson also dictated a long message to Sir Patrick for the press of Canada.

Conversation being temporarily exhausted and all business transacted between the vessel and the shore, a gramophone selection of "Beautiful Ohio" was played aboard the *Victorian* and was heard at Signal Hill with a clarity which was admired by all.

Further assistance to the publication of *The North Atlantic Times* was afforded by the station at Newcastle, Nova Scotia, which transmitted news of Canadian and general interest. Messrs. Reuters, Ltd., also co-operated in compiling three special messages for transmission *via* the Clifden-Glace Bay Service.

During the voyage conversation was exchanged between Lord Burnham on the *Victorian* and Capt. Sir Bertram Hayes of the R.M.S. *Olympic*, over a distance of 570 miles. Gramophone selections were also given from the *Victorian* with marked success.

Lord Burnham wished the *Olympic* and her crew every success, and received the following reply from her commander—

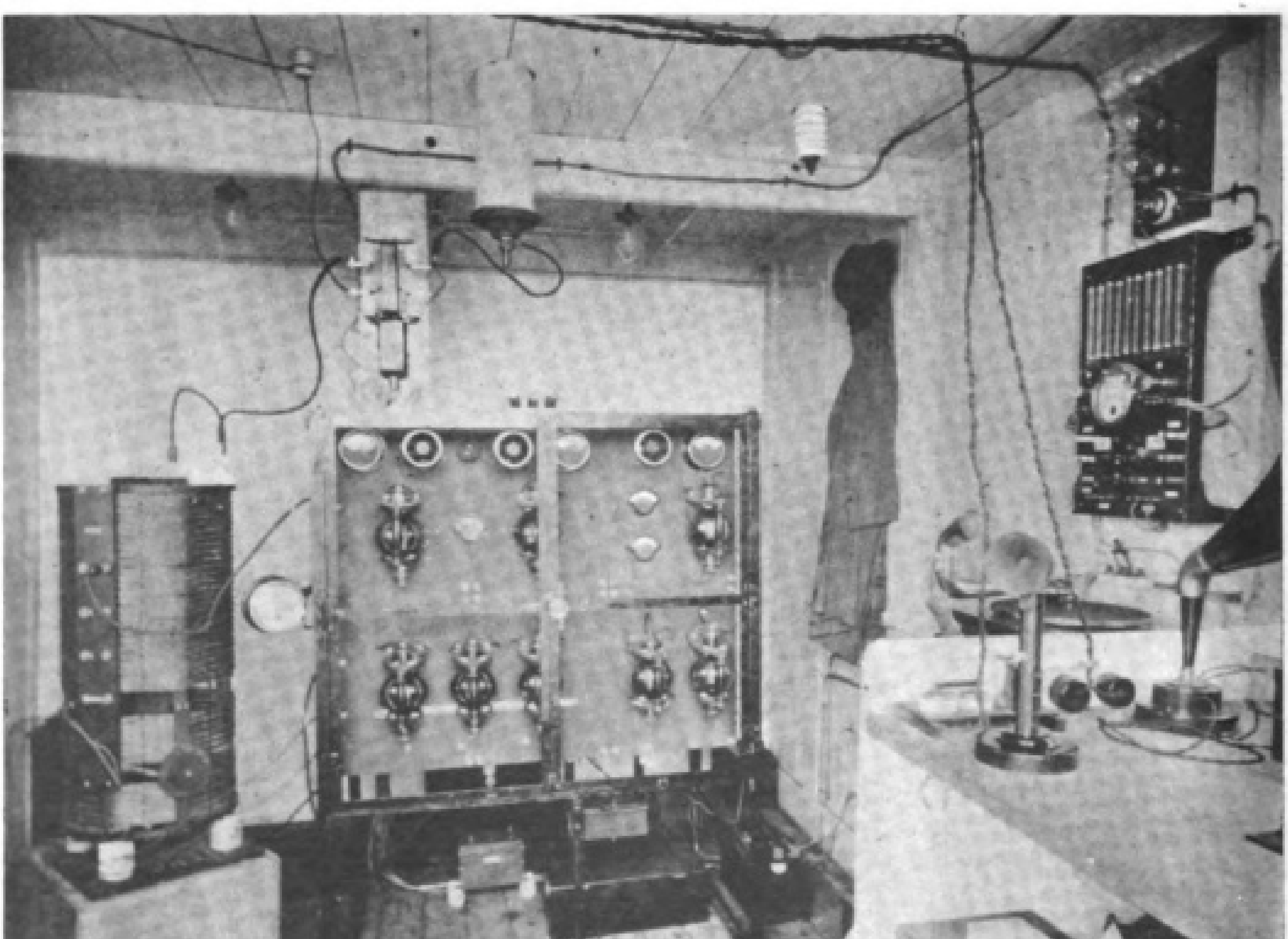
"Your message received by us with much pleasure and great distinctness.

Please accept best wishes of the *Olympic*, known throughout Canada as the *Old Reliable*, for the success of the visit of the British Press delegates to the Imperial Press Conference at Ottawa, and the hope that their deliberations will have a soothing effect on the peace of the world."

For the entertainment of other vessels at sea, the *Victorian* gave concerts by wireless telephony each evening, the Gramophone Company having lent for the occasion a very fine instrument and specially selected records.

Good speech was received on the *Victorian* from Chelmsford, up to a distance of 1,200 miles. From the time the vessel left England passengers had the good luck to listen to music so distinct that they could easily have danced to it. Although the vessel was distant 300 miles (land), plus 1,550 miles (sea), the Chelmsford concerts were continued and were so much appreciated that Chelmsford was repeatedly asked for *encore*.

As can easily be imagined, the delegates were greatly impressed by the success of the experiments. There are still too many people who regard wireless telephony as being a wonderful invention still in its experimental stages, and it is to be hoped that this latest demonstration on the *Victorian*, which establishes a record entirely new in that she is the first vessel of the world's Mercantile Marine to carry out such an extensive and successful programme, will at last bring home to the general public that wireless is no longer a laboratory "wonder," but is an established means of communication in everyday use. Every effort was made throughout the voyage to show that wireless is well-nigh as essential



View of the Wireless Cabin on the Victorian.

to the newspaper world as the petrol engine is to aviation.

On July 27th the *Victorian* reached Sydney, N.S., and there disembarked her passengers after affording them a voyage such as has never been known before. The date of the opening of the Conference was August 5th, and one of the first subjects to receive discussion was that of wireless communication.

Amongst the delegates representing the United Kingdom the following are a few; from their names and the influence they bring to bear in the newspaper world our readers will be able to realise the serious attitude with which the Empire Press Union is treating the subject of wireless and its advantages as applied to the press. Lord Burnham is both President of the Empire Press Union and Chairman of the delegation; Mr. Robert Donald, Chairman of the Union; Lord Apsley, the *Morning Post*; Miss M. F. Billington, the Society of Women Journalists; Sir Robert Bruce, LL.D., the *Glasgow Herald*; Sir Emsley Carr, the *News of the World*; Sir Howard d'Egville, the Empire Parliamentary Association; Sir Roderick Jones, Reuter's; Mr. Percival Marshall, the British Association of Trade and Technical Journals; Sir Frank Spender, the *Westminster Gazette*; Sir Campbell Stuart, the *Times*, the *Daily Mail*, the *Evening News* and *Weekly Despatch*; Mr. H. E. Turner, Secretary of the Empire Press Union.

Marconi's Wireless Telegraph Company, Ltd., was represented on board by Mr. A. R. Burrows, who was in charge of the demonstration throughout the voyage. Mr. Burrows was also responsible for the editions of *The North Atlantic Times*.

One of the illustrations we give shows the music room of the *Victorian* fitted up ready for the "Wireless" concerts. The other portrays a part of the wireless apparatus on board, including the wireless telephony set.

In conclusion we would point out to our readers that the undoubted success of these demonstrations goes to show that no longer can wireless telegraphy be regarded as the *dernier cri* in the matter of communication at sea. In every way as efficient, wireless telephony has enabled conversation to be conducted over distances far greater than those covered by wireless telegraphy when the latter was as old as the art of wireless telephony is at present: moreover, those distances are of an order which qualify wireless telephony for immediate adoption in commerce generally. Judging from results, there is now no technical reason why every ship should not carry a wireless telephone in addition to her usual wireless equipment. One great advantage of the telephone is that it is a time-saver where discussion is needed; the rapid exchange of questions and answers necessitated by a business consultation can, obviously, be handled much more satisfactorily by an efficient telephonic system than by telegraph.

Though the larger liners are all equipped with a doctor and staff, a large percentage of the Mercantile Marine, the food-carrying "tramps," are rarely so luxurious. Relative to the number of souls on board, the accidents and sickness occurring on these small vessels are equal to those on board the liners, and yet the captain's scanty knowledge of medicine is all that can minister to his crew. Cases have been known—and, indeed, are not rare—in which medical advice from another vessel would have saved the life of many an ailing seaman. Wireless telegraphy has often done useful work in these cases, but as is illustrated in business each day, never can the telegraph prove equal to the telephone where conversation is imperative to immediate action. A ship equipped with wireless telephony and carrying no doctor could, should occasion demand it, establish telephonic communication with another ship similarly fitted and carrying a doctor, thereby receiving medical advice without delay.

NOTES AND NEWS

Radio Research Board.—The Department of Scientific and Industrial Research has now established four sub-committees to assist the Radio Research Board in the investigation of problems in connection with the work of the Board. The constitution of the Sub-Committees is as under :—

Sub-Committee A (on the Propagation of Wireless Waves): Dr. E. H. Rayner, Sc.D. (Chairman); Prof. E. H. Barton, D.Sc., F.R.S.; Major J. R. Erskine Murray, D.Sc.; Prof. H. M. MacDonald, F.R.S.; and Prof. J. W. Nicholson, D.Sc., F.R.S.

Sub-Committee B (on Atmospherics): Colonel H. G. Lyons, D.Sc., F.R.S. (Chairman); Mr. A. A. Campbell Swinton, F.R.S.; Prof. S. Chapman, F.R.S.; Major H. P. T. Lefroy, D.S.O., M.C., R.E.; Mr. G. L. Taylor, F.R.S.; Mr. R. A. Watson-Watt; Mr. C. T. R. Wilson, F.R.S.

Sub-Committee C (on Directional Wireless): Mr. F. E. Smith, O.B.E., F.R.S. (Chairman); Mr. M. P. Hinton; Capt. C. T. Hughes, M.C., R.E.; and Capt. J. Robinson, M.B.E., R.A.F.

Sub-Committee D. (on Thermionic Valves): Prof. O. W. Richardson, D.Sc., F.R.S. (Chairman); Mr. E. V. Appleton, M.A., B.Sc.; Capt. S. Brydon, R.E.; Capt. H. L. Crowther, R.A.F.; Prof. C. L. Fortescue, O.B.E.; Mr. B. Hodgson, M.Sc.; Prof. F. Horton, D.Sc.; Major A. G. Lee, M.C., R.E.; Mr. H. Morris Airey, C.B.E., M.Sc.; Mr. R. L. Smith-Rose; and Prof. R. Whiddington, D.Sc.

Additional Stations transmitting weather reports may be added to the list given in the *Wireless World* of July 10th, 1920, as follows:—Somerset Island, Bermudas, BZR, 0015 and 1215, wavelength, 1,600 metres. Barrington Passage, Canada, VAL, 0130 and 1330, wavelength 1,600 metres. St. John's, Newfoundland, BZM, 0100 and 1300, wavelength 1,600 metres. Christiania, Jamaica, BZQ, 0100 and 1300, wavelength 1,200 metres, the times being G.M.T. throughout.

Einstein's Theory of Relativity.—Messrs. Methuen have recently published a translation by Robert W. Lawson of Einstein's book on Relativity. In this book, which is written for the average reader, Prof. Einstein explains his famous theory, which has so excited the scientific world. It is intended primarily for those readers who, though interested in the trend of modern theory, are not conversant with the mathematical analysis used in theoretical physics. The author's aim has been to give an exact insight into the clearest and simplest form.

Canadian D.F. Stations.—On and after August 1st, 1920, the Canadian Radiotelegraph Direction Finding Stations at Chebucto, N.S.; Canso, N.S.; and Cape Race, Newfoundland, use the wavelength of 800 metres exclusively for transmission and reception. All use of the wavelength of 600 metres by Canadian Direction Finding Stations is discontinued as from August 1st, 1920.

2 QR—Amateurs will perhaps be interested in a record which has just been made by amateur station 2 QR (Keyport, N.J.), a photograph of which appeared in the July 10th issue of the *Wireless World*. This station has just been adviced by letter that Station 8 JM, located at Ashland, Ohio, a distance of from 600 to 625 miles by air line from Keyport, has reported the reception of strong telephone signals of both voice and music.

The most remarkable part about this transmission is that it is being done with a radio-phone using rectified current from 110 volt 60 cycle supply, and that the radiation is approximately seven or eight tenths of an ampere.

Chelmsford Telephony Tests.—On July 30th, when the Marconi Station at Chelmsford, working on a wavelength of 3,500 metres was in communication with the Scandinavian countries, the London correspondents of the *Nationaltidende* (Copenhagen), *Morgenbladet* (Christiania), *Aftonbladet* (Stockholm), and the *Morgenpost* (Gothenberg), transmitted news messages to those journals, and afterwards Mr. Lauratz Melchior, the celebrated Danish opera tenor, gave a number of selections, including the anthems of Denmark, Norway, Sweden, and Great Britain. By arrangement with the various telephonic departments, the telephone exchanges of the big Scandinavian towns were connected up with the wireless stations. The test was fairly successful, but was interfered with by atmospheric disturbances. Several wireless telephony messages, including one from Queen Alexandra, and one from Senatore Marconi, were also transmitted from Chelmsford.

North Borneo Wireless Station.—At the half-yearly meeting of the British North Borneo (Chartered) Co., held in London recently, it was said that the wireless system was working most efficiently. Uninterrupted communication was maintained throughout the year 1919, except for a day-and-a-half, when the Sandakan station was closed. The inauguration of a wireless service between Jesselton and Sarawak had been followed by the establishment of a regular wireless service between North Borneo and the Philippine Islands.

Telephonic Photography.—Mr. Edward Belin, a French scientist, has recently invented a system of telephonic photography, and the Government has taken up the matter as a result of experiments conducted, when Mr. Belin telephoned a reproduction of a document, from La Malmaison, near Paris, to Lyons. The Minister of Posts and Telegraphs has ordered two of this inventor's instruments for further trial. The instrument is understood to consist of a luminous circular plate, against which the photo is projected, setting up vibrations of various wavelengths. An advantage of the apparatus is its practicability. As the machine weighs only about a stone it can be attached to any telephone.

Meteorological Office of North London.—The sunshine records of the Royal Botanical Society, Regent's Park, are in future to be accepted as the official records of the Meteorological Office, North London. Hitherto the figures given have come from the British Rainfall Office, Camden Square, but the exposure there has not been satisfactory, owing to the enclosed nature of the site

A Leucoscope in Pyrometry.—The Bureau of Standards has recently been making experiment, with the Leucoscope, an instrument devised many years ago by Helmholtz for light and colour analysis, and finds that this instrument, originally used in

"Hello! Victorian." A view of the Marconi Wireless Telephone Station at Chelmsford.

the study of vision, has useful application in pyrometry. New laws have been discovered relating to the reading of the instrument to temperature and spectral energy distribution in a light source or furnace. The results of this investigation have been given to the Optical Society of America for publication in its journal.

International Meteorological Conference.—A report of the International Meteorological Conference which met in Paris last October, at the invitation of the French Government, has just been published. In view of the far-reaching changes that have recently taken place in the scope and methods of meteorological work, due especially to the new requirements of commercial aeronautics, this meeting was timely, and most of the national weather services of the world were represented by delegates. The general Powers were not invited to participate, and the U.S.A., which possesses the most imposing meteorological bureau in the world, was not represented, owing to Congress failing to make the modest appropriation recommended by the President to provide for the expenses of two delegates.

Much important work was accomplished by the Conference, looking to a material enlargement in the scope of weather reports andtheir dissemination, especially by wireless telegraphy for the benefit of aeronautics.

Secret Wireless at Malta.—A wireless telegraph outfit has been discovered by fishermen at Melleha Bay, anchored in 20 fathoms of water, with the masts and working parts below the surface to a depth of 8 fathoms. The apparatus, which is said to be complete in every detail and of German manufacture, was removed by the Dockyard Authorities for examination.

P.M.G. Certificate.—H.M. Stationery Office has issued an official pamphlet (ref. (37)–10,820 Wt. 2,136, 451/582) on the impending changes in the scope and method of conducting examinations for the P.M.G. Certificate in Wireless Telegraphy.

Wirelessly-steered Ship.—Some time ago the United States Naval Authorities announced that the old battleship *Iowa* was to be fitted with apparatus to permit of her being steered by wireless telegraphy. It is now announced that when her boilers have been completed for oil fuel she will be used as a target by the Atlantic Fleet, and will be controlled by wireless.

LINKING THE WIRELESS TELEPHONE TO THE LAND LINE TELEPHONE SERVICE

ONE of the promises that wireless experts have made to the public is that before long it should be possible for any lucky person who may have a telephone to speak by wireless telephony to a ship or an aeroplane whilst sitting in his office or home, and that without any additional apparatus or effort on his part.

The circuits now to be described, and which are due to Marconi's Wireless Telegraph Co., Ltd., have been designed to enable communication by wireless telephone to be extended to the land telephone network where, under the control of the station operator, telephonic speech can be maintained between any standard telephone instrument and a wireless telephone installation.

In designing the circuits the principle adhered to throughout is that the operator's primary duty is to listen for signals from wireless telephone installations, and he is therefore never disconnected from the wireless apparatus, even though he may be talking on the exchange lines.

It is not possible with a station of this type to employ duplex wireless telephony at present. Therefore it is necessary for the operator to change over (*i.e.*, to move a two-way switch) from transmit to receive. It has been arranged for the operator always to listen into a conversation and do the necessary switching over when required.

The telephone signalling system employed is such as to allow of this apparatus to be connected to any type of Standard Post Office Exchange System, be it a central battery, magneto ringing or automatic.

The principles on which the circuit has been built are as follows. Normally, the operator has his microphone and head-receivers connected through the telephone switching key contacts to the wireless telephone transmitter and the receiving set respectively. By the operation of the change-over or send-receive switch he can energise his wireless transmitter when he wishes to send a message, or, on switching to receive, can cause his transmitter to become inoperative and his receiver sensitive. By a selective key he can also send, instead of wireless telephony, Morse signals by pure continuous waves or interrupted continuous waves.

Under these conditions, *i.e.*, with the line switching key on the W/T. side, the exchange line is connected through a 2 mfd. condenser to a standard bell circuit, so that the station may be called by the exchange. If the circuit is connected to a magneto calling exchange, a magneto will be included in circuit for calling purposes.

On the reception of an exchange call the operator will move the key over to "line" side, which will short-circuit the bell, condenser and generator, and connect up through a repeater his microphone and telephones on to the exchange line, thereby operating the supervisory signal on a C.B. exchange and enabling him to converse with the exchange.

Should the exchange line desire to be connected through to the wireless station to speak to a distant wireless station, the operator moves the key into the central position, when the exchange will be connected either to the wireless receiver or transmitter through the operator's change-over switch. The operator will listen in and control the strength of speech according to the sensitiveness of the receiving apparatus and the range over which the speech is being transmitted. He will change from "transmit" to "receive" as directed, and generally, from a combined wireless and telephonic point of view, supervise the conversation.

The operator is further provided with a line holding key for lines connected to C.B. exchanges.

This will enable him to hold a line while he returns his key to the W/T. position for the purpose of calling up a distant station with which communication is desired. It will be seen that with this method of switching and by making use of the wireless microphone and telephone for the dual purpose of wireless and exchange line working, no time is lost, as would be the case if a separate standard telephone instrument were installed at the wireless station.

Circuit Details.

Figures 1 and 2 show a theoretical circuit arrangement and a wiring diagram respectively. The circuits are controlled by a number of standard "Kellogg" keys mounted to form a complete unit, controlling telephone switching, send-receive switching, interrupted continuous waves (tonic train), continuous waves, and telephony transmission and motor generator remote control.

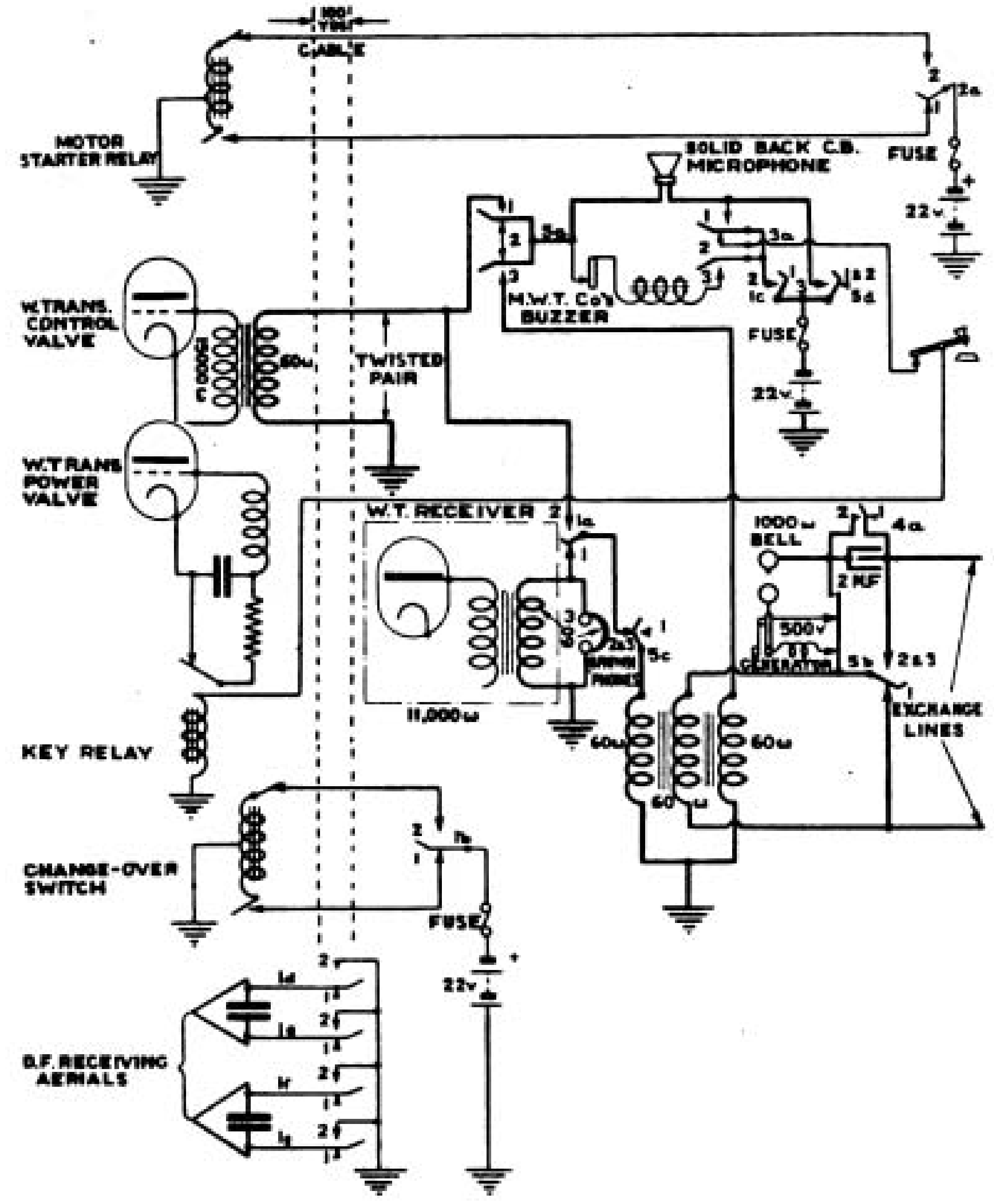


Fig. 1.

Referrring to Fig. 1, the telephone circuits are shown in thick lines. For the sake of simplicity the various key contacts have been dissociated. Five keys in all are employed (*vide* Figure 2), viz. :—

No. 1.—The Change-over Key (made up of two separate keys linked together) ;
No. 2.—The Motor-starter Key ;
No. 3.—The Transmission Key, for switching over to either Tonic Train C W or Telephony ;
No. 4.—The Line-holding Key ;
No. 5.—The Line-switching Key.

In order to indicate clearly the function of the various contacts shown in the circuit, switches are numbered as above, individual groups of springs of the same key being labelled 1A, 1B, 1C, etc., while the switch positions are numbered 1, 2 and 3.

CONDITION 1.

OPERATOR CONNECTED TO WIRELESS SET. LINE SWITCHING KEY IN POSITION No. 1.

(*a*) ***Transmission.***

Hitherto low voltage microphones have been used in connection with wireless telephony systems. New conditions have arisen, however, in which the microphone is dissociated from the wireless transmitting set, being connected thereto by a length of underground cable. In order to reduce resistance losses in the cable to a minimum the local battery system has been abandoned in favour of a 22-volt central battery arrangement.

(*b*) ***The Wireless Transmitter.***

An additional speech-magnifying valve has been added to the standard wireless telephone transmitter. This is specially to cater for weak transmission from exchange lines.

Referring to Figure 1, it will be seen that current is fed from an earthed 22-volt battery *via* key contacts 1C and 5D in parallel to one side of a solid-back microphone. These two contacts are employed for cutting off the current from the microphone when not actually in use, *i.e.*, when the operator is listening for wireless signals. The 1C contact is on the change-over key, and the 5D

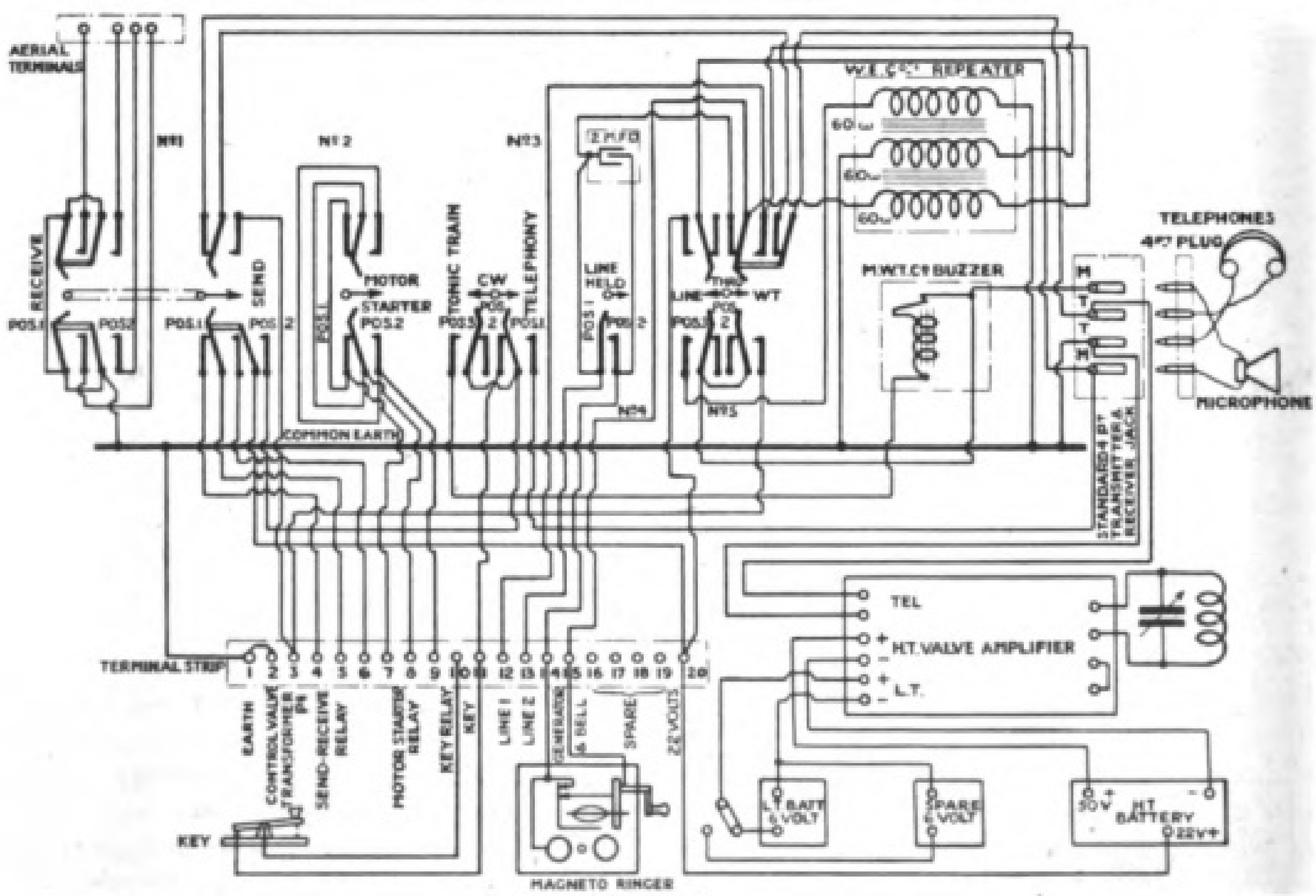


Fig. 2.

contact is on the line-switch key, to connect up the microphone (with the change-over key still in "receive" position), when the operator is talking to exchange lines. It is evident that the combination of these two contacts acts as a guard circuit, making it impossible for the operator to connect the buzzer, used for wireless signalling, to the exchange line.

Key No. 3 is used for the purpose of changing the type of wireless transmission from telephony to either pure continuous waves or tonic train. In position 1 the 22-volt battery through key contact 1c is connected to the microphone, positions 2 and 3 controlling C.W. and Tonic Train transmission.

The circuit is extended through the microphone on to the moving springs 5A of the line switching key. In position 1 of this switch (the W/T. position), it will be seen that this microphone is extended through a length of cable to the 60 ohms primary of a transformer, by which speech is impressed on the grid of the control valve of the wireless transmitter.

In position 2 of this switch the microphone is disconnected, and in position 3 (the line side) the microphone is extended to the exchange line apparatus to be described later.

(*c*) *Reception.*

The operator's 120 ohms telephones are permanently connected to the 60 ohms secondary of the transformer in circuit with the wireless receiving set. One side of the telephones is earthed and the other side is extended through change-over switch contacts 1A to the line switching key contacts 5c, which are held open in position 1. When the operator is connected to W/T, therefore, his telephones are not shunted by any part of the line circuit.

(*d*) *Line Circuit.*

The exchange line is completed through a 60 ohms coil of a repeater, a 500 ohms generator, 1,000 ohms bell, and 2 mfd. condenser, all in series. The generator is of the type fitted with a cut-out which short-circuits its armature when at rest, and short-circuits the bell when the handle is rotated. The 2 mfd. condenser is inserted for C.B. working, and is arranged to be short-circuited by the contacts of a line-holding key 4A.

A tapping is taken between the terminals of the repeater and the generator, which is connected to springs 5B which are arranged in position 1 to short-circuit the repeater coil, that is, when the operator is connected to W/T. An incoming ring will operate the bell, while the operator can call the exchange either, in the case of a C.B. exchange, by moving the line switching key to line side, or in the case of magneto ringing systems by turning the magneto.

CONDITION 2.

OPERATOR CONNECTED TO LINE. SWITCHING KEY No. 5 IN POSITION No. 3.

All communication between operators and exchange line is done with the change-over switch on receive side. Contacts 1A and 1c will therefore be in position No. 1: Contacts 5A, B and C will be in position No. 3.

The microphone circuit will be completed from battery *via* contact 5D (1c will be open), microphone 5A, position 3, 60 ohms winding of repeater to earth.

Thus on speaking into the microphone the operator will now transmit speech along exchange lines.

The exchange lines circuit will be completed *via* contacts 5B which will, in position 3, short-circuit condenser, bell and generator, and will complete the circuit of the middle winding (60 ohms) of the repeating coil and so back to line.

Speech from the exchange lines will be induced into the third 60 ohms winding of the repeater, which circuit will be completed as follows:—Earth 60 ohms winding, 5c contact, 1A contact, operator's telephones, earth.

The operator's telephones will still be connected to the wireless receiving apparatus, so that an urgent message can be picked up at any time and given preference over other calls. Should jamming or irrelevant signals cause annoyance when the operator is talking to the exchange, this can be eliminated by detuning or dimming the receiving valves.

CONDITION 3.

EXCHANGE THROUGH TO WIRELESS. LINE SWITCHING KEY IN POSITION NO. 2.

It will be seen at once that the operator's microphone circuit is disconnected by contact 5A, and therefore although he can listen in, he cannot interrupt or break into the conversation. Speech transmitted from the distant wireless station is picked up on the wireless receiving set, and is adjusted for correct intensity by the operator, and a shunt circuit is completed across the operator's telephones as follows :—Earth, telephones, contacts 1A, 5C, 60 ohms winding of repeater and back to earth. Received speech is therefore induced into the line winding of the transformer to line *via* contact 5B. On hearing the termination of a sentence of received speech, the operator will change over, moving contact 1A from position 1 to position 2.

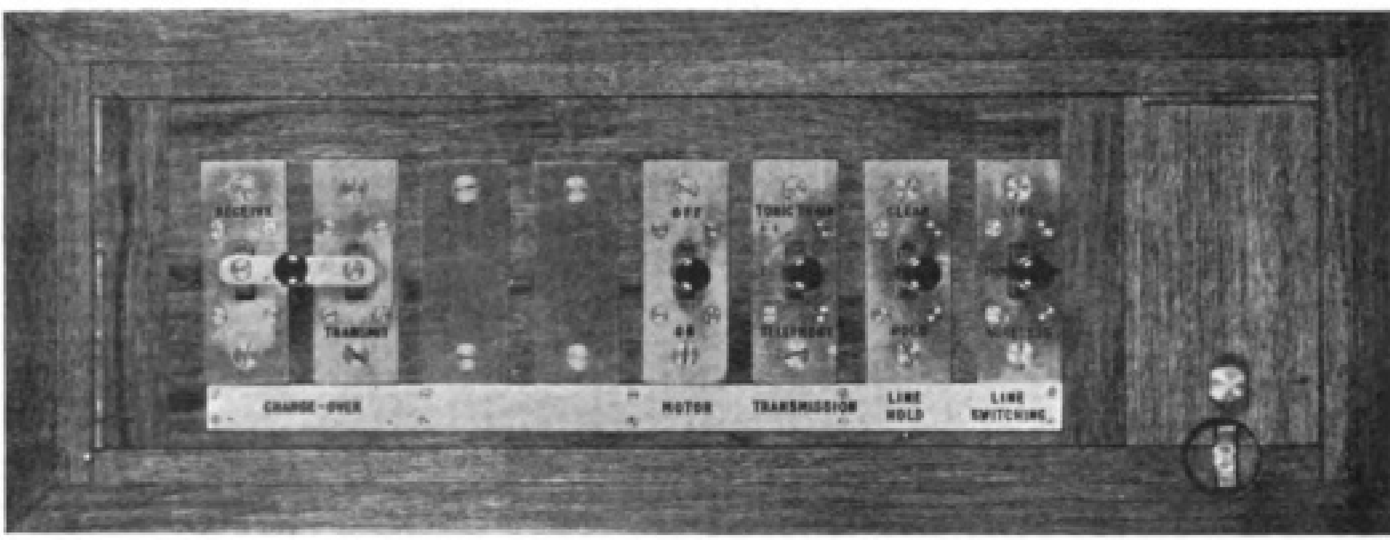
Incoming speech from the exchange line will be conveyed, *via* contact 5B, windings of repeater, contacts 5C and 1A through cable to 60 ohms primary of transformer to W/T Transmitter control valve, back through the return circuit of the cable pair to earth.

Speech from the exchange will therefore be radiated, the wireless receiver picking up the radiated speech. The operator will therefore hear both sides of the conversations, although there is no parallel circuit across his telephones when transmission is taking place.

TELEPHONE TRANSMISSION CIRCUITS.

It will be observed that the transmission circuits are as efficient as can readily be obtained. The triple winding repeater insulates the exchange line from direct connection with any of the wireless apparatus.

When the exchange line is through to wireless on transmit side, the secondary of the repeater is connected direct to the wireless transmitter, and when on reception is connected directly across the operator's head telephones.



APPARATUS EMPLOYED.

Standard types of telephone apparatus are employed throughout, except in the case of the operator's head telephones, which are of the special Brown diaphragm type (not the reed type).

Each telephone has a resistance of 60 ohms, the two being connected in series. The transformer to which they are connected is of high impedance, having a resistance of 60 ohms and is specially designed for use with valve receivers.

Transmission Key Circuits.

Referring to the connection of key No. 3 (the transmission key) it will be seen that the positive side of the 22-volt battery is fed *via* contact spring 1c to the moving springs in parallel of No. 3.

In position 1 the 22-volt battery is therefore connected to the microphone as previously described. In position 2 the moving spring comes into contact with an inner spring which connects up a circuit to a contact of the manipulating key and *via* its pivot and the underground cable to the 250 ohms winding of the key relay, situated on the transmission panel. On the operator moving the transmission key into the central position the key relay will at once be actuated providing that the send-receive switch is in the send position when contact 1c will be closed. The operation of the key relay will cause the grid circuit of the transmitting valve to be broken and also the primary of the high-tension transformer. No power will therefore be radiated. On the operator pressing his key, the circuit of the key relay will be broken. The armature of the key relay will fall back, thereby closing its circuits and energising the transmitter : that is to say, continuous wave transmission will take place. On moving key No. 3 into the third position the second moving spring of the key will complete a circuit from the 22-volt battery *via* a specially-wound high note buzzer, spring 5A of key No. 5 in position No. 1, the underground cable, and through the 60 ohms winding of the control valve transformer and back through the cable pair to earth. The circuits set up in position No. 2 of the key relay are still retained for position No. 3, therefore, on the operator pressing his key, interrupted continuous waves will be radiated.

Relay Control Circuits.

Contact 1B of the send-receive key places the positive pole of the 22-volt battery on to either leg of a pair of wires extending through the underground cable to the change-over relay on the transmission panel. This relay is a specially constructed piece of electrical mechanism, which is actuated by an impulse of current only. On changing over from transmit to receive, or *vice versa*, the current is fed from the 22-volt battery *via* key contact 1B in position 1 or 2, as the case may be, underground cable, through a contact on the relay and *via* one coil of its differential winding to earth. The mechanism of the relay is so adjusted that at the end of its travel it breaks the contact through which the current is fed, through the one differential winding and connects up the contact of the other coil, so that on moving the switch again into the other position the field of the relay is reversed and the armature moves back in the opposite direction : at the end of this movement it again breaks its own circuits, and so on. This principle is employed for actuating the change over, or send-receive relay, as shown by springs 1F and their associated connections. The same system is used to operate a motor starter relay, as shown by springs 2A in positions 1 and 2 and their associated connections.

The Relays.

Three electro-magnetic relays of special design are provided, their function being to enable the operator in a distant control station to start up at will the high-tension motor generator set preparatory to actually transmitting a message, and, secondly, to energise the wireless transmitting circuits when his switch is thrown over to "transmit," and, thirdly, to make inoperative the transmitter when switching over to "receive" ; and, fourthly, for the purpose of sending out Morse signals.

These relays are interesting, inasmuch as they work by impulse only, and do not rely for their action upon the continuous action of a steady current. This means that the magnitude of the currents used momentarily can be made much larger than if they had to be continuously maintained, and so the relays are more certain in action.

WIRELESS CLUB REPORTS

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A well attended meeting of the above Club was held on Wednesday evening last, the 11th inst., at 8.30 o'clock, at Shaftesbury Hall, Bowes Park Station. Great interest was shewn by some new members in the Club's apparatus: during the evening a wireless message of congratulation was sent to the Club from a local station, which afforded the members the opportunity of "listening in" to some really good signals. Application was made for membership by several present during the evening.

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

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

The senior section of this Club is now being formed and all who may be interested are invited to communicate with the Hon. Secretary. This Club is desirous of securing the support of a large number of new members to enable the present members to carry out certain plans. Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton.

Liverpool Wireless Association.

(Affiliated with the Wireless Society of London.)

A meeting of the above Association was held at 56, Whitechapel, on Wednesday, August 11th, Mr. N. D. B. Hyde in the chair. Mr. C. Wortley, of Egremont, has taken over the duties of Treasurer. Mr. S. Lowery delivered his second lecture on "Elementary Wireless for Beginners." It was announced that a licence had been obtained for a portable receiving outfit; various pieces of apparatus were on view, including two portable receiving sets. The present is a very opportune time for beginners to join the Association, and applications should be addressed to Mr. S. Frith, Hon. Secretary, 6, Cambridge Road, Crosby, who will also be pleased to interview enquirers by appointment.

Radio Society of South Africa.

The Society will consist of full members, associate members, and honorary members. Candidates for full membership must have attained the age of 21 years, and must have been engaged in research or experimental work in radio science for at least two years, and must also satisfy the Provincial Committee of the Society that they possess the necessary qualifications or training. Candidates who do not fulfil the foregoing conditions are eligible for associate membership.

The Society will be managed by Provincial Committees at Johannesburg, Cape Town, and Durban, having jurisdiction and financial control over all members in their respective areas. A president and vice-president will be elected by each Provincial Committee. The Provincial Committees will have the power to appoint sub-committees for the management of club rooms, the issue of certificates to members applying for licences, the establishment of libraries, and the purchase of instruments. All matters of policy will be dealt with on the vote of the Provincial Committees, each committee to exercise one vote.

The subscription will be £1 1s. per annum, excepting in the case of any elected *bona-fide* student or apprentice whose subscription shall be 10s. 6d. per annum as long as he remains in that category. The entrance fee will be 10s. 6d., but foundation members will not have to pay this fee. To become a foundation member it is necessary to be present at the first meeting held at any centre and to signify at the meeting the intention of becoming a member of the Society.

The Radio Society of South Africa deserves every support and encouragement possible. The Postmaster-General has signified his approval of the formation of this body, and all that is now necessary is for every amateur in the Union to roll up and make this body as influential and useful as the other radio societies all over the world. Those interested please communicate with Mr. G. L. R. Lowe, 57, Kitchener Avenue, Bezoidenhout Valley, Johannesburg.

Rugby and District Wireless Club.

A well attended meeting was held in Rugby on Wednesday evening, August 11th, to consider the desirability of forming a Wireless Club.

The acting Hon. Secretary (Mr. A. T. Cave) stated that he had received a number of replies to his letters inviting gentlemen to join, and it was unanimously resolved to form a Society to be called "The Rugby and District Wireless Club."

It was decided to ask several local gentlemen to support the movement by becoming Vice-Presidents. Mr. A. T. Cave was appointed Hon. Secretary and Treasurer.

An executive committee of six gentlemen was elected to prepare a programme for the winter session. The meeting was ultimately adjourned until August 25th. Intending members kindly write to Mr. Arthur T. Cave, 3, Charlotte Street, Rugby.

Stockport Wireless Society.

A meeting of this Society was held in the new club room at St. Thomas' Schools, on August 6th, but owing to a great number of members being on holidays it was of an informal nature; the opportunity such absence of members afforded was taken by the Chairman, Mr. Woodhall, to exhibit his portable valve set, and after constructional details being discussed, the aerial was connected and most splendid results obtained.

August 13th.—A special meeting was held, Mr. Woodhall being in the chair. He addressed the members before opening the meeting by asking them to join him in welcoming the secretary's return to take up his official duties, and loud applause was given. Mr. Faure thanked all members for their hearty appreciation of his return, expressing his delight at the progress made by the Society since its formation. The meeting opened, and items on the paper were discussed, the following resolutions being passed—

(1) Mr. Hallsworth's resignation as treasurer accepted, and Mr. Faure appointed secretary and treasurer.

(2) That two guineas be sent to the Wireless Society of London for affiliation and a secretary elected to represent as the member and delegate for Stockport Wireless Society.

The Secretary gave an interesting lecture on C.W. Reception. A number of members brought home-made apparatus for exhibition, and keen interest was shewn in Mr. Woodhall's three-valve amplifier, from which good results were obtained on out-door and frame aerials.

Intending members are invited to apply to the Hon. Secretary and Treasurer, Mr. Z. A. Faure, 3, Banks Lane, Stockport, or to attend at the St. Thomas' Schools, Marriott Street, Stockport, any Friday evening at 7.45 p.m.

The Wireless Club of Rotherwood & District.

A meeting was held at "Eureka Lodge," Rotherwood, on 14th August, for the purpose of forming a Wireless Club for Rotherwood and district. It was decided to adopt the title of "The Wireless Club of Rotherwood and District." The following officers were elected:—President, Mr. J. Knowles Hassall; Hon. Secretary and Treasurer, Mr. J. F. Trevor.

The President reported that he would be pleased to place a room of his house, "Eureka Lodge," Rotherwood, at the disposal of the Club, and to grant to the Club the use of his aerial.

It was decided that application be made for affiliation with the Wireless Society of London.

It was resolved that membership of the Club should be open to all residents in Rotherwood and district who had attained the age of 18 years.

Mr. A. Cooper with his receiver, using frame aerial and "R" valve. A very neat set.

The annual subscription was fixed at 10s. 6d., payable in advance, the entrance fee to be 1s.

It was resolved that meetings should 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 session.

The Hon. Secretary and Treasurer, Mr. J. F. Trevor, 20, South Street, Ashby-de-la-Zouch, will be pleased to receive the names of intending members, and supply any further information.

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 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. W. Mitchell, 237, North Street, Charing Cross, Glasgow.

NOTE.

Will Club members kindly note that at present we cannot make exceptions to our rule and reply to questions by post, even if the queries are accompanied by a stamped envelope and an appeal for urgency.

"There are others."

HOW TO MAKE A HIGH-TENSION BATTERY

By F. Richardson (Student I.E.E.).

WITH the advent of the thermionic valves one of the disadvantages with respect to amateurs is the need of a high tension supply. The great majority of wireless amateurs are unfortunately not in possession of a lighting supply and therefore are forced to resort to other means of obtaining the necessary power.

There are, of course, many ways in which one can obtain voltages, say up to 100 volts, but almost all of these are out of the amateur's reach. Accumulators are too expensive and bulky, even if it is fairly convenient for the amateur to charge them. Primary batteries are quite efficient, bu he majority are also bulky, and, fur hermore, often run down as quickly without use as when in use.

Bearing this important fact in mind there are many who may perhaps welcome the description of a high voltage battery which besides being capable of giving a constant current of about twenty times the amount needed, will last two or three years without any attention, and is very compact and easily fitted up

In Fig. 1 (G) is a glass test tube 4" × ⅞" diameter ; these can be obtained very cheaply from a wholesale chemist in large quantities. (A) is a carbon rod (also cheap) such as is used in street lamps, etc., cut in lengths each 4½" (diameter about ¼"). (Z) is a length of flat zinc ⅜" wide by about ⅛" thick, and 4" long. There is no reason why the length should not be made from ordinary Leclanche No. 2 circular zincs cut in halves.

A 3" piece of 16 S.W.G. bare copper wire is soldered to the tops of the zincs and the joints then enamelled or treated with shellac. To make the connections on the carbon rod a mould is made by boring a ½" diameter hole ¾" deep in teak or other hard wood, and melting plumber's metal into the same. The rod is dipped into the molten metal which is then allowed to set. See (L) in Fig. 1. The 3" copper wire is then soldered on the top of the lead cap.

The next thing is to fit the cell up. To do this fill the test tube with fine sand to about ½" from the top, first placing in it the zinc, which should rest on the bottom of the tube, and also placing the carbon opposite but keeping it about ¼" clear from the bottom and as far as possible from the zinc : then pour melted pitch or marine glue round the carbon and zinc and allow it to set. Fig. 1 (E). A small piece of glass tube about ⅛" internal diameter Fig. 1 (T) should be inserted with the pitch, or else two holes should be made on opposite sides with a French nail of about the same diameter (⅛"). These holes are to allow for the removal of the fine sand, and for filling in the electrolyte.

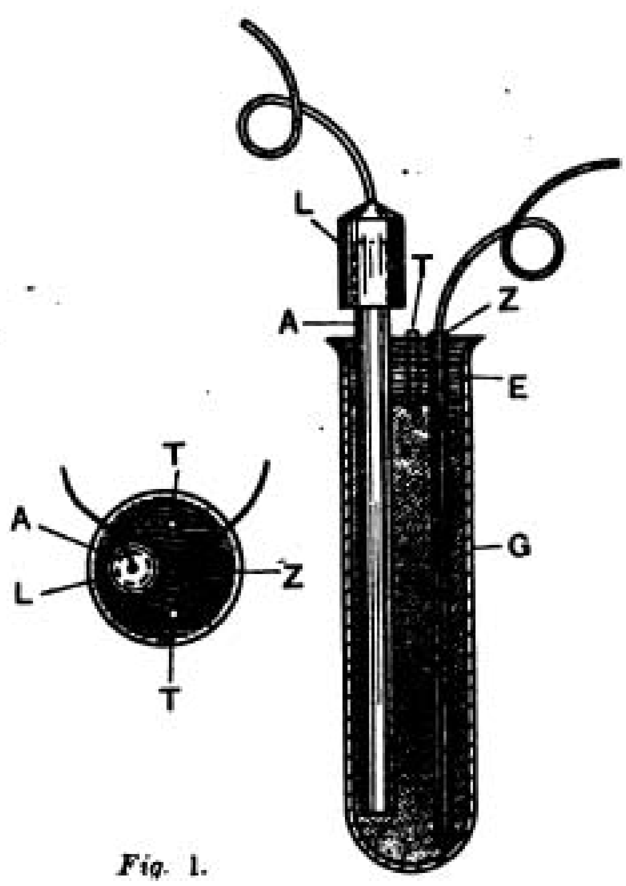


Fig. 1.

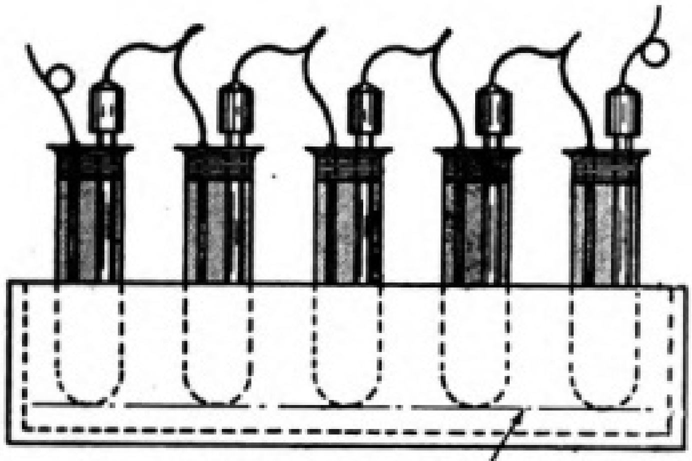


Fig. 2.

The sand is then emptied out, and the cells are mounted in a cigar box filled with paraffin wax, and fixed by first covering the bottom of the box with wax, and then standing the cells upright in two rows of five each, and filling the box slowly with paraffin wax which must not be too hot When mounted and set, the cells are filled by means of a fine-mouthed funnel placed in the small tube or holes, with a weak solution of sal ammoniac and water to within ½" of the top of cell, and the cells joined up in series by twisting the wires as in Fig. 2.* In order to assist the zincs to be well amalgamated a small drop of mercury may be dropped in the cell.

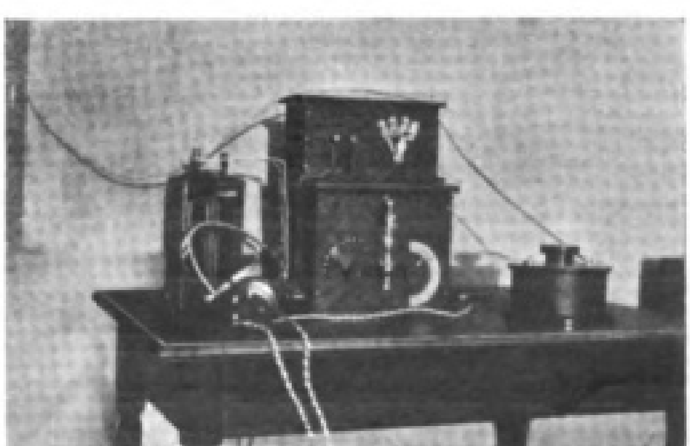
Ten cells in each box will give twelve volts, and as many valves need only from twenty to thirty volts, two or three boxes or twenty to thirty cells will be ample for all needs with such valves. I have used 200 of these cells giving 240 volts and taking 250 milliamps for hours at a stretch, the e.m.f. keeping constant. Fig. 2 represents a complete battery.

*Quickly-made soldered joints would be better—Ed.

A DUTCH AMATEUR PORTABLE STATION

AS our readers may know, there is a very active and enthusiastic body of amateur wireless workers in Holland, as there should be, of course, in the country which is the fatherland of that prominent radio engineer, Dr. J. de Groot, who is well-known for his work in connection with the problems of the transmission of electromagnetic waves round the earth, and of the elimination of "atmospherics."

Now the members of the "Nederlandsch Vereeniging voor Radiotelegraphie," who live at Noordwijk, near Leyden, have there formed a local wireless club, the "Noordwijksche Radio Club." With the object of introducing this club to British amateurs, the President has been good enough to send us some interesting details concerning it, together with a description of the apparatus it possesses. He adds that when the ban on amateur transmission in this country is lifted the members of his club will be only too pleased to communicate by wireless with any English brother-amateurs. As it looks as if the ban is not likely to be lifted to such an extent, we suggest that communication



The set arranged for long distance reception.

should be established by post; indeed, we believe that this has already been done in a number of cases.

The club has five well-equipped receiving stations composed of home-made apparatus, including multi-stage H.F. and L.F. amplifiers, a ½ K.W. transmitter with a synchronous rotary gap, having a daylight range of about 100 miles. Frame and ground aerials are used in addition to the more usual types, and the club has succeeded in intercepting signals from the Dutch station at Bandoeng in the Dutch East Indies, a very good performance.

The set adapted for "walking" reception.

After experimenting with many different receivers the members have constructed a single-valve tuner for universal radio work. Designed originally for 400 to 2,000 metres, this set gives good results on both frame and ground aerials, and has been adapted for "walking" reception, as the accompanying illustration shows, and used in this manner has produced good signals over a range of 200 miles.

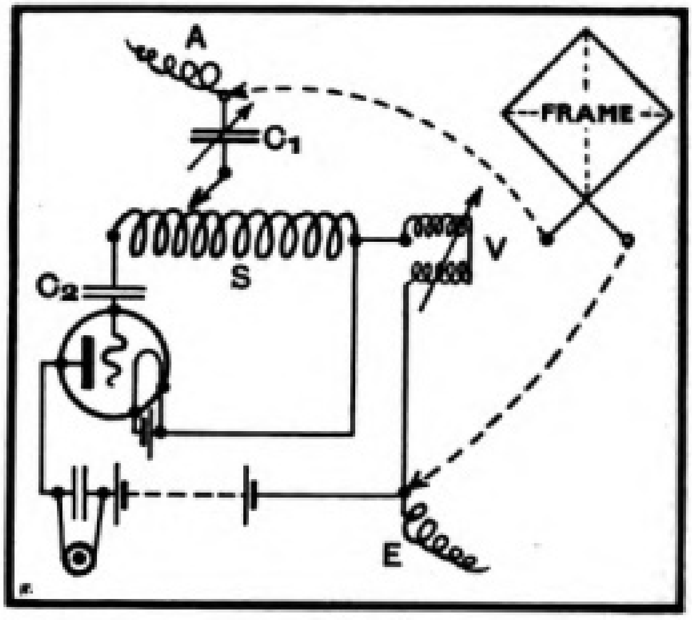


Fig. 1

Figure 1 shows the connections. V is a variometer, which is also used as a reaction coil. C_1 is a variable condenser of 0·0005 to 0·001 mfds. (max.); C_2 is a fixed grid condenser of 0·0005 mfds. S is a single-layer coil of about 240 turns with eight tappings. The inner coil of V has 40 turns and the outer coil has 40.

The frame aerial used with this set is 80 centimetres square, and is wound with 12 turns spaced ½ inch apart. This arrangement gives good results on 600 metres.

TO WIRELESS CLUB SECRETARIES.

Has *your* club ever done any "stunts" like that described in this article. Have you had a "field day" lately which gave striking results? If so, why not send us a description, photograph or diagram. If your club is "alive," let our readers know it. Publicity pays.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

INDUCTANCE COILS.

THE following information will be useful to those who are just making a start in the practice of radio reception and who wish to make up their own apparatus.

In designing tuning coils, either for primary or secondary circuits, one can determine the amount of inductance to give a certain wave-length, and it is then necessary to know what winding will give that value of inductance.

With primary or aerial circuits the "effective" capacity of the aerial cannot easily be determined, but it has been found in practice that the effective capacity of a

TABLE 1.

Inductance of a solenoid wound 20 turns per cm. Inductances in microhenries. Diameters of solenoid in cms.

Length cms.	Diameter of solenoid.										
	4.	5.	6.	7.	8.	9.	10.	12.	14.	16.	18.
1	23	32	41	50	60	70	80	—	—	—	—
2	66	93	122	155	185	218	253	324	399	478	559
3	118	169	224	283	346	389	480	623	784	932	1095
4	174	252	338	432	531	636	745	974	1221	1480	1745
5	232	340	460	590	719	881	1040	1370	1725	2095	2482
6	292	430	587	761	945	1201	1350	1790	2270	2795	3300
7	351	523	717	932	1165	1415	1680	2240	2850	3490	4180
8	413	617	850	1109	1390	1695	2016	2710	3454	4250	5110
9	474	711	985	1291	1624	1980	2360	3200	4080	5025	6050
10	537	807	1120	1472	1858	2275	2720	3680	4725	5857	7050
12	666	997	1395	1842	2345	2870	3440	4700	6074	7546	9130
14	786	1193	1673	2216	2810	3475	4185	5740	7450	9310	11290
16	911	1390	1951	2593	3300	4090	4940	6800	8880	11140	13600
18	1037	1583	2231	2972	3800	4711	5700	7880	10310	12980	15850
20	1162	1779	2512	3352	4290	5330	6460	8970	11780	14860	18190
22	1287	1975	2794	3734	4820	5960	7230	10060	13250	16750	20560
24	1414	2170	3005	4115	5290	6590	8000	11160	14730	18670	22940
26	1536	2370	3357	4502	5790	7380	8780	12270	16230	20610	25370
28	1666	2565	3642	4883	6290	7840	9680	13390	17730	22550	27810
30	1792	2761	3922	5264	6790	8480	10330	14500	19230	24500	30260
32	1920	2958	4207	5652	7290	9110	11100	15620	20750	26460	32730
34	2044	3155	4490	6040	7800	9519	11930	16730	22260	28650	35200

standard Post Office regulation aerial is approximately 0·00025 to 0·0003 mfd., and sufficiently accurate results will be obtained if this value be assumed.

For secondary circuits the maximum capacity of the secondary condenser is known, and this value may be used for calculation.

The value of inductance required to tune to a given wavelength may be obtained from the formula—

$$\lambda = 1{,}885\sqrt{LC} \text{ or } L = \frac{\lambda^2}{1{,}885^2 C}$$

wherein

L=inductance in mhys. and
C=capacity in mfds.

For calculating the inductance of a solenoid there are several formulæ available, but the best and easiest is the one given by Dr. Nagaoka. He gives the formula—

$$L = \pi^2 d^2 n^2 l K \text{ cms.}$$

wherein

d=diameter of the coil in cms
l=length " " cms.
n=number of turns per cm., and
K=a constant depending upon the ratio d/l

TABLE 2.

CORRECTION FOR INSULATION.

Values of A depending upon ratio diameter of wire bare to diameter covered $\frac{d}{D}$

$\frac{d}{D}$	A	$\frac{d}{D}$	A	$\frac{d}{D}$	A
1	+0·5568	0·4	−0·3594	0·6	+0·046
0·95	+0·5055	0·35	−0·4928	0·55	−0·041
0·9	+0·4515	0·3	−0·6471	0·25	−0·8294
0·85	+0·3943	0·75	+0·2691	0·2	−1·0526
0·8	+0·3337	0·7	+0·2001	0·15	−1·3404
0·5	−0·1363	0·65	+0·1261	0·1	−1·7457
0·45	−0·2416	—	—	—	—

Values of B depending upon total number of turns T.

T	B	T	B	T	B
1	+0	15	+0·2857	80	+0·3257
2	+0·1137	20	+0·2974	100	+0·3280
3	+0·1663	30	+0·3083	200	+0·3328
4	+0·1973	40	+0·3148	300	+0·3343
6	+0·2329	50	+0·3186	400	+0·3351
8	+0·2532	60	+0·3216	1000	+0·3365
10	+0·2664	—	—	—	—

The inductance values are given in centimetres and should be divided by 1,000 to give microhenries. Tables have been compiled giving the values of K for all values of $\frac{d}{l}$ between 0·01 and 10. The most useful sections of these tables have been published in text-books (*see* "Calculation and Measurement of Inductance and Capacity," by W. H. Nottage).

For the assistance of amateurs in the calculation of inductance the following tables have been prepared, using the above formula.

Table 1 gives the inductance of various lengths of winding on formers 4 to 18 cms. diameter and wound 20 turns per centimetre of length

For windings other than 20 turns per cm. calculate as for a 20 turn per cm. winding and multiply the result by the factor $\frac{X^2}{20^2}$, — X being the actual number of turns per cm. of the winding For example, a coil wound 10 turns per cm. multiply by 0·25, and if 25 turns per cm. multiply by 1·56

If a coil is outside the dimension limits take the value for a coil half the diameter and half the length and multiply the result by $2^3=8$, or take one-third of the dimensions and multiply by $3^3=27$.

The inductances given by the above formula are what are known as current sheet values, *i.e.*, they are only correct for a coil wound with a flat strip, the turns of which touch without making electrical contact. the insulation being assumed infinitely thin.

For a coil wound with round wire a correction is necessary for accurate results. Where the insulation is thin compared with the conductor and the coil has a large number of turns the correction is small, but for other cases it may be appreciable.

To make this correction subtract from the result $2\pi\, d\, n\, l\, (A+B)$, wherein d, n and l have the same meaning as in the above formula and A and B are constants ; A depending upon the ratio of the diameter of the wire bare to the diameter covered, and B depending upon the total number of turns. Complete tables giving values of A and B have been given in the Bulletin of the Bureau of Standards, U.S.A., by Messrs. Rosa and Grover. Some values are given in Table 2.

Table 3 gives the ratio $\frac{d}{D}$; diameter bare to diameter covered for various gauges of wire.

Table 4 gives the number of turns per cm. for wires of different diameter.

TABLE 3.

Ratio $\frac{d}{D}$—diameter bare to diameter covered.

S.W.G. Gauge.	Single Silk $\frac{d}{D}$	Double Silk $\frac{d}{D}$	D.C.C. $\frac{d}{D}$
20	0·947	0·905	0·781
22	0·94	0·911	0·737
24	0·934	0·879	0·687
26	0·915	0·855	0·643
28	0·899	0·83	0·597
30	0·888	0·804	0·553
32	0·88	0·81	0·545
34	0·86	0·783	0·535
36	0·838	0·773	0·487

TABLE 4.

Turns per cm.—covered wire.

S.W.G.	Single Silk.	Double Silk.	D.C.C.
20	10·4	9·9	8·6
22	13·2	12·8	10·7
24	16·7	15·7	12·3
26	20	18·7	14·1
28	23·9	22·1	15·9
30	28·2	25·5	17·6
32	32	29·6	19·9
34	36·8	33·6	22·9
36	43·3	40	25·2

BOOK REVIEWS

THE HOW AND WHY OF RADIO APPARATUS. By H. W. Secor.

New York: The Experimenter Publishing Co., Inc., 1st Edition, pp. 160, 159 Illustrations.

THE author of this book has endeavoured to describe in as simple a manner as possible the functions and uses of various wireless apparatus from which the average radio student can derive the most practical and theoretical value. It is pointed out that though many students are able to connect up apparatus capable of reception, there are a few only who are able to give sufficient explanation of the principles upon which such instruments are made to work. On the other hand, with these principles once understood, there is nothing to prevent the ambitious and intelligent student from either designing or constructing his own apparatus in a manner capable of giving good results.

The opening chapter of the book deals with the induction coil, showing its construction in diagram; the description is simple, succinct, and written in an interesting style. The student is led from the induction coil to transformers, condensers, spark-gaps, detectors, and so on through the complete list of apparatus most commonly used in radio work

Chapter X, devoted exclusively to amplification, deals with the subject from the "Multi-Audi-Phone" to the present-day valve. The chapter should be of unusual interest to students in that the development of wireless, present and future, would seem to centre about the vacuum tube as applied to both transmission and reception, therefore too complete an understanding of the subject is neither possible, nor compatible with ambition. Realising the rapid strides made by wireless telegraphy and telephony in recent years, it is understood that no longer can we afford to ignore the mathematics involved; therefore, to aid in the mastering of this *bête noir* of amateurs, the author has, in the three last chapters of his work, endeavoured to acquaint the amateur with the calculation and measurement of inductance. The formulæ involved are both simple and easy to follow, so much so that no student need fear for his comprehension of the subject.

WIRELESS TELEGRAPHY AND TELEPHONY.

By Alfred P. Morgan.

New York: The Norman W. Henley Publishing Company, 2 West 45th Street, New York City. Pp. 154, illus. 156. Third edition.

The author of this book has endeavoured to place upon the market a comprehensive explanation, in simple language, of the theory and practice of Wireless Telegraphy and Telephony.

The opening chapters of the book introduce the principles of wireless transmission, what is meant by aether, and how it serves as a medium of communication.

Chapter VI. gives an interesting description of the uses to which wireless is applied, in peace and war, on land and sea, and in the air. This chapter also points out how several enterprising newspapers recognising the value of wireless telegraphy in collecting and distributing news, have installed outfits for the assistance of their reporting bureaux. The little book is full of illustrations, making its reading doubly interesting. Full-page photographs of commercial and amateur wireless stations give the reader new ideas, new conceptions of the general outlay in the designing of wireless installations. Photographs of motor-car, airship, pack and field sets, together with full descriptions and methods adopted, may be studied with marked benefit to one's knowledge of wireless and general education.

One of the many favourable points in this book is the absence of any complicated engineering or constructional details other than those necessary to elucidate the text, and even those existing may be easily followed by the average reader, even without a knowledge of wireless.

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.**

N.H. (Newcastle-on-Tyne) *asks* (1) *If the crystal and valve set described in the April 17th issue would work with a frame aerial.* (2) *If a copper galena combination would give good results with this set.* (3) *About what range in miles would it have.* (4) *Where he can get No. 50 wire, and the price.*

(1) This set is not sensitive enough for good results with a frame aerial.

(2) Yes, any crystal combination could be used.

(3) This depends on aerial used, power of sending station, skill of user, local conditions and many other uncertain factors, and we therefore can give no answer.

(4) Consult advertisers in this magazine.

A.W. (Nuneaton) *sends a sample of carborundum, and asks if it is of suitable nature for use as a crystal detector.*

The crystalline structure and general character of sample sent do not point to its being suitable for a detector. We have tried it in a receiver and obtained unsatisfactory results.

A.J.S. (Northampton).—(1) Poldhu now sends at 1 a.m., 9.30 a.m., 9.20 p.m. (2) No, there is no direct connection between the coupling of the transmitter and the receiver. Best results are always obtained with coupling as weak as is consistent with fairly loud signals. The effect you mention, as far as it has any real existence, is probably derived from this point. (3) BYC most probably. 1920 Year Book of Wireless Telegraphy and Telephony.

T.T. (Rochdale) *refers to article page 99, issue of May 1st, and asks how it is possible to wind 3,320 turns with ⅜ lb. of wire, when there are only 233 yards to a pound.*

If you will read the article again you will see that it is only suggested that you should use 320 turns in all.

Article states that section 3 should contain 215 turns, not as you appear to have taken it 3,215 turns, which figure a very little experience would fix as quite absurd for the purpose. You will get 320 turns with ⅜ lb. as suggested.

S.E.P. (Enfield) *says that he has pancake coils capable of tuning to 33,000 ms., and a valve board. He asks for a diagram of a receiver capable of receiving C.W., spark, or phone to 20,000 ms. or more.*

You are ambitious in your range. If you get above 15,000 ms., which is unlikely, you will not find much C.W. ,spark, or phone to listen to. However, you will find a diagram on page 675, February issue. A H.T. battery should be introduced if your valve needs it. From your description and dimensions of your pancakes, we are fairly sure that they are not true single layer pancakes at all, but short multilayer coils; if this is so they will be quite useless for the purpose. We do not think you could tune to 33,000 ms. with true pancakes 4" in diameter with a 2" hole in the middle.

J.E.H. (London), *referring to Fig. 2 of the Proceedings of the Wireless Society of London, published in the "Wireless World," May 29th, asks* (1) *What are the working values of* Ba, Bg, C, L1, L2. (2) *Are* C, L1, *and* L2 *variable.* (3) *What class of valve can be used. i.e.,* N, Q, V24, R, K (*Mullard or audion*). (4) *Will a* P.O. *polarised relay wound with* 20,000 *turns* 44*g. enamelled approximate resistance* 1,600 *be suitable.*

(1) A very wide range of values may be used, but these will be found satisfactory :—

Ba = 60 volts ; Bg = 8 volts ; C = 0·0005 mfd; L1 = 85 mhys ; L2 = 500 mhys.

Additional condensers, say of capacities of 0·001 mfd. could be placed across Ts and the winding of the P.O. Relay.

(2) All fixed.

(3) An R valve, suitable for most purposes.

(4) An A or B Post Office polarised relay wound with 44 S.W.G. is suitable.

E.H. (London).—(1) Commercial sea-going operators must hold the P.M.G.'s certificate ; R.A.F. training would prove most valuable in procuring the commercial qualification. (2) It is impossible to say. (3) The Marconi's Co. age limit is 25.

A.H.R. (W. Ayton).—For information concerning FL and POZ weather reports, please see pages 847 and 863 of the 1920 *Year Book of Wireless Telegraphy and Telephony.* To answer your question more fully in these columns would be too big a demand upon our space.

A de D. (Flouppe).—Thanks for post card. The information is much appreciated.

THYRZA (Worcester Park).—Subject to the licences of the station this may be done. In any case permission must be obtained from the P.M.G.

J.B.B. (Purley).—Owing to the large number of technical questions with which we have to deal we are sorry we cannot spare the time to look up call letters for you. Most of the information you require in this respect is to be found in the Year Book of Wireless Telegraphy and Telephony or in the Berne List.

A.H.O. (Warrington) *asks* (1) *Where he could obtain working drawings for a wireless telephony receiver station for distances up to 800 miles.* (2) *Would the use of aluminium terminals be any serious disadvantage if used throughout the construction of the set.*

(1) We regret we know of no working drawings. Any receiving set constructed as described in the *Wireless World* would probably enable a strong telephone station to be received within the specified range. No special arrangements are required for telephony reception. (2) We see no objection except the difficulty of working the material

S.B. (Belvedere) *asks whether the same results would be obtained (a) by using a continuously graduated* A.T.I. *and a series condenser made up in progressive steps and (b) by using a continuously graduated condenser and an* A.T.I *tapped off in progressive steps.*

Yes.

D.H.B. (Ipswich) *asks what is the wavelength reached by a coil comprising* 250 *turns of No.* 23 S.W.G. *on a former* 3½" *diameter.*

We cannot say without knowing the circuit to which the coil is connected. If it is used as A.T.I. with standard P.M.G. aerial, the wavelength will be about 1,400 ms.

J.D. (New Cross) *gives particulars of a receiving set which he wishes to modify in accordance with the description of a set given in the issue of September,* 1919, *page* 354, *Fig.* 3, *and asks* (1) *Whether his original inductance* (305 *turns,* 22 S.W.G. *on* 7" *former) can be used as aerial inductance.* (2) *Whether Nos.* 22, 24, *or* 30 S.W.G. *are suitable sizes of wire for coupling coil and jigger secondary.* (3) *What would be suitable diameters of formers and gauge, No. of turns of wire, for coupling coil and jigger secondary to give a range of wavelengths of* 600 *to* 3,500 *ms. with existing double slide inductance.* (4), *What number of plates would be required for secondary tuning condenser of* 0·0003 *mfd. capacity if made* 3" × 3" *with glass dielectric* 1/32" *thick.*

(1) Yes. (2) Primary No. 24 S.W.G., secondary No. 30; (3) Primary former 5½" diameter, length of winding 8½"; secondary former 4" diameter, length of winding 7½". (4) One pair of plates will give you approximately the correct capacity. It is advisable, however, to employ a variable condenser for tuning the secondary circuit, the secondary inductance being kept constant, otherwise tappings or a slider on the secondary inductance will be required.

W.S. (Levenshulme) *asks* (1) *If a tuning inductance* 3½" × 11" *wound with* 600 *ft.* (720 *turns) approximate, of No.* 2 S.W.G. *enamelled wire with ten coarse and ten fine tappings is suitable for a single circuit crystal receiver.* (2) *What advantages, if any, are to be derived from a two-circuit crystal receiver as against a single circuit receiver, with an aerial within the* P.M.G. *limits.* (3) *What is a suitable capacity for a blocking condenser for use in conjunction with* A.T.I. *in* (1) *and* 2,000 *ohm 'phones.* (4) *What are suitable dimensions for a telephone transformer.*

(1) Quite suitable. (2) A two-circuit receiver is more efficient in every way. It allows greater control of coupling, more selective tuning and greater power of cutting out X's. (3) Try about 0·001 mfds. The exact value will depend on telephones. (4) See March, 1919, issue of *Wireless World.*

P.P. (Bootham) *asks* (1) *If a telephone receiver of* 3,000 *ohms will be efficient when used with a telephone transformer as described in the* "Wireless World." (2) *If the above transformer will not do, what are the dimensions of one that will.* (3) *If a telephone transformer is the only cheap safety device against shocks when working with valves.* (4) *If it would be possible to use* 3,000 *ohm telephones and no telephone transformer in the* "*Crystal Receiver and Valve Amplifier*" *as described in the April* 17*th issue.*

(1) and (2) No telephone transformer would be efficient with high-resistance telephones. Use without transformer. (3) Put telephones on earth side of high-tension battery. (4) Put telephones in place of telephone transformer and shift H.T. battery to plate side of tuned circuit. The set will probably not be quite so efficient when arranged in this way.

MICROHENRY (Barnet) *asks, referring to the article in May* 29*th number on* FL *weather reports* (1) *In the* 0945 *weather report programme, do they transmit BBB and then the reading, say* (7)6 3/10. *Similarly with the other letters. If not, how.* (2) *How do they differentiate between MM and mm, and how do they send β.* (3) *For position of Sea View wireless station.* (4) *Whether Malin Head is on Culver Cliff, near Sandown.*

(1) and (2) The letters referred to are not actually sent. For instance, instead of *BBB* (which is the model group for barometric pressure) three figures are substituted; these being the actual pressure in mms. and tenths of a mm. As the first figure is always 7 it is omitted, and a pressure of, say, 756.3 mms. would be sent as 563. This would be followed by two figures giving the direction of wind according to scale shown in article. (3) 52° 22′ N. 7° 19′ 25″ W. (4) No. Malin Head is on the N. coast of Ireland.

F.E.B. (Blackburn) *describes a receiving set and asks for criticism. He states that his aerial is suspended* 4 *feet above chimney stacks, and describes a type of tubular condenser for aerial tuning purposes. He further proposes to make a telephone transformer in accordance with the description in the March issue, and asks* (1) *What would be the resistances of coils wound with* 26 *and* 42 S.W.G. *wire instead of* 30 *and* 44 S.W.G., *and if it depends simply on the resistance of the wire itself.* (2) *If there is sufficient wire on a* ½" *spark induction coil to be able to convert it into a telephone transformer.* (3) *What is the resistance of an old style Bell type receiver, and would this be suitable with a telephone transformer.* (4) *If there is any means of testing his apparatus before the aerial and telephones are fixed.*

Your apparatus is all right except that the aerial is not suspended high enough above the chimney stacks. Further, the tubular condenser is not suitable for aerial tuning purposes; its capacity is probably considerably too low. With regard to your further questions. (1) The resistances would come out at 2,000 and 10 ohms approximately. The action of the transformer depends mainly on the ratio of the number of turns in the primary and secondary circuits; this would be quite upset by the alteration in the sizes of wire. (2) The ratio of turns and the resistance of the low resistance winding are quite unsuitable for a telephone transformer. (3) The resistance varies considerably over wide limits. The receiver could be used with a suitably wound transformer. (4) You could test your apparatus with a galvanometer.

W.O.M. (Bugle) *asks* (1) *For particulars of sizes and resistances of two samples of resistance wire, A and B.* (2) *What is size of sample of copper wire enclosed and whether it is suitable for secondary of loose coupler, the primary being wound with No. 26 SWG.* (3) *What is the value in microfarads of the following condensers—(a) Foreign made air-vane condenser, 22 moving plates, 23 fixed, calibrated in degrees 0°—180°, and marked 700 to 2,300 cm. (b) Tubular condenser 4½" long with inner brass tube ¾" diameter surrounded by thin sheet ebonite dielectric, stated to be about 1 cm. thick, and having outer brass tube fitting closely over ebonite sheath.*

(1) A, 47 SWG, 180 ohms per yard; B, 36 SWG, 30 ohms per yard. (2) Your sample did not come to hand. The information you give is insufficient in any case to enable us to answer the second part of your question. (3) (*a*) We cannot judge from the dimensions you give as the distance between the plates is not specified. The marked capacity is probably correct, 9×10^6 cms. being equivalent to 1 microfarad. (*b*) The thickness of the ebonite sheath (1 cm.) is clearly wrong. If the correct value is 1 mm., the maximum capacity is about 0·00034 mfds.

S.K. (Normanton) *asks* (1) *What is the capacity of a single wire aerial of 14 SWG copper wire, 85 ft. horizontal portion, 10 ft. down lead, height 24 ft.* (2) *If it is advantageous to use telephones of 4,000 ohms or more with a single valve set, or what is the best value.* (3) *If the set described in June 26th issue for* **H.E.J.S. (Ealing)** *could be given enough inductance with the above aerial to tune to 15,000 ms., or what would be the longest wavelength for fair efficiency.* (4) *In the above, what should be the capacity of the billi condenser, and what is a billi condenser.*

(1) 0·00018 mfds. (2) 4,000 ohm telephones will give quite good results. The best result would be obtained by using telephones of 8,000 ohms resistance or by employing low resistance telephones in conjunction with a telephone transformer. (3) We do not advise you to attempt to tune to more than about 8,500 ms. with this set. This would require an inductance of 100,000 microhenries in the aerial circuit. (4) 0·0003 mfd. The term "Billi Condenser" (billi = billifarad) is usually applied to a small tubular condenser used for fine tuning purposes.

W.J. (Colwyn Bay) (1) *describes a type of "loud speaking" telephone, having a resistance of 180 ohms, and asks whether it would give satisfactory results with the telephone transformer described in the issue of last March.* (2) *States that with a zincite-bornite crystal and 4,000 ohm telephones he can only hear Poldhu, Cleethorpes, Eiffel Tower and Nauen (Time signals), apart from 600 metre stations, and asks if he should be able to receive any other stations between 2,800 and 3,500 ms.* (3) *Gives diagram of circuit for criticism (Fig. 1), in which three variable condensers are of 0·00036 capacity and the telephones of 4,000 ohms resistance with blocking condenser. The position of the secondary is stated to be fixed, but it has 15 tappings brought out to studs. Particulars of aerial are also given.*

(1) Probably no advantage would be obtained by using the loud speaking telephone except with strong signals. (2) This is probably all right as there are not a great number of stations, other than those mentioned, which work on these wave-

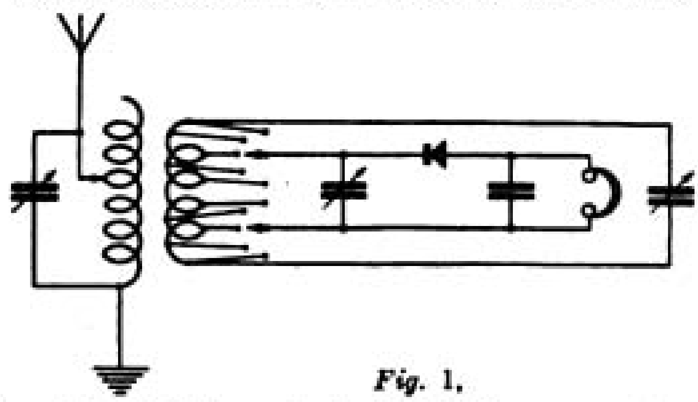


Fig. 1.

lengths. (3) Your circuit is all right except that the condenser C is undesirable and probably weakens signals considerably.

C.H. (Royton) *sends sketches of a 3-valve receiver and asks* (1) *For dimensions for A.T.I. and loose coupler.* (2) *What wavelength range will be, and if circuit is of good type.* (3) *If transformers are suitably designed.* (4) *If circuit could be improved.*

(1) and (2) Sizes for A.T.I. and coupler will, of course, depend on wavelength required. If you fix the maximum wavelength required you can then fix sizes of coils to suit, from constructional articles or recent replies in these columns. Circuit is of quite a good type. (3) The intervalve transformers are of too low a resistance. They should be wound to about 4,000 and 10,000 ohms with No. 44 or similar wire. The telephone transformer is O.K. (4) You might add a reactance coil in the plate circuit for C.W. reception.

F.S. (Swinton) *wishes to construct a telephone transformer and asks various questions regarding it.*

See issue of March, 1920. For the best results with your telephone we would advise 4 oz. of No. 34 in place of 6 oz. of No. 30.

PHONE IMP (Zurich) *asks* (1) *If reception with valves will interfere with neighbouring telephone service.* (2) *If interference will be caused by using a public telephone line as an aerial (F. Duroquier in his "Elements de T.S.F.," p. 59, stating the contrary).* (3) *How we reconcile the statement that in frame aerial reception the gear should be as high above the earth as possible with the essential of a short earth lead.* (4) *For suggestions for improvement of a sketched aerial system.*

(1) Not with a reasonably well designed set. (2) We should imagine there would be considerable interference with an ordinary circuit. There may, however, be some special method of preventing it known to the writer quoted. (3) We do not see the necessity for any reconciliation, seeing that no earth lead is used for frame aerial reception. However, remarks quoted should only be taken to mean that the gear should be in position to have little capacity to earth. (4) Aerial system is not good, but it is difficult to advise without know-

ing what is within your scope. At any rate, avoid having instruments at the highest point of the aerial system, if at all possible. Also raise mast end.

G.D.W. (Harlesden) *sends a very rough sketch of a frame aerial circuit with detecting valve and 3-valve L.F. amplifier. Set will not work and he asks for advice.*

Sketch is by no means clear: in fact it is doubtful whether frame aerial circuit is closed or not. This circuit should be closed, and the grid and filament of detector valve should be across the tuning condenser. You do not state type of detector valve, but it probably needs more than 12 volts on the plate. We do not know construction of L.F. amplifier in use. We take it there is a coil across the input terminals and that they do not go straight to the first valve? This is probably the case, but if not you should couple up to the amplifier through a step up transformer. A grid potentiometer in the detector valve would be an improvement.

F.M. (Walton-on-Tyne) *asks if he will get good results from a set consisting of an inductively coupled tuner, choking coil, with 2 slides, crystal detector, 2,000 ohm telephones and normal aerial.*

We do not know exactly how you propose to use both the loose coupler and two slide inductance. The gear could certainly be made to work satisfactorily if suitably coupled up, but it would have helped us considerably in advising you if you had sent a diagram of proposed connections and dimensions of coils. With the little information you give we should suggest using the 2-slide coil as an A.T.I.

R.F.P. (Godalming) *asks* (1) *If he is right in calculating the inductance of (a) a loading coil as 3,800 mhys., where number of turns per cm. (enamelled) is 13; length of coil in cms. is 22·2; and diameter of coil in cms. is 11·1. (b) A jigger primary as 1,550 mhys., where number of turns per cm. is 13; length of coil in cms. is 10·8; and diameter of coil in cms. is 13·3.* (2) (a) *Assuming the formula* $\lambda = 1{,}885\sqrt{LC}$, *what is the effect of switching out entirely the variable condenser in an aerial circuit since this should give, from the formula, an enormously large value for* λ. (b) *If the formula should be written* $\lambda = 1{,}885\sqrt{\frac{L}{C}}$ *when the variable condenser is shunted across the jigger primary. If so, surely the value of* λ *is absurdly large with a condenser of small capacity.* (c) *If the natural wavelength of an aerial be taken as 4·5 times its length in metres, will the loaded aerial have a wavelength of approximately this figure plus the wavelength of coil and condenser.* (3) *What is the approximate wavelength of 100 ft. horizontal aerial with loading coil and jigger primary as above, and with condenser of capacity 0·0035 mfd. (max.) shunted across the jigger primary.* (4) *With coils and condenser above, to what extent is it possible to increase the wavelength (in order to receive C.W.) by increasing length of aerial to an indefinite extent or by having two wires in parallel.*

(1) Yes, within fairly close limits. (2) (a) Formula is only true for simple closed circuit containing localised inductance and capacity, and does not apply to an aerial circuit. In any case the effect of switching out the variable condenser should apparently reduce the value of λ, as given by the formula, to zero, and not make it large. (b) This formula is incorrect. (c) No. There is no simple formula of this description. (3) Probably about 2,500 ms. (4) Only practicable way of increasing λ is by increasing coils or capacity. Doubling wire or increasing length has little effect.

RADIO (Rushden) *asks for the inductances of the following coils*—(1) 11½″ × 6″ *wound No. 22 wire.* (2) 9½″ × 4″ *wound No. 22 wire.* (3) 10¼″ × 6″ *wound No. 30 wire.* (4) 9″ × 4½″ *wound No. 22 wire.* (5) 18″ × 2″ *wound No. 22 wire.* (6) *He also asks for natural wavelength of an aerial of given dimensions.*

(1) 11,500 mhys. (2) 4,500 mhys. (3) 45,000 mhys. (4) 4,500 mhys. (5) 1,200 mhys. (6) About 65 ms.

AMBITIOUS (Wellington College) *says that he cannot find in any book a suitable circuit for spark and C.W. reception from 300 to 20,000 ms. He asks for a suitable design, with details of all inductances.*

You are indeed ambitious. The design of a good set of such abnormal range is a lengthy and not easy matter, and is quite out of the scope of this section. There is no special type of circuit which should be employed, as any reasonably good one would do. In any case you cannot expect to get really useful results over such an extreme range with a small aerial. We think your ambition would be better employed in mastering the methods of designing and calculating dimensions for a receiver of ordinary range, rather than in building a freak receiver which would be of very little use when made.

WIRELESS J.P.M. (Havre) *encloses a design of a type of electrolytic rectifying valve for charging accumulators with A.C., consisting essentially of two plates, aluminium and lead, immersed in a solution of potassium or magnesium phosphate, the action of which is to interrupt the flow of current from the aluminium plate to the lead plate but to allow the passage of current in the opposite direction. The effect is obtained owing to the formation of a film of alumina on the aluminium plate when the latter is positive, this film being reduced in the succeeding half cycle, owing to the evolution of hydrogen. He asks if this manner of charging is feasible without damage to the accumulators, and wishes to know if we can tell him of a better valve which can be made by an amateur.*

We do not think that the method described would damage your accumulators provided the instructions regarding the manufacture of the valve were carefully carried out. The only possibility of damage would be through the passage of a large reverse current during the half cycle, when the aluminium plate is positive. During this half-cycle the voltage across the valve is that of the battery on charge, plus that of the alternator; this should be taken into account when charging up a large battery. Undoubtedly this danger would be lessened by a method of double rectification, employing both half cycles of the alternating current; this method would have the additional advantage, as pointed out in your description, of making the charging process more regular. We know of no other rectifier of this nature which could easily be made by amateurs.

CIRCUIT (**Glenageary**) *asks* (1) *If, to save expense, the tuning inductance, as described in the "Wireless World," December, 1919, could be wound with No. 26 enamelled copper wire instead of No. 26 D.W.S. wire, and if it would work as well.* (2) *If circuit (Fig. 2.) is good.*

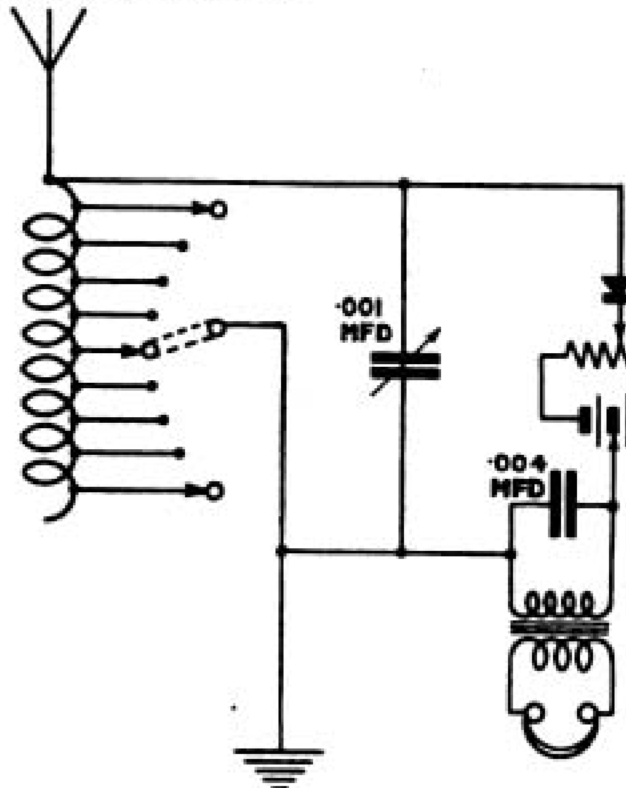


Fig. 2.

(1) Enamelled wire could be used if carefully wound. The results should be nearly as good if the insulation is not damaged in winding. (2) Your circuit would be all right with a double slide coil and a smaller variable condenser, say 0·0005 mfd.

C.A.J. (**Bury St. Edmunds**) *wishes to instal a wireless telephony receiving set and asks for particulars as to cost of instruments and where to obtain them; also, what combination will give fair results for a small outlay.*

Your questions are so very general that it is difficult to advise you. We recommend an examination of lists of various advertisers in the *Wireless World*, the choice of a set being largely dependent upon the length of your purse. In your case we recommend buying a complete set rather than separate parts. Quite interesting results can be obtained with a crystal only; better can be got with a valve, and the best of all are obtained with some combination of several valves. A fairly efficient crystal set could be *made* for about £1, and a single valve set for about £3, including valve. The cost of mast gear is not included in either case. Prices of sets of either type, if purchased complete, will, of course, be considerably higher. Consult recent issues of *Wireless World* for many suitable circuits.

F.L.K. (**Greenwich**) *sends description of components of receiving set and a sketch of proposed connections. He asks* (1) *What will be range of wavelengths, and* (2) *What will be greatest distance of reception.*

(1) Circuit shown will be quite useless. Consult any diagram of a crystal circuit for proper connections for telephones and detector. Telephones are of rather inconvenient resistance (1,000 ohms)—too high for use with transformer and too low for use without. Loose coupler primary should preferably be wound with coarser wire than No. 30. Range when correctly coupled up will be up to about 2,500 ms. (2) See reply to **W.H.** (**Bolton**).

K.E.H. (**Walthamstow**) *asks for windings for a loose coupler for 300—900 ms., the formers being, Primary, 8″ × 6″ and secondary 8″ × 5″; the aerial being somewhat shorter than the P.M.G. limit.*

Formers suggested are somewhat large for this range. You should get rather more than this by winding primary with No. 20 and secondary with No. 22. Wound thus, the coupler should be very efficient. Winding with somewhat finer wire will give you a larger wavelength range with practically as good signals.

X-RAY (**Birmingham**) *asks* (1) *Exactly what is the limit required for a P.M.G. license as he wishes to experiment in principles, resonance, etc.* (2) *If he would obtain a sinusoidal current by attaching a slip ring to one point in the winding of a D.C. motor running off a battery, the other end being earthed, and what would be the efficiency of the arrangement.* (3) *With reference to a spark coil rated at ¼″ spark, but only giving about ⅛″ spark on about 8 volts, 1·5 amps, what current would be required for the full spark? It is stated that in connecting the extra capacity across the break, the spark falls off rapidly.* (4) *For dimensions of a Tesla coil to be run off the coil in* (3).

(1) There is no question of limit. To possess or use wireless apparatus you must have an official permit. (2) This is not easy to do. If done, the current will be alternating, but almost certainly not sinusoidal—the wave form will probably be very poor. The efficiency will be very low, output in watts probably less than 25 per cent. of input. (3) You give too little information. The extra capacity, of course, reduces spark; possibly you have some already, in which case spark will be less than rated value. The insulation may also be faulty. (4) Outside our range, but see recent reply *re* Tesla coils.

R.G.A. (**Ashington**) *encloses sketch of receiving set and asks* (1) *For criticism of the set.* (2) *If potentiometer would be of use as filament potentiometer.* (3) *With a suitable loading coil, would the set take* FL *and* PCGG.

(1) O.K. (2) No, resistance would be too high. Your filament resistance should only be about 2—3 ohms, while potentiometer should have resistance of about 200 ohms. (3) Range would be quite as high as you wish, but, as you suggest, you may find an additional loading coil useful.

CONSTANT READER (**Kingston**) *has a set which gets X's but no signals. He asks for advice,* *and sends diagrams of 4 circuits tried. He says that all the apparatus has been tested and is quite O.K.*

Your trouble is rather mysterious, for we can find no fault with any of your circuits, except that in the valve circuits the tuned circuit condenser is too small (0·000015 mfds.). You do not give dimensions of coils; we presume these are fairly normal. We suspected your aerial, as rubber insulated wire is liable to break under the insulation and yet appear sound; but use of aluminium aerial negatives this. Are your telephones perfectly satisfactory? We can only suggest carefully examining all connections, and putting down a new and larger earth system.

W.H. (Bolton) *sends a sketch of a variometer (Fig. 3), which he proposes to use for aerial tuning, and asks (1) If it will be suitable. (2) How far certain gear will receive messages. (3) What size wire to use on the variometer.*

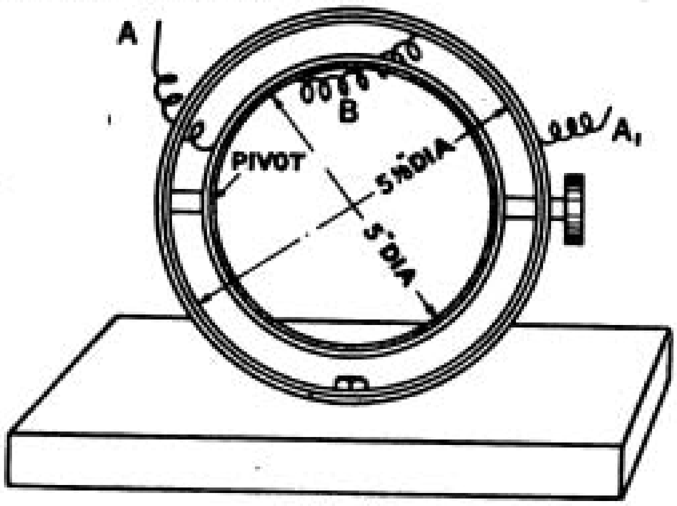


Fig. 3.

(1) Variometer shown has two layers of 12 turns on each coil. It is always undesirable to wind more than one layer on a receiving coil. Variometer shown should be quite useful for fine tuning, but will not contain anything like enough wire to tune aerial to average commercial wavelengths. It should be used in series with a single layer coil of many turns tapped at, say, every 50 turns. (2) It is never possible to say what distance any set will receive as this depends on many factors which cannot be predicted. Set suggested should give useful results if properly connected up. Range will depend largely on skill in construction and use. (3) Use about No. 22 or 24 wire, and put as much as you can get on single layers.

R.G.H.C. (Portsmouth) *quotes a formula attributed to Austin—*

$$I_2 = 4{\cdot}25\, I_1 \frac{h_1\, h_2}{\lambda\, d}\, \epsilon^{\frac{-ad}{\sqrt{\lambda}}}$$

and asks why it is that no allowance is made for the effect of directional aerials, which, he states, must have many times the radiating power in one direction than in another. He suggests that the formula would only be applicable to single wire vertical aerials.

The expression was obtained empirically for umbrella aerials, and, of course, applies only to this type. No attempt was made at the time to derive an expression for directive aerials. The directive effect for any aerial, of ordinary and not direction finding type, is never "many times" the ratio of maximum strength to minimum, and is seldom as much as 3.

SPARKS (R.N.V.R.) *suggests the following dimensions for a loose coupler to tune a P.M.G. aerial to 8,000 ms.: Primary, 4¾" × 3¼" wound with No. 22. Secondary, 4¾" × 3" wound with No. 30. He asks if this will be satisfactory.*

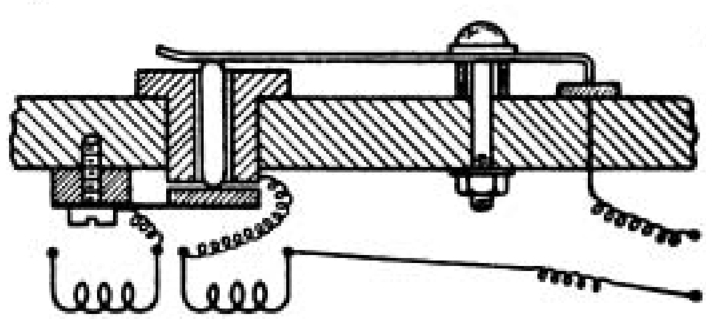
Coupler suggested is much too small for this range. Following dimensions would be more suitable: Primary, 12" × 7" wound with No. 32. Secondary, 10" × 5" wound with No. 32.

S.J.D. (Seacombe) *asks (1) Are there any books published on the subject of wireless control of a model, such as a boat that could be made to start, stop or turn round while in the middle of a lake. (2) Who are the publishers. (3) Are amateurs allowed to use a wireless receiving set with or without a licence, and (4) If a licence is essential, where can same be obtained.*

(1) "Radio-dynamics," by B. F. Meissner. (2) Crosby, Lockwood & Son, 7, Stationers' Hall Court, E.C.4. (3) and (4) No; application for a licence should be made to the Secretary, G.P.O., London.

NOTE.

Below we present another diagram relating to the article "Wireless Gadgets and Fancies" which appeared in our issue of August 7th. The author informs us that the white central portion of the stud is of bone, the stud being metallic. The shaded portion beneath the bone is metallic, and is soldered to the spring. The lead-in is taken to the right-hand end of the inductance.



SHARE MARKET REPORT.

Since our last issue business has continued to be very quiet in the Share Market.

Prices as we go to press (August 26th):—

Marconi	Ordinary	$2\frac{1}{16}$
,,	Preference	$2\frac{1}{8}$
,,	Inter. Marine	$1\frac{1}{4}$
,,	Canadian	10/6

The WIRELESS WORLD

VOL. VIII. No. 13, NEW SERIES] SEPT. 18th, 1920. [FORTNIGHTLY

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

VOL. VIII. No. 13. SEPTEMBER 18TH, 1920 FORTNIGHTLY

INDOOR AERIALS

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

(*Continued from page* 411.)

IT is not essential to employ reaction with such receivers, but it forms a convenient means of increasing the sensitiveness of the apparatus without having recourse to a multi-valve amplifier. The reaction need not necessarily be increased up to the point where oscillations commence, as the signals—both spark and C.W.—may be augmented with any degree of reaction, although, of course, C.W. signals (except in the case of telephone or buzzer modulated transmission) cannot be detected unless a separate heterodyne is used, or the actual receiving valve is oscillating.

In connection with these indoor aerials of reduced size, attention may be called to the paper read by Mr. G. G. Blake at the last meeting of the Wireless Society of London,* in which for aerial a single wire a few feet in length only was used. This and the earth connection were joined up across the receiver terminals in the manner described above, and similar to that shown in Fig. 3, page 411, Sept. 4th issue.

Incidentally, it may be remarked that those experimenters fortunate enough to possess a complete heterodyne wavemeter unit may employ it very easily as a receiver in connection with experiments such as have been described above, since the arrangement shown in Fig. 3 constitutes little more than a simple form of separate heterodyne unit with the aerial and earth connections joined across the tuning condenser in the grid circuit. With some forms of heterodyne unit, as made up in practice, provision is made for joining the telephones into the grid circuit of the valve instead of in the plate circuit. Although possessing some advantages from the point of view of the heterodyne itself, the arrangement may with advantage be modified when required for the above mode of use, so that the telephones are joined in the plate circuit in the usual manner of detecting valves, or coupled thereto by means of a telephone transformer, if preferred.

With regard to the use of short lengths of wire indoors to form receiving aerials, it may be pointed out that it is not essential that the wire used should be one specially reserved for use as the aerial. As a matter of fact, it is quite possible to so employ almost any wire that may be found about the house, generally without in any way interfering with its normal functioning. As examples, lengths of bell wire forming part of the ordinary electric bell circuits, may very easily be used, as may also telephone circuits, and even the electric light wires, if proper precautions are taken. In general, when using for the aerial wires that may also be employed for other purposes, it is advisable to insert in circuit with the wire joining on to the receiving apparatus a small condenser, of, say, about 0·001 mfd. capacity or more. When this is done, the earth connection, which is normally joined to the other

* *Wireless World*, 8, pp. 316-324, July 24th, 1920.

terminal of the receiver will not interfere with the circuit wires. This point is of especial importance if the electric light wires of the house be employed, as the large majority of the public lighting supply systems have an earth connection at some point of the system, and great care must then be taken that no earth connection is made at any other point or the circuit fuses will most likely be blown. The condenser used must be one that will safely withstand the voltage of the supply circuit, and greater safety is secured if a lamp is joined in series between the receiving apparatus and the line wires. When these precautions are taken, the connection may be made to the wires at any convenient lampholder, taking care, of course, that only one wire is employed so that the supply circuit is not short circuited. Less risk is attached to the use of a telephone circuit for the aerial, but the condenser should in any case be included, so as to avoid disturbing the signalling arrangements at the telephone exchange. Wires that are encased in earthed conduit or sheathing would not be suitable for these purposes.

Another piece of apparatus that may readily be made to serve as an indoor aerial is a long helix of wire, such as was described as suitable for exhibiting the phenomena of stationary electric waves on wires.* One of the earliest applications of a long helix for the exhibition of such stationary waves was made by G. Seibt in 1892, subsequently to which they have been employed by many workers, notably by Prof. J. A. Fleming, who, also in 1904, described many useful modifications of the original Seibt apparatus.† When such a helix is oscillating at its fundamental wavelength, the nature of the waves established along it resembles closely the conditions existing in an ordinary elevated aerial, except merely as regards size, and therefore it seems natural to suppose that such a coil could be made to serve as an aerial for reception purposes. As far as the writer is aware, however, no mention has been made of the use of such a helix of manageable size as a receiving aerial until the publication of the results of some recent tests by General G. O. Squier. In the simplest of all arrangements one end of the helix may be connected to one terminal of the receiver, the other terminal of which is earthed, as in Fig. 3, and the tuning effected by means of the variable condenser C_1. The helix is then used merely as a conductor having a capacity to ground by reason of which the signals can be picked up. If provision is made for tapping a connection on to various points along the helix, it is possible to dispense with C_1, and to tune up the complete aerial circuit comprising the helix and the coil L_1 (Fig. 3), by varying the number of turns in the helix, in a similar manner to tuning up an ordinary receiving circuit.

Another way in which the helix can be used is to suspend it horizontally a few feet above the receiving apparatus, and to connect its two ends to a tuning condenser to the terminals of which the receiving valve is connected, as indicated in Fig. 4. In this

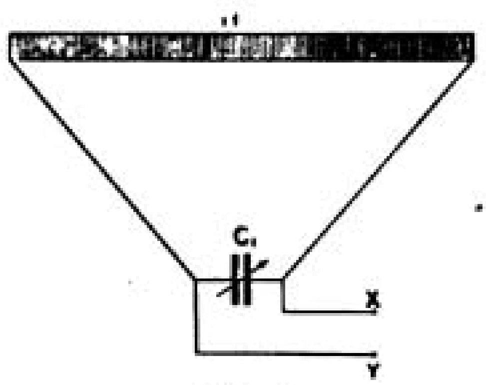


Fig. 4.

diagram, H represents the long helix, and C_1 the variable tuning condenser. The points X, Y, in this diagram correspond with the points marked X, Y, in Fig. 1, and the apparatus shown to the right of those points in that figure may be joined up to these same points in Fig. 4. When used in this way, the helix may be looked upon as forming a single turn receiving loop, but at the same time it possesses a very much greater inductance than an ordinary single turn loop of the same size would have. Such an arrangement is therefore very suited to the reception of long wavelengths, as the tuning condenser can be

* *Wireless World*, 8, pp. 217–219, June 26th, 1920.
† *Philosophical Magazine*, 8, p. 417 (1904).

kept down to a reasonable size, whereas with an ordinary single turn loop a very large condenser would be required, and the reception would consequently be very inefficient. It is not meant to imply by these remarks that such an arrangement is more efficient than a well designed multi-turn loop aerial would be if it were properly designed for the wavelength to be received, but the method forms an unusual application of an aerial with a concentrated inductance, or rather with an augmented inductance, as compared with the corresponding single turn loop of the same size. It should also be noted that the turns of the helix themselves can form a not insignificant loop aerial, and it is probable that in the case of the arrangement described above, this action forms part of the mechanism by means of which the signals are received.

This brings us to a consideration of the arrangements particularly described by General Squier, in which, apparently, the turns of the helix form a multi-turn loop for picking-up purposes. However, be this as it may, the helix he employed (or resonance coil, as he terms it) was connected to earth at one end, and connected to the grid of the receiving vacuum tube at the other, after the manner shown in Fig. 5. In this diagram, H represents the long helix, which was connected to earth at the left-hand end as shown. A moveable contact S, or rather a sliding band of metal which provided a capacity connection to the helix at various points along its length, was connected to the grid of the first valve V_1 of a multi-stage amplifier, a resonance circuit L C being joined across the grid, and filament

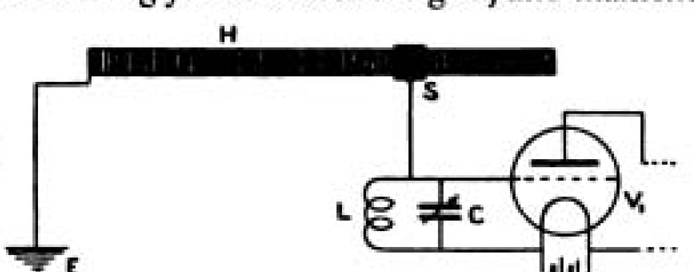


Fig. 5.

terminals of the valve in the manner indicated. When in use, the helix itself was tuned up to the wavelength to be received by moving the sliding band S along its length until the appropriate point was found, and the circuit L C was also tuned up to the same wavelength, when it was found that signals could be heard from distant radio stations, and, what is more, that the helix possessed the properties of directional reception. These directional properties were found to indicate the true direction of the incoming waves, and, therefore, to be unlike those of the ordinary loop aerial, which gives only the line of the transmission which is being received, and not the actual direction.

As regards the mechanism of this indication of the absolute direction, it would seem likely that the helix in this case is operating both as a loop aerial and also as an ordinary elevated aerial, having capacity to earth. If this should be the case the true direction would be indicated for the same reason that the loop arrangement described on page 350 of the August 7th issue of the *Wireless World* indicated the true directions. In any case, however, such an arrangement forms an interesting piece of apparatus for experimental work, and as such is worthy of attention.

While on the subject of reception with small aerials, it may be worth mentioning that it will often be found that the coils of the receiving apparatus itself are capable of picking up quite an appreciable amount of energy from a distant station. This effect is particularly noticeable when using multi-valve amplifiers with considerable magnification, and is also a point to be borne in mind when experimenting with small aerials, as the energy picked up in this way by the coils of the receiver may often mask any special effects that may be looked for.

Finally, for receiving purposes, given a sufficiently sensitive apparatus with a valve amplifier, almost any conducting object that possesses capacity to earth may be used to pick up radio messages at least from the higher powered radio stations, and many interesting tests may be carried out by the enthusiastic experimenter using various common objects to be found about the house.

A SINGLE VALVE TRANSOCEAN WIRELESS SET

WE have received from a reader particulars of a receiving set designed by himself, which is the result of an attempt to get the best possible results from *one* valve, using an aerial of the dimensions allowed by the P.M.G. Believing that many of our readers must have been striving after the same desirable end we have much pleasure in publishing the following account of the set.

It will be seen from the illustration that the apparatus consists of a single valve and also a crystal detector built in a special manner, so as to be absolutely protected from dust or moisture.

Of course, for C.W. reception the valve is used alone; but for spark reception the current is first rectified by the crystal and then amplified by the valve. The crystal affords a convenient stand-by for taking time signals, etc., or for use when possible battery failure has rendered the valve side inoperative. A tumbler switch is provided, and this controls high and low tension circuits; thus, when it is desired to commence reception, one switch is merely thrown over.

The designer of this apparatus states his conviction that the best way of tackling the problem of all-round reception is to read direct by either valve or crystal wherever possible; if amplification is desired, this can be effected by a separate amplifier which will either amplify the C.W. or crystal signals at will.

The apparatus shown in the illustration is of an ideal form for use before an amplifier, should amplification be really necessary, and the amateur is strongly recommended to work along these lines.

The tuner is of special design which renders

The set complete except for 4-volt accumulator.

the use of a variable condenser unnecessary. The coils are of the honeycomb type, cast in wax; eight of these cover all wavelengths from 200 to 25,000 metres on a standard 100 feet aerial. Tuning is effected in the following manner:—The largest coil of a selection of three is used for reactance, the next coil in size is spaced at the correct distance from this to give maximum reaction effect, whilst the smallest one is then moved backwards and forwards to obtain correct tuning.

On the extreme right of the coil stand is shown a coil of the smallest size, as used for receiving 600 metre waves on a ship's aerial approximately 200 feet in length.

It will be gathered from the foregoing that this type of tuner has the following advantages over old style transformers. There are no stops, dead ends or sliding contacts; tuning is therefore free from the mechanical noises inseparable from old type coil apparatus. These noises are positively injurious to the head if the coils are used before amplifiers of high power.

The new type of coils are wound crosswise from side to side as the coil is revolved, thus ensuring that the distributed capacity is kept as low as possible.

Another feature about these coils is that, especially when oscillating, they are particularly free from static noises; for instance, whilst using them it has been possible to continue reception from Annapolis after Nauen has asked that station to cease sending on account of static.

The coils are provided with silk wrappings of different colours so as to be immediately distinguishable by the eye; incidentally, the silk wrappings obviate mechanical noises when a slight movement is necessary for tuning purposes.

Low resistance telephones and a telephone transformer are used. The crystal detector is of zincite, bornite, or zinc and tellurium, and are mounted up inside a rubber tube for the purpose of keeping them absolutely free from dust or moisture.

At the right hand side of the illustration is shown the high tension battery with a four-stop tapping down from a maximum of 75 volts, so that the illustration shows everything required for reception excepting a four-volt accumulator.

The apparatus has proved itself to be highly efficient over all wavelengths used, from 600 metres to that employed by the new Lafayette station, whose wavelength must be in the neighbourhood of 18,000 metres.

One particular set has been in constant use for receiving signals from the high wavelength American stations; it has always afforded clear reception of Annapolis time signals at 6 p.m. British summer time, and this station and at least two other American stations can be read without amplifiers, provided it is dark in America. The aerial from which this particular apparatus works is 160 feet long, single wire.

When using a single wire aerial 100 feet long, there is no difficulty whatever in obtaining readable signals from America, under favourable conditions, but the aerial must be directional.

As to the actual performance of this set when used in conjunction with aerials conforming to Post Office regulations, suffice it to say that it will give signals from stations as distant as Annapolis (U.S.A.), Moscow and Malta. Considering the simplicity of the whole outfit and the fact that only one valve is needed, "daylight signals from America" is a noteworthy achievement. In a "rough and ready" test, for which was used an aerial consisting of a few yards of wire, mostly in wooden casing, and all inside a house, this set gave excellent signals in London from Horsea and Eiffel Tower.

NOTES AND NEWS

Wireless in the Fishing Industry.—A number of North Sea trawlers, together with many steam drifters have been fitted with wireless telegraphy. Although their transmitting radius is small, the receiving capabilities are of the average. The purpose of the installations is said to be receiving, and most of the messages handled by them are in relation to the state of the fish market. When the market is glutted and the price of fish is low, they are instructed to stay out and continue their fishing for another day or two. Similarly, when conditions force dealers to sell fish as manure, the fishing hauls can be diverted to other parts more fortunately situated.

S.S. "Vaterland's" Wireless Apparatus.—On this ship, recently recommissioned, there are three complete wireless transmitters, one of which is worked in connection with a high frequency generator, this being the first instance of the use of such a generator on board ship. For transmitting on waves of 600 to 1,800 metres, and for use with the high frequency generator, an aerial, 190 metres long, is carried. For shorter wavelengths and for emergency transmitting two other aerials are provided, each consisting of a single wire spread between the funnels.

Secret Wireless in Ireland.—Recently a complete wireless installation was found in a house at Drumsna, co. Leitrim: the police attach much importance to the capture of the installation.

World's Largest Wireless Station.—It would seem that there is a keen competition at present between various nations as to which of them shall have the most powerful wireless telegraph station. A claim was made by the United States some time back, but was outclassed by France asserting that her new station at Bordeaux would be the biggest. Now it is announced that the Radio Bureau of the Swedish Telegraph Department is planning the erection of a large wireless station to deal with traffic with the United States. The proposed station will be able to maintain constant communication both night and day, with North America, and will have such a great range that during favourable atmospheric conditions it will be able to embrace practically the entire globe. The Ridskag has already appropriated two million kroner for the purpose.

New Petrol Motor for Wireless.—Messrs. C. P. Harrison, Ltd., of Birmingham, will shortly put on the market a new 2-h.p. two-stroke petrol engine suitable for wireless telegraphy and telephone work.

A Luxurious Bathchair.—Visitors to Asbury Park, N.J., U.S.A., are being entertained with a somewhat unique innovation introduced by Mr. W. H. Warren in the form of a bathchair fitted to receive wireless telephony signals as the passenger is wheeled along the boardwalk. Various demonstrations, conversations and music may be enjoyed by interested pedestrians, and so compact is the

The Masts (475 feet high) and Aerial at the Marconi Works, Chelmsford, which are used for the Wireless Telephony Demonstrations.

apparatus said to be that three persons can sit comfortably in the chair.

Lizard Wireless D.F. Station.—This station ceased to be in operation from midnight (G.M.T.), August 22nd/23rd, and will not function until further notice. The position of this station is Latitude 49° 59′ 07″ N., Longitude 5° 12′ 18″ W.

Private Wireless in Australia.—The Council of the Wireless Institute of Australia (New South Wales Division) has drawn up a scheme under which it is proposed that members shall operate privately-owned experimental wireless stations. Commenting on the scheme, the Secretary, Mr. Malcolm Perry, writes: "As distinct from the commercial and military uses of wireless, the construction and operation of experimental wireless apparatus is a class of study and pastime which attracts a very large number of people of both sexes and of all types. In Australia to-day there are between 1,000 and 2,000 wireless experimenters, and it is anticipated that the number will grow very rapidly. It is a well-proven fact that the private experimenter has made valuable contributions to the advancement of this art, while his services in the war were invaluable because the ranks of experimenters provided a large number of men who could be quickly brought up to the stage of experts for naval and military purposes. There has been a tendency in this country to legislate against the private experimenter, but that has been happily overcome, and regulations were recently passed through the Federal House which provide for licensing privately-owned experimental stations. The same official ideas which created a tendency for prohibitive legislation, are of course still in existence, and likely to be used in restricting the liberties of the experimenter."

Air Ministry Weather Reports.—As from September 1st the synoptic reports issued from the Air Ministry and Aberdeen, will be as follows:—Air Ministry (GFA), wavelength 1,400 metres C.W., at 0315, 0845, 2015; Aberdeen (BYD), wavelength 3,300 metres, at 0230, 0830, 1430, 1930; the times being Greenwich Mean Time.

Wireless Telephony Developments. — On August 19th Messrs. Instone & Co. successfully established communication with their aeroplane, *City of London*, during its flight to Paris, by means of combining the ordinary telephone with wireless telephony instruments.

After the machine had left the Croydon aerodrome for Paris it was found to be urgent to convey some special instructions to the pilot, on business connected with coal supply at Marseilles. Mr. Instone telephoned to the Air Ministry seeking their aid, and was able through them to connect his ordinary telephone with their wireless telephony installation at Croydon. By the combined telephones communication was established with *City of London*. Mr. Instone then gave the instructions he was anxious to communicate, and as an additional test of the capabilities of the telephone under these special conditions, the pilot of the machine read a passage from a newspaper which Mr. Instone was able to follow. At one point communication was interrupted by the telephone exchange, being restored again in the ordinary way, after conversation with the operator.

Wires and Wireless.—A working agreement has been entered into between the American Telephone and Telegraph Company and the G.E.C., whereby both obtain the mutual use of all patent and scientific secrets. At present the G.E.C. is associated with the Radio Corporation. Mr. Thayer, President of the G.E.C., says, with reference to the new agreement, "The world-wide wireless system of the Radio Corporation and the universal service of the Bell system are thus brought into a harmonious relation that will facilitate the use by the public of the present wireless telegraph facilities of the Radio Corporation, and as the art advances, will enable the American Telephone and Telegraph Company to extend its telephone service to ships at sea and to foreign countries." The arrangement also makes it possible, according to Mr. Thayer, for several conversations to take place simultaneously.

Costa Rica and Wireless Telegraphy.—The *Gaceta Official* (San José), of June 10th, published the following decree:—"The Executive Power is authorised to employ the sum of 250,000 colons from the Public Treasury in the purchase and installation of a wireless telegraphic or telephonic station of sufficient power to obtain direct or indirect communication with the places in the world where wireless telegraphic and telephonic, cablegraphic or telegraphic public offices have been opened."

Amplification of French Wireless.—The reorganisation of the French systems of posts, telephones and telegraphs, and the amplification of the wireless network, were the subjects recently of a speech by M. Deschamps, Under-Secretary of the Department concerned with these services. Existing stations, said M. Deschamps, already had received or forwarded 4,500 radiotelegrams in January, 4,800 in February, and 5,730 in March. The long distance network organisation was under weigh. While awaiting the establishment of a station specially designed to exchange radiograms with the great European stations, the administration purposed utilising the Tour d'Eiffel station, and perhaps that of Doua, near Lyons, and, if agreeable to the Ministry of Marine, the station of Basse Lande, at Saint Philibert de Grand Lieu. There was already a service of several hours' duration daily with Hungary, and another was about to be opened with Belgrade. Negotiations had been begun with the American Radio Corporation with a view to setting up connection between Tuckerton and the Doua station. The last-named would only be used for Franco-American traffic until the completion of the Croix d'Hins station, near Bordeaux. Lastly, the administration, in agreement with the Ministry of the Colonies, had framed a programme for a network of very powerful stations directly linking the French capital with all its oversea colonies. The construction of the colonial network would take some time, but meanwhile a temporary system was under consideration for the use of the Press, and private telegrams by means of fairly powerful stations linked up to the Doua station and that of Croix d'Hins, which will shortly be working. This programme, M. Deschamps says, when completed, will render France independent of the English system.—*The Electrical Review.*

Observations on Radio Transmission Phenomena.—The Bureau of Standards has secured the co-operation of the A.R.R.L. in a collection of data for a study of the nature and causes of the fading of wireless signals. It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, this variation probably depending upon the weather and various meteorological conditions. In order to secure simultaneous observation of signals, arrangements have been made for a number of well-equipped amateur wireless stations, including six transmitting stations and about forty receiving stations, to begin a series of tests. Forms have been provided by the Bureau of Standards, on which the operators will record the strength of the signals which they receive, weather conditions, presence of strays or atmospheric disturbances, and the general character of wireless transmission at the time of each observation. It is hoped that from this programme of careful observations, some valuable conclusions regarding wireless transmission will be arrived at.

Dr. Eccles and Mr. Jordan.—With reference to our digest of the paper of these gentlemen, on page 460 of this issue, the following letter is of interest :—

To the Editor of the " Electrician."

Sir,—In your issue of the 13th inst., Dr. Eccles and Mr. Jordan describe a method of amplifying electrical low-frequency variations by the use of a subsidiary high-frequency oscillation. As we have recently been carrying out some experiments of a different character, which also emphasise the utility of this method, it is perhaps worth while to communicate one of our preliminary results. A self-excited triode high-frequency *generator* can be used as a very efficient low-frequency amplifier, the low-frequency voltage amplification factor under such conditions being quite different from the natural factor of the tube. Thus it has been possible to produce a voltage amplification of 40 with a tube possessing a natural factor of 10. The circuits we used are different from those described by the above-mentioned authors, but have one principle in common—the use of a subsidiary high-frequency oscillation.

We are, etc.,

E. V. APPLETON.
MARY TAYLOR.

Cavendish Laboratory,
Cambridge.

August 20.

Hourly Weather Reports.—The Air Ministry, in an Official Notice to Airmen, details innovations recently introduced in the dissemination of meteorological forecasts by wireless telegraphy for the use of aircraft. Reports are issued from the Croydon aerodrome on 900 metres C.W. each day, including Sundays, at hourly intervals between 7.30 a.m. G.M.T. and 4.35 p.m., the data in each consisting of observations made 35 minutes previously at the following places :—Felixstowe, Croydon, Biggin Hill, Lympne, Beachy Head, Botley Hill, (North Devon). In addition to the usual information, the messages include the direction and speed of low cloud, the character of the sea-swell, and the visibility towards the sea as distinguished from that over the land, the latter feature being observed at various points along the Channel coast. Reports of a similar character are also issued on the same wavelength from Le Bourget seven times daily, observations transmitted in this case being delivered from St. Inglevert, Abbeville, Maubeuge, Havre, and Le Bourget.

The British Association.— The only paper delivered upon the subject of Wireless Telegraphy this year was given by Prof. G. W. O. Howe. The subjects chosen were the efficiency of aerials and the power required for long-distance transmission. It was pointed out that the great discrepancies in the calculated values of the power required for long-distance transmission indicated the necessity for further research, mentioning that, as far as present knowledge went, the power required to transmit messages a distance of 10,000 km. might be either 10 k.w. or 20,000 k.w., or anything between these two limits.

Another Shanghai Station.—According to the *Times*, a powerful wireless station, which will be available for commercial and official purposes, is to be established at Shanghai. Already there are two stations of medium power and one of high power at this Far Eastern city.

New Wireless Service.—The *Naval Communication Service* began on August 17th, when commercial, private and press messages were accepted for transmission to France by wireless. Messages will also be accepted for Belgium, the Netherlands, Italy, Switzerland, Luxemburg, Czecho-Slovakia, and Jugo-Slavia, *via* Lyons.

Wireless Telephony at Sea.—Lord Liverpool, the retiring Governor-General of New Zealand, who arrived at Southampton on August 21st in the White Star liner *Ionic* had an interesting experience off the South of Ireland. He was awakened from sleep and told that Lord Jellicoe, the new Governor-General, wished to speak to him. Lord Jellicoe was then some miles away, on the outward-bound *Corinthic*. By means of wireless telephony, however, conversation and good wishes were exchanged.

Commercial Wireless in France.—In order to improve the Lyons silk market a request has been made to the postal authorities for permission to use the wireless station near the city for the transmission of daily market rates to and from the Far East. It is found that a delay of ten to twelve days, necessitated in the case of messages by cable, seriously hampers business. The wireless station is already used by a Japanese business agency, and by the American Press.—*The Times.*

Private Wireless Installations.—Messrs. R. G. Dalgleish, coal exporters and shipowners, Newcastle-on-Tyne, have been refused permission to install a private wireless set for communication with their ships. It is said by the Post Office that an adequate system of coast stations is in existence, and the station at Cullercoats serves for all shipping on the Tyne. Private stations, the Post Office say, would entail heavy loss to the State, and would cause both confusion and interference.

WIRELESS TELEGRAPHS ON SHIPS

NEW BOARD OF TRADE RULES*

THE MERCHANT SHIPPING (WIRELESS TELEGRAPHY) RULES, 1920, DATED JULY 10TH, 1920, MADE BY THE BOARD OF TRADE UNDER THE MERCHANT SHIPPING (WIRELESS TELEGRAPHY) ACT, 1919†

Interpretation.

1.—In these Rules—

The expression "coasting trade" means trade exclusively carried on between ports in the British Islands.

The number of hours occupied in a voyage from port to port means the normal number of hours occupied in a voyage between one port of call and the next.

Classification of Ships.

2.—For the purposes of these Rules ships shall be classified as follows :—

Class I. Ships carrying 200 persons or more which are not engaged in the coasting trade.

Class II. Ships not engaged in the coasting trade carrying 50 but less than 200 persons and ships engaged in the coasting trade carrying 50 persons or more.

Class III. Ships carrying less than 50 persons.

In reckoning the number of persons carried by a ship there shall be included the normal crew of the ship and the maximum number of passengers permitted to be carried by the passenger certificate of the ship.

Nature of Installation.

3.—The installation shall comply with the requirements of the International Radio-telegraph Convention, 1912, as modified by any other international agreement (and in particular the International Convention of Safety of Life at Sea, 1914), or of any international agreement by which the said Convention of 1912 may be superseded.

4.—The installation shall be of the spark or interrupted continuous wave type.

5.—(1) The installation shall include a normal installation and an emergency installation, except that where the normal installation complies with the requirements of this rule as to emergency installations as well as those as to normal installations a normal installation alone shall suffice.

(2) A normal installation must be capable of transmitting clearly perceptible signals from ship to ship over a range of at least 100 nautical miles by day under normal conditions and circumstances.

(3) An emergency installation must include an independent source of energy capable of being put into operation rapidly and of working for at least six continuous hours with a minimum range from ship to ship of 80 nautical miles for ships of Class I., and 50 nautical miles for ships of Classes II. and III., and such independent source of energy must be capable of being worked for at least six continuous hours independently from the source of propelling power for the ship, the steam supply system and the main electricity supply system.

(4) For the purposes of this rule an installation shall be deemed to comply with the above requirements as to range if it is able to maintain communication on a 600 metre wave at a range

* Statutory Rules and Orders, No. 976 of 1920. † 9 and 10 Geo. 5, c. 38.

of one and a half times the number of nautical miles hereinbefore respectively prescribed over sea by day with a Post Office Standard Station when employing a receiver without amplification devices.

6.—There shall be provided between the bridge and the wireless telegraph room means of communication by voice pipe, telephone or other means and an operator or watcher when on duty shall not leave the wireless telegraph room to deliver messages or to call his relief.

Ships not Fitted with Approved Automatic Apparatus.

7.—If not fitted with an approved automatic apparatus for registering the signal of distress—

(i) A ship of Class I. shall carry certificated operators in accordance with the following table, and while at sea a certificated operator shall be always on watch :—

Nature of Voyage.	*Number and Grade of Operators.*
(*a*) Voyage exceeding 48 hours from port to port	Three operators, of whom one shall hold a First Grade Certificate, and not more than one a Third Grade Certificate.
(*b*) Voyage exceeding 8 hours but not exceeding 48 hours from port to port.	Two operators of whom one shall hold a First or a Second Grade Certificate.
(*c*) Voyage not exceeding 8 hours from port to port.	One operator who shall hold a First or a Second Grade certificate.

(ii) A ship of Class II. shall carry certificated operators and certificated watchers in accordance with the following table, and while at sea a certificated operator shall always be on watch at the times specified in the Schedule to these Rules, and either a certificated operator or a certificated watcher shall always be on watch at other times.

Nature of Voyage.	*Number and Grade of Operators and Watchers.*
(*a*) Voyage exceeding 48 hours from port to port.	One operator who shall hold a First or a Second Grade certificate, and two watchers.
(*b*) Voyage exceeding 8 hours but not exceeding 48 hours from port to port.	One operator who shall hold a First or a a Second Grade certificate, and one watcher.
(*c*) Voyage not exceeding 8 hours from port to port.	One operator who shall hold a First or a Second Grade certificate.

(iii) A ship of Class III shall carry one operator who shall hold a First or a Second Grade certificate, and while at sea the operator shall always be on watch at the times specified in the Schedule to these Rules

Ships Fitted with Approved Automatic Apparatus.

8.—In the event of an automatic apparatus for registering the signal of distress being approved by the Board of Trade and the Postmaster-General a ship of Class III. shall be fitted with such apparatus unless the duration of the voyage on which it is employed does not exceed eight hours from port to port, but in such a case the operator shall be on watch during the whole time of the voyage.

9.—If fitted with automatic apparatus for registering the signal of distress approved as aforesaid :—

(i) A ship of Class I. shall carry certificated operators in accordance with the following table and while at sea a certificated operator shall always be on watch during the times specified in the Schedule to these Rules, and a watch shall be maintained at all other times either by a certificated operator, or by a watcher, or by means of the approved automatic apparatus.

Nature of Voyage.	*Number and Grade of Operators.*
(*a*) Voyage exceeding 48 hours from port to port.	Two operators, one of whom shall hold a First Grade certificate.
(*b*) Voyage not exceeding 48 hours from port to port.	One operator who shall hold a First or a Second Grade certificate.

(ii) A ship of Class II. shall carry one operator who shall hold a First or a Second Grade certificate, and while at sea the operator shall be on watch during the times specified in the Schedule to these Rules, and a watch shall be maintained at all other times either by an operator, or by a watcher, or by means of the approved automatic apparatus.

(iii) A ship of Class III. shall carry one operator who shall hold a First or a Second Grade certificate, and while at sea the operator shall be on watch during the times specified in the Schedule to these Rules, and a watch shall be maintained at all other times either by an operator, or by a watcher, or by means of the approved automatic apparatus.

Provided that if a ship of Class III. is fitted with an automatic apparatus for registering the signal of distress and with an automatic apparatus for registering the ship's own distinguishing signal, both of which have been approved by the Board of Trade and the Postmaster-General, the operator shall not, while the ship is more than 150 nautical miles from any coast station, be required to be on watch at the times specified in the Schedule to these Rules.

Qualifications of Operators.

10.—(1) Operators shall be graded into three grades in accordance with Rules to be made by the Postmaster-General with the concurrence of the Board of Trade and watchers shall be certificated by the Postmaster-General.

(2) Until graded in accordance with such Rules as aforesaid :—

(i) An operator who holds the Postmaster-General's First Class Certificate of Proficiency and who has had three years' experience as an operator may be employed as if he held a First Grade certificate, but if an operator holding a First Grade certificate is available an operator holding a First Class certificate shall not be so employed on a ship of Class I. which is required by these Rules to carry three operators.

(ii) An operator who holds the Postmaster-General's First or Second Class certificate of Proficiency and who has had one year's experience as an operator may be employed as if he held a Second Grade certificate.

(iii) An operator who holds the Postmaster-General's First or Second Class certificate of Proficiency and who has had less than one year's experience as an operator may be employed as if he held a Third Grade certificate.

11.—The Postmaster-General may accept certificates granted to operators by the Government of any part of His Majesty's Dominions or of a foreign country in pursuance of the regulations annexed to any International Radiotelegraph Convention for the time being in force.

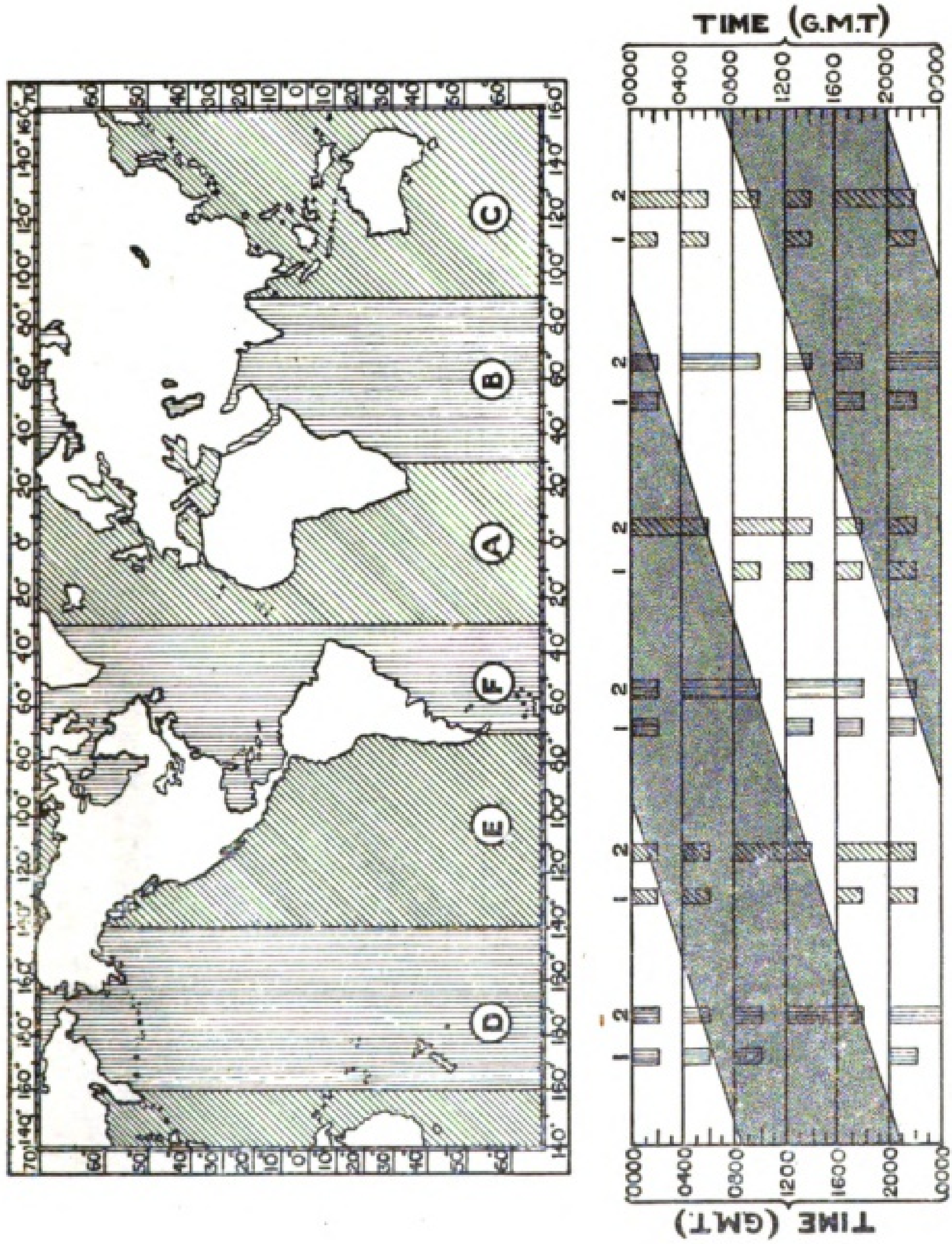
12.—These Rules shall come into operation on the 1st day of September, 1920.

Schedule.

TIMES OF WATCH FOR SHIPS REQUIRED TO CARRY ONE OR TWO OPERATORS.

Zones.	Western Limit.	Eastern Limit.	Times of Watch for One Operator, Greenwich Mean Time.	Times of Watch for Two Operators Greenwich Mean Time.
A. Eastern Atlantic, Mediterranean, North Sea, Baltic, Western Arctic Sea.	Meridian of 30° W., Coast of Greenland.	Meridian of 30° E. to the South of the Coast of Africa. Eastern limit of Mediterranean, Black Sea, and of the Baltic, 30° E. to the North of Coast of Norway.	from 8 h. to 10 h. 12 h. „ 14 h. 16 h. „ 18 h. 20 h. „ 22 h.	from 0 h. to 6 h. 8 h. „ 14 h. 16 h. „ 18 h. 20 h. „ 22 h.
B. Indian Ocean, Eastern Arctic Sea.	Eastern Limit of Zone A.	Meridian of 90° E...	from 0 h. to 2 h. 12 h. „ 14 h. 16 h. „ 18 h. 20 h. „ 22 h.	from 0 h. to 2 h. 4 h. „ 10 h. 12 h. „ 14 h. 16 h. „ 18 h. 20 h. „ 24 h.
C. China Sea, Western Pacific Ocean.	Eastern Limit of Zone B.	Meridian of 160° E.	from 0 h. to 2 h. 4 h. „ 6 h. 12 h. „ 14 h. 20 h. „ 22 h.	from 0 h. to 6 h. 8 h. „ 10 h. 12 h. „ 14 h. 16 h. „ 22 h.
D. Central Pacific Ocean.	Eastern Limit of Zone C.	Meridian of 140° W.	from 0 h. to 2 h. 4 h. „ 6 h. 8 h. „ 10 h. 20 h. „ 22 h.	from 0 h. to 2 h. 4 h. „ 6 h. 8 h. „ 10 h. 12 h. „ 18 h. 20 h. „ 24 h.
E. Eastern Pacific Ocean.	Eastern Limit of Zone D.	Meridian of 70° W. South of the Coast of America, West Coast of America.	from 0 h. to 2 h. 4 h. „ 6 h. 16 h. „ 18 h. 20 h. „ 22 h.	from 0 h. to 2 h. 4 h. „ 6 h. 6 h. „ 14 h. 16 h. „ 22 h.
F. Western Atlantic Ocean and Gulf of Mexico.	Meridian of 70° W. South of the Coast of America, East Coast of America.	Meridian of 30° W., Coast of Greenland.	from 0 h. to 2 h. 12 h. „ 14 h. 16 h. „ 18 h. 20 h. „ 22 h.	from 0 h. to 2 h. 4 h. „ 10 h. 12 h. „ 18 h. 20 h. „ 22 h.

TIMES OF WATCH FOR SHIPS REQUIRED TO CARRY ONE OR TWO OPERATORS



The white portion of the above diagram represents the average light hours and the shaded portion the dark hours.

The interrupted shaded bands show the hours at which an operator is to be on watch in ships carrying one or two operators respectively, when a continuous service is not maintained.

THE P.M.G. EXAMINATION

Addendum to Appendix V. of the Postmaster-General's Handbook

After the 1st January, 1921, candidates for the Postmaster-General's certificate will be required to satisfy the examiners in a written examination in addition to the practical examination outlined in paragraph 2, Appendix V. There will be two papers of two hours each.

The scope of the examination is entirely elementary. The following syllabus is given in detail for the purpose of indicating to teachers the limits to which their courses need extend. The knowledge of mathematics required will not exceed simple arithmetic and algebra up to simple equations.

ELECTRICITY AND MAGNETISM.

Magnetism.—Poles of magnets. Force between poles. Magnetic moment. Magnetic field of force. Strength of magnetic field. Materials for magnets. Permeability. Residual magnetism. Methods of magnetisation. Elementary notions of terrestrial magnetism.

General Electrical Phenomena.—Elementary notions of molecules, atoms, ions and electrons. Elementary explanation of charge, current, resistance, potential and potential difference. Attraction and repulsion of charged bodies. Spark and brush discharges.

Condensers.—Elementary theory. Seat of charge. Capacity. Formula for calculation of capacity of parallel plate condensers. Material for condensers. Effect on capacity of charge of dielectric in a condenser. Units of capacity. Limit of charge. Energy stored. Methods of joining up, and simple calculations of joint capacities.

Atmospheric Electricity.—Elementary theory of thunderstorms. Lightning conductors.

Electric Currents.—Elementary idea of production of currents by chemical action in primary cells. Positive and negative poles. Elementary notions of polarisation and local action, with methods of prevention in "Daniell" and "Leclanché" cells. Voltage and internal resistance of cells. Units of current, voltage, resistance.

Dry Cells.—General construction and uses.

Secondary Cells.—General principles of construction and action. Care of cells. Capacity of cells. Methods and rates of charging. Indications of correct connections for charging. Testing polarity of charging mains. Maximum and minimum limits of voltage and specific gravity. Use of hydrometer. Gassing. Causes of buckling and sulphating of plates. Testing condition of cells. Protective devices.

Resistance.—Conductors and insulators. Resistance of a body depends on material, cross section, length, and temperature.

Ohm's Law.—Statement and simple calculations. Joining up resistances in parallel and series. Calculations of currents in simple branched conductors. Joining up cells in parallel and series.

Direct Currents.—Elementary magnetic, heating and chemical effects. Distribution of magnetic field round a wire conveying a current.

Electro-Magnets.—General elementary principles. Solenoids. Ampere turns. Elementary notions of a magnetic circuit.

Electromagnetic Induction.—Effect of relative motion between conductors and magnetic fields. Eddy currents. Elementary notions of self induction and mutual induction. Unit of inductance.

Alternating Currents.—General elementary principles. Frequency. Elementary ideas of effect of capacity and inductance in producing phase alterations.

Voltmeters and Ammeters.—Elementary principles of construction. Moving coil and hot wire instruments. Use of. Methods of joining in a circuit.

Power.—Definition. Units. Measurement by voltmeter and ammeter. Elementary notions of power factor.

Transformers.—Elementary principles of construction and action.

Induction Coil.—Elementary principles of construction and action.

TECHNICAL WIRELESS TELEGRAPHY.

Ether Waves.—Elementary notions on the transference of energy by ether waves, continuous and discontinuous (damped and undamped).

Dynamos.—Elementary theory of the process of obtaining D.C. from a dynamo.

Motors.—Elementary principles of construction and action. Action of field regulators and starters. Care.

Motor Alternators.—Elementary principles of construction and action.

Rotary Converters.—Elementary principles of construction. Slip rings. Brushes. Speed and Frequency. D.C. and A.C. voltages. Protection devices (guard lamp, fuses, switches, etc.).

Charging Circuit.—Functions of apparatus usually included and method of connections. Keys, manipulative and magnetic. Measuring instruments. Pilot lamps. Fuses. Iron core inductances. Choking coils.

Transformers.—Use of, in wireless installations. Ratio of transformation. Multiple windings of coils, and methods of joining up. Testing of coils for faults.

Resonance in Charging Circuit.—Natural frequency of a circuit. Elementary notions of resonance. Use of iron-core inductance and field regulator in obtaining resonance. Effect of resonance on power. Indications of lack of resonance. Probable re-adjustments required to maintain resonance on change of capacity, etc., in secondary circuit.

Oscillatory Currents.—Method of production by spark discharge. Formulæ for frequency and wavelength. Elementary idea of damping. Desirability of keeping resistance low. Elementary ideas of high frequency resistance. Method of changing wavelength.

Closed Oscillatory Circuit.—Functions of apparatus usually employed. Methods of joining up.

Main Condenser.—Principles of construction for wireless installations. Energy and quantity of electricity stored. Risk of damage. Protective spark gaps. Methods of testing.

Dischargers.—Fixed and rotary (synchronous and asynchronous). Quenched spark. Adjustments. Elementary theory. Advantages and disadvantages of the various types.

Spark Frequency.—Definition. Advantages of high spark frequency. Methods and effects of varying spark frequency.

Oscillation Transformers.—Functions and adjustments. Resonance between oscillatory circuits. Principle of tuning circuits.

Coupling.—Percentage of coupling. Inductive and direct. Methods and effects of variation.

Radiating Circuit.—Essential difference between open and closed oscillatory circuits. Functions of apparatus usually employed and methods of connection. Secondary of oscillation transformer (jigger). Aerial tuning inductance. Arrangements for changing from "send" to "receive." Use of short-wave condenser. Tuning lamp. Aerial ammeter.

Aerial.—General types. Elementary notions of properties of different types. Inductance and capacity of aerials. Function of the "earth." Necessity for high insulation of aerial. Type of insulators used.

"*Plain-Aerial.*"—Principle of transmission by plain aerial. Advantages and disadvantages.

Induction Coil.—Use of induction coil in wireless circuits.

Reception.—General principles of reception.

Tuning Received Signals.—Types of tuning circuits usually employed and methods of connection. Functions of aerial tuning condensers and inductances. Coupling. Protective devices.

Telephones.—Elementary theory of telephone receivers. General construction. High and low resistance telephones. Telephone transformers.

Magnetic Detector.—General principles. Construction and method of joining in circuit. Adjustments.

Crystal Detectors.—Properties of. Elementary notions of characteristic curves. Materials for detectors. Potentiometers. Principles of balanced crystals.

Thermionic Valves.—Elementary theory of action of two and three electrode valves.

Reception of Continuous Waves.—General principle of heterodyne reception using three electrode valves. Simple circuits of detectors and amplifiers.

Buzzers.—General principles of construction and use of testing buzzers. Tuned buzzers.

Testing Apparatus.—Use of galvanometers (detectors) in testing for faults. Testing with cells and telephone receivers.

C.W. and I.C.W. Transmission.—Advantages of continuous wave transmission.

Generation of H.F. oscillations by means of three electrode valves. Simple generating circuits. Methods of obtaining H.T. voltage for the anode circuit. Principles of interrupted continuous wave transmission.

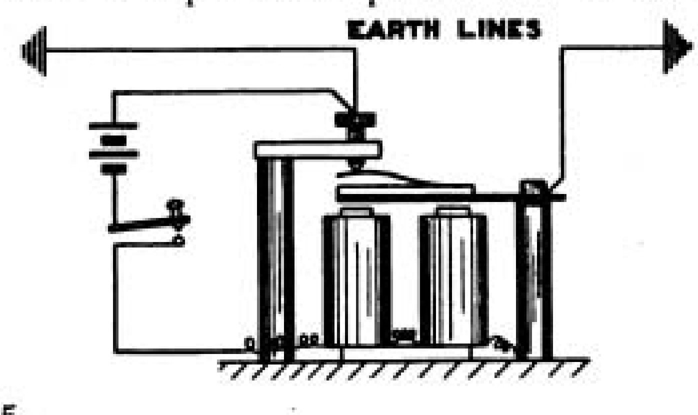
Diagrams.—Simple skeleton diagrams of circuits will be required.

A WIRELESS CLUB FIELD DAY

The Wireless and Experimental Association of Peckham at Work

EARLIER in the year one of our members, who was probably provoked into a fit of optimism by a fleeting glimpse of sun,* suggested that we should arrange a field day. We agreed heartily, and sent in an application for official permission. After some delay the magical document arrived, and, having obtained the consent of the Camberwell Borough Council, we proceeded to One Tree Hill, Honor Oak, the scene of our activities.

We took with us two power buzzers and some amplifiers, with two 6-volt accumulators and high tension batteries. One transmitting station and three receiving stations were set up as follows. At the ends of a base line forty feet long, two galvanised iron earth-pins were pushed into the stiff



*A luminous, heat-giving body said to exist 93 million miles from the earth.

clay and connected with the power buzzer (see Fig.) by lengths of 3/22 copper wire. The receiving stations consisted merely of similar pins stuck in the ground and connected to the headgear telephones.

The ammeter on the buzzer showed 0·5 ampere when working with 12 volts, so that we were well within the 10 watts allowed by our permit. A small motor-cycle spark coil with 4 volts on the primary and the secondary connected direct to the sending circuit did not give such good results.

As soon as the receiving stations announced the receipt of healthy signals our Secretary began to transmit at about ten words a minute, and did not desist until he had ploughed through a column of the *Evening News*. So little did we desire the embarrassing juvenile audience that usually springs up like magic in the vicinity of a "show," that we hid as much as possible in the folds of the ground, so successfully, in fact, that a newspaper reporter who was hunting for us failed to find us.

To wireless club enthusiasts who desire to improve their Morse reading amidst open air surroundings all the participators in our test recommend the same arrangement, as being easy to carry out, and involving no "jamming."

The writer has succeeded in signalling over a surprising distance with a small buzzer and a pocket lamp battery, so our readers need not despair if a power buzzer is unobtainable.

[We shall be pleased to receive other accounts of similar outings.—ED.]

STORM WARNINGS BY WIRELESS*

A SYSTEM of wireless telegraphy storm signals for the coasts of France has been established by the French Government. The system embraces transmission by the Eiffel Tower and by the stations here given, when the weather forecast shows the wind to exceed 50 feet per second (force 7 on Beaufort's scale). The French coast has been divided into four areas, viz. :—"Manche" (English Channel), "Bretagne" (entrance to English Channel, south coast of Brittany and northern part of the Bay of Biscay), "Océan" (from the Loire to the Spanish frontier, including the central and southern parts of the Bay of Biscay), "Mediterranean" (French coast in the Mediterranean).

The signals are sent *en clair*, giving the name of the area threatened and the probable direction from which the wind may be expected. Eiffel Tower (FL) transmits at 0945, 1600 and 2330 G.M.T. on 2,500 metres wavelength, immediately after the daily weather bulletin, and again at 1100 on 3,200 metres, after the press message which follows the 1045 time signal.

Cherbourg (FUC), Brest (FUE), Lorient (FUN), Rochefort (FUR), Toulon (FUT), and Ajaccio (FUI), also transmit warnings, as soon as they are received by land line, or from FL, on a 600 metres wave. These latter stations first send out the International safety signal TTT. This is followed a minute later by the storm signal, which is repeated three times at intervals of ten minutes.

FUC, FUE, FUN, FUR transmit signals concerning "Manche," "Bretagne" and "Océan," FUT and FUI concerning the "Mediterranean" area. When the transmitting time does not coincide with the watch keeping hours of ships carrying one operator the message is repeated at the commencement of the succeeding watch.

* Admiralty Notice to Mariners, No. 1236 of 1920.

WIRELESS CLUB REPORTS

The Wireless Society of London.

The Wireless Society of London commence their new session with a lecture on 30th September, at 6 p.m., in the Lecture Hall of the Institution of Civil Engineers, Great George Street, Westminster.

The lecturer is to be Mr. Maurice Child, one of the Committee of this Society, and he will give his personal experiences in the construction and working of a H.F. amplifier. Since the last session closed large numbers of applications for membership have been received, and these will be balloted for at the September meeting.

It is gratifying to note that many more provincial Societies have made application for affiliation, and it is hoped that those Clubs that are not yet affiliated will come into line at an early date. Particulars of the Society, application forms for membership, etc., may be obtained from the 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 a meeting on August 25th, a 15-minutes' buzzer practice and keying instruction were followed by our genial General Manager, Mr. C. Sanders, producing from under his hat a miniature receiving set. The outside dimensions of the box were 2 inches by 2¼ inches by 3¼ inches, and with it he had received signals up to 1,400 metres. It comprised a tuned primary and secondary, with variable condenser and crystal detector, and displayed the marvellous ingenuity and boundless patience necessary to make this bijou set.

Our Chairman, Mr. A. W. Knight. then described with examples, a new telephone set he is constructing. Mr. Kloots, with the aid of the gas and water mains, then told us what Eilvese, (Hanover), was saying, and tuned in Horsea with remarkable strength.—Hon. Secretary, Mr. G. Sutton, Melford House, 18, Melford Road, E. Dulwich.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

It will be of interest to embryo experts to know that the lines on which the Society works appeals to them rather than to the more advanced students. No knowledge of wireless is required to qualify for membership, but the applicant must show conclusively that he intends to take the matter up seriously with a view to assisting in every possible way the aims of the Society. Especially are those in the electrical profession requested to take an interest in this science, as there are many electrical subjects closely allied with wireless telegraphy and telephony.

A special Advisory Committee deals with Corresponding or Associate members and those residing in the Manchester district who become full members and are entitled to use the various apparatus which is installed at headquarters. One member, who had endeavoured in vain to obtain messages on a complete receiving set for three months prior to enrolling as a member, was requested to bring his set with him the following evening, and within half-an-hour the owner had the pleasure of receiving his first message on a small frame aerial used for testing. Since that time he has had no difficulty in receiving all the European routine stations. So much for the amateur.

As regards the more advanced students, they will find that many a pleasant hour can be passed at the Clubrooms, the winter programme being exceptionally attractive in the way of lectures, demonstrations, conducted parties to various works, stations, etc.

The Hon. Secretary will be pleased to supply all particulars and answer any questions which correspondents consider necessary regarding membership.—Address: Hon. Secretary, Mr. Y. W. P. Evans, 7, Clitheroe Road, Longsight, Manchester.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

The Club continues to hold its meetings fortnightly, and although during the holiday season the attendance has fallen off, it is anticipated that by the middle of September the meetings will show a greater increase in the number of members than ever. By that date the lecture evenings will have been resumed, and members will be getting busy with their experiments. At the meeting held on August 25th it was hoped to be able to receive some special signals, but unfortunately it was found that an accident had happened to the Club's aerial, and although this was temporarily fixed up, the results were disappointing. Full particulars of the Club may be obtained from the Hon. Secretary, E. H. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21.

The Bristol and District Wireless Association.

(Affiliated with the Wireless Society of London.)

Meetings of this Association were resumed on Friday, September 10th, at 11, Leigh Road, Clifton.

Will candidates for membership please notify the Secretary of the Association at the above address as soon as possible.

There are large numbers of amateurs in Bristol and district who appear to be unaware of the existence of the Association. If they read the *Wireless World*, and see this report, it is hoped that they will be enlightened.—Alan W. Fawcett, Hon. Secretary.

Liverpool Wireless Association.

(Affiliated with the Wireless Society of London.)

The above Association held a practical demonstration in Wireless Telegraphy (Reception only) at Calderstone Park, Liverpool, on Saturday, August 21st, which was well attended by members and friends. Experiments were carried out on both valve and crystal reception. A simple one-wire aerial was formed by attachments to trees, a pond near by assisting in obtaining an earth. Very satisfactory signals were obtained. The weather, however, was somewhat cold and windy, and not ideal for sitting out.

An excellent tea was afterwards partaken of at the café situated in the grounds, and this was followed by a very good musical programme rendered by the Wavertree Male Voice Choir. Altogether a most enjoyable time was spent, and it is hoped this will be the forerunner of many other such outings.

Applications for membership should be addressed to Mr. S. Frith, Hon. Secretary, 6, Cambridge Road, Crosby

Burton-on-Trent Wireless Club.

(Affiliated with the Wireless Society of London.)

During the summer months a correspondence section has been formed. A series of papers on "How to Make a Wireless Receiving Set" have been prepared by a Sub-Committee of members, and will be forwarded to those corresponding members requiring information. The Sub-Committee also advises members on other questions relating to experiments in wireless.

Several members of the Club have been busy erecting apparatus during the summer. It is hoped to recommence winter operations in a few week's time. The present membership of the Club is fifty.

Persons wishing to become corresponding members (annual subscription, 5s.) should communicate with the Hon. Secretary, Mr. R. Rose, 214, Belvedere Road, Burton-on-Trent.

Leicestershire Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting of this Society was held on August 27th, Mr. C. T. Atkinson, Vice-Chairman, presiding. During the first part of the evening the members of the Society present divided up into small companies for the purpose of Morse practice. During the business proceedings the newly-appointed Secretary reported that in future the headquarters of the Society would be at the Vaughan Working Men's College, Great Central Street. Mr. H. Dyson then gave a demonstration on "Honeycomb" coils, and after pointing out the advantages of "Honeycomb" over other tuning coils, and of the system of capacity tuning, made possible by a proper use of same, Mr. Dyson wound a coil before the members. The process proved so easy that several members showed their grasp of the subject by taking turns at winding the coil. A method of winding honeycomb coils on a lathe was described and also a method of winding duo-lateral coil. The demonstration was greatly appreciated by the members, and in well-chosen words the Chairman suitably thanked the speaker.

The Society is hoping to extend its activities during the coming winter session, and those resident in the County of Leicestershire who are interested in the study of wireless will be welcomed by the Society. The Secretary, Mr. W. E. Dent, "Claremont," 45, Baden Road, Leicester, will be glad to give information to all who may be interested with a view to membership.

Stockport Wireless Society.

The weekly meeting of the above Society was held on Friday last, August 20th. The Chairman, Mr. H. C. Woodhall, presided over a good attendance, and at the conclusion of business discussion the Secretary gave an interesting lecture on Induction Coils and Transformers. The lecture was made particularly lucid by means of blackboard illustrations and sketches, a very interesting discussion taking place at its conclusion. Major Swart then gave an interesting discourse on present day detectors. The lecture was ably given and illustrated by the exhibition of a portable valve set in which every member was keenly interested.

On August 27th, at the Rechabites' Hall, some sixty members, friends and visitors, assembled at a dance and wireless demonstration, arranged by the Society.

At 9 p.m. the demonstration took place, and proved of great interest to all present. The Secretary, addressing the assembly, dealt briefly with the wonderful developments in wireless telegraphy and telephony, and stated that members welcomed the opportunity of giving so many laymen a practical demonstration of the possibilities of wireless. Calling attention to the six-valve set (installed by Messrs. Faure, Swart, Woodhall and Emerson), he announced that a transmission by telephony over a distance of ten miles had been arranged by two members. A few minutes before 9 p.m. the preliminary whistle was duly picked up, and with the introductory "Hello! Stockport Wireless" the operators read snatches of news, which were also heard by a number of visitors in the multi-headgear. Following this the Secretary took down BYB Press. During the refreshment interval the Chairman, Mr. H. C. Woodhall, read the news as taken down by our 30-word man, Mr. Z. A. Faure. The remainder of the programme ensued, and we feel sure that both sections of the entertainment were well enjoyed.

The Secretary would be glad if amateurs who heard the above-mentioned telephony transmission at 9 p.m. on August 27th would communicate with him.

Will all members kindly note that the Winter Session commenced at the Foresters' Hall, Churchgate, Stockport, on September 3rd. All interested in wireless work and desirous of joining the above Society should communicate with the Hon. Secretary and Treasurer, Mr. Z. A. Faure, 3, Bank's Lane, Stockport.

Bradford Wireless Society.

A meeting of this Society was held on August 12th in the Club room at 5, Randall Street, but on account of the holidays few members were present. It is hoped to arrange a programme of lectures and papers for meetings throughout the winter session, and all members who are able to assist in this matter will oblige by communicating with the Secretary. Permits have been obtained for the erection of an installation at the Club room, and also for a portable set; the latter not to be moved outside a radius of twenty miles. The membership book shows a total of 38 members and the Hon. Secretary, Mr. J. Bever, 85, Emm Lane, Bradford, would be glad to supply all information to whomsoever this report may have excited interest.

Co-operation wanted at Portsmouth.—With a view to forming an amateur wireless club at Portsmouth, Mr. E. Martin, Jnr., of 200, Lake Road, Portsmouth, is seeking the assistance and co-operation of other amateurs in the district. Mr. Martin is not only willing to offer his services, but is also prepared to furnish a sum of £2.2s. in starting a satisfactory Club amongst those wireless enthusiasts of Portsmouth, *noms de plume* of some of whom have appeared from time to time in our Questions and Answers columns.

Enfield Amateurs.—A reader of this magazine, a resident of Enfield, has communicated to us a desire to form a Wireless Club at Enfield or in its neighbourhood. Observing no less than three amateur aerials, all within proximity to his own, he is of the opinion that there is much which could be discussed between their owners with good advantage to all. Interested readers will please communicate with Mr. Geo. E. Barsham, 43, Landseer Road, Bush Hill Park, Enfield, N.

Amateur Call-signs.—A number of enquiries have reached us concerning the identity of certain wireless stations, the call-signs of which are unknown to us. For the purpose of answering these enquiries where possible, and as a guide to other amateurs, will the readers of this paragraph who are in possession of transmitting licences kindly forward their call-signs to us for our information and the benefit of the "Questions and Answers" column.

TRANSATLANTIC TESTS FOR AMATEUR RECEIVERS.

THE steady monotony of receiving routine stations and signals which have no bearing on the amateur advancement as a whole, is to be pleasantly substituted by work similar to the early experiments of bridging the Atlantic in the '90's.

A number of American amateurs who have stations of various types along the Atlantic Coast are anxious to co-operate with British operators of receiving sets in this country, to establish a long distance amateur record.

Those American operators who have established communication over distances in excess of one thousand miles with a transformer input of 1 k.w. or less, would now like to make transatlantic tests with the assistance of one or more English experimental stations equipped with very sensitive receiving apparatus.

The champions of spark transmitters believe that they can cover the distance with 1 k.w. sets, while those who have vacuum tube transmitters are equally sure that it can be done as soon as cool weather, with the reduction of static, sets in. Amateurs in this country who are willing to make the attempt are requested to communicate with Mr. M. B. Sleeper, Radio Editor, *Everyday Engineering Magazine*, 2 West 45th Street, New York City, through whom arrangements will be made with those experimenters who wish to attempt the transmission.

That the project is not impractical is shown by the degree of efficiency attained by the English developments in high amplification and the success of the American experimenters with their transmitting equipment. The accomplishment of this feat, with an input not exceeding 1 k.w., will create tremendous interest in amateur activities. It will bring about an increased mutual interest between the radio men of the two countries, and will be an achievement for the experimenters comparable to the first commercial transatlantic communication.

We would point out to the amateur the immense interest such tests as these are able to afford, and hope in all sincerity that no stone will be left unturned to bring the experiment to a successful issue. At the conclusion of these transocean tests we will be pleased to receive photographs of the first successful apparatus, together with its description, for publication in the *Wireless World*.

NOTE MAGNIFICATION WITH A H.F. AMPLIFIER

IN a recent article in the *Electrician*, by Dr. W. H. Eccles and Mr. F. W. Jordan, the authors discuss the possibility of utilising an amplifier designed for operation at high or radio frequencies for the purpose of amplifying low frequency currents. In the case of a receiver picking up either ordinary continuous wave signals or radiotelephone signals, it is well-known that such received oscillations can be accurately amplified by means of ordinary radio frequency amplifiers, that is to say by amplifiers in which the coupling coils or condensers are designed to be suitable for operation at high frequencies. The reason for this is to be found in the fact that the modulation of the steady continuous waves is equivalent to a change of their frequency. If we represent the frequency of the wave oscillations by N and assume for the moment that the modulation current impressed upon them in the manner of a radiotelephone transmitter consists not of ordinary speech currents of irregular waveform and frequency, but of a pure sine wave alternating current of frequency n, then the resultant frequency of the transmitted oscillations will vary between $N+n$ and $N-n$. Since, however, n is usually small compared with N, the resultant change in frequency of the oscillations is on the whole quite small, and hence an amplifier designed for the frequency N will usually be easily able to amplify satisfactorily, currents of frequency $N+n$ or of frequency $N-n$.

This in brief is the principle of the arrangement suggested by Dr. Eccles, as he proposes that the low frequency currents to be amplified should be combined with high frequency oscillations and thus be able to be amplified by a radio frequency amplifier. One of the arrangements described in the article is illustrated in Fig. 1. The low frequency currents for amplification are applied to the apparatus through the coupling transformer T_1, connected in the anode circuit of the valve V. This valve is arranged to set up steady undamped oscillations in the circuit LC by the action of the retroactive coupling M. The low frequency currents impressed in the anode circuit through T cause the amplitude of these high frequency oscillations to vary in accordance with the wave shape of

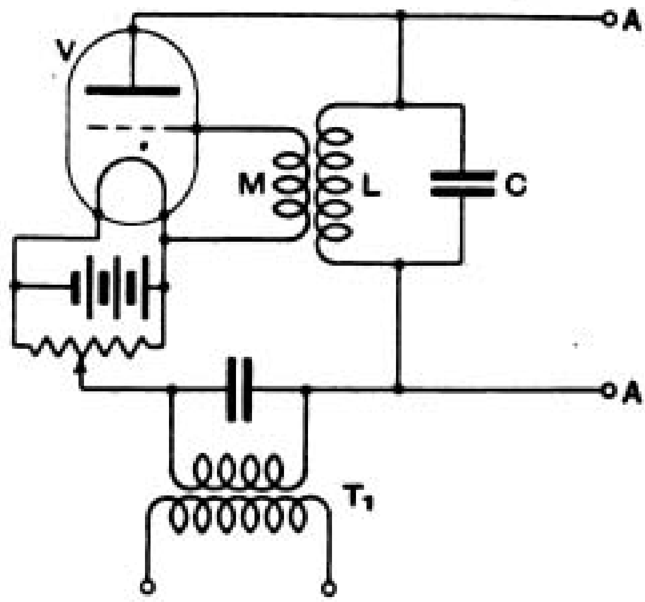


Fig. 1.

the low frequency current, and thus the high frequency output from the terminals A_1 and A_2 likewise varies. These terminals may be connected to the input of an ordinary radio frequency amplifier, and the whole current amplified. The output from the amplifier may then be rectified, by which process the high frequency component is removed, leaving only the amplified low frequency current. It is stated that either speech or very low frequency currents may be amplified in this way without the least distortion.

Many arrangements of this apparatus, other than the one sketched in the figure, are possible, but the principle of their operation is the same in each case, so that further description is unnecessary. As a matter of fact practically any of the well-known methods of radiotelephone modulation could be applied to this arrangement with good results.

PAGES FOR BEGINNERS

WIRELESS TELEGRAPHY CALCULATIONS

I. CONDENSERS.

THE capacity of a condenser can be defined as the quantity of electricity required to raise its potential by one volt This can be expressed in symbols by $C=\frac{Q}{V}$ where C is the capacity in farads, Q is the quantity of current in coulombs, and V the potential in volts. The formula for calculating the capacity of any condenser can be derived from the definition as follows :—

Take the case of a pair of parallel plates separated by a small layer of air (Fig 1).

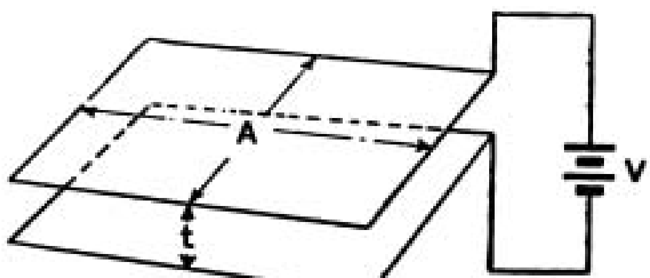


Fig. 1.

If a voltage V is applied to one of the plates, electric lines of force will extend across the whole space between the plates. These lines of force (or electric field) will depend for their intensity on the applied voltage and the distance between the plates. The field therefore is equal to $\frac{V}{t}$ where t is the thickness of the dielectric between the plates

It is necessary here to introduce another definition which occurs in electrostatics, namely that of surface density. The surface density of an electric charge on a plate is the amount of electrification per unit of area at any point on the surface. To explain further :—If we charge any metal plate by some means, such as an influence machine, the charge will spread uniformly over the whole surface ; that is, no part will be more strongly electrified than another. The intensity of this charge can be expressed as the amount of electrification per unit of area. Thus, of two plates one having ten units of electrification per square centimetre, and the other twenty, we should say the latter was charged twice as strongly as the first.

In the case of the plates under consideration, if one is charged with a certain potential, the electric field between them will clearly depend on the strength of the charge.

Calling the surface density ρ, the strength of electric field is equal to $4\pi \times \rho$ at any point on the plate.

Equating this to the previous expression for the electric field, we have :—

$$4\pi\rho=\frac{V}{t} \text{ or } \rho=\frac{V}{4\pi t}$$

To find the whole charge on the plates we have to multiply this expression by the area A ; the charge, therefore, is $\frac{VA}{4\pi t}$

If V is one volt, this expression will give the capacity of the condenser, with an air dielectric. Thus :—

$$C=\frac{A}{4\pi t} \text{ absolute units.}$$

For other materials we must multiply this expression by the figure for the specific inductive capacity of the material.

The S.I.C. of a dielectric, it will be remembered, is the ratio of the capacity of a condenser with an air dielectric to that of a condenser with a dielectric of that particular material.

Also, if we wish to express the capacity in microfarads, the expression must be divided by 9×10^5.

In its final form, therefore, the formula for the capacity of a condenser is—

$C \text{ (mfds.)}=\frac{A\times k}{4\pi t\times 9\times 10^5}$ where A is the area of the plates in square centimetres, t, the thickness of dielectric in centimetres, and k the specific inductive capacity.

As an example, let us take the following :— Find the capacity of two plates each measuring

10 cms. × 20 cms., and separated by a layer of air 1 mm. thick.

The total area of the plates is $2 \times 10 \times 20$ sq. cms. k in this case is unity. We have, therefore—

$$C = \frac{400}{4\pi \times 0 \cdot 1 \times 9 \times 10^5}$$

$$= \frac{1}{\pi \times 9 \times 10^2} = 0 \cdot 00035 \text{ mfds.}$$

In the case of a condenser having many pairs of plates we must only consider the number of dielectrics between the outside plates. It will be seen that the number

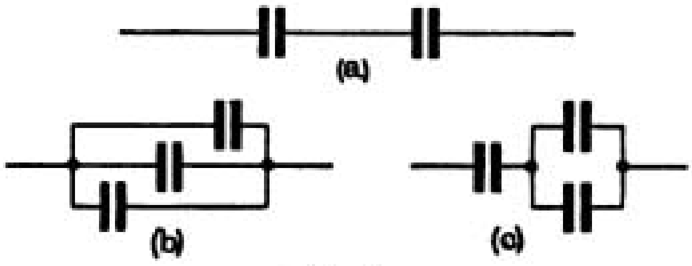


Fig. 2.

of plates in the condenser is one more than the number of thicknesses of dielectric. If we take n to represent the whole number of plates in any condenser, to find the capacity we must multiply the expression above by $(n-1)$.

As a further example let us calculate the size of condenser required for a capacity of 0·001 mfds. If, instead of air, we use some dielectric such as ebonite, or, better still, mica, the size of the condenser will be considerably reduced. The S.I.C. of mica is approximately 8, and a convenient thickness of sheet will be 0·25 mm. We have, therefore :—

$$0 \cdot 001 = \frac{A \times 8 \times (n-1)}{4\pi \times 0 \cdot 025 \times 9 \times 10^5}$$

$$\text{or } A \times (n-1) = \frac{4\pi \times 0 \cdot 025 \times 9 \times 10^5 \times 0 \cdot 001}{8}$$

$$= 441 \text{ approximately.}$$

If we make $n = 11$, $(n-1)$ is 10, and A is therefore 44·1 sq. cms. The area of each plate will be 22·05 sq. cms. A suitable dimension would be 5·5 cms. × 4 cms.

The condenser required, therefore, will consist of eleven sheets of tin foil or other metal, 5·5 cms. × 4 cms., separated by mica sheet of 0·25 mm. thickness.

Where condensers of large capacity are required it is sometimes convenient to calculate dimensions for several small condensers, and then connect them so that the whole arrangement will have the required capacity. Condensers may be connected either in series, in parallel or in a combination of both series and parallel (Fig. 2 a, b and c respectively). In the case of condensers connected in parallel, it is easily seen that this corresponds in effect to one large condenser, since the whole of the plates on each side are connected to a common terminal. The total capacity of any number of condensers in parallel is, therefore, the sum of the individual capacities. When the condensers are connected in series, however, the result is not so easily seen.

Suppose two condensers connected in series had a certain voltage applied to them. The same quantity of electricity will flow through each, and therefore the voltage across each condenser will be in proportion to its capacity.

We have $C = \frac{Q}{V}$ where C is the total capacity of the condensers, and V is the voltage applied across them.

For each individual condenser

$$C_1 = \frac{Q}{V_1} \text{ and } C_2 = \frac{Q}{V_2}$$

Where C_1 and C_2 are the separate capacities, and V_1 and V_2 the respective voltages across them.

Also, $V_1 + V_2 = V$.

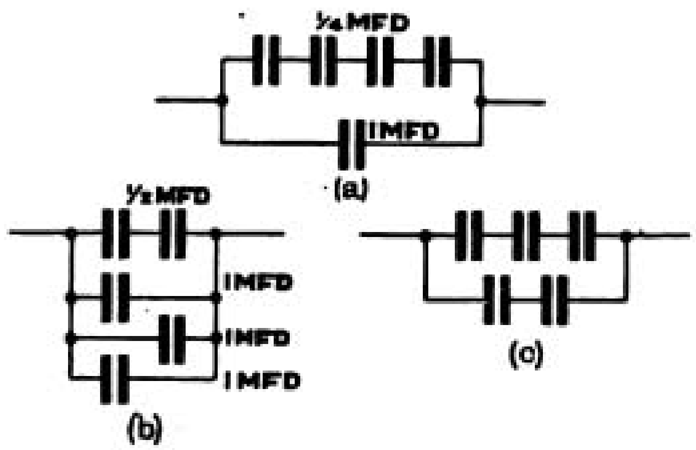


Fig. 3.

Combining these expressions, we obtain—

$$V_1+V_2=\frac{Q}{C_1}+\frac{Q}{C_2}$$

$$=Q\left(\frac{1}{C_1}+\frac{1}{C_2}\right)$$

$$\text{or } V=Q\left(\frac{1}{C_1}+\frac{1}{C_2}\right)$$

$$\text{But } C=\frac{Q}{V}$$

$$\text{Therefore } \frac{1}{C}=\left(\frac{1}{C_1}+\frac{1}{C_2}\right)$$

That is, the effective capacity of two condensers in series is equal to the reciprocal of the sum of the reciprocals of the capacity of each.

Let us apply this result to find the capacity of two condensers (1) in parallel, (2) in series. If each condenser has a capacity of 0·001 mfd., the capacity of the two in parallel is $2\times 0{\cdot}001$ or 0·002 microfarads. If they are connected in series—

$$\frac{1}{C}=\left(\frac{1}{0{\cdot}001}+\frac{1}{0{\cdot}001}\right)=\frac{2}{0{\cdot}001.}$$

$$\therefore C=\frac{0{\cdot}001}{2}=0{\cdot}0005 \text{ mfd.}$$

By having a number of condensers of the same capacity, it is possible to connect them to obtain a wide range of values.

The following table shows how five condensers of 1 mfd each can be connected for any value of capacity from $\frac{1}{5}$ to 5 mfds.

Arrangement.	Total capacity.
5 in series - - - - -	$\frac{1}{5}$ mfd.
3 in series - - - - -	$\frac{1}{3}$ mfd.
2 in series - - - - -	$\frac{1}{2}$ mfd.
4 series ; 1 parallel* - -	$1\frac{1}{4}$ mfd.
2 series ; 3 parallel* - -	$3\frac{1}{2}$ mfd.
3 in series, in parallel with 2 in series* - - - - -	$\frac{5}{6}$ mfd.
3 parallel - - - - -	3 mfd.
4 parallel - - - - -	4 mfd.
5 parallel - - - - -	5 mfd.

*See *Fig.* 3 a, b and c.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

INDUCTANCE COILS (Part II.)

THE tables and particulars of windings given in the last issue were for the calculation of the inductance of single layer solenoids. This type of winding is suitable where space is not of much account, but where it is necessary to build up inductances in as small a space as possible, other methods of winding are adopted.

There are several types of winding in practice, single layer, basket winding, honeycomb winding, machine winding, layer winding and pile winding. In a recent article on the C.W. oscillator, we dealt with basket and honeycomb winding, and we will now describe the advantages and disadvantages of layer and pile winding.

Layer Windings.

This type is shown in Fig. 1. The wire is wound backwards and forwards like a reel of cotton, until the required number of turns to give the required inductance is reached. As far as the inductance value is concerned this is quite in order, but the self-capacity of the coil will be very high. This fact will be readily understood by considering the potential difference between the ends of each layer at the point marked P in

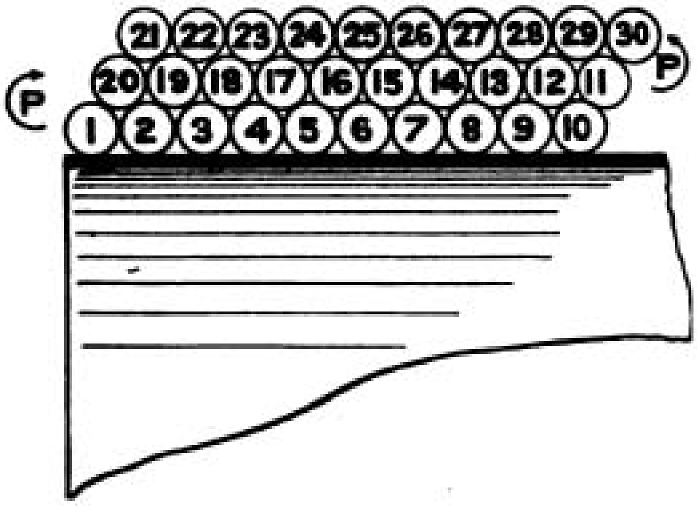


Fig. 1.

Fig. 1. To overcome this difficulty a method of layer winding called pile winding is used.

Pile Windings.

Figs. 2 and 3 illustrate this method quite clearly. Before winding, it is necessary to determine the number of turns of pile necessary to give the required inductance.

To calculate the inductance, proceed to calculate as for a single layer solenoid, wound with wire of the gauge it is proposed to use, and multiply the values so found by the square of the number of piles it is proposed to use, *i.e.*, for a two-pile winding multiply by $2^2=4$, or for three-pile multiply by $3^2=9$,

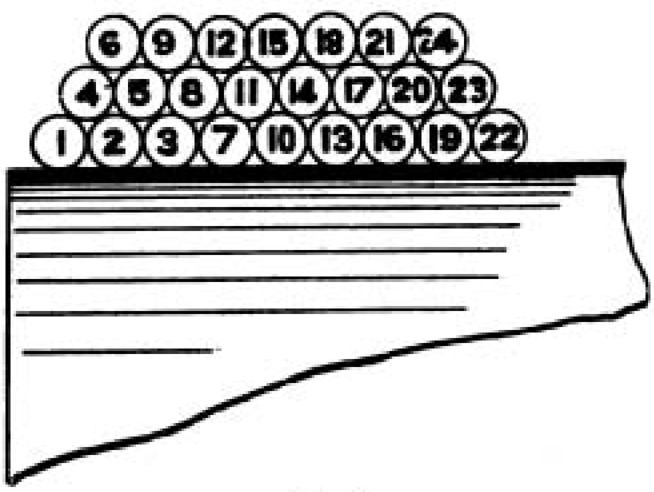


Fig. 2.

and so on. This method of calculating will be found approximately correct.

Having determined from the calculations the gauge of wire and the number of piles to be used, the winding may be proceeded with as follows. Assume that we wish to use a four-pile winding. Commence by winding four turns of wire and then take the wire back from the fourth turn on to the top of the first and second turns, and then wind three turns, which will lie between first and second, second and third, and third and fourth turns; this brings us up to a total of 7 turns. The eighth turn must now be taken over, to lie between turns five and six, winding two turns which will bring us up to the ninth turn, completing the last layer with the tenth turn, which will lie between turns eight and nine. The winding has now the cross sectional form of a pyramid.

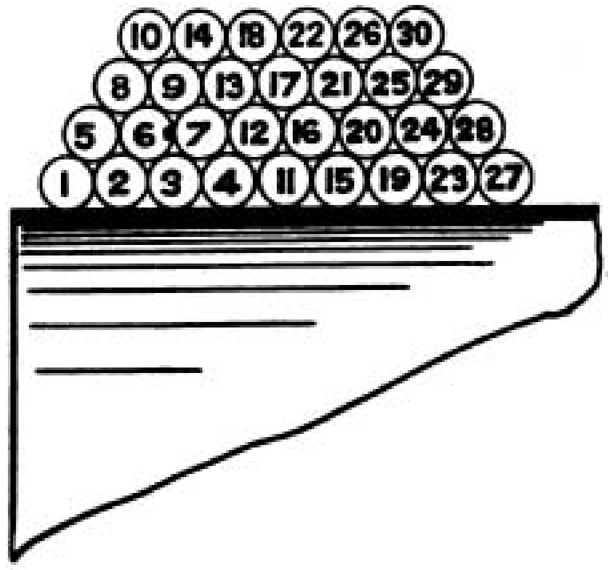


Fig. 3.

Now, to continue, the eleventh turn must lie on the former against turn number four, turn number twelve on eleven, thirteen on twelve, fourteen on thirteen, and fifteen on the former again, and so on in this manner until the required number of turns are reached. Fig. 2 shows clearly how the former is wound and if the wire is wound on to the former tightly, and the turns wound closely, no difficulty will be found in constructing a coil of this type.

A two-pile winding is very easily made;

first wind two turns, wind the third turn back on to the top of turns one and two, wind the fourth turn by the side of turn two, and proceed in exactly the same manner as in the four-pile example.

The self-capacity of a pile wound coil is small, due to the fact that there is no great potential difference between any of the turns. An example illustrative of this point, and which arose in practice, may be of interest to the reader. A former was wound with 180 turns of No. 22 D.W.S. in three layers, 61, 60 and 59 turns per layer. Its apparent inductance was 14,600 microhenries, and its natural wavelength 4,660 metres. The former was used as a wavemeter inductance, and with a variable condenser, gave a maximum wavelength of 21,000 metres, while with the condenser at minimum the wavelength was 7,800 metres. This was not considered satisfactory, the minimum wavelength being too high. The self-capacity of the coil was measured and found to be 0 0011 microfarad; this proved that the inductance measured (14,600 mhys.) was not correct. This result also showed why the minimum wavelength was so high; the capacity of the coil was higher than the minimum capacity of the condenser.

The coil was rewound using a three-pile winding having 168 turns of No. 22 D.W.S. The apparent inductance was found to be 10,800 mhys., and the self-capacity 0·00004 mfd. Its natural wavelength was 1,110 metres. The wavelength range using the same variable condenser at minimum and maximum, was 6,000 to 20,000 metres. The coil was now considered satisfactory. The differences in the minimum wavelengths of each coil was due to the self-capacity of the coils only.

I do not propose to discuss machine winding because the reader is not likely to require this type of coil. The coils are wound on a machine which feeds the wire on to the former by a travelling arm. The wire, by means of this arm, is wound on to the former in a wave form, and by mechanical means is built up similar to pile winding, the result being that the coil has a low self-capacity. These machines are only set up where several coils of the same type are required.

BOOK REVIEWS

A THOUSAND AND ONE FORMULAS.

By S. Gernsback.

New York: The Experimenter Publishing Company, Inc. Pp. 160.

OUR readers will forgive us, we hope, if to describe this book we drag in once more the age-old joke about the curate's egg, and say that the volume under review is "good—in parts." We have here a hotch-potch—we say hotch-potch instead of *pot pourri* because our American friends strongly prefer the good old Anglo-Saxon—a hotch-potch of recipes for making most things from cement to soap. If this book sells the American housewife will be robbed of her bottles, tins, corks, string, sealing-wax and every scrap of metal which she has stored up in the garret; she will be stupefied (and either bleached or dyed) with a variety of fumes and startled by explosions. Her furniture will be glued and shellaced and stained—and improved in numerous other ways.

Many of the "tips" described seem to be very useful, though here and there we detect some which are fine in theory, and according to the illustrations, but which we are afraid are likely to be feeble in practice. However, there is a fascinating variety of subjects dealt with, and we are certainly going to try our hand at some of them; any genuine "tinkerer"* is bound to love this book. Yet we are sorry to see many childish and useless parlour-tricks sandwiched in amongst really ingenious contrivances and methods; for instance, the surreptitious treatment of a friend's cigarette papers with potassium nitrate is a poor game for a youthful scientist, and the manufacture of coloured liquids, imitation volcanoes, and home-made fireworks, are matters more suitable for a boy's book of games. Knowing what we do of Mr. Gernsback's work we feel sure that for a later edition he will eradicate these wasteful and useless tricks and fill their places with "ideas."

We should like to know why in the body of the book we find atrocities like "oxid," "tartrat," "sulfat" and "nitrat," whereas in the appendix this truncated spelling is superseded by the older and original method. We are conservative over here—everybody tells us so—so that is why we bar "sulfat" and mourn over "oxid."

E. B.

PRACTICAL AMATEUR WIRELESS STATIONS.

Compiled by J. ANDREW WHITE, Editor of *The Wireless Age*, New York: The Wireless Press Inc., pp. 136, fully illustrated. 5s. net.

This little book is intended to serve as a guide to those amateurs in wireless, who are desirous of erecting their own stations. It does not present itself as being a textbook of wireless communication "in the academic sense," but proclaims its use in the fact that its pages record the experiences of practical workers in the amateur and experimental worlds.

The book opens with two chapters devoted to the learning of the Morse Code, and for those amateur clubs holding buzzer classes these chapters contain much that might prove of use to them. The general lay-out of the buzzer class-room at the Marconi Institute, New York, is also given, with photographs. Chapter IV deals with the wiring of an amateur station, and how care should be taken not to endanger the residence by fire. Systems of wiring to house mains, together with gauges of wire, are given to aid those amateurs fortunate enough to possess transmitting licences. Only too often does the experimentalist neglect this subject of wiring, though at the same time it will be recognised that the power allowed in this country does not rate as high as that permitted to our American cousins.

The book of experience is, undoubtedly, the book from which we may all reap the most benefit, and Chapters VI and VII give from experiences the best methods of erecting an efficient spark station, and the best aerial to adopt.

Chapter X describes apparatus which any amateur can make, embracing such parts as cat-whisker detectors, rheostats, and quick break switches. To the experimenter with an aptitude for making apparatus, these chapters, though short, should prove of marked interest.

* Americaine: "Bug."

WIRELESS TELEGRAPHY.

By W. H. MARCHANT. (*Second Edition.*) London: Sir Isaac Pitman & Sons, Ltd., pp. 302, 201 illustrations. 7s. 6d. net.

Intended to serve as a handbook for the use of operators and students, this book is such that it will effectively aid those aspirants to the P.M.G.'s certificate.

The various systems of wireless telegraphy most commonly in use are dealt with in a clear and interesting manner; the apparatus described, though correct in detail, and still in use, is not sufficiently advanced to benefit the modern day student. The underlying principles of wireless telegraphy are ever the same, but in these present years when the valve is rapidly supplanting the magnetic detector and crystal receiver, the student is likely to require a more advanced text-book.

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.**

V.E.S. (Alexandria) *asks* (1) *If* V24 *valves are more sensitive than* Q's, *as he has a* 3 Q *valve commercial receiver which gives little better results than a Type* 31. (2) *If any secondhand Multiple Tuners are procurable, and if so, at what price.* (3) *For an opinion of a set sketched* (*Fig.* 1).

(1) No. The set described must be either very poorly designed or there must be some fault in its

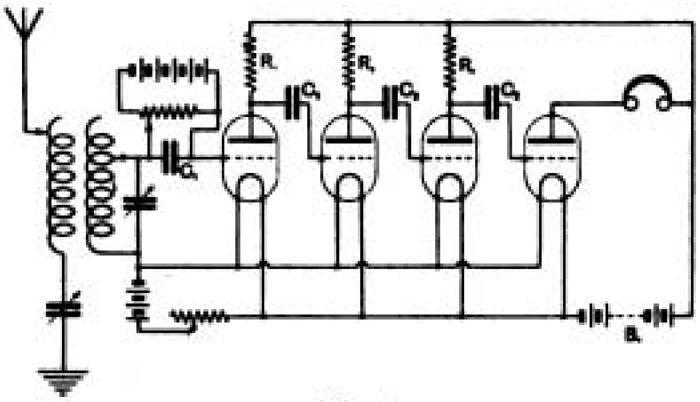


Fig. 1.

connections. Results should be very much better than with a crystal. (2) Enquire of the makers. (3) Set is of quite good type but the position of the potentiometer across the grid condenser of the first valve is an error of a very glaring nature. For successful working you will require a leak resistance of 3—5 megohms across the grid and filament of each valve.

C.F.H. (Enfield) *asks* (1) *Why inductances for crystal receiving sets are always wound on cardboard formers so that they are in single layers, whereas for valve sets the inductance consists of a coil of wire wound in a bundle.* (2) *Which of two circuits, of which he encloses diagrams, we should advise.* (3) *What would be the required amount of No.* 27 *wire required for the* A.T.I. *and the reaction coil to tune from* 600 *ms. up to* 18,000 *ms.*

(1) Crystal receiver inductances are wound in single layers (not necessarily or even often on *cardboard* formers) to keep down losses from self-capacity. The coils of valve *receivers*, as distinct from low-frequency amplifiers or aperiodic high-frequency amplifiers in which bobbins may be used, are always wound in single layers. Broadly speaking, a single layer coil is used when a strong response to a particular wavelength is required; it has no other advantages. (2) No. 2. (3) The former for the A.T.I. would have to be at least 16" in diameter and 30" long. You will require about 2 miles of the wire, or about 10–12 lbs.

F.B.W. (West Ealing).—(1) If *BBB* is expressed in millimetres and tenths the initial figure 7 is omitted. If it is expressed in millibars and tenths the initial 9 or 10 is omitted. This information is given in the Year-Book for 1920, and whether *BBB* is given in millimetres or millibars should be clear to you from actual observations of the signals. (2) We have no information concerning 2MN and 2MJ. They are probably experimental wireless telephony stations.

F.B.Soc.E. (Congleton).—(1) No. (2) Nine months to a year, according to individual capability. (3) " Physically fit " means in this instance physically fit to perform the duties required. The question is actually settled by medical examination.

F.P. (Southport) *asks* (1) *if a* 110 *volt* A.C. *supply can be used for the filament of a receiving valve, with a suitable series resistance.* (2) *If different plate volts would be required.* (3) *What should be the resistance of* L.R. *telephones for the telephone transformer described in the March issue.* (4) *How much resistance wire is needed for the potentiometer described in the May* 15*th issue.* (5) *If three Leclanche cells would be sufficient for a crystal.*

(1) No, there would be too much induction in the telephones. See reply to **G.P.K. (Leeds)** recently. (2) If this could be done there would be no necessity to alter the plate volts if the series resistance were put in in a suitable place. (3) Any value not very different from that of the L.R. side of the transformer will do. (4) About ¼ oz. (5) Yes.

R.L.W. (Nottingham) *asks* (1) *If in the present state of wireless telephony it is possible to reproduce in an ordinary room, " with no adulteration of sound whatsoever," vocal or instrumental music.* (2) *If such an experiment has been made, and if so with what measure of success.*

Absolute freedom from adulteration of tone is a state of perfection which is hardly likely to be attained as long as we have to make use of such imperfect instruments as the gramophone and telephone diaphragms, which are our present means of reproducing sound. Up to the limits imposed by our reproducers the quality of the results depends almost solely on the trouble and expense that the experimenter is prepared to undergo. Many experiments on these lines are continually being made, and roughly speaking the results in the best of them are a good deal better than those obtained with the gramophone record of similar music.

PILOT (Streatham) *sends a diagram of a combined crystal and valve circuit, and asks* (1) *For criticism.* (2) *If a loading coil* 7″ × 24″, *with* 14 *turns per inch will be suitable.* (3) *If the inductance of the loose coupler is too high—Primary* 1,500 *mhys., Secondary* 2,000 *mhys.* (4) *Where he can get a diagram of a Mark IV* 3 *valve* L.F. *amplifier.*

(1) Set is all right for crystal working, but we do not like the suggested valve arrangement. You would get better results by applying the secondary circuit to the grid and filament of the valve in the usual manner; or if you put it in the plate circuit as you show, put a crystal and telephones across it, using the valve for amplification, and the crystal for detection. (2) Yes. (3) Primary should be all right, secondary could with advantage have a good deal more inductance. (4) We are afraid we cannot say. You might try recent Signal Service manuals.

Thanks for your appreciative remarks about the *Wireless World*. As to publishing weekly, we must give the fortnightly a longer trial first.

H.P. (Stoke Newington) *asks for instructions for making an inductance to tune to* 3,000 *ms. for crystal reception, the coil to fit in a box* 5″ × 4″ × 4½″, *and having tappings brought through the lid.*

You do not say what sort of circuit you propose to use, or what part of the circuit the coil is to be used for. If it is for the closed circuit inductance, wind it with No. 30 in a single layer on a cylindrical former 4½″ × 3½″. This will not be suitable for an A.T.I., which you would have to wind with more, and therefore thinner wire. The result would not be satisfactory, and you should use a larger box, and more and thicker wire.

W.H.D. (Elvet Moor) *asks* (1) *how the* H.F. *resistance of an earth can be measured.* (2) *If there is any point in insulating an earth lead.* (3) *If the disposition of earth plates with regard to the aerial affects the strength of signals.* (4) *If No.* 4 S.W.G. *iron wire would make an efficient earth lead; he wishes to buy a good deal of this wire to obviate underground connections.*

(1) There are several possible methods, none of them very easy or convenient to work. One of the handiest depends on the fact that with a suitable transmitter the current in the aerial varies inversely as the total resistance in the aerial circuit, provided that everything else is kept exactly constant. If then the aerial is excited by the transmitter and the current measured; and a known resistance added to the aerial and the current again measured, we can derive an equation which will give us the total resistance in the aerial circuit. If we subtract from this total resistance, the ohmic resistance of the aerial, and also its computed radiation resistance, the quantity left is the earth resistance required. (2) Very little, if any. (3) This is too big a subject to treat here. For small earth systems the manner of disposition is not very important, provided the plates are spread out as far as possible from each other. (4) Iron is not good for this purpose, owing to its large H.F. resistance, etc. If you use it you should use as many wires in parallel as possible.

SPARKO (Whitley Bay) *asks* (1) *For dimensions for loose coupler and* A.T.I. *to receive from* 300 *to* 14,500 *ms., with* 70′ *aerial and a crystal.* (2) *Is capacity of* 0·00045 *mfds. suitable for use with a crystal.* (3) *How a variable condenser can be easily made.* (4) *If distilled water can be used as a dielectric.* (5) *If a tikker can be used for telephonic reception.* (6) *What wavelengths and times* MUU *and* MFT *use, and the times and wavelengths of* FL *press on C.W.*

(1) You will not get any useful results over such a range with crystal reception. See recent replies to similar queries. (2) Yes. (3) Consult page 539, in December issue, for a simple type. (4) Distilled water is quite useless, it has much too high a conductivity. What is the matter with oil? (5) No, a crystal gives quite good results for telephony, as explained several times recently. (6) Carnarvon; 0000 to 0100, CQ press; 0230, R.A.F. weather report; 0070, U.S.N. traffic to Constantinople and Venice; 1420, weather report; 1630 to 2000, CQ press; 2000 to 2030, U.S.N. traffic as at 0070; 2030 to 2100, CQ press; all other times, commercial traffic to EAA and IDO. Wavelength, 14,000 metres, *C.W.* These programmes are liable to alteration. Clifden; continuous commercial service to Glace Bay (*GB*). Spark, musical note; wavelength, 5,800 metres. Eiffel Tower (*FL*) sends press on spark from 1500 to 1530 on 2,500 metres, and on *C.W.* at 0800, 1300 and 1620 (G.M.T). *Four* questions, please.

L.S. (Wolverton) *sends the following list of his apparatus:—loose coupler,* 4,000 *ms. variable condenser, capacity not stated.* 4,000 *ohms telephones, crystal detector, potentiometer, and battery. He asks* (1) *If with standard twin* L *aerial he should receive* FL, *other continental stations, and also Clifden.* (2) *If he needs any other instruments.* (3) *If a* T *aerial would do as well.*

(1) With suitable connections you should certainly get FL and other continental stations. Clifden is more doubtful depending chiefly whether your loose coupler, which you describe as "4,000 ms.," is generously designed or not. (2) An aerial tuning condenser, while not essential, would facilitate accurate tuning. (3) No, for small aerials the T type is not so good as the L.

G.H.P. (Kristiania) *asks* (1) *Why his spark coil will not spark on* A.C. *with shorted hammer break (? hammer break shortened).* (2) *If an electrolytic break can be used in series with a spark coil on* 220 *volts* A.C. *without a series resistance.* (3) *Whether* L.R. *or* H.R. *telephones should be used with galena.* (4) *What is the inductance of the* A.T.I. *in the crystal receiver described in the April* 17*th issue, and how many tappings it has.*

(1) Probably the dimensions of the windings and core are quite unsuitable for the voltage and frequency you have used. (2) The usual forms are unsuitable for so high a voltage, even with a series resistance. You should step down with a transformer to about 60-80 volts. The ordinary electrolytic break is used on D.C. There does not appear, however, any reason why certain types should not be adapted for A.C. work. (3) Fairly high resistance. (4) Former 7″ diameter by 9″ long, wound with No. 24; about 5 tappings.

QUESTIONS AND ANSWERS.

G.T., Junior (Dover) *sends a sketch (Fig. 2a) of a proposed receiver for criticism.*

Fig. 2b shows a more efficient way of connecting up. The circuit is of a common elementary type,

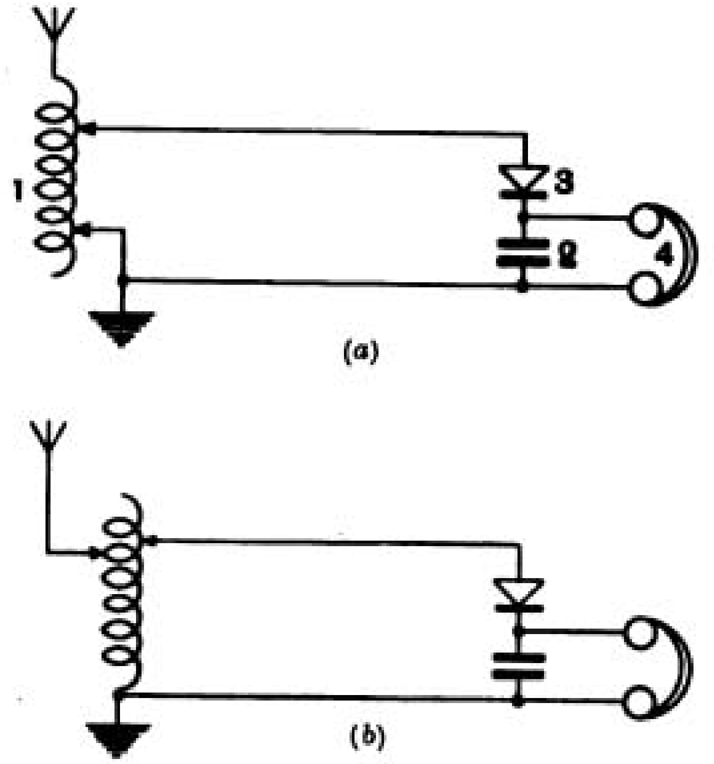


Fig. 2.

and, connected as we suggest, should give as good results as can be obtained in any other way with as little apparatus.

E.H.D. (Kennington) *asks (1) If tellurium gives better results than silicon. (2) Is a potentiometer necessary with tellurium. (3) Should tellurium be mounted as silicon, i.e., with steel wire contact. (4) If small pancake coils could be used for a loose coupler for a crystal receiver.*

(1) There is little difference, the results depending largely on the quality of the sample. (2) Potentiometer not essential, but improves results. (3) Yes, or it can be used in conjunction with aluminium, or with silicon. (4) Yes.

SPARKS (Sheffield) *asks (1) For criticism of a 3-valve amplifier. (2) Is the presence of the H.F. bye-pass condenser A (value 0·001 mfd) across the primary of the first intervalve transformer detrimental to the operation of the whole circuit as a L.F. amplifier. (3) When used as a H.F amplifier the primary B of the input transformer is still connected to the aerial terminal. Is this detrimental. (4) The intervalve transformers are wound for high voltage valves and he wishes to use low voltage valves. Is much difference to be expected in the results.*

(1) O.K., but disconnect telephone transformer when using H.R. telephones only. (2) No. (3) Not serious. Would be better to arrange a blank stud in tuning switch, in order that this coil might be cut out altogether. (4) No. Same coils will do for either.

G.S. (Birmingham) *states he is interested in electricity from a medical point of view, and asks (1) If it would be possible to give a patient shocks by wireless, say up to a distance of 150 to 200 miles. (2) For the name of any firm manufacturing wireless apparatus.*

(1) With present resources, quite impracticable. (2) See advertisements in the *Wireless World*.

C.U.L. (Brighton) *asks (1) Will telephones of 2,800 ohms do for wireless telephony. (2) Can wireless telephony signals or speech be heard by crystal detector.*

(1) Fairly well; rather too low for use without a transformer and too high for use with it. You should get best results by the former method. (2) Speech can be heard with a crystal receiver. We do not know what you mean by a wireless telephony signal.

L.E.G. (Stafford) *encloses a diagram of a circuit for wireless reception in which no particulars as to dimensions, etc., are given, except that he thinks of using a pair of 1,000 ohms telephones. He asks—(1) If it is likely to work successfully or should he alter the gauge of wire in the resistance coil or increase the high tension, or would we suggest any other connections. (2) As he has the aerial on the roof, would it be advisable to fix a lightning conductor as well.*

(1) Your set is theoretically correct. We can suggest no alterations of detail if you give no particulars. (2) No; earth the aerial when not in use.

C.A. (Liverpool) *asks (1) For the dimensions of a variable condenser of 0·0005 mfd. capacity, and particulars regarding construction. (2) For a formula for finding dimensions for capacities of variable condensers.*

(1) Construct a condenser as described in the issue of December, 1919, p. 539, only using 8 plates in one set and 7 plates in the other. (2) For a condenser with equal parallel plates the capacity is approximately given by the formula—

$$C=\frac{kan}{4\pi d}$$

where C is capacity of condenser;
k is dielectric constant of material between plates ($air=1$).
n is total number of plates minus 1;
a is area of overlap of plates;
d is distance between plates;

for a tubular condenser consisting of two cylinders, approximate formula is—

$$C=\frac{\frac{1}{2}kl}{\log_e \frac{r_2}{r_1}}$$

Where r_1 is radius of outer;
r_2 is radius of inner;
l is length of overlapping part of cylinders.

W.J.T. (Lurgan) *asks (1) What is the maximum wavelength for efficient reception on a ship's T aerial; horizontal span 235 ft., and down lead 70 ft. (2) For approximate capacities and inductance for a type of circuit shown, for the limit of wavelength given in answer to previous question (3) Is it possible to get the 25,000 metre stations.*

(1) It is always difficult to give limits of this sort. However, with an aerial of this size, and a suitable set, you might get almost any station at present working. (2) Circuit shown is of very unusual type; so much so that we cannot follow its method of operation, and can therefore not supply much information. Set may be all right, but we are rather doubtful if some of the arrangements to which it can be switched will be of any use. For maximum of 10,000 ms. A.T.I., should be about 75,000 mhys. Other honeycomb coil about 50,000 mhys. (3) Are there any 25,000 ms. stations yet working? We know of none, but if there are, you might get them, though receiver would need very big coils and would not be very efficient even with your aerial.

A.L.B. (Manchester) *sends sketch of a receiver, with some information as to dimensions of parts. He asks* (1) *If circuit will receive spark and C.W.* (2) *If a telephone transformer would improve results.* (3) *What range and wavelengths he may hope to get.* (4) *If a 1" trembler coil with contacts, etc., removed, could be used for a telephone transformer.*

(1) Spark only, receiver being of crystal type. Coarser wire would be better for the A.T.I., say 22 or 24. Your condenser in aerial circuit is unnecessary, and condenser in secondary circuit much too small in capacity. Thickness of dielectric should be about 1/100", not ⅛", otherwise circuit O.K. (2) Yes, if designed to suit your 750 ohm telephones, *i.e.*, with larger primary than the usual type for 100 ohm telephones. (3) We cannot say, particularly as you do not give diameters of any of your coils. (4) No, resistance of L.F. winding would be quite unsuitable.

F.J.R. (Midlothian) *sends description of some apparatus for a receiver, and asks* (1) *Whether a coupler primary 11"×5" of No. 30, secondary 11"×4½" of No. 26, will give him continental stations.* (2) *If twin aerial 25' long with 20' lead in, height 30' will do.* (3) *Maximum wavelength of set.* (4) *Capacity of air condenser, 9 fixed, 8 moveable plates, radius 2½", ⅛" between plates.*

(1) Yes. Primary wire would be better if of heavier gauge—say 24, but this would reduce maximum wavelength. (2) Make it full permissible length if at all possible: you could then use, say, No. 26 for coupler primary, getting better results. (3) About 4,000 ms. (4) About 0·00026 mfds. *N.B.*—No. 26 copper wire is of no use for a potentiometer. Use No. 36 Eureka.

S.O.S. (Nuneaton).—(1) Yes. Refer to the advertising pages of the *Wireless World*. (2) One valve, or two at the most, for daylight working. (3) If you can afford the sum you mention, we should strongly advise you to buy a complete set; although if you prefer to construct the apparatus yourself we shall be glad to give you a circuit diagram. You could probably make a set yourself for half the sum mentioned, and such apparatus would fulfil all the requirements referred to in your letter and would do a very great deal more besides.

J.W.B. (Garston).—(1) Read R. D. Bangay's *Elementary Principles of Wireless Telegraphy* (Part I) and follow the Constructional Articles and Pages for Beginners in the *Wireless World* as from the issue of April 3rd last. (2) The Liverpool Wireless Association, Hon. Secretary, S. Frith, 6, Cambridge Road, Crosby, Liverpool.

C.E.D. (near Grimsby).—MJS: *U.S.S. Frederick*. NOT: *U.S.A. Pitsburg*. 2.SS: this is an unknown amateur station. The Dutch station you have heard talking to PCH is probably PCGG, the station at the Hague.

G.E.B. (Enfield).—The results you have obtained on your set would be a great deal improved if you gave further attention to the wiring. We do not think it is anything to be proud of to have a badly wired set. Without any particular expense you could greatly improve it. GJJ: s.s. *Idaho*. OST; *Ostend*. KOND; s.s. *Indiana Bridge*. FFB; *Boulogne*. DSX (we cannot trace this); YDR; s.s. *Pontwen*. PEC; s.s. *Noordam*. KELK; s.s. *West Elcajon*.

E.S.R.B. (Shoeburyness) *proposes to make a receiver of the self-heterodyne type as described in the issue of February, 1920, and gives dimensions of two condensers he wishes to employ in it. He asks* (1) *What are the capacities of the condensers.* (2) *For a diagram showing suitable positions of condensers in a circuit of the type specified and for dimensions of pancake coils (as in article in issue of 12th June, 1920), to give range of 6,000 ms.* (3) *What modification should he make for reception of spark signals.* (4) *If he can use a dynamo giving 8 volts, 3 to 4 amps, to light valve, instead of accumulator.*

(1) 0·0004 mfds. and 0·00016 mfds. respectively. (2) See Fig. 3. Neither of your condensers are suitable for aerial tuning purposes. You could

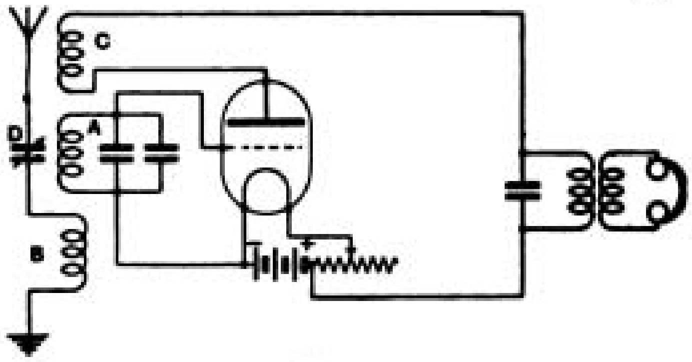


Fig. 3.

employ them in parallel in the oscillatory circuit A, and a coil of 6" external diameter wound with 36 D.W.S. wire would enable you to tune to 6,000 ms. The reactance coil C might be made with 32 D.W.S. wire and wound to 3" external diameter. Condenser D should be of about 0·01 mfd. capacity. Coil B should not be wound in pancake form, but on a cylindrical former with coarser wire. See article in December issue for a suitable aerial circuit on crystal set (3) Weaken coupling between A and C until circuit just ceases to oscillate. (4) No; noises of dynamo would probably drown signals.

S.S. HALO (Beckton) *asks* (1) *If there is any demand for a true direct-reading instrument, without making use of a "Search Coil" to give the bearing* *of any station from a ship—e.g., "n° on Port or Starboard Bow," "Dead Ahead," "Dead Astern," etc.* (2) *If such an instrument is already protected or marketed.* (3) *If the beat method of reception for C.W. is finally accepted for future use.*

(1) There would appear to be a field for such an instrument—always provided that the elimination of the fairly harmless search coil was not achieved by the introduction of any considerable complications in the gear. A search coil method is cheap, handy, and gives little trouble. An alternative device to be successful would have to at least equal it on all these heads. (2) We do not think so. (3) The heterodyne method is now firmly established, and will probably remain the standard method until some new system, entirely different from anything at present in use, and with still more advantages, is developed. We cannot, of course, say when or even if ever this will be done.

W.A.S. (Kilburn) *describes certain apparatus which he has constructed for wireless telephony purposes and asks* (1) *How to connect up the instruments.* (2) *If he needs a transformer to work with telephones of 800 ohms, and for details if necessary.* (3) *What power battery is necessary for his set.* (4) *What will be the maximum wavelength with his tuning inductance and aerial.*

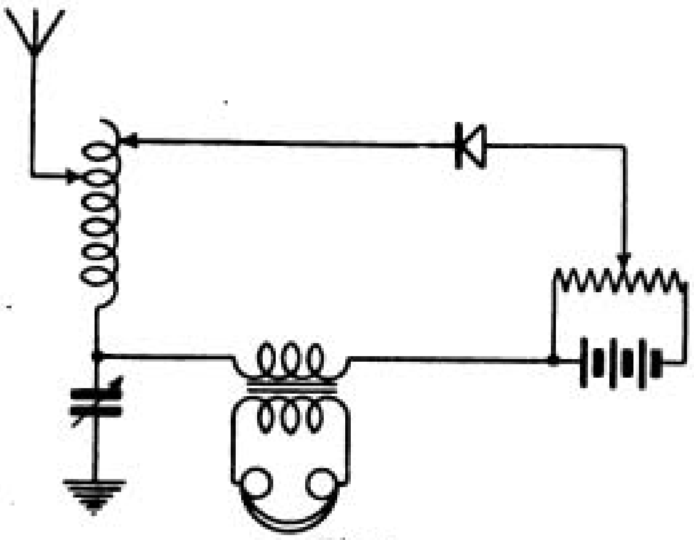


Fig. 4.

(1) See Fig. 4. (2) Yes. See March, 1920, issue, but wind low resistance coil with 5 oz. of No. 34, instead of 6 oz. of No. 30. (3) 4-volt dry cells of quite small size. (4) Perhaps nearly 1,000 ms. For more useful results increase size of coil considerably, say to 10″ × 6″.

BILLY (Morecambe) *asks for simple tests of a crystal detector and also for the method of mounting copper pyrites.*

There are only two methods of testing—one is to put in receiver, excite the latter by means of a buzzer and test for results in the telephones. The other is to take the characteristic curve. This requires instruments not likely to be possessed by an average amateur. You will find the method and a discussion of the results in most theoretical text books. Copper pyrites is best used with a crystal of zincite. Iron pyrites is used with a metal point, *e.g.*, gold; it is therefore probable that copper pyrites will work in this way, too.

R.W. (Malden) *sends sketch of proposed receiver with some dimensions. He asks* (1) *If design is correct.* (2) *Range of wavelengths to which it will tune.* (3) *For a design for telephone transformer, suitable for 100 ohm telephones.* (4) *What kind of wire to use, as cheap as possible.*

(1) Design will not be of much use. You have shown telephone transformer between the tuned circuit and detector, which is quite wrong. Consult any crystal receiver diagram. (2) We cannot say. You do not give thickness of dielectric of your condensers, and we therefore cannot determine their capacities. (3) See page 699, March issue. (4) Use about No. 14 or 16 copper, and be careful to keep it free from kinks.

NOVICE (Birmingham) *wishes to construct a receiving station with range from 300 to 3,000 metres and specifies certain sizes of former, etc., which he wishes to embody in his apparatus. He asks* (1) *What gauge wires would be suitable for aerial and inductances, and what amount of wire would be required for the inductances.* (2) *What is the best crystal to use.* (3) *If a potentiometer is necessary, and, if so, what size and length of wire is needed.* (4) *How should these instruments be connected up to give best results.*

You should consult article in issue December, 1919, for much useful information regarding a receiving station of this type. (1) *Re* aerial, see above article. Your single slide inductance may be used for aerial tuning purposes, and should be wound with No. 22 wire. Your triple slide inductance may be used as an auto coupler; if you use No. 26 wire you will make certain of attaining the wavelength you specify. (2) See article mentioned above. (3) Potentiometer improves results with most crystals, but not all. If you use it wind with No. 36 Eureka wire 20 to 30 yards should suffice. (4) We append diagram of a circuit we suggest. See Fig. 5

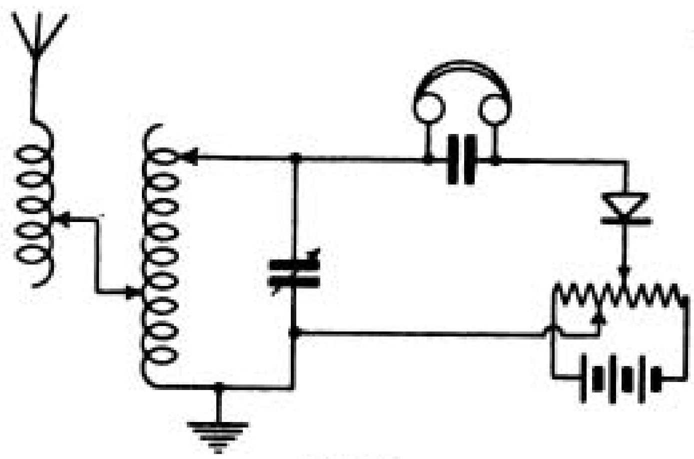


Fig. 5.

G.S.H. (Goring-by-Sea) *gives a diagram of his crystal receiving circuit and asks how it is that he gets signals, but weaker, when it is disconnected from earth.*

Your apparatus probably has a capacity to earth which would be sufficient to account for what you describe.

H.W. (Liverpool) *asks* (1) *For a diagram of a 2-valve set, using certain instruments.* (2) *If he could receive 4,000 miles, and if he could hear Washington.* (3) *If it is necessary to use grid leak and condenser with valves He also states* (4) *That he can hear Seaforth, 12 miles away by only using a piece of silicon and No. 24 wire, cat-whisker, 2,000 ohm telephones (double), and* P.M.G. *aerial, and that when he connects inductance, signals are weaker. Diagrams of the two circuits are given.*

(1) See Fig. 6. You will require a reactance coil to make the first valve oscillate in order to

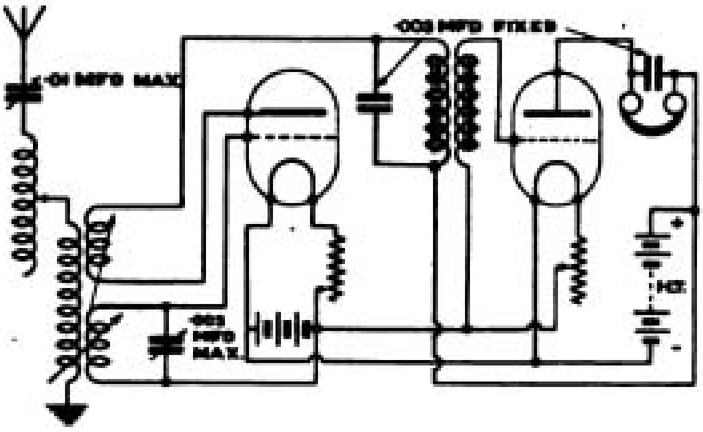


Fig. 6.

receive C.W. See article in issue of February, 1920. Your transformer may not be suitable for inter-valve purposes. The high resistance coil should be connected to the grid and filament of the second valve. You will probably get shocks off your telephones, but you cannot avoid this unless you use two high tension batteries. (2) You might, on a well-made set, in perfect adjustment. (3) No; in the set illustrated above no grid condenser is employed. (4) You should connect your crystal across the whole of the inductance as shown in various recent replies, and your telephones should be in series with the crystal. Only the nearness of Seaforth permits you to hear anything at all.

L.B. (Balham), *asks* (1) *If a 25 ft. earth lead would be too long, and, if so, how could he overcome this difficulty as his intended cabin is at the top of the house.* (2) *If a third wire in his aerial (twin wire 40 ft. long with spreaders 4′ 6″ long) would give better results.* (3) *In a simple crystal receiving circuit which would give best results, low resistance telephones with a telephone transformer or high resistance telephones.*

You should consult article in issue of December, 1919, for much useful information. (1) A 25′ earth lead is on the long side. We know of no means for decreasing the distance between your cabin and earth, except putting the former in a different place. If you have a water pipe at the top of the house you might try making connection to it. (2) No. (3) See numerous recent replies.

AMPLIFIER (Halifax) *encloses sketches of a receiving circuit, one being an amended version of the other, and asks* (1) *If it is possible, by inserting extra condensers, or by any other means, to get down to 600 metres.* (2) *With reference to a sketch of single valve amplifier, what proportions should the winding of the two transformers, primary and secondary, be, using No. 44 wire. He proposes to wind an iron wire core of about ½″ diameter.* (3) *If the first transformer should be a step down or a step up.* (4) *If he inserts another valve in the amplifier what will be the proportions and approximate windings of the transformers.*

Your amended sketch is still wrong as it shows two condensers, one of which is permanently shorted, and the other is out of circuit with the switch in one position. (1) The obvious method is to cut out some inductance. (2) For intervalve transformers windings should be 4,000 and 12,000 ohms. For information *re* telephone transformers consult March issue. (3) Step up—since filament-grid resistance is greater than filament-plate resistance at the working point. (4) Same as first.

Nota Bene.—Owing to the increasing activity in the world of amateur wireless workers, the number of queries received for these columns has trebled during the past few months, and we have accordingly increased the pages devoted to them from two to six. In spite of this, however, we are regretfully compelled to hold over a number of replies each time we go to press.

Now, we welcome this steady influx of Queries, because it is the best proof we could have that we are being of direct assistance to our readers. Nevertheless, in respect of many instances, we are not altogether sure that we are helping them in the best way, because whilst we give them a "lift" over a stile, we ought, perhaps, to encourage them instead to help themselves.

Take, for example, the calculation of Inductance. The necessary formulæ can be found in dozens of books; they involve simple mathematics only; they have been printed in the *Wireless World* scores of times, and yet almost every post brings us requests to work out the Inductance values of simple solenoids.

Similar remarks apply to the calculation of capacity, wavelength, or windings, the connections of simple receiving circuits, the use and construction of telephone transformers and the design of aerials.

We shall continue to reply to these questions, because our business is to impart knowledge. No-one need hesitate to bring his difficulties to our notice. Yet we take this opportunity to throw out the hint that if querists would look through recent issues before writing to us, they would in all probability find the required information already in print, and would thus save room in our pages for replies to their co-workers on subjects of more general interest.

SHARE MARKET REPORT.

Since we last went to press business has continued stagnant in the Share Market.

Prices to-day (September 9th) :—

Marconi	Ordinary	2⅞
,,	Preference	2⅝
,,	Inter. Marine	1¼
,,	Canadian	10s. 6d