The WIRELESS WORLD

VOL. VIII, No, 23, NEW SERIES]. FEBRUARY 5th, 1921. [FORTNIGHTLY.

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 23. FEBRUARY 5TH, 1921 FORTNIGHTLY

RELAYS AND RECORDERS—I.

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

IN the earliest commercial reception of wireless messages relays and recording apparatus were employed, as detectors suitable for telephonic reception had not at that time been developed. As is now generally well known, the method then adopted depended upon the use of a coherer type of detector in conjunction with a make-and-break relay of similar type to an ordinary telegraph relay, with a Morse tape inker as recording instrument. The successful operation of this chain of mechanism by an incoming signal, apart from the question of relay sensitivity, necessitates the employment of a detector having a large range of resistance variation under the influence of the signal. These conditions were complied with by coherer type receivers, since their resistance was generally greatly diminished under the influence of the signal, although there is another type of coherer in which the reverse action takes place.

With the discovery and perfecting of the crystal and similar contact detectors, the use of recording apparatus fell into disuse, since, under normal working conditions, neither the resistance variations nor the magnitude of the currents flowing were suitable for operating a relay. Telephonic reception also offered the further advantage of aural selection of the desired signal from interfering signals having other note frequencies. Given suitable apparatus, however, this selection may be effected by purely electrical means, by employing the principles of resonance. Ordinary acoustic resonance apparatus may also be used.

For ordinary reception work using detectors of the crystal type the mechanical recording of the message is not usually required, as it offers little advantages over direct aural methods, while bringing in its train certain attendant disadvantages.

The most important application of recording apparatus for reception is in connection with the transmission of wireless messages at high speeds—that is, at speeds higher than can easily be transcribed directly by hand. For this purpose some form of relay, operated by the detector, is generally essential, although its use can be dispensed with in some cases. For instance, if the output circuit of the detector includes some form of galvanometer or current indicating instrument of sufficient sensitiveness, the signals may be recorded by a photographic attachment registering the movements of the instrument. Most forms of galvanometer of sufficient sensitiveness for this purpose, are unsuitable as their natural period of vibration is far too long, with the result that they take a considerable time to reach their reading and to return from it. This precludes their use at high speeds. There is, however, one form of galvanometer which is very suitable for such purposes as this—viz., the Einthoven galvanometers, the uses of which for such purposes have already been referred to in these columns. These

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consist essentially of a stretched conducting fibre placed in a powerful magnetic field, and provided with a powerful optical arrangement for projecting a much enlarged image of the fibre on to a screen, or on to the photographic film as required. The current to be indicated is passed through the conducting fibre, and so causes its movement by reason of the electro-magnetic reactions between the current and the magnetic field.

As an alternative scheme to photographically recording the movements of the galvanometer thread, its image may be projected upon a narrow slit in an opaque screen, so that when at rest its shadow blocks the opening and prevents the passage of light into the space beyond—Fig. 1. Behind the slit a selenium cell may be placed,* so that when the thread

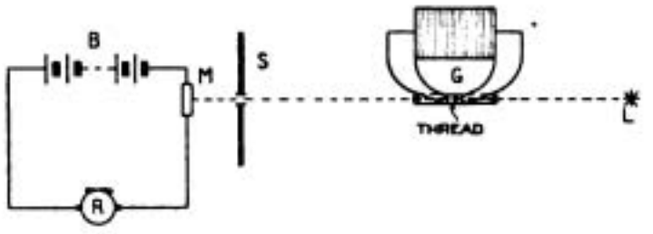

Fig. 1.

moves under the action of a received signal current light can pass through the slit S, and falling upon the selenium cell M, cause its electrical resistance to drop and current to flow through the relay R from the battery B, and so enabling some recording apparatus (such as a Morse inker) to be operated. The sluggishness of the selenium is the main objection to this method, but with suitable apparatus it could probably be worked satisfactorily.

The sensitiveness of these Einthoven galvanometers is very great, and some patterns will give a measurable deflection with less than 0·0000000000015 amp.—*i.e.* less than one sixty-thousand-millionth of an ampere—so that they are very suitable for use with simple crystal contact rectifying detectors, employed without polarising e.m.f. It is generally preferable to sacrifice some of the available sensitiveness for speed of operation, particularly where high-speed reception is under consideration.

Brown's amplifying relay (or "telephone relay"), although a very sensitive instrument that is easily applicable to wireless work, does not help much in the problem of recording high speed signalling, although it has proved extremely useful for general recording purposes in lecture work and under similar conditions. It will not, therefore, be dealt with further in this article.

Another simple form of recorder that has also been used extensively with crystal receivers, as well as with more sensitive apparatus, is of the "dictaphone" type, in which the incoming signal after detection is passed through a type of telephone receiver much in the usual manner, while this instrument is then used to record the message by impressing it upon a rotating wax cylinder, just as ordinary sounds are recorded upon such a cylinder in a phonograph, or office dictaphone apparatus. Apparatus of this kind has been extensively used in practical work.

As in other branches of wireless work, the thermionic tube, or triode valve, has indeed revolutionised the treatment of the problems of recording wireless signals, as apart from its use as an amplifier it has other and more direct applications to the subject in hand.

Thus, taking the case of a simple detecting valve, the receipt of a signal will vary the mean plate current through the valve, so that if an appropriate relay can be arranged to operate with this variation recording becomes possible. The main difficulty that is met with arises from the relatively large steady plate current, which flows permanently through the relay, and upon which the variations are impressed. This steady current will often obliterate the effect of the variations unless special means are provided for balancing it. The use of a differential relay provides one solution, as indicated in Fig. 2. In this diagram, the thermionic valve V is shown connected to a receiving aerial A, and

* See *The Wireless World*, 8, page 145, for description of selenium cells.

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earth E and to the receiver unit $L_1L_2C_2$ in the usual manner, a grid condenser C_1 and leak R_1 being inserted in the grid circuit. The plate circuit is completed through one-half of the winding of the relay R, the connection of the plate battery B_2 being made to the centre of the winding as shown. An auxiliary circuit is made up through the second half of the relay winding, so as to include a high resistance R_2, which should be given a value approximately equal to the normal internal, or plate-filament, resistance of the valve.† It will be found necessary to adjust R_2 to achieve the desired balance when the valve is joined up and the normal plate current flowing. The relay contacts should be joined to a local circuit containing some form of recording apparatus. When using the connections shown in this figure, the receipt of a signal will usually cause a decrease in the normal plate current, causing the currents through the two halves of the relay windings to no longer balance, so that the relay tongue moves over to close the local contact. The "bias" of the relay should be adjusted so that this decrease of plate current will cause the tongue to move in the proper direction to close the local contact. A grid potentiometer P is usually required to obtain the best results.

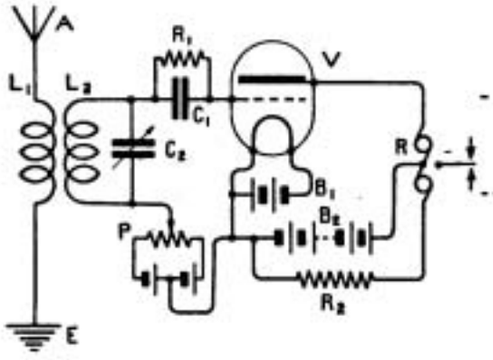

Fig. 2.

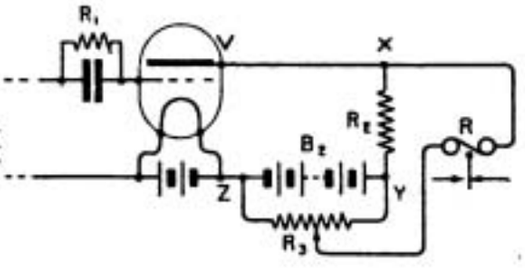

Fig. 3.

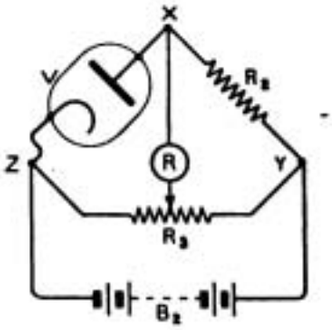

Fig. 4.

An alternative arrangement is shown in Fig. 3. This one possesses some advantages in that it is not necessary to employ any special form of relay having a differential winding, as the balancing-out of the normal plate current is effected externally to the relay. For this purpose a resistance R_2, of about the same value as R_2 in Fig. 2, is joined between the positive terminal of the plate battery B_2, and the anode of the valve. When the normal plate current is flowing, the potential of the point X will, therefore, be approximately midway between the potentials of the points Y and Z, at the ends of the plate battery, so that by connecting a potentiometer resistance R_3 across the plate battery, a point can be found on it where the potential of the slider is the same as that of the point X, with the result that no current will then be flowing through the relay R. On the receipt of a signal the plate current will change, causing a variation of the potential of the point X, with the consequent passage of a current through the windings of the relay, causing a signal to be registered on the attached recording apparatus.

As a matter of fact this system of resistances really constitutes a Wheatstone bridge, the plate-filament resistance of the valve constituting one arm, the resistance R_2 forming a second, and the two parts of R_3 the third and fourth, as may perhaps be made clearer by Fig. 4, where these resistances are arranged in the conventional manner of a bridge.

This arrangement forms part of a very low-frequency amplifier due to A. Blondel, to which further reference will be made in a second instalment of this article.

† The requisite value for R_2 will thus be of the order of 20,000 ohms.—depending, of course, upon the type of valve in use.

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NOTES ON THE CONSTRUCTION OF A TUNER AND AMPLIFIER

By L. H. Mansell.

SOME of the "Gadgets" employed during the manufacture of my apparatus may be of use to others. I will therefore first describe a method which I used in the manufacture of studs for inductance switches, potentiometers, etc. These little articles entail a considerable expenditure of time and patience to turn up in the normal way, and the method in which this was overcome is as follows. I obtained a quantity of 2 B.A. commercial cheese-headed screws, 1 inch long. Having made a small face-plate to screw on the nose of the lathe, I next marked out and drilled a circle of holes, in the same way as would be done in an ebonite lid for one of these switches. The 2 B.A.

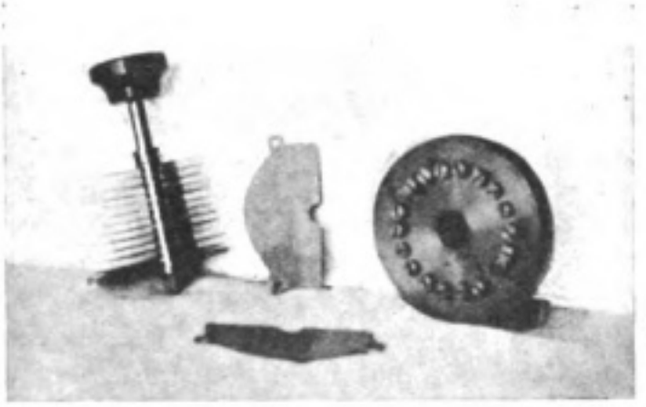

Fig. 1. Type of variable condenser used in C.W. and Spark Receiver.

screws were then placed in the holes and clamped down flat by screwing up their respective nuts on the back of the face-plate—the scheme will be easily followed by reference to Fig. 1. The face-plate was then mounted on the lathe head, and a couple of cuts taken across the face of the circle of screws, thus taking the screwdriver slots right out and leaving all the studs *exactly* the same height. This makes for the smooth working of the switch handle. In this way a huge number of studs can be turned out in a very short time. Incidentally, this face-plate makes an excellent jig for the subsequent drilling of holes in the ebonite top. A considerable amount of time is saved if there are two or three such switches to be made. The "jig" should be located by means of the centre hole, a special plug being used for this, as shown in Fig. 2.

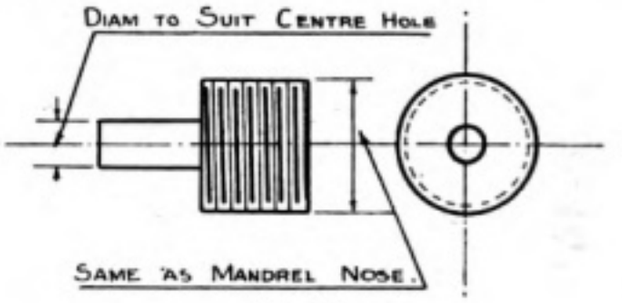

Fig. 2.

The aerial tuning condenser of tuner (see Fig. 3) is of the Marconi double capacity type, 0·0025 mfds. The vanes are cut from 10 mil. zinc sheet, with a small margin left all round for trimming up. To finish, they are clamped between two pieces of $\frac{1}{8}$" thick sheet brass, which is also cut to approximate shape. When tightened up in the vice jaws, the zinc plates will be found to press into a solid block of metal, and it is an easy matter to file them to the correct size and contour,

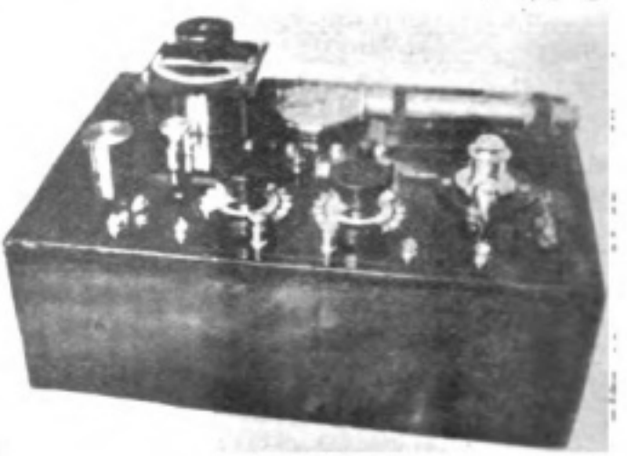

Fig. 3.

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using a smooth file, and watching carefully to see that particles of metal do not lodge in the file teeth. Whilst under pressure the vanes are drilled for the securing screws, which are 4 B.A. The dielectric of mica, 12 mils.

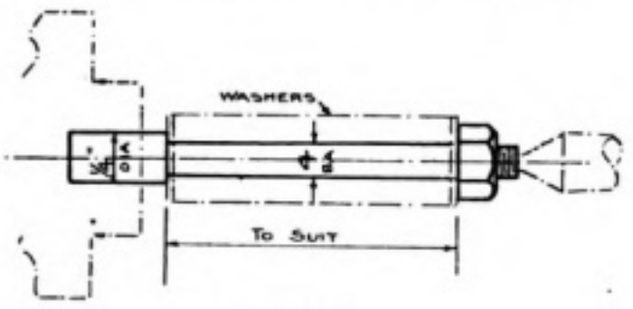

Fig. 4

thick, and distance washers are 14 gauge. Using the gauge of zinc before specified, this will give a nice smoothly working condenser

It is a heart-breaking job making the distance washers separately. If, however, access can be had to a lathe, procure some 14 gauge copper washers with the correct size of centre hole, and string them on a small mild steel mandrel held in the lathe chuck. Clamp them with a nut on the end of the mandrel and steady by bringing the lathe back centre up to it (see Fig. 4). Then, taking comparatively light cuts the washers can be turned down to required size. This method makes quite a "posch" job of the finished article, both as regards accuracy and appearance. The variable condenser used in the amplifier (see Fig. 1), is made of the same materials, and made by the same processes, with the exception that it has an air dielectric and is of single capacity type. When making this I had a good deal of difficulty in turning out the vanes with a true flat finish. The difficulty was, however, finally overcome by clamping the vanes, after filing and drilling, between two pieces of ¼-inch steel plate, and playing a blow lamp on the outside of the steel plates. Considerable care must be exercised when doing this, as it is essential that too much heat is not applied, or there will be trouble. Once they have got nicely hot, put on further pressure and then allow to cool, they will come out beautifully flat. The spindle of this condenser works in a plain brass bush at the top, and has its lower end drilled to rest on the coned end of an upturned brass screw, from which contact is taken. This permits adjustment to be made when assembling, so that moving parts are quite clear. A switch is provided for placing the aerial tuning condenser in series or parallel for short or long wave reception.

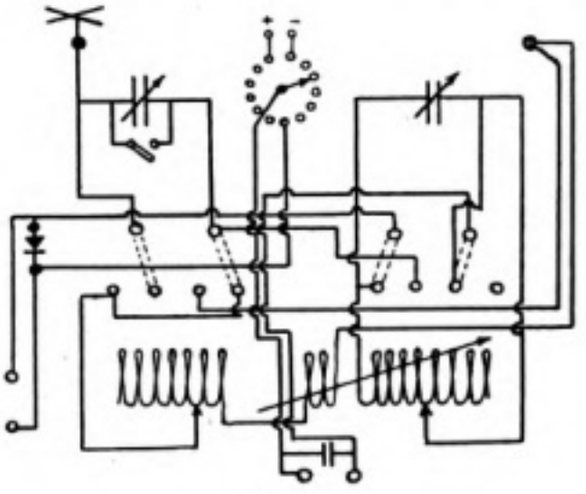

Fig. 6.

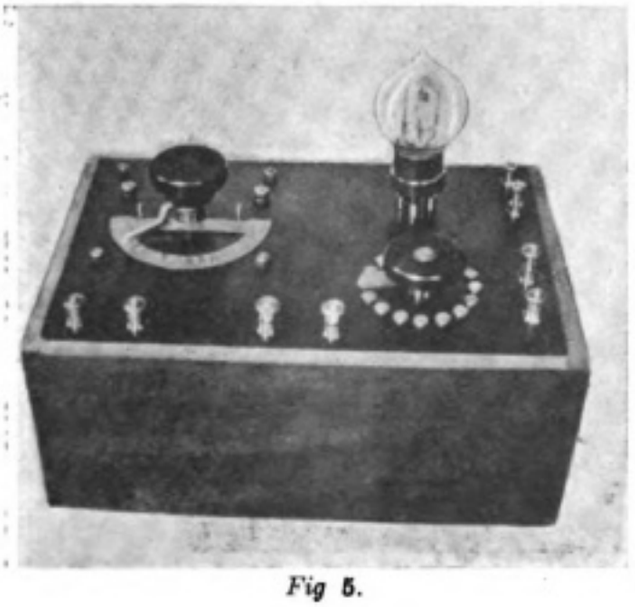

Fig 5.

The values of all components used in the set are as below. The tuner is particularly successful, and I shall be pleased to give further particulars to any reader requiring them. The aerial tuning condenser has a maximum capacity of 0·0025 mfd. Bill

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condenser C.C.C., 0·0003 mfd., aerial tuning inductance 600 mhys. wound with 22 D.C.C. closed circuit inductance, 600 mhys. wound with No. 28 D.S.C., each are brought off to a rotary switch of 16 studs. A carborundum detector is used, the potentiometer, 250 ohm, can be seen in the centre at back of tuner. Terminals are provided for extra detector and valve. I am at present using it with a circuit for reception of C.W. and spark signals, simultaneously. The aerial is double wire, each wire 65 feet long on spreaders 5 feet apart. Height is about 18 feet at the house end and 48 feet at the mast end. Using single valve circuit, above mentioned, I get

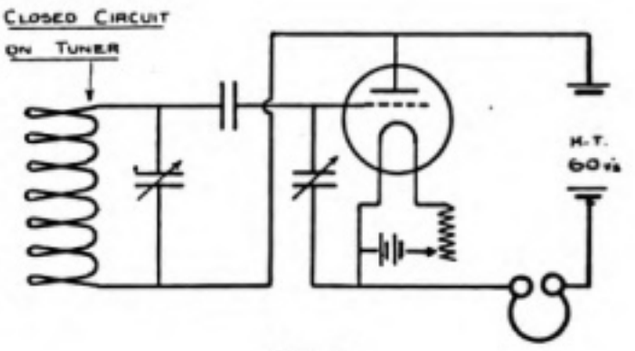


Fig. 7.

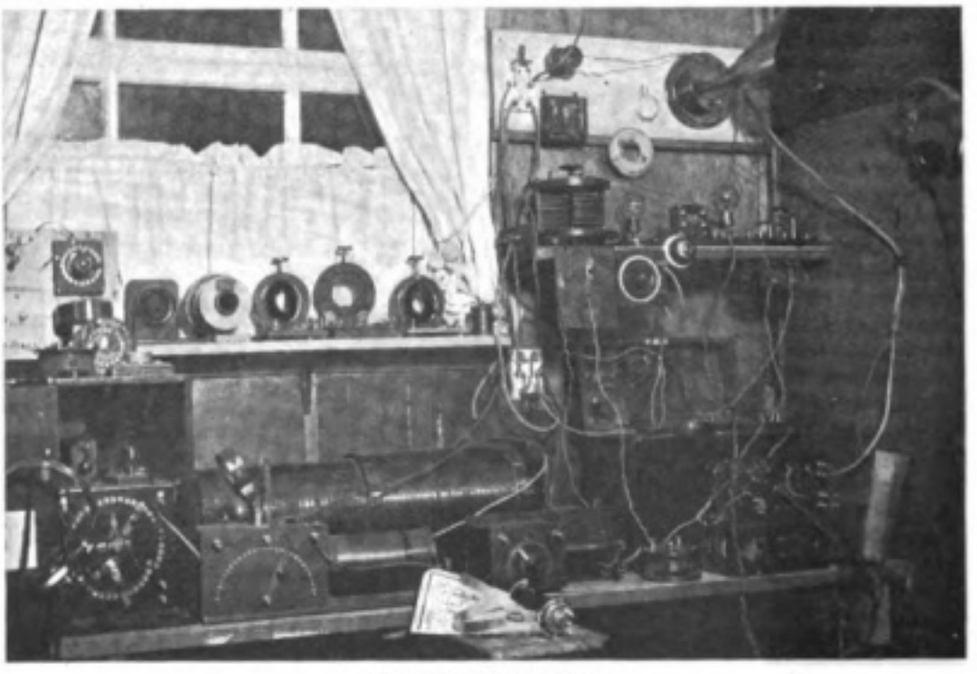
F.I.. faint but readable with aerial and earth disconnected. Fig. 5 shows the C.W. receiver and amplifier, and Figs. 6 and 7 the tuner and amplifier circuits respectively.

AN AMATEUR STATION

The photograph shown here represents the station of Mr. J. F. Bruce, at Hounslow.

The apparatus is nearly all home made and the station has a very considerable range. With one valve magnification telephony from aeroplanes in France and the Channel Isles has been clearly heard. NSS can be read with two magnifications. The aerial is horizontal "L" type and is only 50 ft. long by 20 ft. high.

An examination of the photograph will show that a great deal of labour and skill were required in the manufacture of the apparatus depicted.



An Amateur Station

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NOTES AND NEWS

Long Distance Reception.—Mr. J. Kenneth Hele, of Plymouth, has written to us that he has been successful in receiving messages from the station at Bandoeng (Dutch East Indies).

This reception was not due to a "freak night," as the performance was repeated regularly every evening for a week, and on occasions the station had to be read through bad atmospherics.

The distance from Bandoeng to Plymouth must be about 9,000 miles, so that this achievement probably constitutes a record for amateurs in this country.

We understand that Bandoeng has been read by certain amateurs in Holland. Mr. J. Kenneth Hele has given us sufficient proofs to substantiate his claim.

Award to M. Léon Bouthillon.—M. Léon Bouthillon has been awarded the Hébert prize, by the Paris Academy of Sciences for his work and publications on wireless telegraphy.

Receiving Wireless Signals by Sense of Taste.—A Paper presented to the Institute of Radio Engineers, New York, by Messrs. A. N. Goldsmith and E. T. Dickey, was intended to describe the tests made to determine the feasibility of Mr. A. A. Isbell's suggestion, that under certain operating conditions, it might be better to make use of the operator's sense of taste rather than his sense of hearing. The results of the tests go to prove that it is possible to read signals by the sense of taste if the speed is not great (say, five to ten words per minute). When the speed was increased the taste sense became confused, and the same effect was produced when interference from strays or other signals took place.

The K.D.K.F. Distress Signal.—In the United States it is proposed to make use of the letters K.D.K.F., as a distress signal, taking precedence next after the S.O.S. signal, the new letters serving to indicate that individual life is in danger and that assistance is required.

The "Radio Review."—With the new volume of *The Radio Review* several improvements have been introduced, with the object, firstly, of making the journal of greater interest and usefulness to its present readers, and, secondly, by broadening the scope of the articles published, to appeal to a wider circle of readers. Articles of a more general and less mathematical character will be included without modifying, in any way, the comprehensive policy of the journal, which is one of its characteristics. An article in the January number, entitled "The Heterodyne Method of Wireless Reception, its Advantages and its Future," by M. Marius Latour, is of special interest to the general wireless enthusiast.

Amateur Call Signs.—**2AX** is the call sign of the station belonging to Mr. G. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

2JH, power 10 watts, wavelength 180 metres (C.W. and telephony), belongs to Mr. C. A. Barrand's station at Stefano, Willington Street, Slough. The hours of working are 1600 to 1700, and 2000 to 2100.

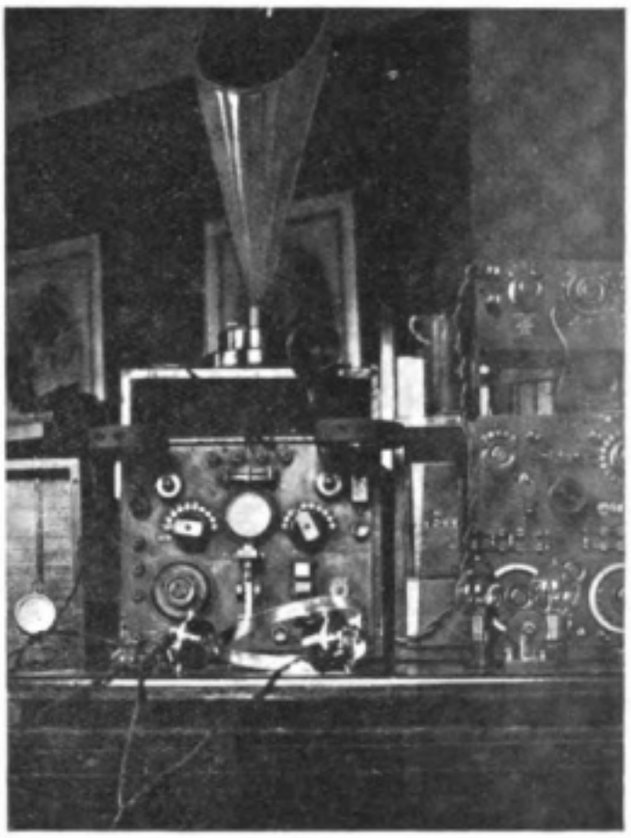
2JN is the experimental station (C.W. and telephony) of Mr. H. B. Burdekin (chairman of the Rugby and District Wireless Club), Bilton, Rugby. Hours of working are 2000 to 2200, Saturdays and Sundays, 1500 to 1600 and 1700 to 1500, power 10 watts and wavelength 180 metres. Messrs P. H. Dorté and K. A. Lindsay are the joint owners of an amateur station, having call letters **2JB**. The address is Roberts House, Downside School, Stratton-on-the-Fosse, near Bath.

Synchronising Clocks by Wireless.—In our Notes and News column in the January 8th issue we referred to the wireless time signals received at the Huddersfield Tramway Offices for checking the clocks from the Eiffel Tower time signals.

Mr. P. W. H. Taylor, of Harvey Institute, Barnsley, now informs us that as long ago as 1913 Major Barker, Borough Electrical Engineer, installed there a system of synchronous clocks, taking the time direct from Eiffel Tower. The system resumed operation as soon as the war restrictions to the use of wireless were withdrawn.

An Amateur Set.—The photograph reproduced here shows the amateur set belonging to Mr. W. C. Gosheron, of King's Arms Hotel, Peckham Rye, S.E.15.

The owner does not claim to have made all the apparatus. As can be seen from the picture some of the instruments are recognisable as Government Disposal gear.



Mr. Gosheron is a member of the Wireless and Experimental Association, and a demonstration of his set was given at the meeting of the Club held on January 19th.

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MORSE PRINTING OF WIRELESS SIGNALS

B. S. T. WALLACE.

IT is remarkable that one hears little from even the most progressive wireless societies of the recording of Morse wireless signals. This is a comparatively simple matter, and even valves are not essential for the purpose.

Every club of standing should have its Morse recorder. Many clever experimenters suffer the handicap of being unable to read Morse with facility and certainty, and, consequently, have but a vague idea of the identity of many of the stations they hear. This disability is greatly aggravated by the similarity in sound of the increasing multitude of C.W. stations. It is even necessary for the expert, or, as one club recently referred to him, "30 word a minute man," to watch some of these stations closely for a long time to ascertain their identity.

How much more interesting would be the irksome learning of Morse, if, as well as listening to the sound in the receivers, the operator could check his reading with the dots and dashes on a running tape! The printed record can be used over and over again amongst the beginners to familiarise them with the Morse symbols and procedure of the various stations.

Any form of Morse inker can be used.

The most important and critical item in a recording scheme is the contact relay to close the local circuit that operates the printer. This relay should respond readily to 0·3 milliamps or less, except for very strong signals when there is no difficulty in obtaining a working current of 0·5 milliamps or more.

The arrangement to be described is not operated by valves, and so far as spark signals go, can be worked on crystal circuits in conjunction with microphone relays. It is equally at home on a valve magnifier. For C.W., one valve, using two microphone relays as amplifier, gives quite satisfactory results.

For amplification I prefer the relays. They cost practically nothing to run, do not wear out, and one does not experience that haunting fear of the last ampere oozing out of the accumulators of a three-valve amplifier at a critical moment. Four dry cells, giving 6 volts with a current of 20 milliamps, supply the two relays for months.

Microphone relays are not foolproof, but to anyone with average electrical intelligence they are easy to adjust and remain perfectly constant and reliable for an indefinite period. They also respond remarkably well to the high pitch obtainable with C.W. notes.

Where an unlimited supply of filament current is available, and a new valve can be had for the asking, this means of amplification is preferable.

The principle of this method of recording lies in the conversion of the telephone signals into a simple direct current, for operating a D.C. contact relay.

The wireless part of the apparatus is quite independent of the printing circuit, so I will only describe in detail the printing circuit, shown in Fig. 1, as it is taken from the output terminals of the valve or microphone amplifier.

The mechanical contact relay used to operate the printer is a single contact telephone call instrument, rewound from 100 to 2,000 ohms., and polarised by an external magnet to increase its sensitiveness. It responds to 0·25 milliamps, whereas originally it required nearly 3 milliam.

Having increased the received signal strength by means of valve amplifiers or microphone relays, it is necessary to convert them so that a direct current passes through the relay every time a signal arrives.

Now the current delivered from a microphone relay is a permanent one, made pulsating when a signal passes. The current in the plate circuit of a valve amplifier is a permanent

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one, varied by the passing signal. Both these currents are unsuitable for operating the contact relay.

The fluctuations, in either instance, consequent upon the passing of a signal, must first be converted into a truly alternating current by means of a transformer.

This transformer can be of similar design to the various valve audio-frequency transformers, but the respective windings must be suited to the circuits in which they are placed. The primary, if used on the local circuit of a microphone relay should be about 400 ohms, for the plate circuit of a valve amplifier it can be as high as 10,000 ohms, and should not be less than 2,000 ohms When used in the plate circuit of a valve a condenser of 0·003 mfs. (the usual telephone condenser) is placed across it. The secondary should have a resistance of 2,000 ohms.

These primary and secondary values can be varied within fairly wide limits without serious loss of efficiency, and most experimenters will be able to put their hand on a transformer suitable for the purpose.

The alternating current from the secondary, being of too high a frequency to operate a contact relay, is passed through a carborundum rectifier, thus converting it into a current suitable for the purpose required.

This rectifier is identical with an ordinary carborundum detector minus a potentiometer. The latter is not required owing to the comparatively large currents employed, and, if used, is likely to cause trouble by passing a permanent current through the relay. What may be a surprise to many is the fact that this carborundum rectifier will pass 2 milliamps and yet remain perfectly constant and stable for an indefinite period.

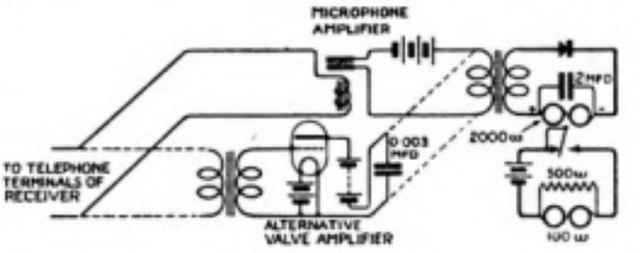

Fig. 1.

Of course, a rectifying valve can be used in its place, but it is a quite unnecessary complication without compensating advantages of any kind.

The relay must be shunted with a condenser, the value of which will vary with the resistance of the former. A good general value is

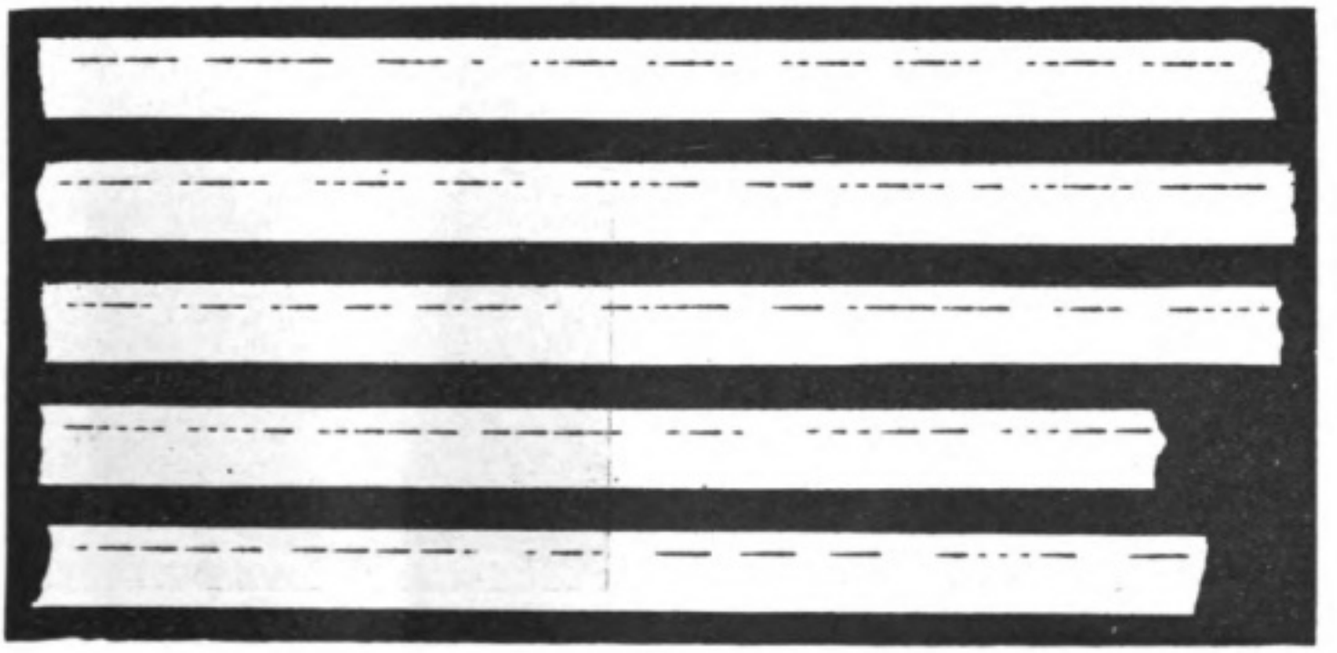

Fig. 2.

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2 mfds., but with relays of very high resistance this can be reduced to 0·5 mfs.

The resulting signal, even with a rough spark, is turned into a clean dot and dash.

It is necessary to place a shunt across any instrument in the local circuit to prevent all trace of sparking at the relay contacts or inductive reaction on the wireless circuit. This shunt should be a non-inductive resistance of a value not less than 5 times the resistance of the instrument across which it is employed. A printer of 100 ohms, for instance, will require a shunt of 500 ohms or more.

Under some circumstances a 2 mfds. condenser can be employed as a shunt for this same purpose.

When first setting up the printing circuit it is advisable to experiment first with a low reading milliamp meter in place of a relay, not forgetting to put a 2 mfds. condenser across it.

A testing buzzer should readily give a steady deflection round about 1 milliamp. Of course, the telephone receivers can be used simultaneously by joining them across the primary of the transformer.

If a polarised relay is used it must be joined for correct polarity.

The Morse slip shown in Fig. 2 was printed in London on a single wire aerial, 100′ long and 25′ high. There has been no difficulty in printing such stations as Paris, Poldhu, Nauen, Carnarvon, Lyons, Hanover, etc. A recent news message of 444 words from Lyons was printed without a blemish, and the Paris time signals and scientific dots are shown to perfection on slip.

The occasional spasms of automatic working up to 40 or 50 words a minute, that are indulged in by some of the big stations can also be printed by this means, provided the Morse inker can be accelerated to that speed. Above this rate a high speed Wheatstone receiver will be required, and it will not be long before the 100-word a minute standard will be the rule, rather than the exception, with long distance work.

AN AMATEUR STATION IN LEICESTER

We reproduce here a picture of the amateur station belonging to Mr. Cyril T. Atkinson, Vice-President of the Leicestershire Radio Society. On the extreme left of the table is the valve amplifier-detector. In the centre are the tuners; a small tubular one (top) for wavelengths up to 1,500 metres, and a honeycomb coil set (below) for wavelengths from 1,400 to 20,000 metres. In front of the tuners are the variable tuning condensers. A 10 watt transmitting set is seen on the left. Very good signals have been heard on crystal sets at a distance of 5 miles.

The call signal of this station is 2CZ.

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PHOTOGRAPHING WIRELESS APPARATUS

By D. Charles.

(Photographer to Marconi's Wireless Telegraph Co., Ltd.)

THERE must be many successful designers of wireless apparatus who make photographic records of their inventions. Among these there are probably few who will be averse from reading some hints intended to assist them in obtaining satisfactory results. It has been the fate of the writer to photograph difficult subjects in general for over twenty years, and wireless instruments in particular for some time past, and he has not found these latter by any means the easiest sort of thing to render to advantage in photographs. Those who use a camera only occasionally will get the best results by avoiding methods which introduce complications to the already complex problem, for example, of black concave details in close proximity to convex white ones, polished and lacquered metal, and glass bulbs, all contained in a single instrument.

Most professional work is sent out with a white background to the apparatus, but this alone introduces difficulties, and is best avoided. A sheet of plain paper or cloth hung up at some distance behind the object is the best sort of background. The colour is immaterial, but something neither very light nor very dark should be chosen. A window-blind is very suitable, but if the only thing available has creases in it that does not matter, as exposures are usually long, and if the background is moved either continuously or intermittently during that time, the result will be a nice even tint.

The "lighting" of subjects is of paramount importance. An object containing deep hollows obviously should not be photographed out-doors where the light comes mainly from above, causing the hollows to be rendered as dark, almost detailless, shadows. If no other lighting is available for this type of subject some sheets of newspaper laid flat between object and camera will reflect a lot of light into the shadows, and still more can be introduced by means of a mirror kept moving during exposure. In any case care should be taken that images of such reflectors or other adjacent objects of light tint do not show in the photograph. To an observant eye they can be seen in the subject before photographing, generally in polished surfaces which act simply as mirrors.

It is useless to stand beside the camera in order to judge of the lighting, or to observe whether surrounding objects are likely to show in the result, and the image on the ground-glass is often hardly brilliant enough to recognise easily all these things. The proper method is, first of all, to get the camera roughly focussed and then to remove the lens and open the focussing-screen, so that one can look right through the camera at the objects to be photographed. A little study will then discover any objectionable details in the lighting. It comes as a surprise sometimes how objects in all sorts of positions will be reflected in polished parts.

A clothes-horse or three-fold screen, placed around the back and two sides of the instrument with some cloth of a plain colour hung over, will cut off much unwanted light. A room with lofty windows is undoubtedly the best place to photograph such objects as we are considering. It is best to cover the windows with muslin or tissue-paper. This might be thought to increase exposures, but, as a matter of fact, it does not, as it diffuses the light, and while softening it generally, throws a little more into the shadows, so that a more even result is secured.

In the case of an instrument in the form of a box having a number of projections, it is far easier to take elevation and plan views separately, than to make one photograph

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showing the apparatus in perspective, for several reasons, which space hardly permits of explaining. The same applies to interior and exterior views. A plan view is made by the simple expedient of placing the box on its side so that the top faces the camera. It is by no means difficult to get the instrument absolutely square to the camera so that the rectangular top of a box will be rendered as such, and not as a quadrilateral of uncertain shape. At the same time it is not a thing that can be done in a violent hurry. If the camera is one with a flat base permitting of its being temporarily screwed on top of a box it makes things easier, but a tripod can be employed by standing it on a mat and the camera carefully levelled by means of a spirit level. Once adjusted, the camera can be moved about on a reasonably level floor, as required, simply by sliding the mat. The back of the camera must be quite vertical and the uprights of the object to be photographed also. If the camera is on a box standing on a table and the instrument on another, it becomes a simple matter to arrange the two boxes square with one another at any distance. With a tripod in use it is almost, but not quite, as easy. Having roughly focussed to the size required and centred the image on the focussing-screen, find the centre of the object where it rests on its support and push a pin into the box on which it stands, Fig. 1. Then get a yard-stick or piece of string and measure the two lines A-B, C-D, turning the subject about the pin until these two lines are equal. The instrument will then be square with the camera.

Fig. 1.

Perspective views of instruments involve not only increased difficulty as regards the points already dwelt upon, but also to a very marked extent show the apparent distortion due to the use of a lens, whose focal length is of the usual proportion to the size of the plate, and, therefore, short for this work. This may be overcome by using the one element of the lens only, which will be of much longer focal length than the complete lens. This will entail the use of a very long extension to the camera, and if this is insufficient an extension box can be improvised.

It is very useful to know how to calculate beforehand the approximate distance from the object to the lens, and, again, from the lens to the plate, in any given case. These figures enable one to save a lot of time in the preliminaries of setting up the camera, and in determining whether the extension of the latter is sufficient to permit of photographing small articles at close quarters. The calculations necessary to obtain these particulars are of the simplest possible character and have been published, in a form very easy to memorise, by Mr. George E. Brown, Editor of the *British Journal of Photography*. It is necessary to know the focal length of the lens fairly approximately. This is the distance between the stop or "diaphragm" of the lens and the plate, when a very distant object—say a church weathercock—is focussed on.

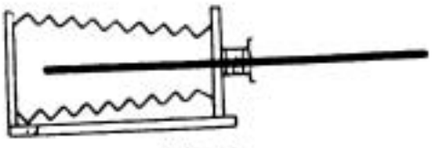

Fig. 2.

The method involves imagining the lens to be the centre of a bar measuring two focal lengths, that is to say, we suppose the bar to project into the camera towards the plate for one focal length, and also forward towards the subject the same distance, Fig. 2. The only thing to do, then, is to measure the longest dimension of the object to be photographed, and to divide it by the availble length of the plate in use; for instance, an object 18" long is to be photographed on a half-plate. The longest side of the plate measures 6", leaving a little margin at each end. The 18" of the object divided by

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the 6" of the plate gives 3 as the result, which is called the "ratio." This ratio represents the number of focal lengths in front of the bar to the subject, as well as the fraction of a focal length between the bar and the plate. See Fig. 3.

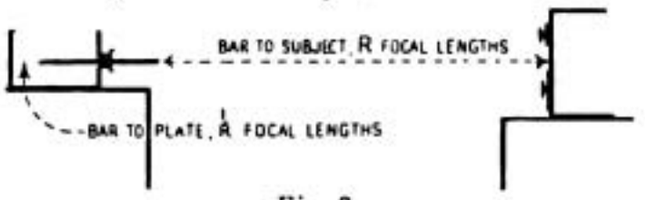

Fig. 3.

where

D = Longest dimension of subject.
d = Available length of plate.

$$\frac{D}{d} = \text{Ratio} = R.$$

Taking the example quoted above of a ratio of 3, and using a half-plate lens of 9" focus, the distances will be as follows :—

Lens to plate -	1 Focal length (bar) -	9"
	$+\frac{1}{3}$ Focal lengths -	3"
	Camera extension -	12"
Lens to object -	1 Focal length (bar) -	9"
	3 Focal lengths -	27"
	Total distance- -	36"

Although the question of exposure has been left to the last it is by no means because it is relatively unimportant. The old dictum that "Exposure is half the battle," is never truer than in photographing objects with such a long "range of gradation," as is found in wireless apparatus, and there is no surer way of estimating correct exposure than by the use of an exposure meter, modifying the result by factors given in the following table. The meter is placed against the object facing the light and the normal exposure read off for an ordinary subject, with the stop it is intended to use.

Dark objects of wood, metal, or ebonite, with no deep hollows -	×3
Dark objects with deep hollows, well lit - - - - -	×4
When the camera has to be used very close to the object - -	×2
When using one element of the lens only (usually) - - -	×4

A plate correctly exposed should develop in a soft-working developer, such as "Azol," in three or four minutes, at a temperature of about 70°F. By adhering to standard times and temperature of developer, and exposing by meter, errors will be diminished and improvement in results rapidly acquired. My insistence on "scientific" methods will be understood when I state that two successive exposures, views of the same instrument taken quite recently by the light from the same window and with the same camera, lens and plate, required three hours and nine minutes respectively, and both resulted in first-rate negatives. The great difference was due partly to the use of a smaller aperture in the lens, in conjunction with a change in the weather, but such divergence could not have been estimated successfully by guesswork, as there is far less "latitude" in this kind of photography than in most other branches.

TRANSATLANTIC AMATEUR TESTS

Full particulars of these tests and the form in which results are to be forwarded to the judges have been communicated, through the post, to those interested.

The results will be published in these columns as early as possible.

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WIRELESS CLUB REPORTS

Wireless Society of London.

At the meeting of the above Society held at the Royal Society of Arts, at 8 o'clock on January 27th, a Paper was read by Lieut. Ducan Sinclair, R.A.F. on "The Wireless Stations of the British Commercial Airways." The Paper was very fully illustrated. A full report of the meeting and Paper will appear in the next issue of *The Wireless World*. During the meeting an illuminated address was presented to the retiring president, Mr. A. A. Campbell Swinton.

Sheffield and District Wireless Society.

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

"The Design of a Panel Tuner" was the title of a Paper read before the members of the Sheffield and District Wireless Society on January 7th, by the Hon. Secretary, Mr. Leonard H. Crowther, A.M.I.E.E.

The various component parts of the complete receiving set were described in detail, formulæ being given for the calculation of the necessary inductance and capacity corresponding to the wavelength range required. Full particulars of a wireless receiving tuner, designed and constructed by the lecturer, and having a wavelength range of 600 to 3,500 metres, were given, the data being supplemented by a splendid series of lantern slides.

The above photograph was taken on the occasion of a dance held recently. The music was received by wireless telephone.

At the close of the Paper, questions were invited, and a keen discussion followed, the lecturer afterwards successfully demonstrating the capabilities of the actual tuner itself, which was coupled to the Society's aerial, by receiving loud signals from the many British and Continental Wireless Stations.

Derby Wireless Club.

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

The tenth Annual General Meeting was held at 95, Canal Street, Derby, Tuesday, January 4th, 1921, Mr. S. G. Taylor in the chair.

The minutes of the last annual general meeting were read and confirmed.

A statement of accounts, duly audited, for the year ending December 31st, 1920, was submitted by the Hon. Treasurer and approved.

The following officers were re-elected for 1921 :—President, F. W. Shurlock, B.A., D.Sc.; Vice-President, T. P. Wilmshurst, M.I.E.E.; Chairman, S. G. Taylor; Hon. Secretary and Treasurer, W. L. Bemrose; Librarian, J. Lowe. The following Committee was elected :—A. T. Lee, E. V. R. Martin, J. W. Downes, A. N. McInnes, B.A., E. F. Clarke, E. S. Huson.

The Chairman reviewed the Club's achievements during the past year, mentioning the greatly increased receiving ranges now common; the difficulties of H.T. supply for valves, local transmitting stations, etc., etc. Regret was expressed at the poor attendance of members at recent meetings. A programme for future meetings was drawn up and hope was expressed that there would be a good attendance in future.

The Amateur Transatlantic Experiments were discussed, and it was decided that the Secretary should ascertain names of members wishing to take part.

Arrangements were made for a visit of members of the N.S. Railway Radio Club on January 15th

The meeting concluded with a vote of thanks to the Chairman.

The Committee will be pleased to receive suggestions or to hear from any member who is willing to read a paper at a meeting of the Club.

Will members please note that subscriptions (5s.) are now due for 1921, and should be paid to the Hon. Treasurer.

Any changes of address, etc., should be notified to the Hon. Secretary, Capt. W. Bemrose, Littleover Hill, Derby.

The Halifax Wireless Club.

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

The last lecture of the above Club was a very excellent one delivered by Mr. W. A. Ward, of the Sheffield Society. Mr. Ward had prepared lantern slides descriptive of the various circuits he outlined, and his remarks were very helpful. A demonstration of Telephony was a feature of the evening.

On December 22nd our Secretary (Mr. H. L. Pemberton) gave a short instructive lecture on tuning, and initiated some of our less experienced members into the art of working the various instruments comprising the Club set. At a later stage of the evening light refreshments were served, through the generosity of the Officers and Committee, and the evening gradually developed into a social function. Opportunity was taken at this meeting to make a presentation of a silver cigarette case, suitably engraved, to Mr. Pemberton, in appreciation of his work as Secretary since the formation of the Club. Our President (Mr. Walter Emmott, M.I.E.E., M.I.C.E., M.I.Cons.E.) made the presentation after an amusing speech, to which Mr. Pemberton responded.

On Christmas Eve, the Club's transmitter was in operation, and a suitable musical programme was sent out to our members, a large number of whom have receiving sets, and they, along with many other gentlemen in the surrounding towns

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and villages, spent a very novel and enjoyable Christmas Eve. We hear of one Christmas party of twenty or more people who thoroughly enjoyed an hour of our music through the agency of a 3-valve amplifier and loud speaker.

Acting Secretary, Louis J. Wood, Clare Hall, Halifax.

Three Towns' Wireless and Model Engineering Club.

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

At the meeting of the above Club, on January 12th, a Paper was read by Mr. Graves on "Accumulators." The Paper dealt very thoroughly with the theory, chemistry, manufacture and care of storage cells. Particularly valuable to the amateur was the latter part of the Paper which dealt exhaustively with the charging, discharging and precautions necessary to avoid sulphating, buckling of plates and disintegrating of the plates. The discussion which followed showed how the Paper had appealed to the audience.

A Club "Field Day."

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

Burton Wireless Club.

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

The fortnightly meeting of the Burton Wireless Club was held on Friday evening, January 14th, Mr. F. V. A. Smith presiding.

A letter was read from the Hon. Secretary to the North Staffs. Electrical Department Wireless Society, Stoke-on-Trent, thanking the Club for the excellent facilities afforded them on the occasion of their recent visit to Burton.

At the last meeting of the Club, early in December, it was decided that the programme of lectures be varied so as to include an occasional lecture on other branches of science and engineering.

The first lecture under this new policy was given at the meeting on January 14th, by Mr. L. G. A. Sims, on "Electricity (as opposed to Steam) as the Universal Traction Medium of the Future." The lecture was very interesting, and aroused considerable discussion.

North Middlesex Wireless Club.

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

The usual fortnightly meeting of the Club was held on Wednesday, January 12th, at Shaftesbury Hall, Bowes Park, the President being in the chair. After the usual formal business the chairman called on Mr. Griffiths to read his Paper on "The Resistance Amplifier."

Mr. Griffiths had provided himself with a number of boldly drawn diagrams, which he fixed in prominent positions. The lecturer drew attention to the importance of allowing for the volt drop in the resistance in series with the valve, when calculating the voltage required for the H.T. battery. Another point of importance was the effect of capacity between the electrodes and leads of the valves. Particularly interesting was the diagram of Mr. L. B. Turner's kallirotron circuit for resistance amplifiers.

Newcastle and District Amateur Wireless Association.

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

The Society held its last meeting for 1920 on December 19th, when the usual programme was adhered to. The Secretary gave an outline of the financial condition of the Club. There was £6 17s. 6d. cash in hand to begin the New Year. The first meeting of this year was held on Monday, January 2nd. Mr. Dixon, of Rowlands Gill, gave a demonstration and description of a 3-valve receiver complete with honeycomb tuning coils. Satisfactory signals were received with this set on all waves between 600 and 20,000 metres.

At the meeting of January 10th an extremely interesting demonstration and description was given of a captured German 3-valve amplifier, fitted with D.R.P. valves and barratters in each filament circuit. Signals received with this set were not quite as good as with British models, in spite of the elaborate design of the instrument in question.

Club meetings will continue every Monday evening at the Wireless School, Eldon Square, Newcastle. Applications for membership to be forwarded to the Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

Preston Scientific Society, Wireless Section.

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

At our last meeting, on Monday the 10th inst., our Vice-Chairman (Mr. W. Paddock) gave a very interesting lecture on the valve as used in wireless telephony, and concluded with a practical demonstration with a 3-valve amplifier in conjunction with a loud speaker. Excellent signals were obtained, which were audible to all in the room.

Our permanent installation for reception at the rooms is now open to members each Tuesday and Thursday evening.—Hon. Secretary, Mr. W. J. Bryce, 119a, Fishergate, Preston.

Wireless and Experimental Association.

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

At a meeting of the above at the Central Hall, Peckham, on January 19th, Mr. Kennedy exhibited a small amplifier which, by the use of a single throw-over switch, used one or both of the valves

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at pleasure. Mr. Sanders showed a short-wave tuner, with several novel points. Mr. Gosheron tuned in his three-valve amplifier and loud speaker on the Club aerial, using De Forest honeycomb coils.

Mr. Kloots then described the stages of making a small rotary converter to derive H.T. voltage from the filament battery, and showed his usual skill in handling the minute quantities and dimensions necessary.

It is hoped that Messrs. Mitchell, of Rye Lane, will be able to make an instrument for demonstration purposes. Mr. Sanders was elected (*nem. con.*) to handle the difficult problem of collecting, coordinating and maintaining the Club's apparatus

The Walthamstow Amateur Radio Club.

On Wednesday, January 12th, the erection of the Club's aerial masts was finished, and on Saturday the 15th the aerial and earth connections were completed Messages were received from Paris, Hanover, Nauen and Madrid on a single-valve receiver, kindly lent by the Chairman for the occasion.

All interested are invited to communicate with the Hon. Secretary, Mr. K. Hardie, at 53, Ulverston Road, Upper Walthamstow, E 17.

The Blackpool and Fylde Wireless Society.

There was a most enthusiastic gathering of members of the above Society on January 6th at Café Waldorf, Blackpool. The members of the Committee gave a demonstration with a frame aerial and three-valve amplifier. Signals were received from several English and Continental high-power stations.

On Thursday, January 13th, the Hon. Secretary had a chat with the members on woodworking in connection with the manufacture of amateur instruments. A description of French polishing and varnishing was given, with various hints and instructions on how to obtain the professional finish.

Intending members are invited to attend at any of the Society's weekly meetings.—Hon. Secretary and Treasurer, Mr. Lewis Pollard, 209, Cunliffe Road, Blackpool.

Dartford and District Wireless Society.

The usual fortnightly meeting of the Society was held on January 1st, nine members being present. Enquiries are still in operation with regard to the Society obtaining permanent accommodation, and it is hoped that something definite will materialise in the near future.

The interest of all members in home constructed apparatus is developing on the right lines. Various apparatus being brought for inspection and discussion. One of the members, having had considerable training in wireless work during the war, has promised to answer any questions the members desire to ask in connection with wireless apparatus, especially valves and valve circuits.

Buzzer practice meetings are being constantly held, the members receiving assistance in learning by means of Marconi Code Records.—Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

The Merchant Taylors' Radio Society.

This Society has entered into the third term of its existence, being formed on July 5th last. The first meeting brought in the full membership.

The above photograph shows some members of the Gloucester Wireless and Scientific Society with the Society's apparatus.

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namely, twenty-two, or one twentieth of the entire school.

The apparatus was purchased and installed the following September. Meetings are held every ten days in the Physical Laboratory, and the lecturer is allowed to have any of the apparatus in order to illustrate his lecture.

The apparatus consists of a single-valve self-heterodyne circuit and high resistance telephones. The aerial is a single wire at an average height of 30 ft., it is, however, badly screened.

The Society has been favoured by an invitation from Messrs. Johnson and Philipps, to inspect their works at Charlton Junction.

Any O.M.Ts. who are interested in wireless should apply to the Hon. Secretary, Mr. A. L. Basham, 114, Argyle Avenue, West Ealing, W.13, for full particulars.

The North London Wireless Association.

The seventh meeting of the Association was held on December 30th, 1920, at its Club-room, 395, St. John Street, E.C., at which a very interesting lecture was delivered by Mr. W. Gartland on "The Construction of a Single-Valve Receiver for Trans-Atlantic Reception." Mr. Gartland illustrated his lecture with a diagram of the circuit, and gave full dimensions of coils, wire, etc., for its construction. He invited members to ask any questions they wished as the lecture proceeded, and many took advantage of his kind offer. The lecture concluded with some very good advice on the use of the apparatus described, which was the result of Mr. Gartland's own experience. The lecture was enjoyed by all present, and a hearty vote of thanks was accorded Mr. Gartland.

At the meeting of the Club, held on the 7th inst., the usual buzzer practice was carried out This was followed by a general discussion of members' experiences with different types of grid leaks, during which some very interesting and instructive exhibits were made. Another member was enrolled.

At a committee meeting, held on the 10th inst., it was decided that the Club should affiliate itself with the Wireless Society of London, and the Secretary was asked to make the necessary application as soon as possible.

The Club has a comfortable room at its disposal, also very efficient receiving apparatus, valves, etc., and its membership is steadily increasing. New members are always welcome. Communications and enquiries should be addressed to the Hon Secretary, Mr. J. W. S. Prior, care of Superintendent, Peabody Buildings, Essex Road, N.1.

Blackburn Y.M.C.A. Wireless Club.

On Wednesday, January 12th, a very interesting lecture and demonstration on wireless telegraphy and telephony was given at the Club's headquarters by Mr. J. R. Halliwell, Principal of the City School of Wireless, Manchester.

Mr. Halliwell explained in simple language the theory of wireless and illustrated his points by various analogies. Afterwards a practical demonstration was given by the lecturer with his valve receiver and amplifier and a small telephone wireless transmitter. Mr. H. A. Hughes (Y.M.C.A. General Secretary) proposed, and Mr. W. F. Altham seconded, a vote of thanks to the lecturer.

The Club meetings are held every Friday at 7.30 p.m. in the Club-room, but members of the Wireless Section may use the valve receiver, which has been installed, at any time when the building is open.

Communications to Mr. J. Whittaker, Hon Secretary, Y.M.C.A., Wireless Club, Limbrick, Blackburn.

Birmingham Experimental Wireless Club.

The usual weekly meeting was held at the Club-room, 66½, Corporation Street, Birmingham, on January 12th, 16 members and 4 visitors were present.

The Chairman, Mr. E. B. Henton, read a letter from Mr. A. T. Headley, tendering his resignation as Hon. Secretary. Mr. Headley's excellent work in the organisation of the Club having been commented upon, his resignation was accepted with regret, and Mr. F. S. Adams appointed to succeed him.

Mr. J. Biggs, to whom the Club is indebted for several interesting lectures, then delivered an able paper on "Continuous Wave Reception." The lecturer commenced with crystal receivers and their adaptation to C.W. work, and proceeded to explain the theory of self-heterodyne reception. The lecture terminated with a hearty vote of thanks to Mr. Biggs.

An interesting series of lectures is being arranged, and all interested in radio work are invited to communicate with the Hon. Secretary, Mr. F. S. Adams, 110, Ivor Road, Sparkhill, Birmingham, who will be pleased to furnish all information.

Leeds.

We have been asked to announce that it is proposed to form an amateur Wireless Society in Leeds, and those interested are invited to communicate with Mr. H. T. Sayer, Head of Wireless Department, Central Technical School, Leeds.

Ilford Wireless Club.—A movement is afoot to establish a club of the above name in the neighbourhood of Ilford, and to that end amateurs living in the district are asked to co-operate with Mr. L. Vizard, 12, Seymour Gardens, Ilford, who is in charge of the project.

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PAGES FOR BEGINNERS

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

SIMPLE RECEIVING CIRCUITS.

ALTHOUGH superseded to a great extent by the thermionic valve, the crystal detector still keeps its place as a simple and reliable method of receiving wireless signals.

For those who do not wish to go deeply into the experimental side of wireless reception, the crystal receiver has the advantage of cheapness and comparative robustness. The circuit of the crystal detector is not complicated—in fact, signals could be received by utilising the potential difference between the ends of a tuning inductance connected in the aerial circuit to operate the detector. For efficient working, however, it is necessary to have further apparatus in the receiving circuit.

In order that the aerial may be in tune with the incoming signals, we must provide a means of readily varying the wavelength between the limits of the receiving station. This is done by connecting in series with the aerial a variable inductance and variable condenser. Coupled* to the tuning inductance is another coil, also capable of being tuned to the wavelength received. The circuit is now as in Fig. 1, and the action of it is as follows :—

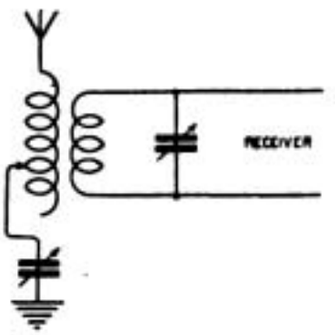

Fig. 1.

* See article on "Coupling," *The Wireless World*, June 10th, 1920, page 280.

The incoming waves, on striking the aerial, will induce in it an oscillatory current. Since the natural oscillation wavelength of the aerial is tuned to the wavelength of the transmitting station, each wavetrain will arrive at the correct moment to augment the oscillatory current induced in the aerial circuit.

In the same manner, an oscillatory current will be induced in the coupled circuit, which is tuned to the same wavelength. Before it will give a sound in the telephones, this oscillatory current must be rectified by being passed through a crystal detector. This may be made of a variety of minerals. The ones most commonly in use are either carborundum or zincite in conjunction with other crystals or metals. If a combination of carborundum and steel is used it is found necessary to apply a small initial potential to the detector in order to bring it into a critical state of sensitiveness. When adjusted to its most sensitive condition, the application of the oscillatory potential due to the passage of the oscillatory current in the aerial and coupled circuits, causes a large increase of current through the detector in one direction but a negligible flow in the reverse direction. Each successive wavetrain will thus cause a momentary rush of current through the detector, which will be evidenced in the telephones by a sharp click.

The complete receiving circuit is shown in Fig. 2. It should be noted that combinations of zincite, such as zincite-bornite, zincite-galena, etc., do not usually require any initial potential for their successful operation.

In order to obtain maximum sensitivity and freedom from interference by stray signals, it is necessary to be able to vary the effect produced by the aerial circuit on the

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secondary circuit. This can be accomplished either by making the secondary coil to slip inside the aerial inductance and thus varying the number of turns acted upon by the aerial coil, or by providing a small coil connected in series with the aerial tuning inductance, which can be moved with regard to the secondary circuit.

If it is required to receive continuous wave signals the receiving circuit described above must be modified to some extent, as the incoming signals will no longer consist

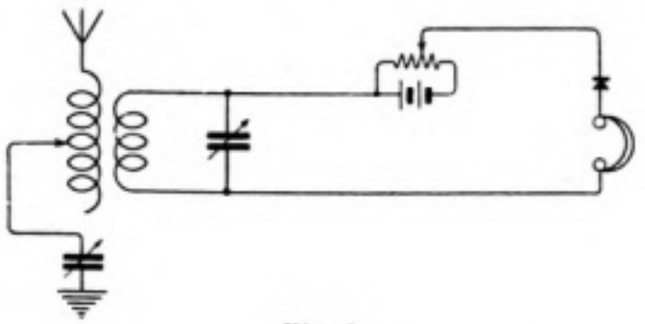

Fig. 2.

of groups of wavetrains, each producing clicks in the telephones, but instead there will only occur a click each time the transmitting key is pressed. The trains of continuous waves must be broken up into groups in a similar manner to spark trains before they will produce the same effect on the receiver. Fig. 3 shows the "*A*" in Morse code as it would be received on spark wave and continuous wave. The lower portion of the figure shows the necessary "breaking up" referred to above. This interruption of C.W. can be accomplished by means of a buzzer in the aerial circuit, or a rotary interrupter, such as Goldschmidt's "tone wheel."

Valve Receivers.

A simple form of valve receiver can be made on the lines indicated in the previous paragraph, employing a valve instead of the crystal detector. The circuit will then be as indicated in Fig. 4. In order to adjust the valve for the most sensitive detector action it is usually necessary to apply a small negative potential to the grid. This may be done by connecting a battery and potentiometer between the grid and filament of the valve.

By a re-arrangement of the circuit, one valve could be used in conjunction with a crystal detector, eithe as a high-frequency amplifier or a note-magnifier (*i.e.*, to increase the sound heard in the telephones).

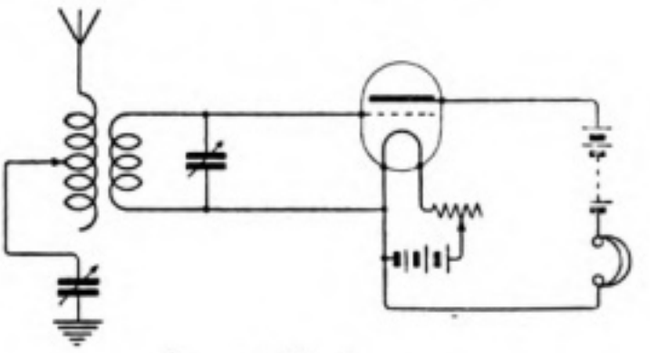

Fig. 4.

In the first case, the valve may be connected between the aerial tuning coil and the secondary circuit, as in Fig. 5. Small variations in the potential of the grid, due to incoming oscillations, produce a corresponding change in anode current on a magnified

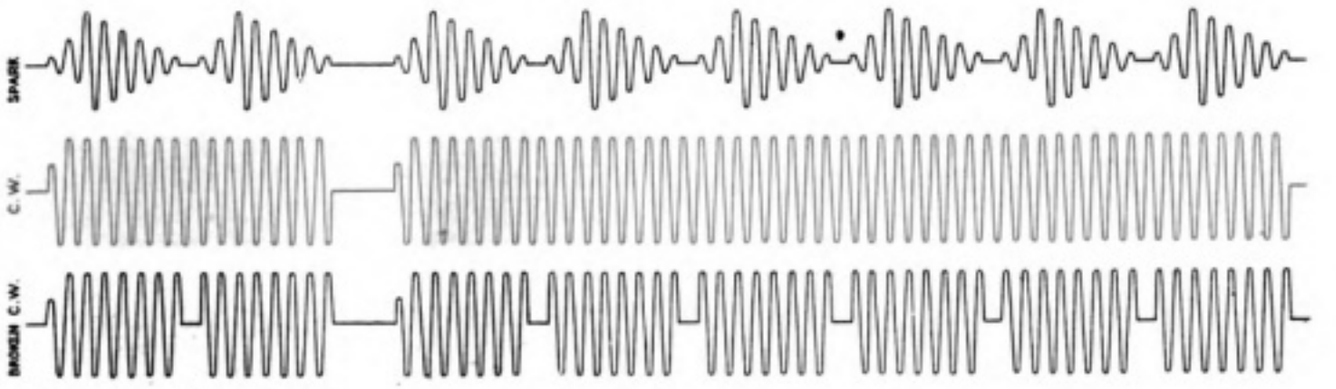

Fig. 3.

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scale. This increased current is passed on to the detector and telephones in the usual manner.

If the valve is only used to increase the effect of the rectified signals, it can be inserted between the detector and telephones, as in Fig. 6.

With two valves a combination of the two circuits can be made up as in Fig. 7, one

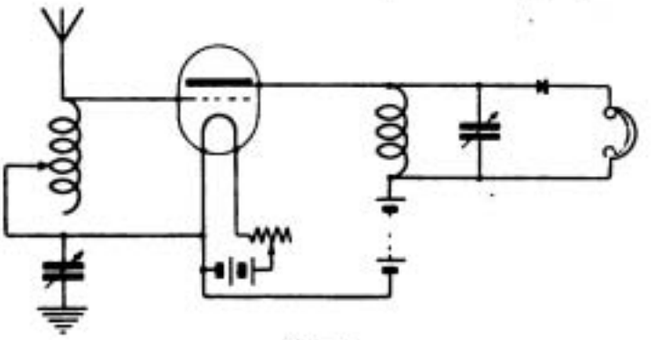

Fig. 5.

valve amplifying the received signal before rectification, and the other magnifying the rectified current through the telephones. If desired, a transformer could be used in the telephone circuit, as shown by the dotted lines in Fig. 7.

The reception of C.W. by valve circuits can be accomplished in two ways; by the employment of heterodyne or by beat reception.*

The oscillations in the tuned circuit can be produced either by a separate generator or by the receiving valve itself. In the first case no alteration to any of the foregoing circuits is required. The continuous wave generator is coupled to the aerial inductance by a small coil, and can be disconnected when

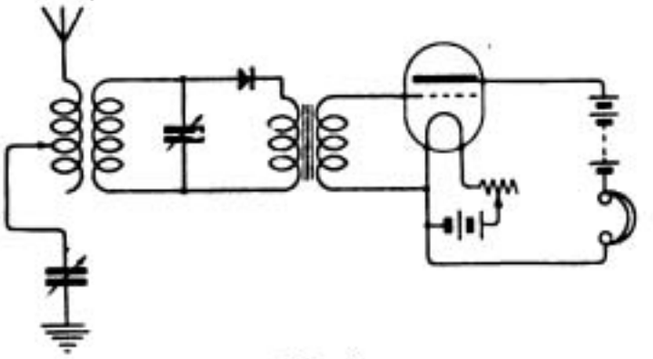

Fig. 6.

*See previous article in this series

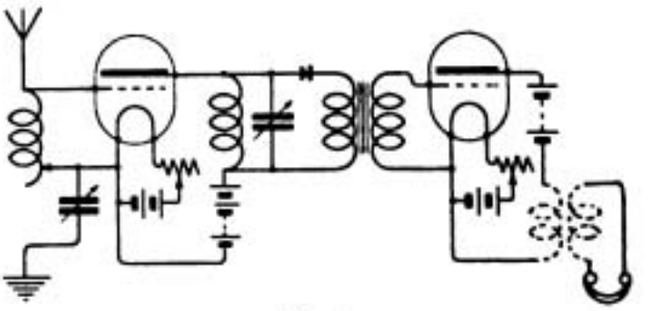

Fig. 7.

not required. In the second case a somewhat different arrangement of circuit is required. Fig. 8 shows a simple valve receiver for continuous waves, and its action may be described as follows :—

The grid potential is varied by the incoming signals, as in the case of an ordinary valve detector, but the impulses through the telephones also pass through the reaction coil,

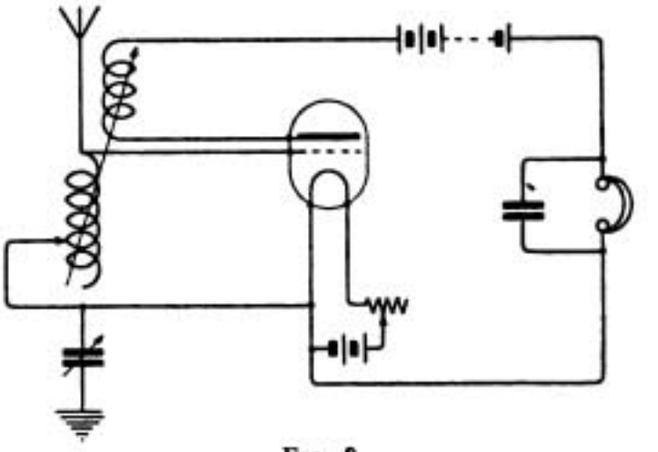

Fig. 8

coupled to the aerial circuit. Some of this rectified current is, therefore, transmitted back to the aerial circuit. Now, if the aerial is exactly in tune with the received oscillations no sound will be heard, because the frequency of the oscillations induced in the aerial coil will be the same as those of the signal, and there will be no "beats." However, if either of the coils is slightly out of tune, a musical note will be heard in the telephones, due to interference between the locally generated oscillations and those in the aerial circuit.

The generation of continuous oscillations by a separate valve circuit will be dealt with in a later article.

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The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A SINGLE-VALVE LONG-RANGE RECEIVER

A SINGLE-VALVE receiver, which will give good signals from the long-wave European C.W. stations, and, under good conditions from the American stations, on the standard Post Office aerial, is very much in demand at the present time. It is our purpose to describe the design and construction of such a set in this and succeeding issues. Its wavelength range shall be from 300 to 20,000 metres or more.

Consider, briefly, the question of design. The capacity of the standard aerial is approximately ·0002 mfd. and if sufficient series inductance were provided to tune it to 20,000 metres the circuit would be hopelessly inefficient. Therefore we must use an aerial circuit with tuning inductance and capacity in parallel and with sufficient capacity to reduce the inductance to reasonable proportions. If the capacity were made 0·006 mfd. the amount of parallel inductance required to give 20,000 metres is approximately 20,000 mhys. A variable condenser having a capacity of 0·006 mfd. is an expensive item, therefore it will be better to use a smaller capacity variable condenser with a number of fixed condensers which may be connected in parallel with the variable condenser.

We will use the 0·0015 mfd. variable air condenser described in these columns in the August 21st issue. Two block condensers of 0·0015 and 0·003 mfd. capacity, used singly or together, will bring the total capacity to the required value of 0·006 mfd.

For efficient working it is necessary to make the set up in two units. The first will consist of the valve, reaction unit and variable condenser. The second unit will consist of the additional inductance, and the block condensers. By this means the long-wave inductance will be quite separate and cut off from the short-wave circuit, and will not interfere with the short-wave reception.

UNIT NO. 1.

This unit has the 0·0015 mfd. variable condenser, the inductance and reaction unit, a series parallel switch for the condenser, the V24 valve holder, filament resistance, and an inductance tapping switch, all mounted on an ebonite or wood panel, approximately 9" square. Its wavelength range is approximately 300 to 3,500 metres. This range is obtained as follows.

The tuning inductance has a maximum value of 2,500 mhys. and has tappings at 270, 600 and 1,200 mhys. When in series with the tuning condenser this inductance tunes the aerial to 440, 640, 950 and 1,300 metres at tappings 1, 2, 3 and "all in" respectively. With the condenser in parallel with the inductance, and set at maximum, the wavelengths are 1,200, 1,800, 2,500 and 3,500 metres. Adjustment of the condenser gives plenty of overlap between the studs at both the series and parallel positions.

The grid of the valve is connected across the tuning inductance. In series with the anode is the reaction coil, which is aperiodic and couples into the tuning inductance, the

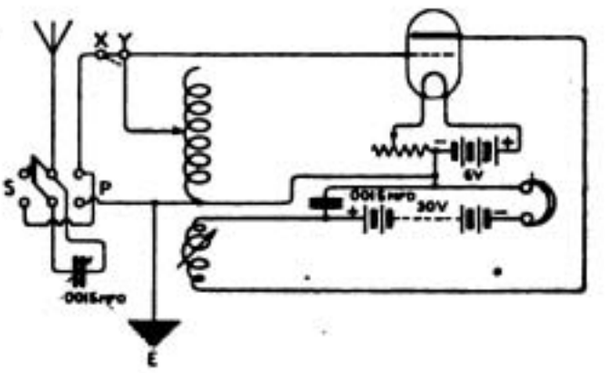

Fig. 1.

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anode battery of 30 volts (7 "Ever Ready" pocket lamp batteries), and the telephones or telephone transformer. Across the anode battery and telephones is a 0·0015 mfd. block condenser—a low impedance path for high frequency currents.

A diagram of the circuit is given in Fig. 1.

The first item of constructional work is the inductance-reaction unit. The drawings, Fig. 2, which are made exactly to scale, give an idea of what is required for this. It consists of a hollow rectangular former, for the tuning winding, in which is mounted, on two spindles, a rectangular block, upon which the reaction coil is wound.

For the outside former we require two pieces of hard, dry wood, 4½" long, 3" wide, and ¼" thick, and two pieces 3½" long, 3" wide and ¼" thick. These should be planed smooth and dovetailed together, making a rectangular former as shown Fig. 2. The former for the reaction coil should be made of hard wood, 4⅛" long, 2⅜" wide, and 1½" thick, planed smooth. This has to be mounted inside the rectangular former as shown in Fig. 2. The two spindles are made of $\frac{3}{16}$" brass rod, threaded at one end to screw into the moving former. Bearing surfaces are provided at each end as shown. Those on the moving former are rectangular shaped, ¾" long ⅜" wide of brass, $\frac{1}{16}$" thick with a $\frac{3}{16}$" hole through the centre. Those for the fixed frame may be of rectangular or circular shape, $\frac{1}{16}$" thick, and should be mounted on the underneath side of the former as shown in drawing. The object of these brass plates will be seen by referring to the drawing. The thickness should be so adjusted by filing that the moving coil is free to rotate, but has very little up and down motion. The bottom has a taper point, upon which presses a piece of hard brass strip. The strip does not press on the point of the spindle but has a $\frac{3}{32}$" hole in it, through which the spindle point comes and allows a much larger bearing surface. The tension on this bottom spring should be sufficient to cause the two bearing surfaces at the top of the former to rub together and make good contact.

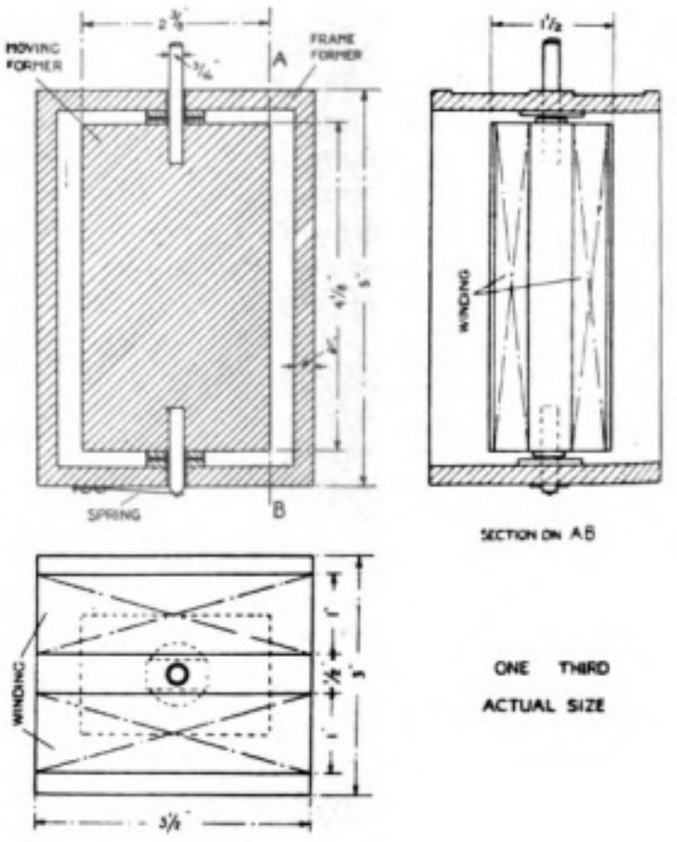

Fig. 2.

It will be noticed that the top side of the fixed former has two shallow grooves cut in it (see Fig 2). These grooves are ⅛" deep and each 1" wide. They are necessary because that side of the former is mounted against the back of the ebonite top, and the winding on the former must not be crushed.

The next issue will contain particulars of the winding and the ebonite top.

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An Auto-Telephone Transformer

By W. J. Fry.

MANY types of telephone transformers have been designed from time to time, mostly employing independent primary and secondary coils, which necessitate, generally speaking, comparatively large cores and former bobbins. The writer has had some considerable experience with such instruments, varying much in constructional details, some being designed with closed cores and some open, also with former windings and layer windings.

Experimenting with auto type transformers, I have been able to gain maximum efficiency, at the same time retaining the smallest possible dimensions in constructional details, with the smallest quantity of wire and sizes. The first coils weighed, complete, 4 lbs., their length being 7", width 4½" and height 4". These coils were of the closed core type with ½ lb. iron cores and 14 ounces of 36 G. copper wire. After many types had been built I was able to reduce the sizes to, length 4½", height 2¼", width 2", the maximum efficiency being still retained, These transformers will be found simple in construction, no particular trouble being experienced in the winding, as comparatively regular winding only is needed. The bobbin can be held in the chuck of an ordinary small hand drill, fixed parallel in the jaws of a vice, a piece of round wood can be inserted in the former tube, and a nail driven into this and held by the same in the chuck. By this means the wire can be quickly wound on, layer on layer, no insulation being required between each layer. On experiment it was found that the smallest permissible wire which can be used is No. 38 (standard wire gauge), which, for economy of space, should be single silk covered. On no account should enamelled wire be used, as it is unsuitable. To construct the transformer the following articles must be obtained—a piece of fibre tube, 3¼" long ⅝" external diameter and ½" bore; two wood or fibre ends, 1½" diameter by ¼" thick. This can be glued on or fixed with Chatterton's compound to the tube ends to form the bobbin. Sufficient No. 24 annealed iron wire to fill the tube for the core, 4 ounces of 38 single silk covered copper wire wound on one reel, and 1 ounce of the same wire (for convenience wound on another separate reel). Two small ordinary electric light wall-plugs make very convenient terminal-ends for the primary and secondary circuits, a small quantity of electrician's black tape, a paraffin wax candle for insulation, and a box made of ¼" wood, 4½" long, 2¼" deep, and 2" wide, will complete the list.

After constructing the bobbin the winding should be commenced. This will be really one continuous coil with a tapping out near the end, which forms one terminal for the secondary connections. First, wind on the 4 ounces (a knot should be tied on the beginning end for convenience in connecting afterwards, or paint may be used of a distinguishing colour). Having wound this on fairly regularly, the end should be left out an inch or two, the winding being taped over. On this wind the 1 ounce in the same direction, connecting the beginning end to the

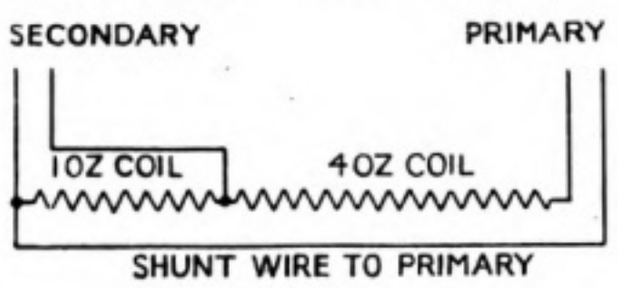

Fig. 1.

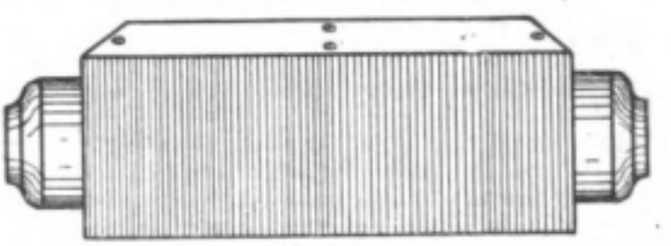

Fig. 2.

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end of the 4-ounce coil, thus forming the terminal of one end of the secondary coil. When wound, bring out the end making some distinguishing mark on it, and tape the coil completely over. A sketch is shown in Fig. 1 of the connections, and Fig. 2 shows the complete instrument, which will be found to give maximum results on any good low-resistance telephones, and is particularly good when used in conjunction with a thermionic valve. The coil, when completed, can be firmly fixed in the containing box by melting the wax candle and pouring the wax over the coil in the box, thus securing it.

CORRESPONDENCE

HARMONICS IN C.W. TRANSMISSION.

To the Editor of *The Wireless World*.

SIR.—*Re* Mr. Broadwood's paper on "Harmonics in C.W. Transmission," published in *The Wireless World*, for May 1st, 1920,* perhaps the following may not be quite uninteresting.

In March last I calibrated a home-made valve receiving set (range 600-17,000 metres) by means of a heterodyne wavemeter of range 1,000-2,500 metres, thus—The receiver was set at some *LC* valve and as many silent points as possible of the different harmonic "chirps" on the wavemeter were noted.

These would be multiplied by consecutive figures till the result agreed, the latter being the wavelength for that particular *LC* value. Thus:—

(1)	(2)
$2,000 \times 2 = 4,000$	$2,400 \times 5 = 12,000$
$1,330 \times 3 = 4,000$	$2,000 \times 6 = 12,000$
$1,000 \times 4 = 4,000$	$1,720 \times 7 = 12,000$
	$1,500 \times 8 = 12,000$
	$1,320 \times 9 = 12,000$

With the longer wavelengths it was necessary to go as far as the 11th harmonic. After a little practice only two or perhaps three points were required, and the results were surprisingly accurate in approximating one another. The wavelengths, when compared with those from known transmitting stations in Europe were found correct. It was not found possible, although many experiments were tried, to calibrate lower than 1,000 metres with the Heterodyne W.M., and from this I concluded that lower harmonics did not exist in wireless. However, some time later I was astonished to find a near-by C.W. station transmitting on 1,800 metres come in on 600 and 5,400 metres, and could only conclude that for the former I was getting him on *his* 2nd harmonic, $\frac{1,800}{3} = 600$, and for the latter he was being received on *my* 2nd harmonic, $\frac{5,400}{3} = 1,800$. Unfortunately, no attempt was made to try any of the other harmonics.

Perhaps the above may explain the point raised by Mr. Rees in the discussion of the paper (*The Wireless World*, page 127, May 15th, 1920). **OUI** coming in on 20,000 and 30,000 metres, but not on 5,000 metres. When he was on 20,000 and 30,000 metres **OUI** (fundamental wavelength 10,000 metres) came in on Mr. Rees' set on the 1st and 2nd harmonics $\frac{(20,000}{2} = 10,000$, $\frac{30,000}{3} = 10,000$). Being so far away from **OUI**, the latter's 1st harmonic $\frac{(10,000}{2} = 5,000$ metres) naturally, was not heard.

Bushire, W.O., Persian Gulf.
October 21st, 1920.

GORDON BARNES.

To the Editor of *The Wireless World*.

SIR,—Mr. Barnes is to be congratulated for explaining a simple method of calibrating a C.W. receiver to a sub-standard.

Monsieur Bloch's absolute method of wavelength calibration is beyond the reach of amateurs and to recommend it would be a council of perfection, for this method involves the use of a standard clock, a tuning fork and a special valve circuit arranged to give an audible fundamental, which is tuned to the fork frequency.

Might I suggest a possible improvement to Mr. Barnes' method? Unless a standard wavemeter is procurable, it is unlikely that the wavemeter calibration is perfect. It is, therefore, necessary to choose a particular wavemeter reading as a relative standard, and to check all other wavemeter readings on this relative standard.

The following should make the process clear.

Take, for example, that it is required to calibrate a receiver between 1,000 and 10,000 metres, by using a heterodyne wavemeter whose range is 400 to 2,500 metres.

Take 1,000 metres as marked on the wavemeter to be correct, and commence with "Even" wavelengths, that is 2,000, 4,000, 6,000, 8,000 and 10,000 metres on the receiver. Use should be made only of those harmonics which do not involve fractional wavelengths.

* *The Wireless World*, 8 pp. 82-91, May 1st, and pp. 123-128, May 15th, 1920 (Discussion).

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For example, at 2,000 metres we have the following :—

$$1{,}000 \times 2 = 2{,}000$$
$$500 \times 4 = 2{,}000$$
$$400 \times 5 = 2{,}000$$

Adjust the receiver so that a silent point occurs exactly at 1,000 metres on the wavemeter, and re-mark the wavemeter at 500 and 400. This can be easily carried out if a paper scale is pasted on the wavemeter. It is clear that 500 and 400 metres are thus referred to the "standard" 1,000 metres mark, and the two former points will come in as check points to calibrate the receiver at other settings. Fresh wavemeter points are obtained in later stages.

The following table should make the method clear. It should be noted that in all cases shown except 1,000 metres, that the "standard" 1,000 metre mark is used.

"Even" Wavelengths.

2,000 Receiver.	4,000 Receiver.	6,000 Receiver.
1,000 × 2 Wave-	2,000 × 2 Wave-	2,000 × 3 Wave-
500 × 4 meter.	1,000 × 4 meter.	1,500 × 4 meter.
400 × 5 ,,	800 × 5 ,,	1,200 × 5 ,,
	500 × 8 ,,	1,000 × 6 ,,
	400 × 10 ,,	750 × 8 ,,
		600 × 10 ,,
		500 × 12 ,,

8,000 Receiver.	10,000 Receiver.
2,000 × 4 Wavemeter.	2,500 × 4 Wavemeter.
1,600 × 5 ,,	2,000 × 5 ,,
1,000 × 8 ,,	1,250 × 8 ,,
800 × 10 ,,	1,000 × 10 ,,

"Odd" Wavelengths.

1,000 Receiver.	3,000 Receiver.	5,000 Receiver.
500 × 2 Wave-	1,500 × 2 Wave-	2,500 × 2 Wave-
250 × 4 meter.	1,000 × 3 meter.	1,250 × 4 meter.
	750 × 4 ,,	1,000 × 5 ,,
	600 × 5 ,,	625 × 8 ,,
	500 × 6 ,,	500 × 10 ,,

7,000 Receiver.	9,000 Receiver.
1,750 × 4 Wavemeter.	2,250 × 4 Wavemeter.
1,400 × 5 ,,	1,800 × 5 ,,
1,000 × 7 ,,	1,500 × 6 ,,
875 × 8 ,,	1,250 × 8 ,,
700 × 10 ,,	1,000 × 9 ,,
	900 × 10 ,,
	750 × 12 ,,

It is easy to see that the method can be further extended to obtain 1,500, 2,500, 3,500, etc., etc., and the advantage is that the wavemeter is automatically corrected to a "standard" point on its own scale. The examples given show that 19 wavemeter readings have all been checked to the "standard."

Mr. Barnes states that he was unable to calibrate below 1,000 metres.

Possibly the receiver could not, in fact, be tuned lower than 1,000 metres, owing to self-capacity in the windings and to valve capacity.

Mr. Barnes does not say whether his receiver was attached to the aerial when he was calibrating it, but judging from the number of harmonics he obtained, it appears that the aerial was assisting matters.

Mr. Barnes uses different nomenclature than I do, and there is always some confusion in technical books on this subject. I prefer to talk of a high harmonic as having a higher frequency than the fundamental, and *vice-versa*. Also, I prefer to identify the 1st harmonic with the fundamental, the 2nd and 3rd harmonics having twice and three times the frequency of the fundamental.

Taking the case of the station Mr. Barnes mentions, whose fundamental wavelength was 1,800 metres. A 3rd harmonic would have three times the frequency and one-third the wavelength which would be 600 metres. Now, supposing Mr. Barnes' receiver also generated a 3rd harmonic, if he set it to 5,400 metres the 3rd harmonic, locally generated, would be one-third the wavelength, that is 1,800 metres, which by slight adjustment would heterodyne the received wave of 1,800 metres.

With regard to the point raised by Mr. Rees during the discussion of my paper, it did not occur to me at the time that Mr. Rees' receiver might generate harmonics of its own.

If Mr. Rees' receiver generated harmonics of its own when set at 20,000 metres, and a 2nd harmonic was present of twice the frequency corresponding to 20,000, the wavelength would be 10,000, which could be made to heterodyne **OUI's** wave of 10,000 metres. Similarly with the receiver set to 30,000 metres, and generating a 3rd harmonic of three times the frequency, the corresponding wave would also be 10,000 metres which would heterodyne **OUI's** wave.

The only proof that a large station radiates prominent harmonics is to ensure that one's own receiver is generating a pure wave. This can be tested by Mr. Barnes' method.

It is advisable to employ as small a plate voltage as possible on the heterodyne valve, so that the shortest possible portion of the characteristic curve can be used. As an additional precaution the grid voltage should be adjusted to bring the plate current on to the straight part of the curve. This means that the grid will be positive, and have a low resistance, which must be compensated for by employing a high valve of grid leak.

L. A. T. BROADWOOD.

London, W.1.
November 5th, 1920.

FURTHER PRIZE OFFER.

Messrs. F. O. Read and Co. Ltd., have offered to present the winner of the Transatlantic Amateur Wireless Tests with one of their Combined Long and Short Wave Receiving Sets, Type W.R.114, Value £20.

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BOOK REVIEWS

MAGNETISM AND ELECTRICITY.

By Robert W. Hutchinson, M.Sc., A.M.I.E.E.

London : University Tutorial Press, Ltd. Pp. 620, illustrated. (8*s.* 6*d.* net).

ACCORDING to the Author, this book has been written for the purpose of providing a course of theoretical and practical magnetism and electricity up to University Intermediate standard, the whole being based on fundamental experiments, accurate scientific principles and definitions, and embodying, so far as the scope permits, the distinctive results of modern research.

The book should prove of particular interest to those of our readers who are beginners in the study of wireless in that an incomplete understanding of the elementary principles of magnetism is neither sound nor compatible with ambition.

To those wireless clubs which devote special attention to the conducting of elementary and advanced classes, the book under review should make especial appeal. Numerous fully-worked examples, illustrating important principles and applications, and a large number of similar problems to be worked by the student, are given ; answers to all numerical examples are included. Some 400 diagrams of a kind most suited to assist the reader are inserted throughout the book.

Chapter XXIII, the last in the book, exclusively devoted to radio activity and the electron theory, should prove of interest to the more advanced of wireless students in that with the growing application of vacuum tubes, the study of the electron is ever claiming more attention.

Special consideration has been given to the various units and systems of units and their relationships indicated, so that students may experience little difficulty in connection with modern research work or general problems, necessitating a change from one system to another.

THE ENGINEERING DRAUGHTSMAN.

By E. Rowarth, A.M.I.E.E.

London : Methuen & Co., Ltd., pp. 245 96 illustrations and diagrams.

This book is an endeavour to bridge the gap between the engineering student and the finished product, the engineer, in such a manner as to take the place of the apprenticeship every draughtsman is called upon to serve. Whether or not this is practicable is open to discussion.

A draughtsman in starting his career is first given a tracing, followed by the study of printing. This latter, usually a stumbling block, is too often given insufficient attention in the point of standardising. A draughtsman or designer worthy of his name is also a good artist ; a neat clean and plain drawing, whatever its practical merit may be, is much to be preferred to a dirty mass of lines and indifferent printing. The Author does not seem to have given sufficient attention to this point. Plain block letters should be insisted upon by all who instruct in this subject of Draughtsmanship. Another matter of regret is the lack of examples on checking, a most important item as every draughtsman will agree.

To this end most modern firms spend proportionately large sums in their drawing offices, and consider such sums well spent. The Author quite rightly insists on ample detailing, and every detail a working drawing in itself.

Another point which in practice is perhaps not sufficiently standardised and insisted upon embodies the methods of projection, the Author, however, explains them all, and most of his examples conform to the best practice. In this and in many other details a large number of qualified draughtsmen, as well as beginners, would do well, not only to read the Author's remarks contained in the introduction, but also to practise a few of the exercises arranged for their guidance.

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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.**

E.N.M. (Hunt's Cross).—(1) This can only be determined with certainty by experiment, which we regret we are not able to undertake. We think that celluloid, similar to your sample, would give condensers of about half the capacity of the mica condensers.

(2) Double the area of overlap to obtain a condenser of the same capacity.

(3) A loose coupler is generally more selective as some of the double slide inductance is usually required for tuning the aerial circuit, and therefore the coupling cannot be weakened sufficiently.

(4) See reply to **W.A. (Huntly).** 30 S.W.G. could be employed on the secondary in your case.

ANODE (Dawley Bank) *sends a sketch of amplifier receiver for criticism, and asks* (1) *What would be the most suitable capacity for the condensers C2 and C3.* (2) *Could a crystal be inserted in the circuit to any great advantage.* (3) *What is approximately the wavelength range of this circuit.* (4) *From what source can the information regarding A.M.I.E.E. and other such degrees be obtained.*

The general arrangement is fairly good. The telephone transformer is probably very inefficient. A pencil line resistance will be probably too high for a plate resistance, which should be about 80,000 watts. Your thick line resistance may be anything over 18 meg. Resistance amplifiers should have considerably more than 50 volts. with Q valves. The aerial will be very inefficient.

(1) About ·00005 mfds., C2 being variable.

(2) No.

(3) Probably about 2,000 ms.

(4) Apply to the Secretary, The Institute of Electrical Engineers, or the Registrar of the appropriate University for particulars.

C.H.W. (Cardiff) *asks* (1) *Thickness and S.I.C. of a sample of material.* (2) *The effect of taking the down lead of a T aerial from a point not in the horizontal span.* (3) *The cause of vibration of the filament of the pilot lamp of his set when the low-frequency circuit was out of tune.* (4) *The maximum capacity of 'billi' on a type 31.4 receiver, and also the inductance of the closed circuit.*

(1) The thickness is 3 1,000 in. Probably about 2·5; but it is impossible to state exactly without an experimental investigation, which we are unable to undertake.

(2) This always results in more or less inefficient radiation

(3) This was probably due to forces between the currents in the filament and the L.F. circuit varying periodically with changes in the latter circuit at a frequency which happened to be about the natural frequency of vibration of the filament.

(4) Capacity, ·00045 mfds. Inductances about 400 mhys., 1,600 mhys, 5,000 mhys.

BEGINNER (Warwick) *asks for a diagram for a small receiver to tune to* 16,000 *ms., suitable for home construction.*

We strongly advise you to commence with a shorter wave range, which will enable you to use a simpler type of set. However, an article with diagrams on a set of this type, which will probably be in print about the same time as this reply, will give the information you require.

F.C.A. (Westcliffe-on-Sea) *asks* (1) *What size condenser, and what capacity to use with the Marconi V24 valve.* (2) *What resistance of grid leak.* (3) *What is the best method of finding out the resistance of a grid leak.* (4) *For comments on a set; are there better connections to use.*

(1) Tuned circuit condenser ·0005 mfds. Grid condenser ·00005 mfds.

(2) 3 megohms.

(3) Failing the use of a megger, or a sensitive galvanometer of known figure of merit, you can only vary it until you get best results; the exact value is not important.

(4) Earth filament and not plate of valve. Connections otherwise O.K.

C.F.H. (Nottingham) *sends sketchs of his circuit and aerials, and asks* (1) *How to improve his signals.* (2) *Has he sufficient apparatus to receive telephony.* (3) *What is the maximum wavelength he will get.* (4) *Can his aerial be improved.*

It is a pleasure to receive such clear and carefully drawn diagrams.

(1) Your circuit is quite O.K., and poor results are entirely due to the smallness of your aerial. You should get somewhat better results by increasing the A.T.I. and reducing the A.T.C.

(2) Yes; your set will be quite all right. Weaken the reaction by coupling till it stops oscillating.

(3) About 1,500 ms.

(4) We can only suggest raising the height of the aerial, particularly at the house end.

G.T.H.B. (Kendal) *sends a sketch of an amplifying receiver which will not work. He asks why.*

There are two reasons apparent to us. The set consists of a crystal rectifier followed by L.F. amplification. The intervalve transformer is unsuitable; the winding on the crystal side should be about 4,000 ohms, instead of 250 ohms.; the secondary winding of 13,000 ohms is probably about right. Also do away with the grid condenser. Otherwise the set should be O.K.

C.J.O.S.S. (Wimbledon) *sends a sketch of a proposed set, and asks* (1) *For criticism.* (2) *The*

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approximate wavelength of set. (3) *The distance over which signals would be recognisable.*

(1) The set, though of elementary type, is quite sound, and should give fair results. The dielectric of the tuning condenser would be much better of mica than of waxed paper. The inductance should be of much bigger diameter than 2½.

(2) We cannot say accurately, as your information is not at all precise, and you say nothing about the aerial. If you are lucky you may get as high as 600 ms.

(3) We cannot hazard a guess.

A.H.R. (Bow) *has an L1 French amplifier which works well on both C.W. and spark; but he does not hear telephony. He asks* (1) *Why he does not get results which two methods of using a frame aerial.* (3) *For a diagram of the receiver circuits originally used with the L1 amplifier.*

(1) There are various possible reasons. Firstly, there is not a great deal of telephony done. Secondly what there is, is almost entirely on short waves, and your receiver appears to be arranged for long-wave working. Thirdly, it is just possible that you are using a circuit with too much reaction in it.

(2) Neither of your methods of using a frame aerial are correct. Connect it across the terminals of a small condenser and connect the same terminals to the amplifier.

(3) We cannot say. We doubt whether the amplifier was designed with a view to use with any special type of circuit. It should be quite satisfactory with all normal types.

F.D. (London), *referring to page 402 of the issue of October 2nd, asks* (1) *How the specific resistance, e.g., $1{\cdot}5 \times 10^{-6}$. for copper is arrived at.* (2) *What 10^{-6} means.* (3) *If the example re 110 yds. of No. 30 S.W.G. wire is correct*

(1) By measuring the resistance of a sample of copper of known size and calculating from its dimensions what the resistance of a 1 cm. cube would be.

(2) $10^{-6} = 1/10^{6}$, *i.e.*, is equal to unity divided by ten to the power of six; *i.e.*, equals 1/1000000.

(3) The example is quite correct. The 10^{-6} appears as 10^{-6} in the denominator. The 10^{-3} in the numerator is necessary to turn the square millimetres of the sectional area into square centimetres.

C.A.J. (Bury St. Edmunds) *asks* (1) *For criticism of a circuit sketched.* (2) *The name of a strong 3000 C.W. station of call letters* **2 B.S.** *working trials on 12.11/29.* (3) *The source of powerful telephony on a wavelength of 4000 ms. on that day and the day after, and the reason of articulation being bad.* (4) *When the 1921 Year Book will be published.*

(1) The set is O.K., except that the reaction coil should be in the plate circuit of the first valve, or, if in the second, a condenser should be put in parallel with the iron-cored inductance, also in the same circuit.

(2) The high power valve set at Chelmsford, working tests with Geneva.

(3) We do not know: possibly Chelmsford, on experimental work, the poor articulation being due to modulation at the transmitter.

(4) February, 1921.

POTEL (Greenock) *asks (with reference to constructional article, page 594, of the issue of November 13th, 1920)* (1) *Is the description of pile winding referred to that of the issue of October 2nd, 1920.* (2) *In which issue is the ·0015 air condenser, referred to in the same article, described.* (3) *In the same article, if the loading inductance is wound with DCC instead of DWS, what difference will it make.*

(1) Yes, as in Fig. 2, page 475.

(2) August 21st, page 401.

(3) The coil will not be quite so efficient. The former should be made slightly longer to get the same number of turns on.

A.K. (Dunfermline) *asks* (1) *Which of the two valve circuits sketched is likely to be the more sensitive.* (2) *What would be the effect of certain suggested alterations to No. 2.* (3) *What would be the approximate size of a coil added as suggested to tune the circuit to 3,000 ms.*

(1) Either circuit should be satisfactory. They will each receive C.W. as well as spark, provided that the coil *B* in (2) is used for reaction—the transformer *A.B.*, of course, being air cored.

(2) The suggested alterations are unnecessary, and would do little if any good.

(3) The coil referred to is not in any tuned circuit, and it is therefore impossible to tune it to any wavelength—we do not see any point in introducing this coil.

STRAIGHTFORWARD (Northampton) *asks* (1) *Is the set sketched satisfactory.* (2) *Size and quantities and gauge of wire of primary, secondary and reaction coils.* (3) *Number of tappings in each coil.* (4) *The best method of mounting, taking compactness and sensitiveness as primary considerations.*

(1) The circuit you give is quite satisfactory in principle. There are, however, many considerations which come into the question of designing receivers of very large wavelengths which make it different, if not impossible, to specify the windings of any single set of coils. You would also be troubled in designing the intervalve *H.M.F.* transformer, so as to be suitable for all wavelengths.

We cannot do better than recommend you to an article shortly to be published in *The Wireless World* on the design and construction of such a receiver.

EMMA G (Bournemouth) *asks* (1) *What is the specific inductive capacity or dielectric constant of glass.* (2) *What are the capacities of two tubular air condensers—(a) Outer radius 1·75", inner radius 1·5", length of overlapping part of cylinders 12". (b) Outer radius 2·125", inner radius 1·75", length of overlapping part of cylinders 6".* (3) *To whom should he apply for the back numbers of "The Wireless World."* 1-12. (4) *What is the maximum fundamental wavelength guaranteed for a full sized (single wire) P.M.G. aerial, under normal conditions.*

(1) It varies over wide limits, according to variety: for the types you are likely to use, probably 6-8.

(2) (*a*) ·000105 mfds. (*b*) ·000041 mfds.

(3) The publishers

(4) We do not understand. The normal natural wavelength is about 120 ms, but we do not know

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of it being the business of any human being to guarantee this, which is simply the statement of a physical fact. Of course, you can load the aerial up to any wavelength you like; there is no theoretical limit to your doing this, as the more inductance you put in, the higher the wavelength will become.

K.M. (South Africa) *intends to construct the short-wave tuner, described on page 477 of the issue of October 2nd, and asks* (1) *The capacity of the condensers.* (2) *Data for loading coil to tune set to 1,200 ms. (P.M.G. aerial).* (3) *Could he dispense with the condenser across the primary.*

This circuit was specially designed for the special purpose mentioned in the article. We cannot, therefore, be responsible for alterations, having in view its adaptation to quite different circumstances.

(1) A.T.C. probably about ·0006 mfds., grid condenser ·00005 mfds.

(2) 14 cms. by 8 cms., wound with No. 22.

(3) Yes, if you make the inductance about 18 cms. by 12 cms., wound with No. 22.

W.P. (Walsden) *asks the reason for "howling" with a circuit as on page 714 of the March, 1920, issue, when reaction is very tight and the tuned circuit capacity very small.*

Such behaviour is by no means uncommon, and is nearly always difficult accurately to account for. We are afraid we cannot give the reason, though it should be possible to trace it experimentally, by altering the disposition of various parts of the set.

SPARKUS (Birmingham) *has a set which he proposes to alter, and asks* (1) *Using a 4 or 6-volt accumulator and a 30-volt H.T. battery, what kind of valve would be suitable.* (2) *What will be the wavelength obtainable.* (3) *In what number of "The Wireless World" is there an article on how to make a valve set, 600 ms.—1000 ms., and also a blocking condenser. How much are these volumes.* (4) *What would be a convenient size of loading coil, and what gauge and how much wire should be used.*

(1) Marconi V.24 would be good for your purpose.

(2) You do not say what gauge of wire you use, nor what capacity you employ across your secondary so we cannot help you.

(3) The articles in the issues of April 17th and May 1st on a crystal receiver, with valve magnifier, gives full constructional details of a set whose range is in excess of your requirements. The article in the issue of April 3rd on a wavemeter and tuning tester gives a description of a fixed condenser which would also be useful as a blocking condenser.

(4) It depends on the rest of the apparatus and the wavelength it is designed to receive. See recent replies.

LEARNER (Barnsley) *sends a diagram of his set, and asks* (1) *Are the connections right.* (2) *Will the aerial and earth do for the set described.* (3) *What stations is he likely to get.* (4) *Is the down lead in the correct position.*

(1) Your diagram is not at all clear, but appears all right.

(2) Yes.

(3) We cannot say without a knowledge of the sizes of your pieces of apparatus. Probably ships near the coast and longer wave stations at a greater distance if your coils and condensers are suitable.

J.M. (Windermere) *asks* (1) *Is a lead water pipe system suitable as an earth.* (2) *Correct buzzer connections to a simple one-circuit receiver.* (3) *Would the insertion of a billi condenser across the secondary tapping improve the reception of weak signals.* (4) *What is the most sensitive crystal without using potentiometer and battery.*

(1) Fairly. Better use a copper wire to a buried plate.

(2) Connect the buzzer across the A.T.I.

(3) Probably. It will at any rate improve your tuning.

(4) It depends a good deal on the specimen you obtain. Perikon is a good one.

W.B. (Barnsley) (1) *sends diagram and description of a set for criticism.* (2) *Asks if he would get results with a valve instead of a crystal, his aerial being indoors, about 10′ high.* (3) *If a valve were used, what windings to use for the telephone transformer for telephones of 3000 ohms.* (4) *What kind of batteries other than accumulators could be used for lighting the valves.*

(1) The set is all right, except for the aerial, which is so small as to be almost useless on such a set.

(2) No, you would need four valves at least for useful results on such an aerial.

(3) With telephones of this resistance you should dispense with a transformer, which at best would be inefficient.

(4) Large size primary batteries, of a type such as the bichromate, which has low resistance and does not polarise readily, could be used, but would be much less convenient and cheap to run, as accumulators, and would cost almost as much to instal.

RADIO (Lincoln) *asks* (1) *Is ebony a good insulator, and, if so, is it as good as ebonite.* (2) *Are wireless signals more audible on a foggy night,* i.e., *is a foggy atmosphere a much better conductor than a clear one.* (3) *Having the choice of two places for apparatus, one on the ground floor, on a table 3′ from the ground, the other upstairs about 14′ from the ground (the earth lead is the same in both cases), does it follow that the signals will be of the same strength in each case.* (4) *For data concerning various stations*

(1) Fairly, if quite dry. Not nearly as good as ebonite.

(2) No.

(3) The strength will be approximately the same.

(4) Consult lists in back numbers of *The Wireless World*, or the "Year Book." The times of working vary considerably.

A.T.R. (Portsmouth) *asks* (1) *For criticism of set.* (2) *What resistance telephones to use.* (3) *From what distance should he receive.* (4) *Is there a club near Tooting in London nearer than Peckham.*

(1) O.K.

(2) 4000 ohms.

(3) Impossible to say. Apart from the strength of the transmitting station, there are so many unaccountable factors which enter into the question.

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(4) None that we know of.

C.W.T. (Dorchester) *sends two sketches of receivers, and asks* (1) *The best position for the variable condenser in No.* 1. (2) *Is the proposed circuit correct, and, if not, will we correct.* (3) *Should he receive C.W. and telephony from* PCGG. (4) *Are basket inductances better than slab.*

(1) In series with the aerial or across the two coils in the aerial circuit.

(2) A by-pass condenser (·003 mfds.) is required across the primary of the first intervalve transformer and preferably also across the H.T. battery.

(3) No dimensions are given, so we cannot judge the wavelength; otherwise you should with a set of this type.

(4) Basket inductances are better for short wavelengths, as they have very small self-capacity.

J.F.E.L. (East Ham) *asks* (1) *Particulars of a station which sends out a time signal at* 1930 *G.M.T., spark, between* 1000 *and* 2000 *metres.* (2) *Apart from strength, does it matter what gauge of wire is used for an aerial.* (3) *For a diagram of a two-valve receiver the first valve being for reception and the second for amplification, using an iron core transformer.* (4) *With two sets of high resistance telephones,* 4000 *ohms. each, would there be any advantage in using a telephone transformer with primary and secondary, both wound to* 4000 *ohms.*

(1) Can you not listen in for the calls in order to identify?

(2) The smaller wire will have much greater resistance, but the resistance of your earth may be

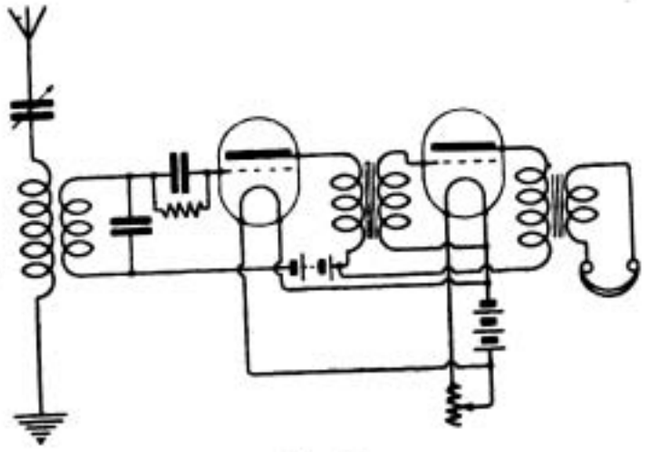


Fig. 1.

large in comparison with both, in which case not much difference would be expected.

(3) See Fig. 1.

(4) No advantage except protection from shocks, this at the expense of signal strength.

F.W. (Manchester) *asks* (1) *For criticism of a diagram for a crystal receiver.* (2) *For criticism of a diagram for a proposed aerial.* (3) *What stations or wavelengths should he be able to pick up.* (4) *Can he receive C.W., spark and telephony on his set.*

(1) Your connections are wrong. Rearrange as in Fig. 2.

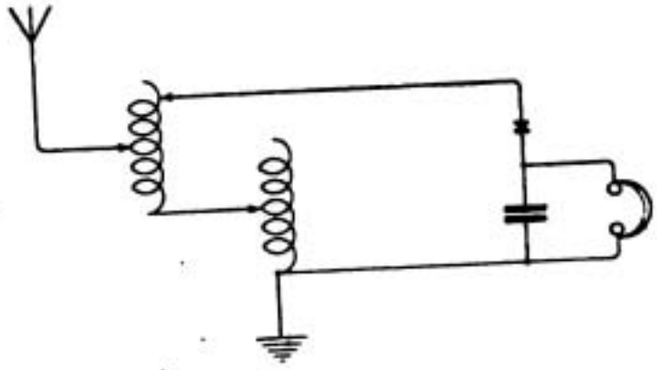


Fig. 2.

(2) Quite good. Take the down lead to the end of the horizontal lead.

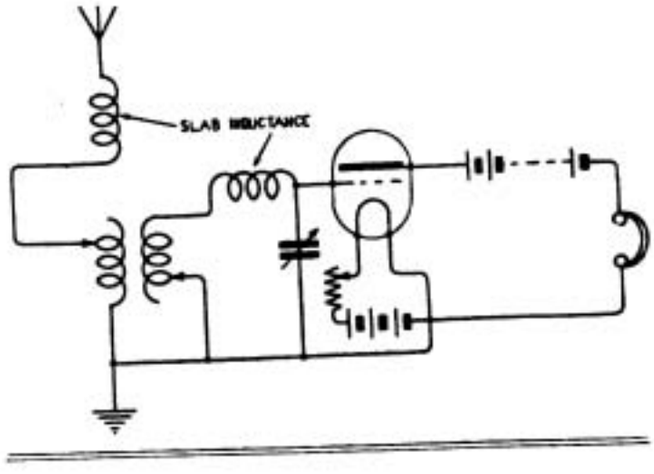
(3) About 2500 ms.

(4) Spark and telephony, but not C.W.

CORRECTION.

G.P. (Leicester) and Billy (Horncastle). In error the Figs. referring to your questions in the January 22nd issue were wrongly placed. Fig. 3 should read Fig. 4 and Fig. 4 should read Fig. 3 in each case.

Radio (Norwich). The Fig. included in the reply to your questions in the January 22nd issue should have been as Fig. shown below.



SHARE MARKET REPORT.

The Wireless Group has been unsteady during the last fortnight and dealings have been dull. Prices as we go to press, January 28th, are :—

Marconi Ordinary	.. .. ..	£2 - 0 - 0
,, Preference	.. .. ..	£2 - 0 - 0
,, Inter. Marine	.. ..	£1 - 5 - 0
,, Canadian	.. .. ..	7 - 6

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The WIRELESS WORLD

VOL. VIII, No, 24, NEW SERIES]. FEBRUARY 19th, 1921. [FORTNIGHTLY.

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 24. FEBRUARY 19TH, 1921 FORTNIGHTLY

LOUD-SPEAKING TELEPHONES

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

PROBABLY almost every wireless experimenter at some period of his work has wished for some means of rendering audible to a number of persons simultaneously the signals picked up by his "set." With most receivers it is practicable to employ a number of separate telephone receivers joined up either in series or parallel, depending upon the electrical characteristics of both the detector and the telephones, but it is customarily found that if more than two or three instruments are used simultaneously the strength of the signals heard in all the telephones falls off rather rapidly.

This phenomenon was perhaps more particularly noticeable when using a crystal detector than it is when valves—and particularly amplifying valves—are employed, as the available power output of the latter may be much greater. Even with crystal detection it is possible to use five or six telephones if a separate crystal is allotted either to each telephone or to each pair of telephones, the whole assemblage being joined across the tuner secondary in the usual way (Fig. 1.)

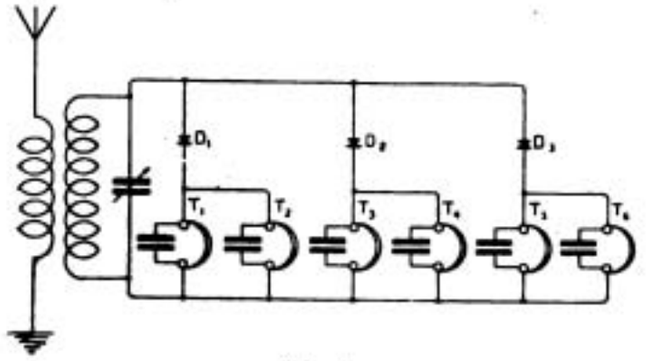

Fig. 1.

It will, of course, be necessary to readjust the coupling between the primary and secondary coils as compared with the value found best for a single detector, as the altered resistance of the detectors will affect the decrement of the circuits.

This method, although workable, is not very satisfactory, as the number of persons who can listen-in simultaneously is still very limited, and the arrangement is of course not at all suited to demonstrations before a large audience. A "loud-speaking" telephone is necessary in the latter case.

When using an amplifier it becomes practicable to so magnify up the strength of the incoming signals that, when passed through an ordinary pair of telephone receivers resting upon the table, they are audible an appreciable distance from the apparatus. By placing a horn or trumpet in front of the receiver, the sound can be still further intensified, and we thus obtain what is perhaps the simplest form of loud-speaking telephone. Fig. 2 illustrates a very simple apparatus constructed in this way.

It consists simply of a base, A, upon which is fixed at an angle a block of wood of about 3 in. square section, B, having a recess bored in one side so that a telephone receiver may be placed in the space so formed. Any ordinary type of telephone may be employed

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for this purpose, but a "Brown" is the best to use if one is available. In this case the recess should be about 2⅛ in. diameter by

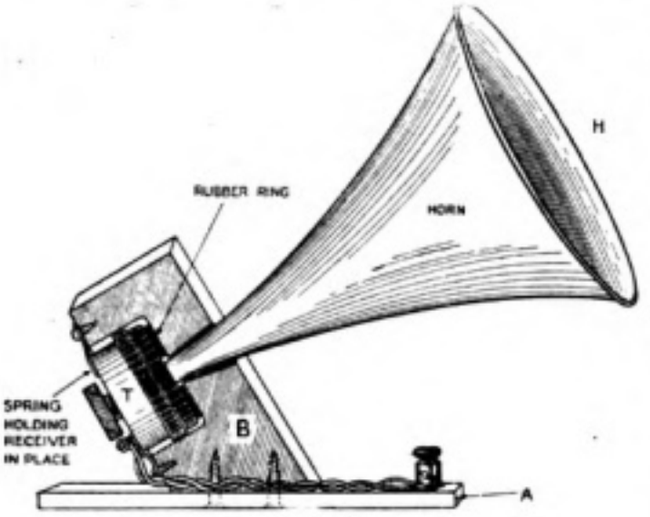

Fig. 2.

A home-made loud-speaker.

1 in. deep, and a rubber ring may with advantage be placed at the bottom for the earpiece to press against. The receiver may be secured in position with three pieces of springy metal, screwed into the wood at the edge of the hole and pressing on the back of the receiver. H is a phonograph horn, which is held in position by being inserted tightly into a hole bored into the wood block B, from the front to meet the centre of the recess. The size of this hole should be adjusted to suit the particular horn to be used.

Several patterns of loud-speaking telephones are available now for wireless and other uses. Some of these possess some novel features, to which it may be of interest to draw attention. The pattern of "loud speaker" most often found in use in connection with wireless apparatus is that manufactured by Messrs. S. G. Brown, Ltd., to which firm the writer is indebted for Figs. 3 and 4. These give respectively a general view of the apparatus with some accessories and a cross-sectional diagram to illustrate the method of construction. The arrangement is somewhat similar to that of the Brown's reed-type telephones, in that a reed is used to which is attached the centre point of a cone-shaped diaphragm. This reed, R, may be seen in Fig. 4 on the left-hand side attached to the upper part of the instrument. The reed is magnetically influenced by the windings on the poles of the permanent magnet, M, and the sensitiveness may be adjusted by varying the distance between the reed and the magnet by means of the adjusting screw seen on the right-hand side of the instrument.

A very interesting form of loud speaker is that known as the "Magnavox," in which a departure is made from the more ordinary patterns of telephone in which the forces producing the movements of the diaphragm are due to direct magnetic pulls of an electro-magnet on the iron diaphragm or on a steel reed mechanically attached to the diaphragm. In the Magnavox instruments these forces are the reactions between a fixed magnetic

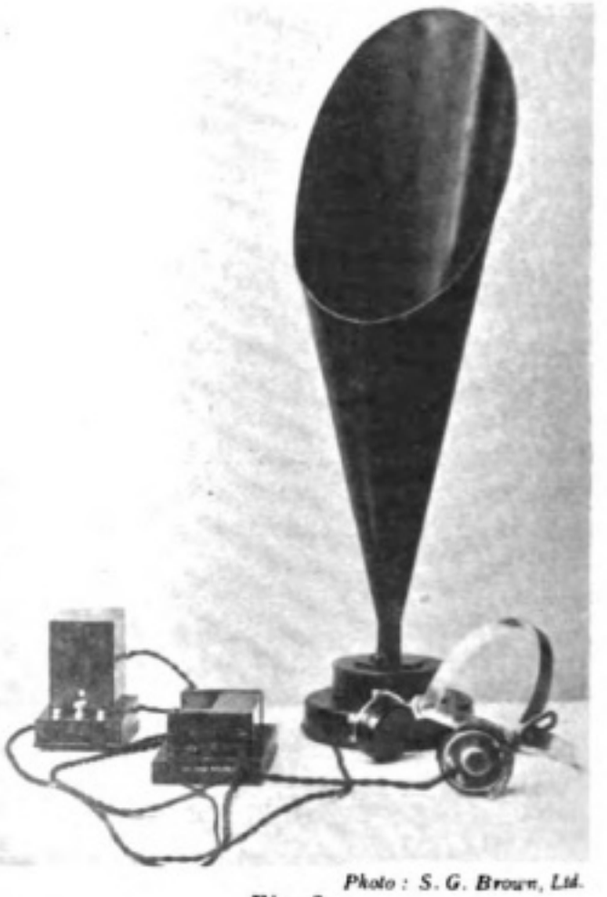

Photo: S. G. Brown, Ltd.

Fig 3.

General View of Brown's loud-speaking Telephone.

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field and a movable coil carrying a current. This type of instrument, therefore, more resembles a "moving-coil" type of galvano-

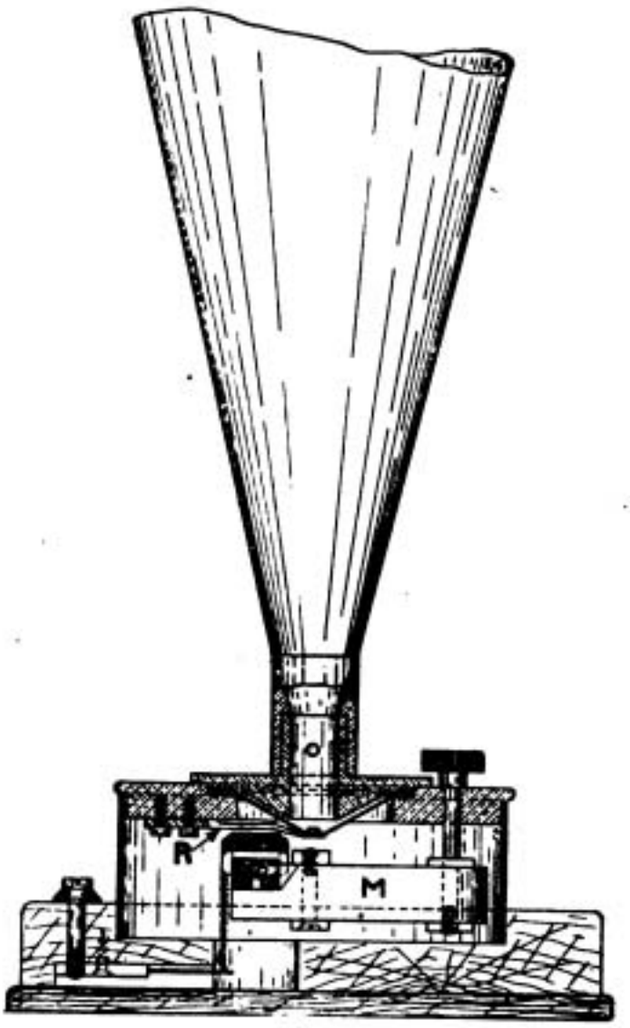

Fig 4.

Sectional diagram of Brown's loud-speaking Telephone

meter, whereas the ordinary pattern is like the "moving-iron" type. The general arrangement of the apparatus is shown in Fig. 5, which is almost self-explanatory. By this special type of construction the vibrations of the diaphragm are not hindered by the proximity of the magnet poles, and their amplitude is therefore the maximum possible. The resultant volume of sound output is therefore great.

The permanent magnetic field in these instruments is provided by an electro-magnet energised from a 6-volt battery, instead of by a permanent magnet, as in the more usual types. This magnet is provided with a narrow circular air gap, in which is produced a dense magnetic field. The circular-shaped, light, movable coil is suspended in this gap, as indicated in Fig. 5.

An interesting curve has been published by the Magnavox Company (U.S.A.), comparing the sound outputs of a Magnavox and of an ordinary instrument. It is reproduced in Fig. 6, and well shows the limitation of the output of an ordinary type of instrument by the proximity of the magnet poles.

Another loud-speaking telephone in which the diaphragm apparently has greater freedom of movement than in the usual types, has been developed by the Western Electric Co., Ltd. A sectional diagram is given in Fig. 7, which indicates the chief features. It may be noted that the diaphragm is provided

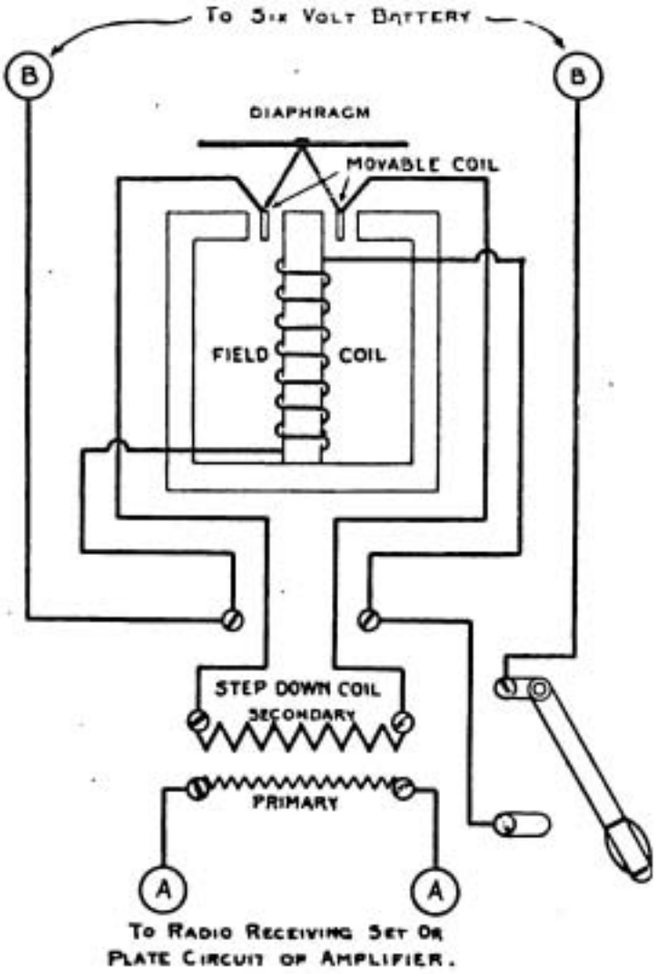

Fig. 5.

Diagrammatic arrangement of Magnavox loud speaking Telephone.

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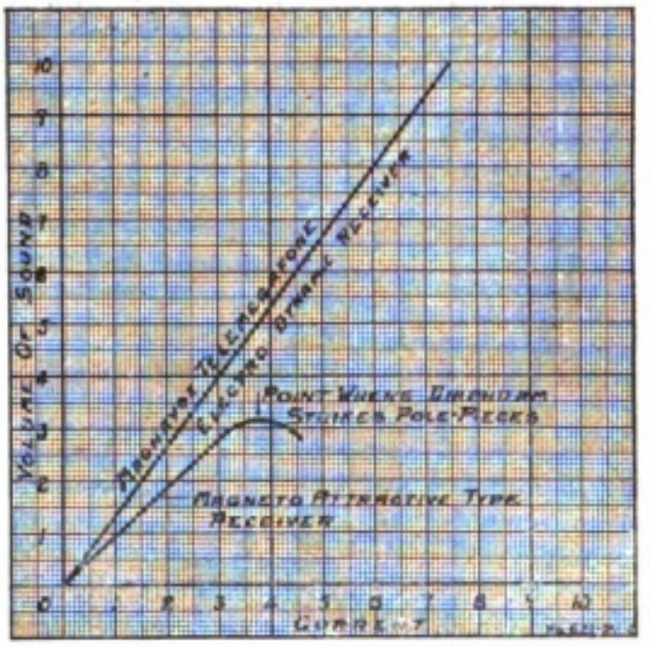

Fig. 6.

Comparison of Magnavox and ordinary patterns of loud speaking Telephones.

with corrugations to give it greater freedom of movement, and that it is set in motion not directly but by being mechanically coupled with an armature whose movements are controlled by the pole-piece windings of a magnet. The shape of this armature is also indicated in Fig. 7, in which the two smaller sketches give an end elevation and plan respectively of the armature, which is seen in side elevation in the main drawing.

In the use of any form of loud speaker it is practically essential to employ a low-frequency amplifier of one or more stages to actuate the instrument. For the production of extremely loud results a number of loud speakers may be used, connected in parallel,

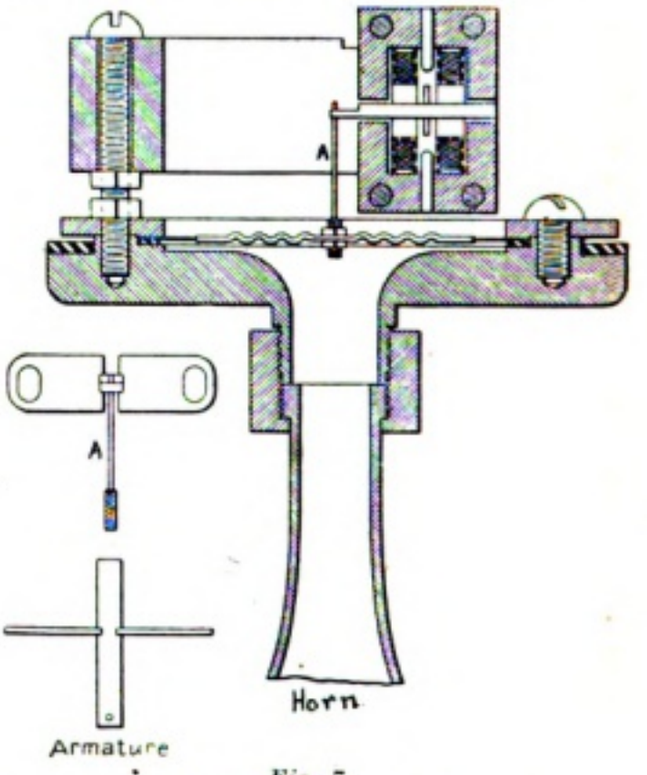

Fig. 7.

Cross section of Western Electric Co.'s loud speaking Telephone.

but the amplifier must also be increased in proportion, by the addition either of more valves in parallel, so as to increase the thermionic current, or by the use of valves of larger size working with a higher anode voltage and passing more current.

AN AMATEUR SET.

The set illustrated here belongs to Mr. E. C. Deavin, Secretary of the Dartford and District Wireless Society. The set consists, in the main, of a single valve receiver, and a two valve amplifier, both supplied by Messrs. F. O. Read & Company. Using a 100ft. single wire aerial 40ft. high, the set tunes to anything from 400 to 4,000 metres. Signal strength is unusually good, and telephony comes in extremely well.

[Photo by Frank Hills, Dart

Mr. E. C. Deavin's Set.

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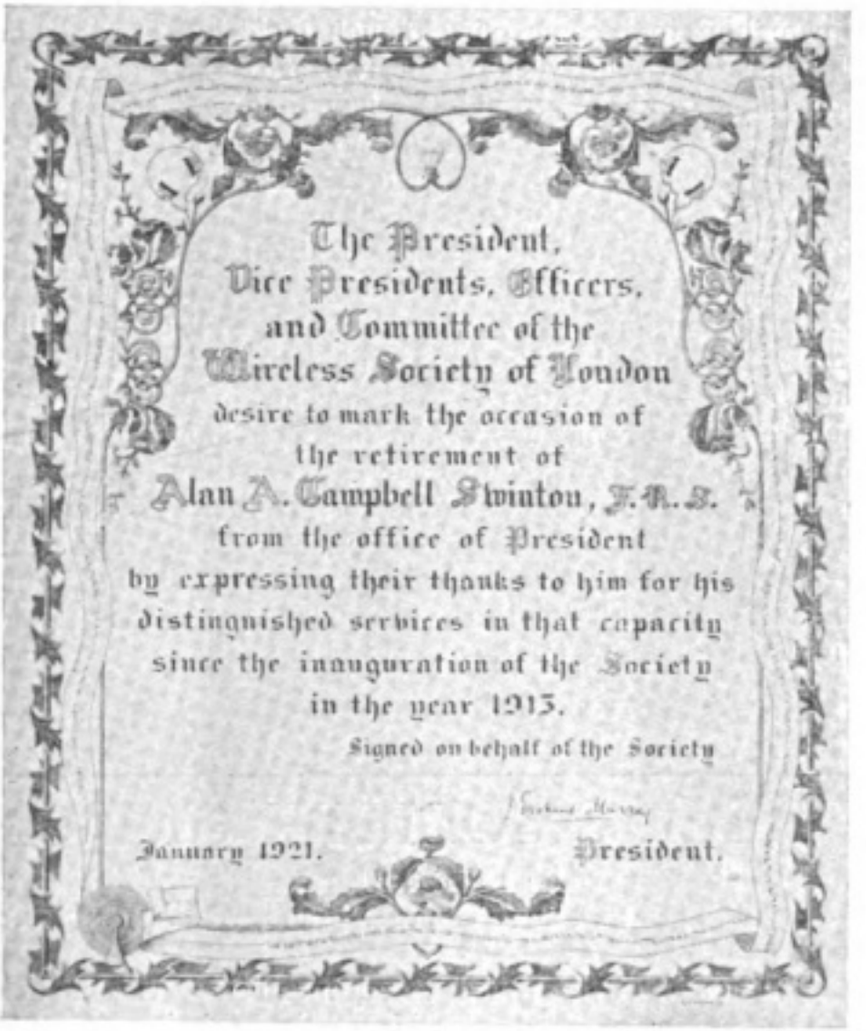
PRESENTATION TO MR. A. A. CAMPBELL SWINTON, F.R.S.

AT the meeting of the Wireless Society of London, held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on January 27th, 1921, a presentation took place to Mr. A. A. Campbell Swinton, F.R.S., of an illuminated address on the occasion of his retirement from the Presidency of the Society.



The illuminated address presented to Mr. A. A. Campbell Swinton, F.R.S.

In making the presentation, the President (Major J. Erskine-Murray, D.Sc.) said: Ladies and gentlemen, I have a very pleasant duty to perform to our past President. Our first President, who has been so much to this Society and whom you all know well, has vacated office after a term in which he has been the moving spirit, or, at least, the guiding spirit, may I say, of the Society. He has given us very definite proofs of his interest and of his continual activity. He has not only given his time and his thought, but in addition he has very frequently given us the convenience for our committee meetings, of his actual office room. We, the officers and committee of the Society, have taken upon us to prepare a small memento which we hope that he will accept. I, therefore, propose that the illuminated address which we have now with

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us here be presented to Mr. Campbell Swinton on behalf of the Society, though at the initiation of the officers and committee. (*Applause, which was renewed and prolonged when Mr. Campbell Swinton came forward and took the address.*)

Mr. F. HOPE-JONES: The President permits me to second his proposal, which has been already carried by acclamation; and when I think of a certain day in September, 1913, I become reminiscent. My mind goes back to the early hopes of those who were engaged in founding this Society, and to the occasion when I called on Mr. Campbell Swinton to invite him to become our first President. He thought seriously before taking up the proposal, because he is the kind of man who never takes on a job unless he can do it thoroughly, and it took him some time to make up his mind. But he accepted, and I have felt since, that I never did a better day's work in my life than when I got him to take the matter up. He has done his work so thoroughly that it has been the greatest pleasure possible—a recreation—for the committee and officers to work under his guidance for the last seven years, with only a short hiatus in the latter stages of the war. He has always been trusted absolutely by the authorities at St. Martin's-le-Grand, and of course is *persona grata* with all their officials. He has initiated traditions for this Society to follow which I am sure all the officers will do their best to maintain. In every respect he has been a most excellent President for us, and, as one who has been engaged in the actual work of the executive, I am very glad, Mr. President, that you have permitted me to add to the excellent terms in which you yourself have made this presentation. (*Renewed applause.*)

Mr. A. A. CAMPBELL SWINTON: Ladies and gentlemen, I assure you I hardly know quite how to express my feelings. This matter is very much of a surprise to me, though I did just hear a rumour of it a day or two ago. It is exceedingly kind of the Society to give me this memorial. I have already, when I vacated the chair, given you a brief *résumé* of how much I felt indebted to all my colleagues on the Committee, who have really made the work of being President of this Society a great pleasure. I will not detain you by referring to all that again, but I would like to say how very much I feel the honour of being given a presentation of this description. I shall treasure this address as a thing that I can keep for the rest of my life, as a very pleasant memento of a period which, as President of this Society, I assure you I have enjoyed most thoroughly. I thank you, ladies and gentlemen. (*Renewed applause.*)

THE WIRELESS SOCIETY OF LONDON

The Presidential Address, by Major Erskine-Murray, D.Sc., F.R.S.E., will be given at 8 p.m. at the Lecture Theatre, King's College, Strand, W.C. (next Somerset House), on Tuesday, March 1st.

Tickets of Admission will be issued to all members; visitors' tickets may be obtained from the Honorary Secretary, Mr. H. Leslie McMichael, 32, Quex Road, W. Hampstead, N.W.6, a stamped addressed envelope to be sent with the application.

The Conference of Wireless Societies will be held on the same date (March 1st) at 3 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C.2.

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Photo : René H. Klein

MR. A. A. CAMPBELL SWINTON, F.R.S.

(First Past President of the Wireless Society of London,)

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THE WIRELESS STATIONS OF THE BRITISH COMMERCIAL AIRWAYS*

By Lieut. Duncan Sinclair, R.A.F.

THE purpose of this Paper is to give information relating to the work that has been accomplished for the establishment of an efficient wireless communication system for civil flying.

In view of the somewhat limited number of stations the subject heading may be regarded as ambitious, for, strictly speaking, the British airways consist chiefly of the continental routes of this country at the present time. Even so, they possess wireless stations in which, no doubt, there are points of general interest.

The general scheme of wireless routine along the air routes comprises several highly important subjects. The meteorological system itself occupies possibly 60 per cent. of the total work, and is divided under various sections.

It is of paramount importance in so far as weather conditions are the deciding factor in modern aviation. No doubt the time will come when flying will be independent of weather—it is definitely coming—but it is not yet here. When such conditions obtain it is safe to say that air traffic will be as punctual and as regular as that of the railways —certainly, in some cases that we meet daily—much more so.

There is one main wavelength allotted for general meteorological work, namely, 1,400 metres. On this wave the whole of the reception of "synoptics" (or weather reports from individual outstations), and the broadcasting of "general inferences," is carried out. These "synoptics" consist of consolidated general reports, covering large areas, and are built up from the synoptics received from the outstations by the Meteorological Department at the Air Ministry. Transmission is effected by the Air Ministry Wireless Telegraphy Station at definite times. "Inferences" are further issued by that station, determined by a consideration of the same date, at other defined times.

Conditions along the air routes are consolidated hourly and transmitted by Air Ministry on 1,680 metres (C.W.), being known as "hourly route meteor messages."

Full details of the codes in use for these routines have already been made public, and I do not propose to go further into details.

Traffic messages, comprising signals relating to the arrivals and departures of aircraft, together with signals between the traffic officers of the air ports, form practically the remaining 40 per cent. of the work carried out. The wavelength of 900 metres is kept as free as possible for radio-telephonic working with aircraft in flight, and the terminal stations and intermediate stations maintain a constant watch, during flying hours, on that wave. This means that the maximum possible amount of attention is given to individual machines, so that at no time need a machine be out of touch with a ground station. The question will at once arise, then—"In what manner is the meteorological and traffic work conducted, and by what stations?" The whole of this routine is carried out by Air Ministry working direct to the French, Belgian and Dutch terminal stations at Le Bourget, Brussels and Soesterberg respectively.

A special direct telephone line is in constant operation between the London Terminal Aerodrome at Waddon, and Air Ministry Wireless Station.

Messages handed in at the duty office at Croydon are checked and passed over this line to the receiving office in London, and are then passed, in order of priority, or of handing in, to the particular operator working with the station of destination, who transmits them.

* A Paper read before the Wireless Society of London, on Thursday, January 27th, 1921.

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Similarly, messages arriving from the Continental termini are passed by the direct line to Croydon and thence, *via* the duty office, to the official or firm concerned. This may, at first sight, appear to be a needless duplication of work, but it must be borne in mind that by no other means can the 900 metre wave be kept clear for aircraft radio-telephonic communication. Some idea of its efficiency may be gleaned from the fact that the average time of passage of a message from terminus to terminus, inclusive of the time taken in handing in and delivery by hand, is in the region of 11 minutes. There have been cases where a message has been in the hands of its "addressee" exactly three minutes after handing in—and that between London and Paris.

This traffic is not small. During the period from April 1st to December 31st, 1920, 21,491 messages were passed, totalling 607,588 words. Of these, 2,227 messages or 44,528 words were route traffic, the remainder being meteorological.

This total does not include repetitions, nor does it take any account of the fact that each message is repeated twice in the normal course of transmission, facts, which, if brought into consideration, at least double the actual amount of wireless telegraphy working. When one thinks, moreover, of the possible sources of interference, notably from some of the spark stations in existence, one must admit that the efficiency is high, both on route and meteor and aircraft waves.

The staffs employed at these stations are ex-Service personnel (mainly R.A.F.), and have been selected for their service records and known capabilities. Of course, the Air Ministry Wireless Station is a purely service station, but several civil operators are temporarily employed there. In the majority of cases these operators are highly expert and of a proficiency not to be obtained without long months of careful training. Most of them are equally at home on the ground and in the air, and at at least one of the stations, their ordinary routine work covers both flying and ground duties, in alternate spells. Moreover, in view of the fact that they may be required to work with foreign machines and stations, some of them are almost polyglot —not in the world-famous manner of the British troop—one per cent. language and ninety-nine per cent. pidgin English—but comprehendable speech of a commercial utility. Possibly you may hear, or already have heard, when listening to Croydon on your own set, an example of this.

Their duties cover the fields of telegraphy, telephony and direction finding, and they are their own mechanics and do their own repairs. In all cases but one, the operators manning stations have built their station themselves from the material issued them.

Fig. 1.

Sketch Map showing positions of Stations of the Department of Civil Aviation.

Let us then turn our attention to the stations themselves. The chart given in Fig. 1 shows the total stations administrated

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by the Department of Civil Aviation. Their names are Croydon ; Lympne, near Folkestone ; Castle Bromwich, Birmingham ; Didsbury, Manchester ; Renfrew, Glasgow ; and Pulham, Norfolk (between Ipswich and Norwich). In telegraphic working the call signs are GED, GEG, GEC, GEM, GER, and GEP respectively, while for radio-telephony the names of the stations are used. In passing it may be also of interest to note that the call signs of the foreign stations, whose work is intimately connected with these stations, are :—St. Inglevert, near Boulogne, AM ; Le Bourget, Paris, ZM ; Brussels, HS and BAV ; and Soesterberg near Amsterdam, STB.

With the exception of Pulham all these stations are situated on Aerodromes engaged in aeroplane work ; Pulham may become a British airship terminus for airships to fly to India and America.

Fig. 2.
External view of Didsbury.

A further station has very recently been opened at Lerwick, in the Shetland Islands, in close proximity to the newly-established geophysical observatory. In point of fact this station is the original Post Office station. Its work will be entirely meteorological, and will not be directly connected with flying operations. Messrs. Handley Page have also been granted permission to instal a radio-telephonic station on their aerodrome at Cricklewood, which they have manned with their own personnel, and which works in conjunction with their machines operating on the continental air routes, for experimental

Fig. 3.
Castle Bromwich Station.

purposes on the 950 metre wave. In case of necessity this station may use the 900 metre wave.

The controlling station of the entire 900 metre group is Croydon, situated on the London Terminal Aerodrome at Waddon.

In dealing with these stations in turn, it will suffice, in the case of the stations of the London-Glasgow route, viz., Castle Bromwich, Didsbury and Renfrew, to describe any one of them, since all are technically exactly similar.

Figs. 2 and 3 show external views of these stations.

The masts are 70 ft. in height, in steel sections, and are spaced roughly 200 ft. apart. At Renfrew the aerial has been built of twin 4's, and at the other two aerodromes it consists of a pair of wires 7 ft. to 10 ft. apart. This wire is 7 strands of 22 S.W.G. copper, and is of medium flexibility. All antennæ are of the "T" type, bearing North and South. The slides do not convey any impression of the earth systems, but in all cases this is built up of a radial lay-out of copper mats, buried to a depth of 2 ft. to 3 ft., there being 6 mats in all, each being 15 ft. by 2½ ft.

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Fig. 4.
Internal view of Castle Bromwich.

Auxiliary aerials are also rigged for working with the lower powered transmitters, and for emergency purposes.

We now come to the general internal arrangements, illustrated in Figs. 4 to 10.

The transmitting unit is rated at 250 watts, with a range of up to 400 miles telegraphy,

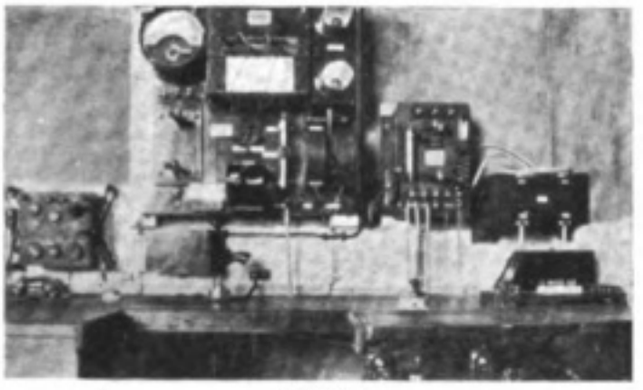

Fig 5
Operating Bench—Renfrew.

and 100 miles telephony. T.2b. valves are employed with 12-volt filament supply, and between 1,700 and 2,000 volts high tension supply at up to 140 milliamperes from a Newton machine. Power is derived from a 4·5 kilowatt Austin D.C. generator, with a floating battery of accumulators of the 2 volt 90 ampere hour variety. By this means charging can be carried out at times most suitable for avoiding interference from the generator in the receiving circuits. During the hours of greatest traffic, the H.T. generator is supplied from the accumulator bank, and on this principle about 48 hours charging suffices for a week's transmission.

The circuit diagram is shown in Fig. 11.

Operation of the Morse key (M) will, owing to the closing of the grid leak circuit (G), alter the potential on the grid of the valve (V), thus causing a change in the value of the current passing to the anode of the valve. Consequently, oscillations are set up in the circuit including the anode, the aerial (A), the aerial inductance (I), the fine turning

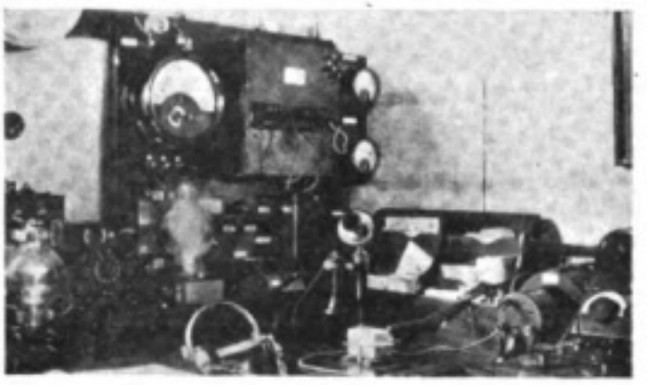

Fig 6
Transmitting Unit—Castle Bromwich.

inductance (i), and filament heated by local battery (B). These oscillations are maintained by the fixed grid reaction coil C. The aerial is connected through a send-receive switch to an aerial tapping plug P, thus giving a ready means of quick tuning and variation of wavelength generally. The in-

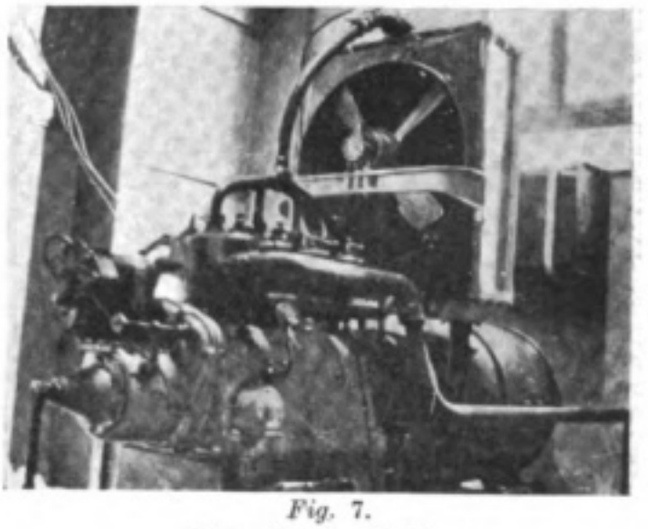

Fig. 7.
Power Plant—Renfrew.

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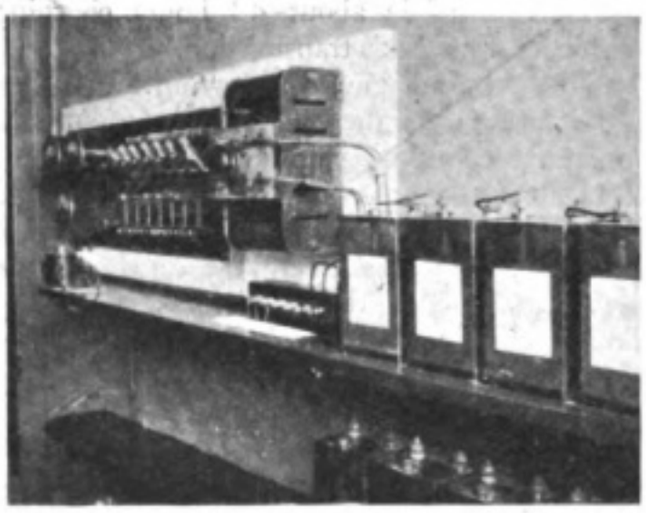

Fig. 8.
H.T. Accumulator Bank at Renfrew.

ductance I is wound on an ebonite former, with as little metal-work as possible to avoid losses due to eddy currents, and is designed to have the minimum H.F. resistance.

A fine adjustment can be obtained by use of the earth plug E, and an anode tapping plug I is provided.

The grid condenser GC is of the Dubilier mica type, and is rated to stand 2,000 volts. The grid leak is wound on grooved ebonite and is of platinoid wire.

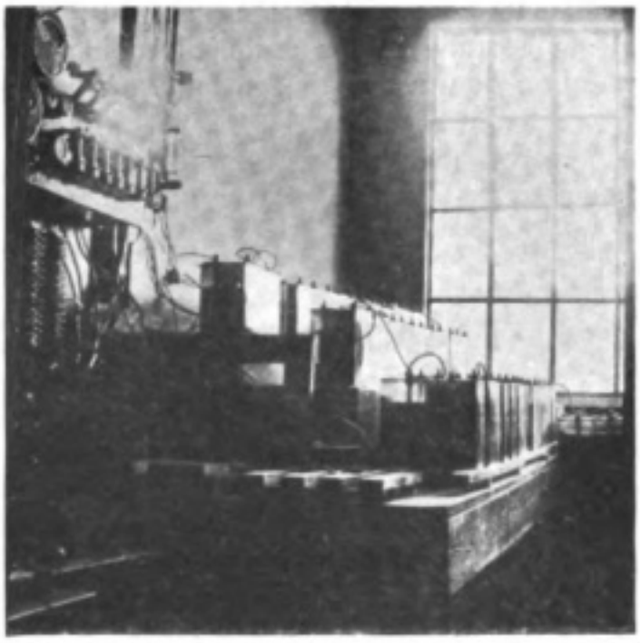

Fig. 9.
Accumulator Room—Didsbury.

If sparking at the key contacts is excessive, an additional condenser is inserted (C). A high-tension switch (S) of "quick-break" pattern, enclosed in an asbestos-lined case, controls the main H.T. supply, and has, arranged across it, the mains condenser (MC), also of Dubilier mica type, and rated to stand 4,000 volts D.C. Its function is to provide a path for the high frequency anode pulses. A moving coil high-tension milliameter (a) measures the H.T. current, and reads up to half an ampere.

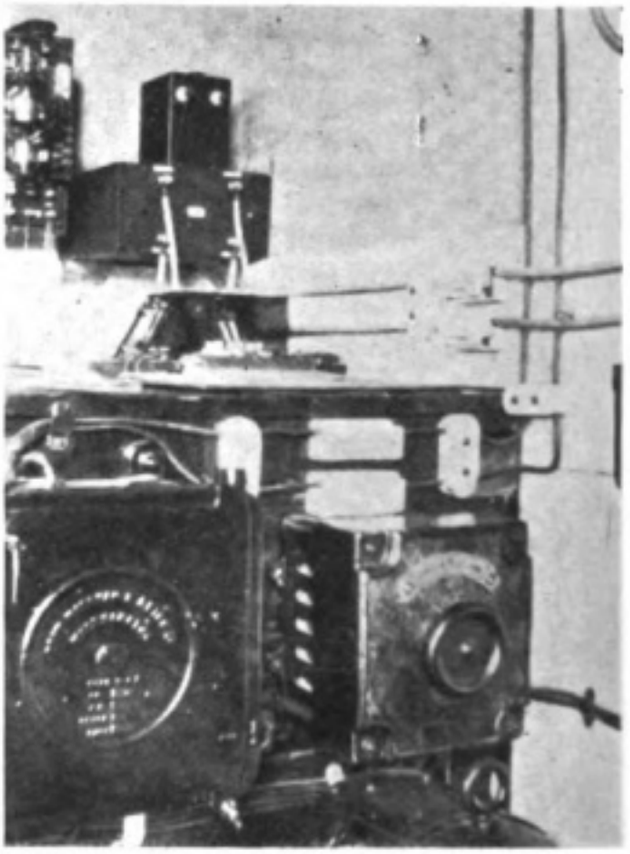

Fig. 10.
Generator Controls—Renfrew.

The earth side of the send-receive switch is connected to one side of the condenser (E'), and rated to stand 10,000 volts D.C. with safety, and is thence connected with the fine tuning part (i) of the aerial, which connection includes the aerial ammeter (A), a hot-wire switchboard instrument, reading 0·6 amps. The position of this instrument in the circuit is such that its terminals have no appreciable high-tension potential to earth,

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and that its reading will not be influenced by any capacity to earth, which the high tension mains possess

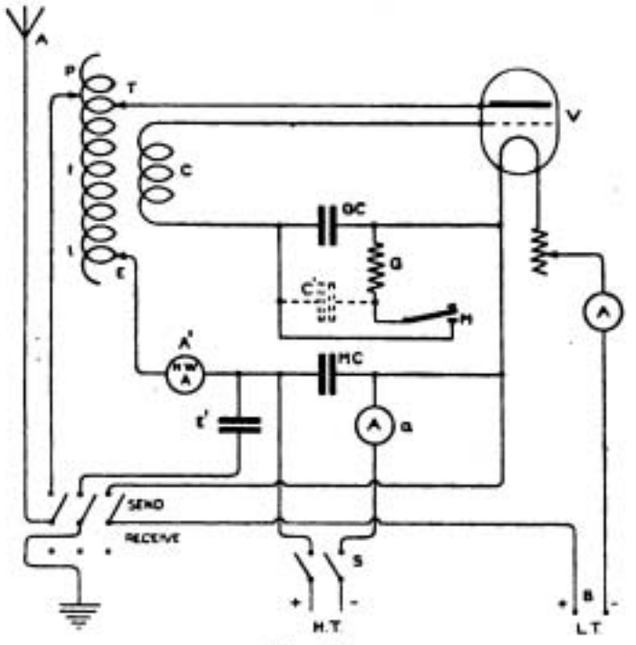

Fig. 11.

Standard Transmitting Unit.

The movement of the send-receive switch also closes a circuit containing the filament-heating battery (B), the valve filament, the filament ammeter (moving coil type), and a filament control rheostat of a sliding type.

From the diagram it will be seen that the earth plug E controls the amount of inductance in both anode and aerial circuits.

On a 1,400 metre wavelength with filament current of 3·7 amps. 1,700 volts H.T. supply, and 140 milliamps, the radiation is 3·2 amps. or more for C.W. telegraphy, and 3 amps. for telephony. It is possible to radiate as much as 6 amperes, transmitting pure C.W.

I regret that I am unable to furnish information of the extra circuits used for telephony, as they cover details which I am not at liberty to publish.

A wiring diagram is given in Fig. 12 of the standard pattern of receiver. Although the design was originally one for purely aircraft purposes, that is to say, for installation in machines, the adoption of this set for ground work has proved eminently satisfactory. Broadly speaking, it is designed to receive spark only up to 800 metres, and C.W. from 800 upwards to 2,500 metres.

This receiver combines the functions of tuning, detecting and amplifying, there being three sets of ranges of wavelengths—150 to 350 metres, 500 to 700 metres, and 800 to 2,500 metres—any set being brought in at will from the 3-range switch. "R" valves are employed, the first acting as detector and high frequency amplifier, and the second and third as audio-frequency amplifiers. To keep the receiver as simple and compact as possible a single tuning circuit is used, consisting of a variometer in series with the aerial, and graduated in degrees.

The connections for the 800 to 2,500 metres range, being the ones that most intimately concerns the work carried out, are shown in Fig. 12.

They are of the usual type, the anode circuit being coupled to the main oscillating circuit. Parallel condensers are introduced in the aerial circuit in order to make tuning possible on small aerials, as, for example, that on an aeroplane, when receiving these longer waves. The first valve only is shown, the low frequency iron core transformers and second and third valves being omitted for the sake of simplicity. In

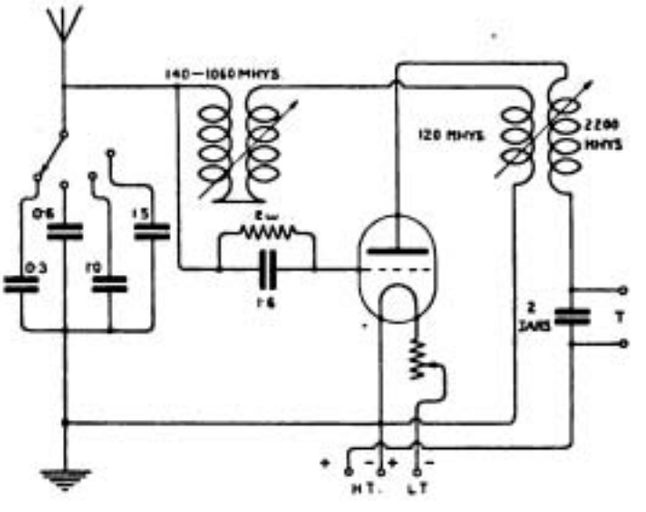

Fig. 12.

Wiring Diagram of Standard Receiver,

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passing it is well to mention that a totally new type of receiver will very shortly replace this one at all these stations.

The wavemeter (Fig. 13) for use, both with these transmitting and receiving units, was designed to be employed in the Royal Air Force as an accurate portable testing set,

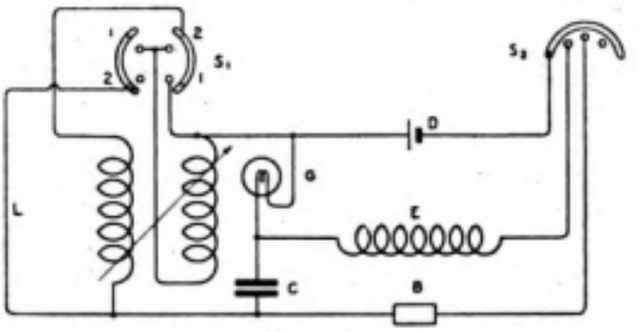


Fig. 13.

for all general purposes. Variation of wavelength is obtained by means of variometer, tuning with a condenser of fixed value.

These wavemeters are wound so that several ranges of wavelength can be obtained with a standard inductance, by varying the connection of the inductance, or the value of the condenser.

The calibration is engraved on a rotating dial. In order that the calibration may not be affected by shaking the instrument, the variometer coils are wound on rigid rectangular frames, with grooves at the corners of the frames for each turn of the coils.

The ratio of the maximum to the minimum inductance obtained by rotating the inner variometer coil in relation to the outer or fixed coil, depends on the space between the fixed and the movable coil, and variometers have been made in which the ratio was as great as 10:1. For practical purposes the distance has been fixed to give a ratio of about 4·5:1. Another range of wavelength is obtained by making the inductances of the two coils approximately equal, and changing the connections from series to parallel. If the wavemeter is calibrated to give wavelengths directly, when the coils are in parallel, the wavelengths when the coils are in series are obtained accurately by multiplying the scale readings by 2. A series-parallel switch is provided for making these changes in connections.

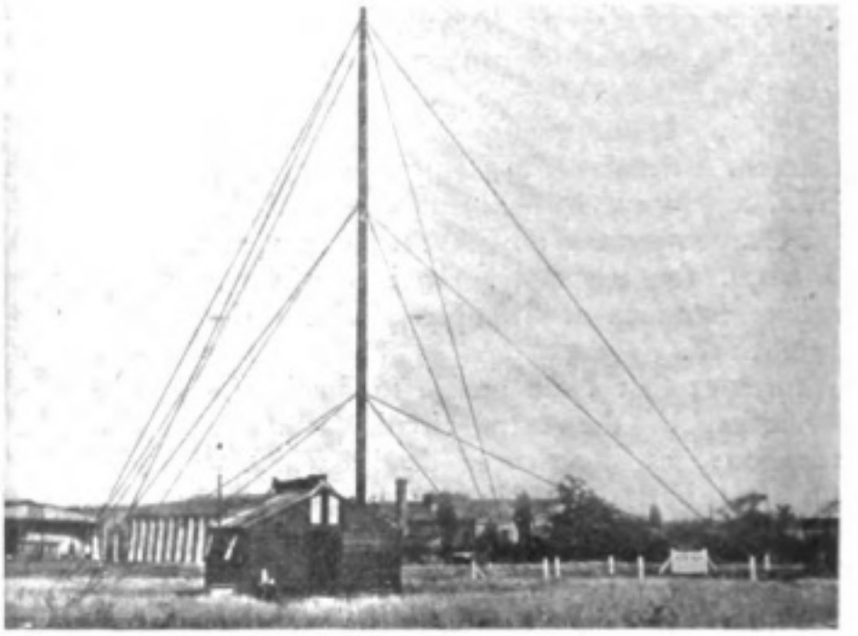
Wavemeters having ranges from 250 to 1,000 metres, or 1,000 to 10,000 metres, are now made with the same variometer, by fitting a condenser of the required value.

For tuning the transmitter the wavemeter is placed in some convenient near position, and the transmitter set in action.

The resonance point is indicated by means of the small electric lamp, which is in series with the oscillating circuit, and which glows more brightly when the received oscillating current is a maximum.

If the aerial current is inconveniently small, further sensitivity may be obtained by bringing the glow lamp to a dull red heat by means of current from the dry cell D

A choke coil E is provided in series with the dry cell and lamp, to prevent the high frequency current from passing through the cell.



D.F. Receiving Aerials—Croydon.

Fig. 14.

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For setting the receiver to any desired wavelength the wavemeter scale is rotated until the arrow points to the desired position, the buzzer set going, and the receiver tuned directly to the wavemeter.

In a comparatively recent number of *The Wireless World*, there was a very excellent description of the "line switching" system in use at the Croydon station, a system by means of which a link is provided between aircraft in flight and any desired centre, *via* the aerodrome wireless station and the line telephone exchanges. You will, no doubt, remember reading in an evening paper how Messrs. Instone were able to speak directly to one of their pilots after his machine had left Croydon for some appreciable time. Briefly outlined, the arrangement is such that the operators head telephones and microphone are connected to a switchboard in such a manner as to enable him at will to listen in or speak on either his W/T circuits, or on the line telephone. He is further capable of switching the two systems, line and W/T, together, so that a person speaking over the line telephone can operate the wireless transmitting gear, and can hear any speech picked up by W/T. The system is not a perfect "two-way" one—that is to say, it does not permit of the person in the air interrupting the speaker on the ground, or *vice versa*, as in the usual manner of telephone conversations. The wireless operator is compelled to listen in to both sides of the conversation, and to switch over from transmission to reception as required. There is no doubt that very soon this drawback will be removed and that R/T conversations will be exactly similar to those of the ordinary ground system; but, in the meantime, satisfactory results are obtained with the existing arrangement.

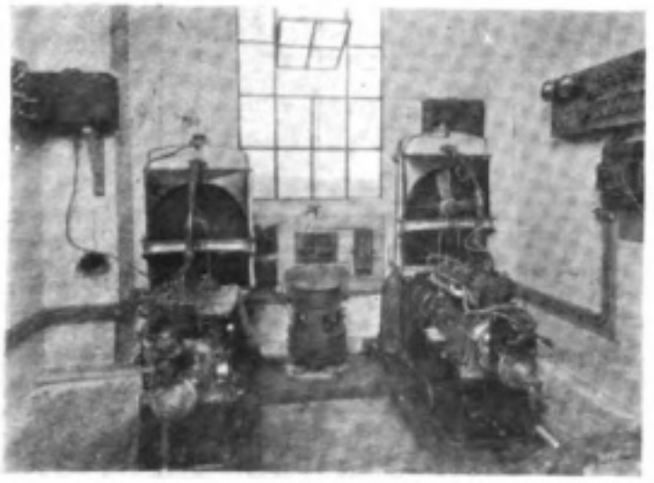

Fig. 15.

Generating Unit—Croydon.

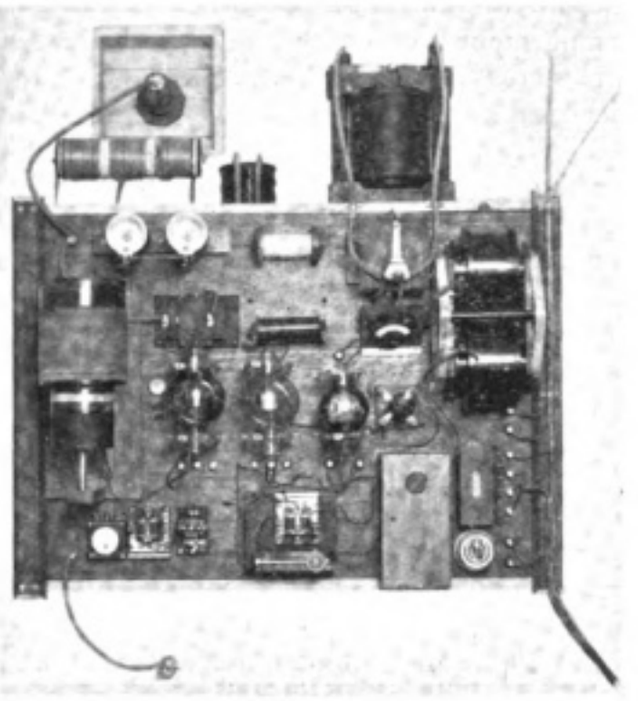

Fig. 16.

Transmitting Panel—Croydon.

The whole station at Croydon, which is to the design of Marconi's Wireless Telegraph Co., Ltd., and is rated at ½ K.W., is divided into two separate sections, contained in different buildings, and situated about 150 yards apart. The first building contains the entire power plant and transmitting units, while the second comprises the reception instruments and controlling panels. The entire station is operated from the reception hut, the transmitting apparatus being remotely controlled by means of a buried cable running between the two buildings (*see* Fig. 14). Since all reception is carried on the D.F. aerials, and these aerials are at present totally unsuited for transmission, a second aerial is erected on

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the site of the transmission building. This arrangement brings with it several advantages, for there is freedom from mechanical and electrical noise while receiving ; an increased possibility of speed in the exchange of signals, for the running machinery need not be shut down at every reception ; and neatness and compactness of the receiving hut. This increase of speed in operating is very necessary in the case of aircraft, because a lost machine calling for position may move a very considerable distance in a short space of time, and minutes, we might almost say seconds, are a question of miles.

Although telephony is primarily used, telegraphy is also possible by a simple keying arrangement, allowing for either pure C.W. or tonic train.

THE TRANSMISSION AND POWER HOUSE

This building is divided into rooms containing—(1) the power plant illustrated in Fig. 15 ; (2) the accumulator room and workshop ; and (3) the transmitting room.

Energy is derived from one of two Austin power plants, similar to those in use at Renfrew and its companion stations. The machines are duplicated, so that the possibility of a lengthy breakdown is reduced to a minimum. The D.C. supply from these generators drives an alternator, delivering power at 85 volts 150 cycles, which is transformed up to 7,000 volts, rectified and fed to the oscillatory and telephone control circuits.

The transmitting apparatus is fitted to a panel (Fig. 16) arranged back to wall, so as to screen, as far as possible, all points at high potential. The general arrangement will be seen from the diagram given in Fig. 17. The filaments of the valves are lighted from the alternating supply through a transformer, which carries two secondaries wound for

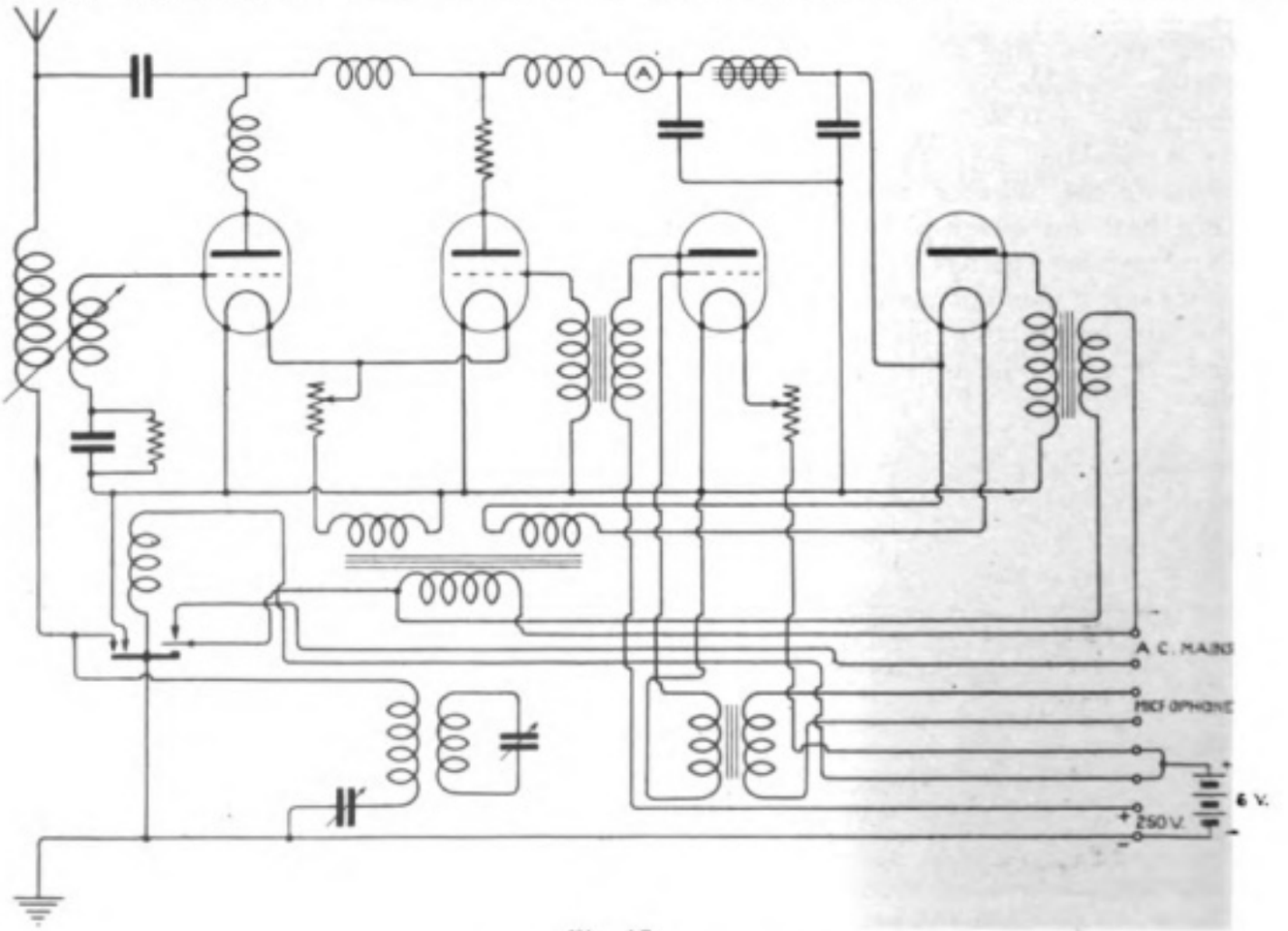

Fig. 17.
Diagram of Transmitting Panel.

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6 volts, one lighting the power and control valves, the other the rectifying valve. The potentials of the rectifier filament rise to 7,000 volts, and the filament transformer winding is, therefore, highly insulated. Smoothing chokes and condensers are employed to smooth out the unidirectional pulses fed from the rectifier. The rectification and smoothing of the filament supply is not necessary, since the filament emission is nearly constant, owing to the fact that the filament temperature is slow in responding to the rapid variations of current supply, this, in itself, constituting a smoothing device. Control of the brightness of the filaments of the valves is carried out by means of series resistances.

Telephone control is effected through two valves. The variations of potential of the microphone transformer are superimposed on the grid filament circuit of a 20-watt valve, and are then magnified through a second transformer, the secondary of which supplies the grid and filament of a 500-watt valve.

The variations of speech voltage are then again magnified up and imposed on the main high-tension supply to the oscillator, by the well-known choke control method.

Reaction is variable.

The send-receive switch is remotely controlled from the reception hut by means of a relay which brings in the aerial, primary of the H.T. transformer, and filament lighting when sending and open circuits them for reception.

Keying, if necessary, is performed by breaking the primary of the H.T. transformer, cutting off the H.T. supply, and is controlled by a second relay working on remote control, from the receiving hut. It is not shown in the Croydon diagram. If tonic train is desired a continuously running buzzer is substituted for the microphone in the control circuits, keying being carried out as before. Tnere are, therefore, no differences in keying C.W. or tonic train, except that in the former case the control circuits are not brought into use. A third relay is used for cutting out the main and subcontrol valves when sending pure C.W.

The transmitting aerial is "T" type, 70 ft. in height, and supported on masts 250 ft. apart. Two wires are carried on 10 ft. spreaders, and the effective capacity is in the region of ·0008 mfds. The earthing system is of one circle of plates placed under the aerial, and 20 ft. in diameter.

In the new station, which is replacing the one described, the masts are to be of the lattice pattern, and the earth system will be of the balancing capacity type, insulated wires being carried on posts 7 ft. high, and spreading fanwise, under the aerial.

The existing main earth is kept isolated from the earth points of the delays, main alternating supply filaments, etc., which run to a subsidiary station earth, thereby greatly reducing the resistance of the actual H.F. system.

The operating and control hut, which we can now consider, contains the entire reception apparatus. This consists, primarily, of a Bellini-Tosi Direction Finding equipment, comprising a radiogoniometer and an amplifier with both high and low frequency circuits. Tuning condensers are provided for wavelength adjustment. In addition, there is the control panel for the complete station, and for enabling the operator to listen and speak on either R/T or line telephone. One operator alone is necessary at any given time, and with a second man as stand-by the total of two operators is all that is needed for any one watch. Occasionally an attendant is necessary from time to time in the power house, but this is not a general rule.

Independent heterodyne is used, local oscillations being generated from a R.A.F. pattern syntoniser, which is switched on for C.W. reception and off for telephony.

A simplified diagram of the connections of the main receiver is shown in Fig. 18.

The reception aerials are supported from a 72 ft. box mast, and from smaller posts 15 ft. in height, and are arranged so that the aerials of "closed-loop" type are at right angles. (See Fig. 14). Each aerial is brought into

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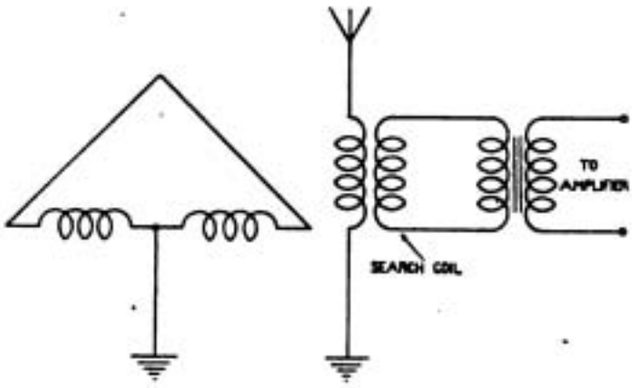

Fig. 18.

D.F. Receiver. Simplified diagram.

the cabinet by a separate lead-in, and goes directly on to two corresponding fixed field coils, arranged in a similar manner at right angles to one another. A searching coil is suspended in the centre of the field coil system, and is connected directly to a variable coupling transformer, with windings designed to suit a range of wavelengths from 750 to 2,000 metres, in conjunction with this particular aerial. The secondary is connected to an amplifier consisting of six high frequency, one detecting, and two low frequency magnifying valves, the latter being arranged so that they can be cut out of the circuit if not desired.

It is a matter of extreme difficulty to lay down a hard and fast statement as to the range of this station at Croydon. Range depends so much upon the sensitivity of the aircraft receiver, which again depends upon conditions in the aircraft itself, and upon the skill of the operator in reading weak speech, or in reading through induced noises from the magneto or through jamming. The range from a machine to ground is evidently the limiting factor for that machine. At a guess, however, it is safe to say that the range may be regarded as anything between 100 and 200 miles from ground to air.

With the completion of the new station and the improving equipment of the aircraft, it is hoped that the range will be largely increased.

With the exception of Cricklewood and Lerwick, Lympne completes our tour of the aeroplane stations. There has been so little time available since this paper was decided upon, that insufficient detail has been forthcoming. Then, again, in the cases of Lympne and Pulham (the airship station), I must content myself with the bare outlines only, because both stations contain sets, the design of which involves a description of components not yet available for publication.

At Lympne the transmitter is a Service pattern, rated at 250 watts, and rather similar in design to the set described at the stations of the Glasgow route. The receiver is that also described as in use at those stations. It will be seen then, that I am rather handicapped in what I am able to tell you of this station, but because it has necessarily been passed over one must not suppose it is unimportant. It is highly important. It is the outpost station, as far as the British Isles and the Continental routes to France, Belgium, Holland and Germany, are concerned, for it is responsible for handing over, in safety,

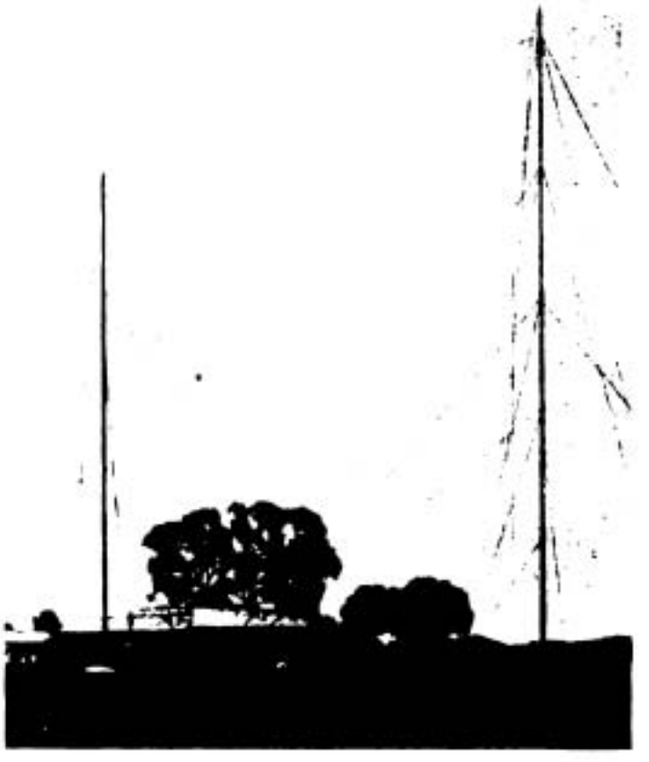

Fig. 19.

Exterior of Pulham Station.

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all outgoing aircraft to St. Inglevert, its nearest French neighbour, and in seeing that home-coming machines do not go astray.

I can, however, tell you that Lympne has

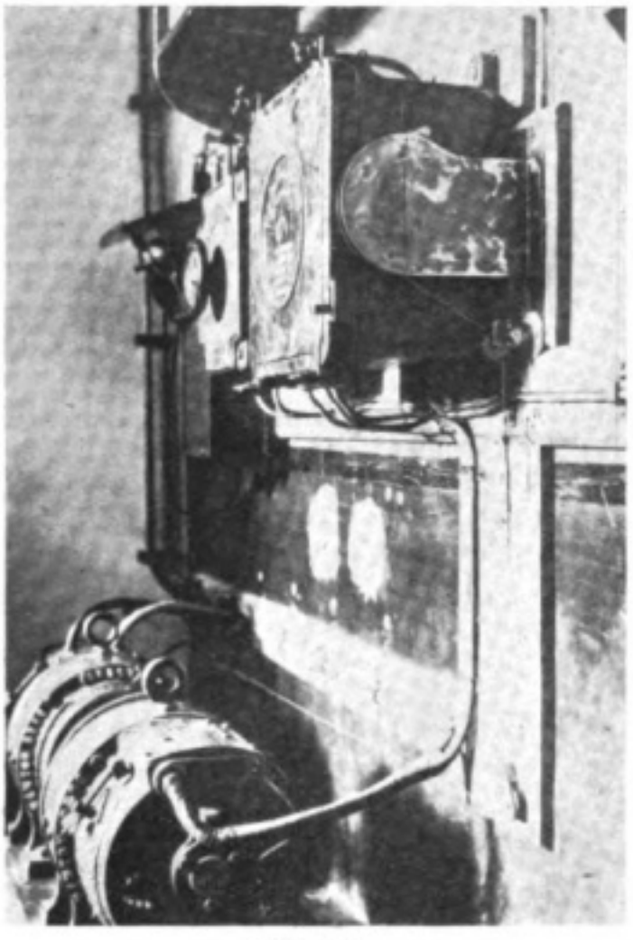

Fig. 20.

H.T. Generator and Controls—Pulham.

worked telephony to Castle Bromwich, a distance of about 160 miles, with perfect ease, and has been heard at Renfrew, but not quite well enough to distinguish the speech.

All civil aviation airship work is now being concentrated at Pulham (Figs. 19 and 20), where a more or less new wireless station will be completed shortly. Direction finding and radio telephony will be the main features, and 900 metres is to be the wavelength used for all work. Direct communication will be maintained with the ships up to 750 miles, and, possibly, much more than that.

The existing station at Pulham you will see from Fig. 19. The masts are 120 ft. in height, sustaining a "T" type aerial. For telegraphic work the usual pattern transmitter and receiver is fitted, while an additional highly selective receiver is in use on a second auxiliary aerial for special work.

Aircraft Sets.

It will be of interest, before concluding these notes to describe briefly the aircraft sets themselves. Model A.D.2 complete aircraft transmitter and receiver, of the Marconi Company, is a compact instrument and combines C.W. tonic train and telephony, any of which can be used at will by the operator in flight. The same unit box contains both transmitter and receiver. I am indebted to Colonel Childs of the Marconi Company for the loan of one of these sets in connection with this Paper.

A diagram of the standard aircraft C.W. transmitter, R.A.F. pattern, is shown in Fig. 22. It is a simple instrument, and hardly needs a description. This instrument, together with the receiver, comprises a com-

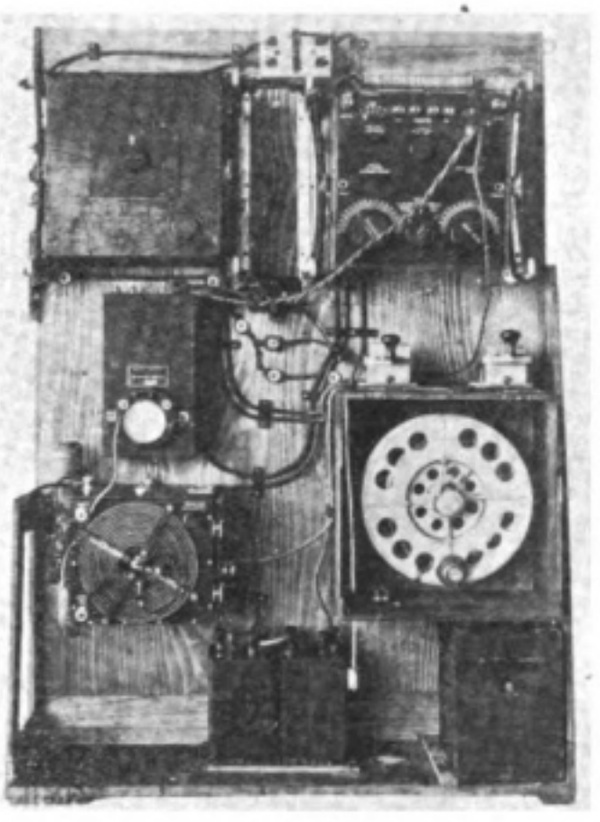

Fig. 21.

Airship Fitting.

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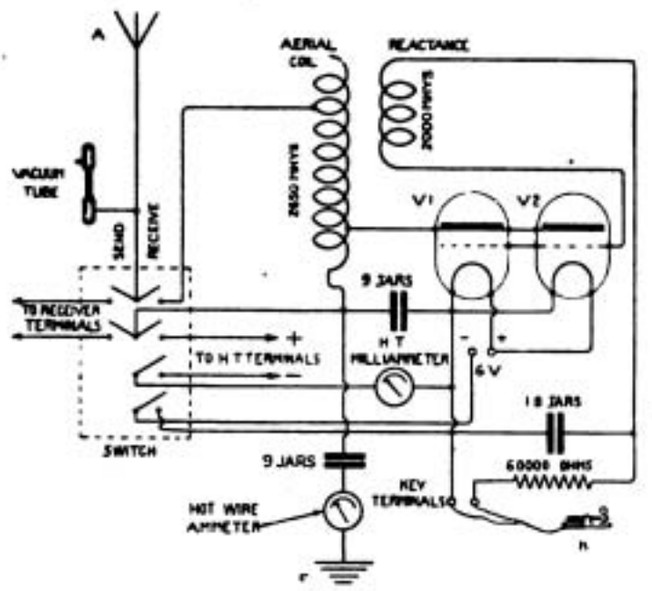

Fig. 22.

Diagram of Standard Aircraft (C.W.) Transmitter.

plete aircraft set capable of giving a range of 150 miles telegraphy between ground and air The particular transmitter here is of rather historic interest, since it was the one fitted in Germany into "L.71," prior to her flight to Pulham, when she was handed over under the terms of the Peace Treaty. Fig. 21 will give some idea of the airship fitting of both transmitter and receiver.

As an additional point of interest, a 7-valve amplifier, as used at all stations for telephony work, is on view. It is a straightforward design of transformer coupled circuit, having 3 H.F. amplifier, 1 rectifier, and 3 L.F. amplifiers.

I should like to express my keen appreciation for the permission given me by Group Captain L. F. Blandy, Controller of Communications, Air Ministry, to prepare this Paper; for the valuable assistance of my colleagues there, and for the help rendered me by Captain Furnival, of the Marconi Company.

(The Discussion on this Paper will be printed in our next issue.)

AMATEUR CALL SIGNS.

Amateur Call Signs.—The following particulars of amateur stations, with their call signs, etc., have been received since going to press with the last issue of *The Wireless World*.

2AU, Mr. A. C. Bull, 25, Fairland Road, West Ham, E. 15.

2DC, 10 watts, 180 and 1,000 metres, spark, C.W. and telephony, Mr. M. Child, Maida Vale, W.

2KG, 10 watts, 80 to 180 metres and 1,000 metres; Spark, C.W., T.T. and Telephony; hours of working, Monday and Wednesday 1900 to 2100, Thursday 1500 to 1600 and 2100 to 2200, other days 2000 to 2100 and 2200 to 2300. Mr, A. E. Hay, 6, Oxford Street, Mountain Ash, Glam.

2IH, Technical College, Cardiff.

2IY, 10 watts, 180 and 1,000 metres, spark, C.W. and telephony, hours of working 1800 to 1900, 2100 to 2200, Mr. J. Briggs, of City School of Wireless Telegraphy, Ltd., 61, High Street, Manchester.

2JM, 10 watts, 180 and 1,000 metres, spark, C.W. and telephony, Mr. G. G. Blake, 10, Onslow Road, Richmond, Surrey.

2JO, 10 watts, 180 and 1,000 metres, spark, C.W. and telephony, hours of working 2000 to 2100 Monday to Friday. Other days times various. Mr. J. W. Whiteside, 30, Castle Street, Clitheroe, Lancs.

2JU, 10 watts, 180 metres, spark, C.W. and telephony, hours of working 2000 to 2200, Mr. E. J. Pearcey, 610, Fulham Road, S.W.6.

2JV, 180 and 1,000 metres, spark, C.W. and telephony, hours of working 2000 to 2200, Mr. A. G. Robbins, Station Road, Epping.

W/T R.N.V.R.

ANNUAL RE-UNION DINNER.

The Annual Re-union Dinner and Smoking Concert will take place at the Talbot Restaurant, London Wall, E.C. 2, on the 23rd of April (day of Football Cup Final) at 6.30 p.m. Lt.-Col. C. G. G. Crawley, R.M.A. will take the chair.

Please write at once for particulars to Lt. Commr. H. E. Sanders, R.N.V.R., Allington, Waterlooville, Hants.

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WIRELESS CLUB REPORTS

The Wireless Society of London.

Proceedings of a Special General Meeting of the Wireless Society of London, held at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on January 27th, 1921.

Major J. Erskine-Murray, D.Sc., President, took the chair at 8 p.m. The Hon. Secretary, Mr. H. Leslie McMichael, read the minutes of the last meeting, and these were confirmed and signed.

An illuminated address was then presented by the President to Mr. A. A. Campbell Swinton, the retiring President, on behalf of the Society. (*See pp.* 795 *to* 797 *of this issue.*)

A Paper by Lieut. Duncan Sinclair, R.A.F., entitled "The Wireless Stations of the British Commercial Airways," was read and discussed. (*For a full report of the Paper, see pp.* 798 *to* 810.)

The ballot papers for the election of new members of the Society were collected, and the President subsequently announced the election of the following as new members:—Hugh S. Pocock, Percy W. Harris, A. Brailsford, Douglas H. Fehr, Michael C. Ellison, K. T. Chu, R. W. Buttemer, Captain R. B. Turnbutt, J. E. McDonald.

The President: I have to announce that the following Clubs and Societies have been affiliated:—Greenwich Wireless Society, North Staffordshire Railway Wireless Society, York Wireless Club, Blackpool and Fylde Wireless Society, Dartford and District Wireless Society, North London Wireless Association, and Croydon Wireless and Physical Society.

There are two other pieces of business; one is an announcement of the Presidential address. I do not think that we have yet been able to get a hall, but it will take place some time at the end of next month. The difficulty is to find somewhere in which we can meet; but you will, no doubt, hear in good time from the Secretary as to the place and date. A further point is the alteration to the rules and the constitution of the Society, notice of which was given in the circular which you have all had. I call upon Mr. Hope-Jones to detail the suggestions of the Committee.

Mr. F. Hope-Jones: This meeting, instead of being an ordinary monthly meeting, is called a special general meeting for the purpose of making a small alteration to our constitution, which I think you will agree is very appropriate. It is simply that Rule 33 shall be altered to read as follows:—"The management of the Society shall be vested in a Committee consisting of the President, the first Past President, Mr. A. A. Campbell Swinton, who shall be a member for life, and any other Past Presidents to the number of three at the invitation of the Committee, the Officers, and eight elective members." In making this alteration to the constitution, your Committee have deliberated carefully. They have had before them the constitutions of the well-known, old-established institutions; such as the Institution of Civil Engineers, the Institution of Electrical Engineers, the Institute of Mechanical Engineers, and other similar bodies. We have studied the custom with regard to Past Presidents, and have adopted what has been found to be the best practice; but we have made one conspicuous exception in the method of dealing with our first and founding Past President, by asking him to be a member of the Committee for life. I am sure you will agree with the Committee that they have been wise in that. We do not wish to be robbed of Mr. Campbell Swinton's long experience and sound judgment; we wish to have it always at our call. I know I am in danger of being called to order if I supplement the remarks I made when last I got up, but I omitted one thing. I wanted to tell you a little that I am sure will interest you, with regard to the artistic production which I hope you will all have a chance of looking at before we go home. You may wonder whom we could get to produce an illuminated address which so cunningly and correctly includes several suggestions of wireless telegraphy. It is thanks to the fact that we had on our Committee—he only recently resigned from it after having been a member for some years—a very expert illuminator in Mr. Kitchen, and that work which you see there done on parchment in the most permanent way we could, is a labour of love by Mr. E. W. Kitchen, one of your own Committee.—(Applause.) You may notice a chronograph tape beginning in the left-hand corner, which wanders round the illuminated address in the guise of a frame. It bears the legend in Morse, "Good luck to you, long life and happiness," and I am sure it represents the feelings of all of us. I will ask someone, preferably not a member of the Committee, to second the alteration of Rule 33.

Mr. H. Powell Rees: I have much pleasure in seconding the proposal of the Chairman.

The resolution was carried unanimously.

The President: I may mention that the Conference of the Affiliated Societies will take place at the same address as the Presidential Address, towards the end of next month.

The meeting adjourned at 9.15 p.m.

Manchester Wireless Society.

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

A meeting of the above Society was held on January 12th, at the Albion Hotel, Piccadilly, Manchester.

A most attractive lecture, fully illustrated by experiments, was given by Mr. J. McKernan, the subject being "High Frequency Currents." Members of the audience were invited to take part in some of the demonstrations. The Chairman paid a tribute to the modest way in which the lecture had been conducted, and expressed his pleasure at being able to attend such interesting and entertaining experiments. Mr. McKernan will probably give the same lecture before the Stockport Wireless Society in the near future.

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

The Halifax Wireless Club.

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

This Club continues to make good progress. Our lecture syllabus is getting nicely complete, and we are looking forward to some treats.

The transmitting set constructed by Mr. P. Denison has been in active operation on many evenings. On Christmas Eve, seasonable music

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was sent out for the benefit of our members, and we were very well satisfied with the results obtained.

On January 15th we sent out a special concert on 1,000 metres during the whole two hours we are allowed, and our members listening in on their own sets. Our call sign was recognised by many amateurs outside our Society, and many letters have been received from the near-by towns commenting on the pleasure the concert gave.

Many of our members have purchased the well-known Mark III sets. We arranged a special lecture dealing with the construction and principles of this, Mr. Denison again giving us the benefit of his knowledge, brought a Mark III, which he had converted into a long-wave set (1,000 to 20,000 metres), which was in operation during the evening, and gave splendid results.

Acting Hon. Secretary, Mr. Louis J. Wood, Clare Hall, Halifax.

East Kent Wireless Society.

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

At a general meeting of the above, held on January 26th last, the following officers were elected for the year 1921. President, Commander Norfolk, R.N.; Chairman, Major J. Martin, R.G.A.; Vice-Chairman, Mr. L. Kelsall; Secretary, Mr. V. Palmer; Treasurer, Q.M.S. E. W. Ovenden, R.E.; Committee, Messrs. A. A. Ward, E. W. Austen, S. G. Vaughan and R. C. Harpur.

It was decided that members could use the Club-room any day between the hours of noon and 10 p.m.

All communications should be addressed to the Hon. Secretary, Mr. V. Palmer, Manor House, Maxton, Dover.

Wireless and Experimental Association.

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

At a meeting of the Association on January 26th, Mr. Voight read a concise and lucid Paper on inductances and showed how he obtained unusual efficiency. Discussion was adjourned to a future meeting. Mr. Powell, late Corporal of the ill-fated "R. 34," then gave a description of the direction finding apparatus employed, as well as other interesting matter, and he promised us another visit in the near future. A letter was read from the President, Mr. Wm. Le Queux, promising a substantial contribution to our library. The meeting closed with votes of thanks to both lecturers and the President.

Hon. Secretary, Mr. G. Sutton, A.M.I.E.E., 18, Melrose Road, S.E.22.

Woolwich Radio Society.

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

The annual meeting of the above Society was held on Friday, January 28th, at the Woolwich Polytechnic, when a good number of the members were present. The meeting opened with an address by the Secretary, who explained the wonders of "wireless," and recent developments appertaining thereto, and also remarked how the Society had improved in membership during the past year and the keen interest taken by all. The Society now possesses a splendid receiving set, and it is hoped all members will induce their friends to join and take an interest in this important subject. He further stated that it was hoped that the Society would enter in the Transatlantic tests, and try and receive the messages being sent from America.

He felt sure that if the Society entered it would be successful with the present set in use.

The following officers were elected for the ensuing year:—President, Lieut.-Colonel Cousins, C.M.G., R.E.; Vice-Presidents, A. F. Hogg, M.A., T. B. Vinycomb, M.C., M.A., M.R.I.A., Capt. Hughes, M.C., R.E., Mr. F. G. Goldstone, R.E., Mr. MacPherson; Hon. Secretary, Mr. W. T. James; Assistant Hon. Secretary, Mr. Beeson; Hon. Treasurer, Mr. E. G. H. Denney; Committee, Messrs. Ellam, Franklin, Exeter and South.

The Treasurer then presented a balance sheet which showed a very satisfactory state of affairs considering the short time that the Society had been in existence, but it was pointed out that more funds were required to buy dry and secondary batteries, valves, etc.

The meeting concluded with a very hearty vote of thanks to the past officers for their services rendered, to which the Hon. Secretary suitably responded, stating that the Society would welcome any new members on Wednesday evenings at the reception classes at the Old Mill, or at the lectures and buzzer classes at the Woolwich Polytechnic, on Friday evenings, at 7.30 p.m. All communications should be addressed to Mr. W. T. James, 32, Ace Street, Plumstead, S.E.18.

Glasgow and District Radio Club.

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

The regular fortnightly meeting of this Club was held on Wednesday, January 5th. There was a good attendance and the chair was occupied by Mr. E. Snodgrass.

The minutes of the previous meeting were read and confirmed, and the Secretary read a letter from Postmaster General in reference to the Club's application for a transmitting permit. This matter was left for the committee to deal with.

Although our membership is rapidly increasing the Chairman drew special attention to the necessity of further recruiting of new members. It should be, he said, the duty of each member to introduce at least one new member.

The Transatlantic 200-metre wave receiving test was mentioned, and Mr. Snodgrass, to whom was allocated the task of making part of the Club's special receiving set, exhibited the aerial coupling coil.

Mr. W. K. Dewar gave a short address on "Wireless Telegraph Traffic Procedure," using Marconi Morse Code records on a gramophone as illustrations of messages met with in actual practice. This was the most appreciated part of the evening's programme, and it is interesting to note that the whole of the messages were accurately written down by our lady member, Miss J. G. Knowles. Miss Knowles is the holder of the Postmaster General's First Class Certificate of Proficiency in Radiotelegraphy. We think the number of Club's having lady members with similar qualifications must be very few indeed.

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A hearty vote of thanks to the lecturer concluded the proceedings.

Another meeting was held on Wednesday, January 19th, at which Mr. Dewar presided. There was a splendid turn out of both old and new members. After confirmation of minutes of last meeting the Secretary read a letter from the Marconi Scientific Instrument Co., Ltd., offering the loan of apparatus for demonstration purposes. The members showed their appreciation of this firm's generous offer, and the Secretary was instructed to write and thank them and obtain further particulars, with the view of arranging a demonstration at an early date.

The sub-committee appointed in connection with the Transatlantic test, reported progress, and it was announced that the apparatus was almost completed. We are, in common with all amateurs, experiencing great difficulty in obtaining a heterodyne wavemeter, calibrated to 200, and it was decided to write Mr. Coursey of the *Radio Review*, asking him to endeavour to arrange for some experimental station to send out "V's" on a 200-metre wave, at specified times, for a few nights before the beginning of the tests. This suggestion, if practicable, and acted upon, would enable all concerned to tune their instruments approximately to the wavelength to be received.

In the near future we hope to have a lecture from Mr. Snodgrass on "The Theory of Valves," and one from Mr. Senior on "Aerials." Both these gentlemen are thoroughly qualified to speak on their respective subjects.

A keen interest in wireless matters is the only qualification for membership at present, and intending members should communicate with the Hon. Secretary, Mr. Robert Carlisle, 40, Walton Street, Shawlands, Glasgow, or during daytime, call on Mr. Dewar at North British Wireless Schools, 206, Bath Street, Glasgow.

The subscription for present session is 10s., but an entry fee of 5s. will be charged to new members joining after October next.

Bradford Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting was held on January 14th in the Club-room. The chair was taken by the President. Following the reading and accepting of the minutes it was announced that the new aerial had been put up and was now ready for use.

A small room is being prepared for the use of members as an instrument room, and as soon as possible will be fitted up.

Some splendid signals were got during the course of the evening on a resistance amplifier (3-valve).

The officers for the current year are as follows:—President, Mr. C. Wood; Vice-Presidents, Mr. W. C. Ramshaw, Mr. A. Bever; Hon. Secretary, Mr. J. Bever; Hon. Treasurer, Mr. N. Hammond; Committee Members, Mr. A. Liardet, Mr. N. Whiteley.

The Gloucester Wireless and Scientific Society.

(Affiliated with the Wireless Society of London.)

A very successful meeting of the above Club was held on January 20th, at the Science Laboratory of Sir Thomas Rich's School.

The first of a series of talks was given by the Secretary on the theory of wireless. These are intended to cover a course similar to that for the P.M.G. examination, and will be given each meeting for about half-an-hour.

Some buzzer practice was also indulged in by the members.

We are promised a most interesting lecture on X-Rays at our next meeting on February 3rd.

All interested please communicate with the Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

North Staffordshire Railway Wireless Society.

(Affiliated with the Wireless Society of London.)

The above Society paid a visit to the Burton Wireless Society, on December 18th, where they spent a most interesting and instructive evening.

The party partook of tea at Boots' Café, and afterwards met the members of the Burton Wireless Society at their headquarters, the Burton "Daily Mail" Office.

The meeting opened with an address by the Chairman of the Burton Wireless Society (Mr. Chapman), who outlined the progress of the Society.

Mr. V. A. Smith then gave a most interesting lecture on the progress of wireless research work, which was received with marked appreciation by our members. Mr. Parkin gave a splendid lecture on resonance, etc., giving illustrations.

The Club apparatus was then examined, and after a vote of thanks from the Chairman and Secretary of our Society, the members adjourned to the station belonging to Mr. Selby, who demonstrated the use of honeycomb coils.

We are indebted to the other members of the Burton Wireless Society for the pleasant time they gave us.

On January 15th, the Society visited Derby Wireless Society, and after being entertained to tea, split up into two parties, visiting the stations of Mr. Bemrose and Mr. Lee in turn.

These gentlemen possess some very fine and up-to-date apparatus, most of which is home-made, the signals at Mr. Lee's being exceptionally good and clear. A source of interest is the electric clock made by Capt. Bemrose, who uses the earth as the battery for this clock.

Thanks are also offered to the other members who conducted the party.

On January 18th, the members received a splendid lecture from Mr. Graham, B.Sc., of Hanley Secondary School, who dealt with the physics side of wireless progress, taking the members through a complete cycle from the simple surges of the Leyden jar up to the modern receiving and sending apparatus.

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

Birmingham Wireless Association.

(Affiliated with the Wireless Society of London.)

The annual general meeting was held at the Birmingham and Midland Institute, on Tuesday, January 18th. In the absence of Mr. J. B. Tucker, Mr. Whitfield took the chair.

The Hon. Secretary submitted a statement of accounts, which was approved.

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The Chairman then reported that owing to lack of time the Hon. Secretary had been compelled to tender his resignation. The resignation was accepted with regret, and Mr. A. T. Lee was appointed Hon. Secretary, *pro. tem.*

The following officers were elected :—Chairman, Mr. J. B. Tucker; Committee, Messrs. Chatwin, Handford, Old, Watkins, Westwood and Whitfield. The meeting closed with a vote of thanks to the retiring Hon. Secretary.

The Hon. Secretary would be pleased to receive lists and catalogues from firms supplying wireless apparatus, for the use of members of the Association.

North Middlesex Wireless Club.

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

A most successful meeting of the Club was held on January 26th, at Shaftesbury Hall, Bowes Park, when a large audience attended to hear Lieut. R. F. Durrant, R.A.F., give his lecture on his flight across the Atlantic in charge of the wireless installation on H.M. Airship, "R. 34."

Among other gifts from the Americans, Lieut. Durrant had a 2-valve amplifier, which he has generously presented to the North Middlesex Wireless Club, of which he is one of the oldest members.

At the close of the lecture, the Chairman, Mr. A. G. Arthur, thanked Lieut. Durrant on behalf of the Club, for his most interesting lecture, and also for his gift of the amplifier, which would be a valuable addition to the Club's instruments. Mr. Beckman offered to present a suitably inscribed silver plate to affix to the instrument.

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

Plymouth Wireless Society.

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

A general meeting of the Plymouth Wireless Society was held on January 21st, 1921, at the Municipal Technical College, Plymouth.

Mr. R. S. Menhennet in the chair. A general discussion took place, and various suggestions were made by members regarding future prospects of the Society.

Mr. J. C. Andrewartha, our late Chairman, was elected local representative of the Society.

The Hon. Secretary, Mr. H. P. Mitchell, Municipal Technical College, Plymouth, would welcome letters from late members of the Society.

Three Towns' Wireless and Model Engineering Club.

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

The Club has now acquired a permanent Club-room in Princes Square, Plymouth, and it is hoped that the Club wireless set will soon be installed. On Wednesday, January 26th, the usual weekly meeting was held, and a lecture was given by Mr. George on his experiences with a crystal set. The construction of his set, which is entirely home-made, was ably and clearly described, and presented several novel features. The lecture was followed by a keen discussion on various points which the lecturer raised.

It is decided to retain Wednesday evenings for weekly lectures and demonstrations, whilst during the remaining evenings of the week buzzer practice and a course of talks on elementary principles will take place.

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

Derby Wireless Club.

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

On Saturday, January 15th, a party of the N.S. Railway Radio Society from Stoke paid a visit to the Club, and inspected the stations of Mr. A. T. Lee and Capt. W. Bemrose.

On Wednesday, January 19th, the first of this year's ordinary meetings was held at the Technical College, Derby, when Mr. E. F. Clark, B.Sc., B.A., read a most instructive and comprehensive Paper on "Electrical Units," first explaining the fundamental mechanical units and then the electromagnetic and electro-static systems of units. The lecturer kindly distributed copies of his notes on the data referred to. The lecture was much appreciated and most interesting.

Following his Paper, Mr. Clark gave a few technical considerations on the question of the design of small alternating current rectifiers, and the Club hope to hear more from him on this subject. The Secretary reported that several new members had joined the Club.

Forthcoming meetings are as follows :—February 9th, "The Construction of a Simple Valve Receiver," Mr. Martin, 7.30 p.m., at The Court, Alvaston. February 19th, "Inductances," Mr. A. T. Lee, at the Technical College, Derby, 7.30 p.m. March 2nd, "Small Spark Transmitters," Mr. S. G. Taylor; and "Morse," Mr. J. Lowe, 7.30 p.m., at the Court, Alvaston. Hon. Secretary, Mr. W. Bemrose.

Dartford and District Wireless Society.

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

The usual fortnightly meeting of the above Society was held on January 29th. Dr. Miskin presided, and a good number of members were present. Two new members were enrolled.

Interesting discussions took place with regard to valves and valve circuits. One member brought for inspection a small Telefunken trench generator, captured from the Germans, adapted for driving with a cycle or small engine.

Enquiries are still in operation regarding permanent accommodation.

All persons interested are requested to communicate with Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford.

The North London Wireless Association.

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

The above Association is now holding regular meetings every Friday. The last two meetings were devoted chiefly to business of the Club, and it was decided that the Association should affiliate itself with the Wireless Society of London. Application has accordingly been made to the Wireless Society. Membership cards, stationery, etc., are also being printed, and it is hoped shortly to arrange for a series of progressive lectures and discussions.

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The membership of the Club is gradually increasing —five new members being elected at the last two meetings.

The ninth meeting was a members' exhibition evening, and many interesting exhibits were made. Mr. Gartland brought his transmitter and gave a short description of same together with the circuit he used on his own station. Amongst other exhibits was a well-constructed loose coupler and a wave meter. A valve amplifier, telephones, inductances, condensers, etc., were also shown, and a very interesting evening was spent in examining these various exhibits.

Will Mr. E. W. Hughes, who was present at the first meeting of the Club, kindly send his present address to the Secretary?

Anyone wishing to join the Association is cordially invited to communicate with the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1., who will gladly furnish further particulars.

Croydon Wireless and Physical Society.

(Affiliated with The Wireless Society of London,)

W. Thompson, Esq., M.A., B.Sc., delivered his presidential address to the members of the above Society on Saturday, January 29th, on the subject of "Standardisation of Musical Pitch," and afforded a fine example of the principle of heterodyne reception.

The next meeting of the Society will be held on March 5th at the Croydon Central Polytechnic, at which Messrs. Creed & Co. will demonstrate their automatic wireless receiver and printer. Ladies will be invited to this meeting, and the Hon. Secretary, Mr. C. Harrison, 11, Carlyle Road, Croydon, will be pleased to issue an invitation to anyone interested in the demonstration.

Birmingham Experimental Wireless Club.

A meeting was held on January 26th, at the City School of Wireless Telegraphy, Corporation Street, Mr. L. T. Dore in the chair. Twenty-four members were present.

Mr. A. T. Lee, of Derby, gave an interesting and practical description of a 3-valve amplifier of his own construction, concluding with a demonstration which proved the exceptional merits of the set. The lecturer was accorded a hearty vote of thanks.

The question of the Club's proposed receiving set is engaging the keen attention of its members. The Club is licensed for transmission, but the exact design of the transmitter has not yet been decided upon.

Hon. Secretary, Mr. Frank S. Adams, 110, Ivor Road, Sparkhill, Birmingham.

The Manchester Radio and Scientific Society and the Manchester Y.M.C.A. Wireless Club.

A joint meeting of the above two wireless Clubs was held in the Y.M.C.A. smoke room on Wednesday, January 19th. The meeting was well attended by members from both Clubs, Mr. Boullen being in the chair. Mr. Halliwell very kindly continued from his last lecture and gave a very clear description of the theory of the valve. Mr. Halliwell illustrated his lecture by means of various diagrams on the blackboard, making it clear that the best results cannot be obtained from a valve without knowing its critical point. He also described the cumulative or grid-leak method which cannot be as successful as the previous method unless both the leak and the condenser are variable.

Mr. Halliwell answered various questions on concluding, and was then accorded a very hearty vote of thanks.

These two wireless Clubs held another joint meeting on Wednesday, January 26th, in one of the new wireless rooms in the Y.M.C.A. building. Before a good attendance Mr. E. Edwards delivered an excellent lecture on "Accumulators." This was a very welcome subject, as most wireless amateurs now use accumulators. Mr. Edwards gave a short survey of the history of this form of battery, and followed it up with the chemical theory of charging and discharging, showing the various chemical formulæ and equations on the blackboard. He also handed round several plates of various forms, and showed others in various stages of completion, on a demonstration board which he had brought with him.

Mr. Edwards then described the effects of charging too quickly, too slowly, at more and less than the right amperage, and so on, in a very clear way. On concluding, various questions relating to accumulators were asked and answered, and finally a very hearty vote of thanks was accorded Mr. Edwards for a most useful and instructive paper.

The new rooms for wireless are now open at the Y.M.C.A., and it is hoped very soon to have an aerial erected and apparatus installed in the room allotted for that purpose. New members will be very welcome to both Societies, and all communications should be addressed to Mr. P. Thomason, 7, Brazennose Street, Manchester, for the Radio and Scientific Society, and to Mr. Day, 56, Peter Street, Manchester, for the Y.M.C.A. Club.

The Stamford Hill and District Wireless Society.

The above Society is a branch of the Woodberry Down Young Men's Club, whose premises, situated at the "Memorial Hall," Vartry Road, Stamford Hill, N.15, are being used as Headquarters. It is expected that by the time this notice appears in print, permission from the P.M.G. to erect an aerial and instal wireless apparatus will have been obtained. The Society would welcome more members so that a definite programme of meetings and lectures can be arranged.

All members joining the Wireless Society automatically become members of the Social Club for which an annual subscription of 10s. 6d. is payable. Meeting nights of the Social Club are as follows:— Monday, 7 to 10 p.m.; and Thursday, 7 to 9 p.m.

Will all interested kindly communicate with the Secretary, Mr. W. J. Law, 17, Hermitage Road, Green Lanes, Harringay, N.4, so that a business meeting may be called at an early date to decide on a programme, etc.

The Rugby and District Wireless Club.

With a view to recruiting members for the above Club a public lecture and demonstration on "The Principles of Wireless Telegraphy," was given by the President, Mr, R. C. Clinker, on Wednesday, 19th inst., at the Benn Buildings. Major Thomas,

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B.Sc., B.A. (Vice-President), who presided, said that anything that would increase the ability of mankind to communicate with others was bound to lead to advancement and progress.

Mr. Clinker remarked that for the advancement of scientific knowledge it was necessary to encourage amateur work in all branches of science. Most great discoveries had been made by men who did the work because they were fond of it.

The lecture was fully illustrated by lantern slides and diagrams, together with films. High-power stations were picked up, demonstrations of wireless telephony were included, gramophone music and a message asking for support, and a notice that the Club was anxious for an increased membership were sent from another part of the building, received by the lecturer, and reproduced to the audience by the aid of a Brown's loud speaker.

There was a crowded attendance, and at the close a vote of thanks was proposed by the Chairman to Mr. Clinker, who, he said, had done a great deal for the Club. Mr. Clinker suitably acknowledged the compliment, and in doing so referred to the efforts of Mr. A. T. Cave, Hon. Secretary, and Mr. H. B. Burdekin, Chairman of Committee, in arranging the lecture.

A silver collection was taken, and over £4 realised for the purpose of purchasing additional apparatus for the Club.

Meetings are held every Monday evening at Headquarters, Radio Institute, 9, Albert Street. New members are heartily invited. Hon. Secretary, Mr. Arthur T. Cave.

The Chester Society of Model and Experimental Engineers.—The above Society held its first annual exhibition of models, etc., in St. John's House, Chester, on Saturday, January 22nd. All things considered, the exhibition was a huge success; over 500 persons passed through the rooms between 2.30 and 9.30 p.m.

In the section devoted to wireless telegraphy, Mr. J. C. Walker (Chairman of the W,T Section) exhibited a receiving set, using one rectifying valve and a 3-valve low frequency amplifier with inter-valve transformers. The tuning was effected by means of a set of 6 interchangeable "honeycomb" coils, having with variable condensers (series and parallel), a wavelength range of from 600 to 30,000 metres.

Demonstrations were given, and with the aid of a Brown's "Loud Speaker," the signals were exceptionally strong and could be heard with ease in all parts of the room. Most of the important European Stations were heard, as well as Annapolis (U.S.A.).

A receiving set, crystal rectifying, valve amplifying, was exhibited by Mr. T. J. Matthews, and a portable set, simple single-valve circuit (short-wave) was exhibited by Mr. D. N. Rayner. A receiving set of pre-war design was also exhibited.

Experimental apparatus, electrical models, motors, dynamos, and various models under construction, were also among the exhibits.

Great interest was evinced by all the visitors, and there were several enquiries regarding membership, which it is hoped will be greatly increased as a result.

For the information of prospective members the workshop equipment now includes a Drummond 4" model maker's lathe.

The wireless section has, at present, by permission of its Hon. Treasurer, the use of a set and aerial, already installed in the Society's rooms. The section has in hand the building of the Society's set, for which the license is pending. At a recent meeting it was decided to affiliate with the Wireless Society of London. A course of Morse code practice and a series of lectures in wireless theory have been arranged and commenced.

Complete details of the Society's present activities, aims, and objects, etc., will be gladly furnished by the Hon. Secretary, Mr. D. N. Rayner, 58, Gladstone Road, Chester.

Luton Wireless Society.

A popular scientific meeting, held on January 12th, was well attended, when Mr. J. W. Tomlinson, A.M.I.C.E., a Vice-President, gave a highly entertaining and instructive lecture on "Radium." At the conclusion a spinthariscope was used to exhibit some of the marvellous properties of radium.

At the ordinary fortnightly meeting held on January 26th, the Secretary addressed the members on the subject of "Valves." Following a description of the manufacture of a typical valve and the methods of exhaustion, the action of a valve in a receiving circuit was explained and also some special uses of valves and valve amplifiers in physical science.

Hon. Secretary, Mr. W. F. Neal, Hitchin Road Boy's School, Luton.

Leeds and District Amateur Wireless Society.

With the assistance of local papers, the above Amateur Wireless Society received over 80 names and addresses of persons interested, and a meeting was held here on Friday, January 28th, at 7 p.m., over 50 being present.

The following officers were elected:- President, Mr. R. E. Barnett, B.Sc., A.R.C.S., Principal, Central Technical School, Leeds; Vice-Presidents, Mr. J. E. Tindall, B.A., B.Sc., Head of Physics and Electrical Engineering Dept., Central Technical School, Leeds, Mr. G. P. Kendal, Major Arthur Bray (late W.T R.E.); Committee, Messrs. A. M. Bage, D. F. Cooper, C. Holliday, S. Kniveton, F. Lodge, D. E. Pettigrew and C. F. Whittle; Hon. Treasurer, Mr. R. E. Timms, Assistant Superintendent (Technical) Telegraphs, G.P.O., Leeds; Hon. Secretary, Mr. H. T. Sayer, Wireless Department, Central Technical School, Leeds.

The Society to be called "The Leeds and District Amateur Wireless Society."

Entrance fee at present, 2s. 6d. Subscription, 5s. per annum (subject to alteration later).

The success of the Society seems very promising. A committee meeting is being held here on Friday, February 4th, at 7 p.m., to enable the committee to prepare a general scheme of work, etc., to place before a general meeting, which will be held here at 7 p.m. on February 11th (Friday).

The Hon. Secretary will be very pleased to hear from any persons who are interested in amateur wireless in Leeds or district.

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PAGES FOR BEGINNERS

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

THE VALVE AS A GENERATOR.

IT was seen that the action of the valve as an amplifier depended on the fact that relatively small changes in the grid potential, such as might be caused by an incoming signal, were able to control a large current in the anode circuit.

Further, if the current in the anode circuit passes through a coil coupled back to the aerial, these impulses can be made to augment the oscillatory current in the aerial, and thus increase the strength of signals.

The amount of assistance that the anode current gives to the aerial circuit oscillations can be controlled by increasing or decreasing the coupling between the anode circuit and the A.T.I.

An important point to notice in connection with this "reaction" effect is this: the oscillatory current, which is liberated in the anode circuit by the variations in grid potential, is in exact synchronism with the received oscillations. The frequency of the oscillations in the reaction coil will therefore augment to the utmost the variation in grid potential.

If the coupling between the anode and the aerial coil is sufficiently tight, the oscillations due to an incoming signal will be prolonged, due to the "boosting" effect of the anode circuit oscillations.

With a very tight coupling the oscillations will continue indefinitely, provided that the conditions of the circuit do not alter.

This statement, at first, seems somewhat difficult to believe—in fact, it savours of perpetual motion! The action of the circuit is easily seen, however, on examining Fig. 1.

In the anode circuit is connected a tuning inductance, of which the reaction coil forms a part, and a variable condenser.

If there were no coupling between the anode circuit and the grid coil, the oscillations in the anode circuit would only persist as long as the grid e.m.f. was varied. But if we bring the reaction coil near to the grid coil, the oscillations in the anode circuit will tend to prolong the oscillatory e.m.f. changes on the grid, since they are of the same frequency. If the reaction coil is tightly coupled, a single change in the grid e.m.f. will be sufficient to start a flow of current in the anode circuit. This, in turn, will give an impulse to the grid which will be repeated in another rush of anode current, and so on. The energy of the oscillatory circuit is derived from the anode battery, which, so to speak, is turned on and off in rapid succession.

This continued oscillation from the point of view of reception is a drawback. When signals are being received the coupling is only made sufficiently tight to enable the oscillations to persist a short while after the received wave train. If the oscillations were maintained until the arrival of the next wave train the signals would be indistinguishable in the telephones.

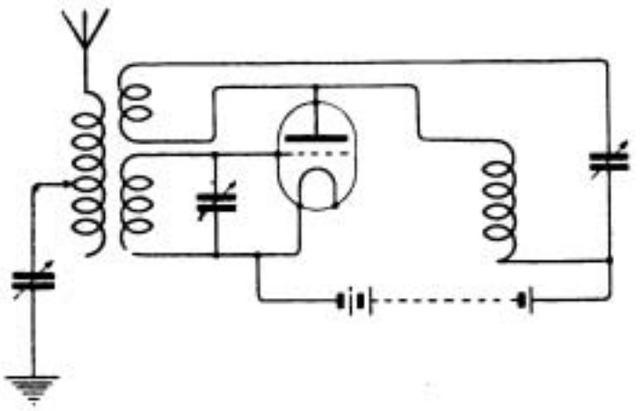

Fig. 1.

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The continuously oscillating valve circuit, however, is of the greatest use in transmitting by means of continuous waves. The essential features of such a circuit will be seen from the foregoing to consist of :—

A high-tension battery of sufficient power to work the valve for long periods without becoming exhausted.

A means of starting the oscillations, such as a switch for momentarily altering the grid potential from its normal negative value to, say, zero.

A diagram of a simple type of valve transmitter is shown in Fig. 2.

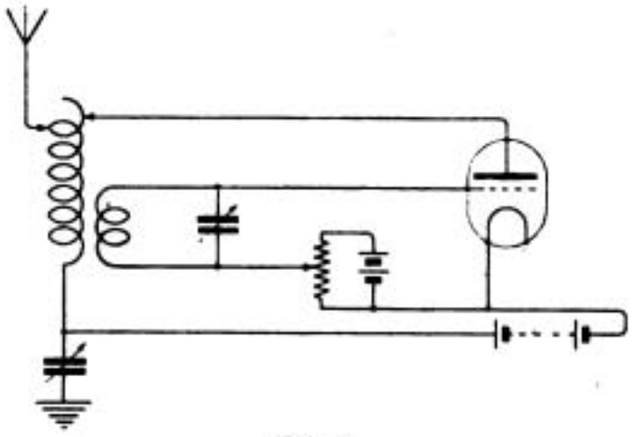

Fig. 2.

The high tension can be conveniently taken from a pair of supply mains. In this case it is sometimes the practice to connect a choking coil in series with the line in order to prevent any possibility of the high frequency oscillations disturbing any apparatus in the neighbourhood. The adjustment of the coupling between the anode and grid currents is of great importance. If the coupling is too loose the grid potential will not change sufficiently to cause a maximum anode current to flow. If the coupling is too tight, the potential on the grid will be varied between very wide limits, and some of the energy in the anode circuit will be wasted in doing unnecessary work.

An alternative method of starting the oscillations is to insert a condenser between the grid and the negative end of the filament (Fig. 3). Since the grid is now insulated it accumulates a negative charge from the filament and intercepts the anode current. On

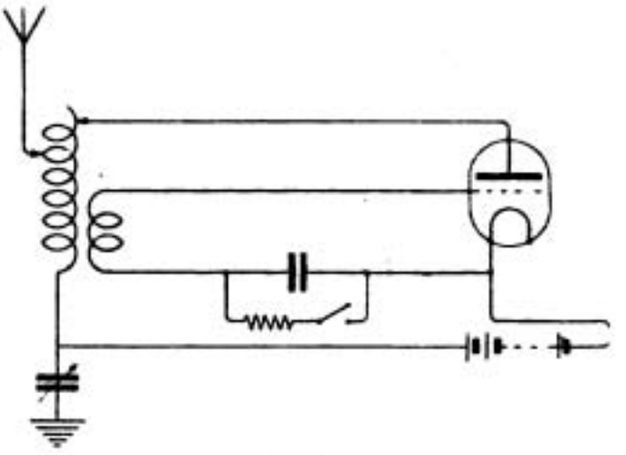

Fig. 3.

short-circuiting the condenser by a switch and resistance, the negative charge leaks away and the flow of electrons to the anode is established.

The type of valve used for transmitting must differ slightly from that required for receiving.

It is obvious that the higher the potential applied to the anode, the greater is the energy available in the aerial circuit. The limit to the potential which can be applied is determined by the valve itself. If the potential difference between the anode and filament is increased indefinitely there will come a time when the rarefied gas in the valve becomes a conductor and "ionisation" takes place between the anode and filament. This ionisation is caused by the violent movement of the molecules of gas under the influence of the high potential, and usually takes the form of a bluish glow which fills the space between the anode and filament. In the case of a receiving valve, this blue glow completely alters the characteristics of the valve and sometimes renders it unfit for further use

The point at which the glow occurs depends on the nature of the vacuum in the valve. The higher the degree of exhaustion, the higher the potential which can safely be applied without causing a discharge.

Valves in which the vacuum is very high are termed "hard" valves, while those which will not stand the application of high potential are termed "soft" valves.

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The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A SINGLE-VALVE LONG-RANGE RECEIVER—II.

WHEN making the wood formers for the Inductance-reaction coil unit, described in the last issue, care must be taken in finishing them so that there are no rough edges left and cracks into which the wire can slip as it is being wound on to the formers. The sharp edges should be rubbed off with glass paper, and any cracks filled in with glue or something which will harden. The formers should be papered smooth—all dust rubbed off—and immersed in a bath of liquid paraffin wax for a few minutes. When taken out of the wax, allow them to drain for a minute or two, and then rub off any surplus drops of wax before they harden.

Next proceed with the winding, doing first the fixed former. This is in the aerial circuit, and therefore the wire used must not be too thin. Use No. 26 double silk-covered copper wire, and wind a two-layer pile winding. This fixed inductance winding is in two sections, one either side of the holes for the reaction coil spindles. There should be 80 turns in each section, 41 in the bottom layer and 39 in the second. The turns should not be wound in two separate layers, but should be "piled" as follows. Make the end of the wire fast to the former and wind in an anti-clockwise direction from the outside of the section to the middle of the former. Wind the first two turns side by side, then the third turn on top of the first two. The fourth turn is wound on the bottom layer hard against number two, while the fifth turn is wound on top of the fourth in the hollow between the second and fourth turns. Continue winding in this manner until the necessary number of turns is complete. The width of the finished section will be approximately one inch. At the ends of the section the windings must be secured by means of a looped tape slipped under two or three turns. The end turn is put through the loop and the tape pulled tight, gripping this turn. It will be seen that, in order to satisfactorily pile the winding, the turns must be wound tightly and close together.

For section two the winding should start in the middle and be wound in an anti-clockwise direction. to the outside of the former, so that when the two inside ends are joined together the two sections form one continuous anti-clockwise winding. As the two sections are wound, tappings should be made as under :—

First tapping,	19th	turn of	Section	1.
Second „	57th	„	„	1.
Third „	27th	„	„	2.

This may be made by running out a loop in the wire, say about 3 inches long, and twisting the two ends together in such a manner that the loop does not slip when the winding is continued and a strain put upon it. These tappings should be made on one of the long sides of the rectangle, and taken to a small terminal board mounted on the side of the frame. The terminals may consist of screws, or pins, in a piece of hard wood or ebonite, to which the tappings may be soldered, and, later on, the leads from the inductance switch and other parts may be taken.

The winding of the reaction coil is more difficult. It is necessary to have two windings, or one winding with a tapping, because the amount of inductance required for oscillation on the long wavelengths is considerably more than the amount for short-wave working, so that one winding will not cover the range of 300 to 20,000 metres.

The long-range winding is a four-layer pile winding of No. 32 double silk-covered

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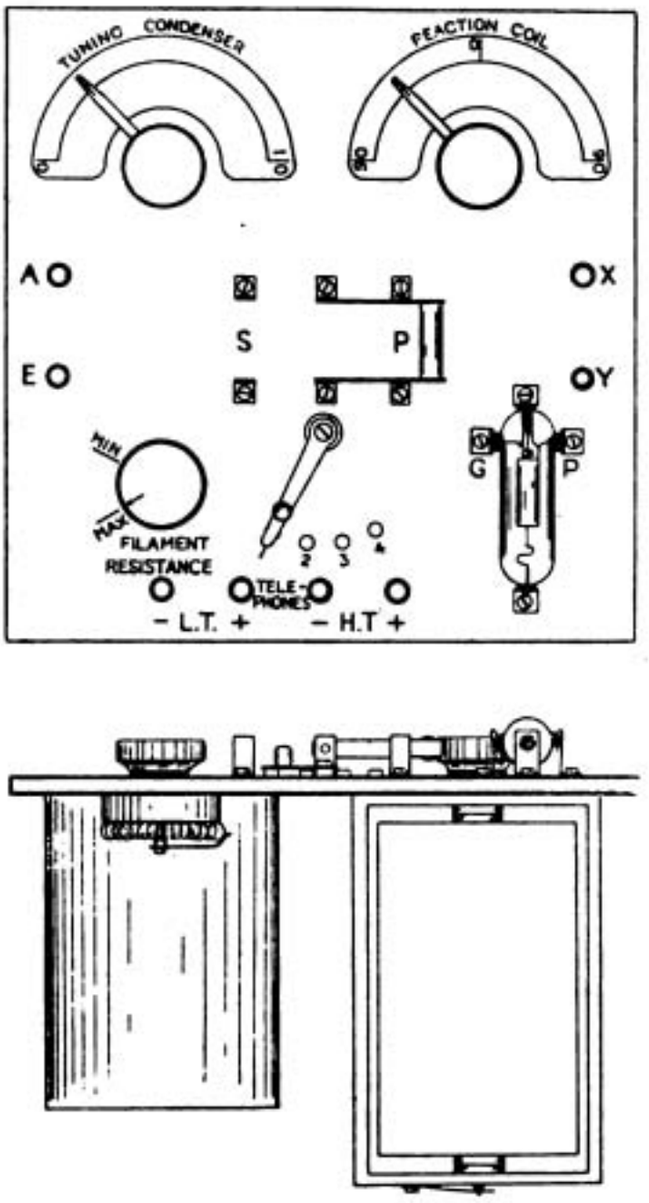

Fig. 3.

wire. There is a centimetre of winding space on each side of the spindle, and into this it is possible to put 100 turns, if a four-pile is used. Start winding from the outside and wind, in an anti-clockwise direction, four turns on the bottom layer, then back three turns over the four; then two turns over the three, and finally one turn over the two. The eleventh turn is wound hard against the first four, the twelfth over the eleventh, the thirteenth over the twelfth, and the fourteenth over the thirteenth. Then the fifteenth on the bottom against the eleventh. This is continued until the end of the section. Finish off this section as previously described, and carry on with the winding of the second section, taking care that its direction properly follows the direction of the first section.

If the winding has been carefully done the surface of the winding should be perfectly even. On top of this winding wind a single layer (both sections) of No. 32 D.S.C., approximately 50 turns in all, which will serve for the short wave reaction.

When all the winding is complete, give each section a coat of shellac varnish and allow it to dry.

In the next issue we shall describe the mechanical construction of the filament resistance, the switches and condensers. The sketch, Fig 3, shows the general arrangement and front elevation of the complete unit.

BOOK REVIEW

LES APPLICATIONS DE LA PHYSIQUE PENDANT LA GUERRE.
By H. VIGNERON.
Paris: Masson et Cie, Editeurs.

This book describes a number of practical applications of physical research made use of in the French Army during the war. The subjects dealt with include gun sights, illumination by searchlight and by rockets, aerial bombardment, airship problems, submarines and torpedoes, photographing projectiles, gyroscopes and their applications, sound and sound ranging, X-ray apparatus, and a special section devoted to wireless telegraphy. The book is admirable as a general *résumé*, written in non-technical language, of some of the applications to war uses of recent scientific developments.

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QUESTIONS AND ANSWERS

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

R.K.B. (Rishton) *asks* (1) *If he can use a one-valve or a H.F. amplifier plus crystal detector in conjunction with an indoor or frame aerial.* (2) *For criticism of two circuits (a) and (b).* (3) *For details of the A.T.I. and reactance coils, if the above are suitable.*

(1) Difficult, but not impossible.

(2) Circuit (*a*) with grid condenser, is correct, except that the blocking condenser should preferably go across the H.T. battery also. Circuit (*b*) should have a tuned circuit in the plate circuit of the valve. See issue of April 17th for a typical circuit of this kind, also for constructional details.

(3) You do not state the wavelengths you wish to receive, so we cannot help you.

A.A. (Chelsea) *asks* (1) *For a diagram for a two-valve amplifier with crystal detector, inter-valve transformer, grid leak, loose coupler, two variable condensers, using one filament battery and H.T. battery; also a change-over switch to earth the outdoor aerial and bring in a frame aerial* (2) *With a pancake tuner with three coils is it possible to have a switch to cut out the loose coupler and put in the pancake coils.* (3) *Would he gain anything by using a double slide tuning coil as A.T.I.*

(1) Diagram as in Fig. 1.

(2) It is doubtless possible, but you give no particulars of your pancake tuner, so we cannot give a diagram. Your coils can be used to load either aerial or frame circuits.

(3) No special advantages in the two slide arrangement. It can be used as A.T.I. in accordance with the diagram in question (1).

A.H.L. (Manchester) *asks* (1) *For a good circuit for spark and C.W. using two valves R type.* (2) *If an enclosed diagram gives the best circuit with one valve and loose coupler for spark and C.W.*

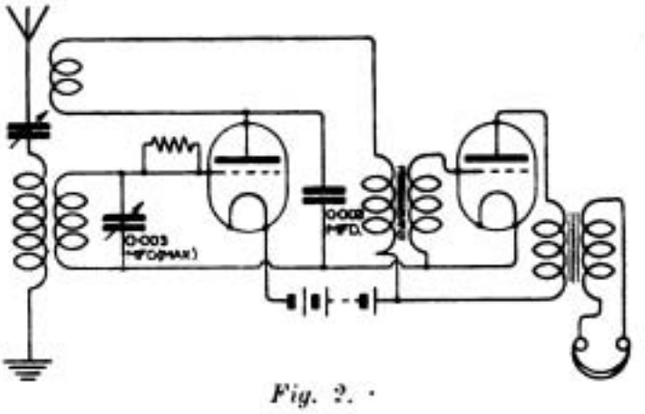

Fig. 2.

(1) Fig. 2 gives one of many possible arrangements. The filament battery and resistances not shown.

(2) Yes, if you limit yourself to the two coils of the loose coupler, but put a ·003 condenser across

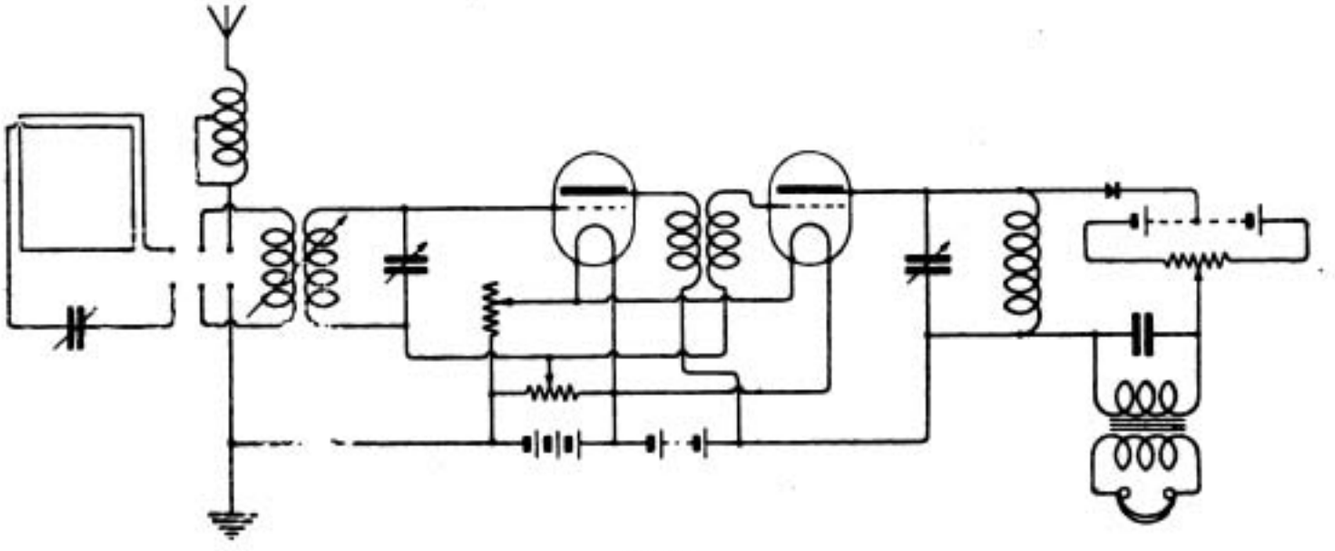

Fig. 1.

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the H.T. battery and telephones to the by-pass H.F. current.

A.R. (Failsworth) *sends a sketch of his set, and asks* (1) *For criticism of set.* (2) *The capacity of the variable condenser (maximum and minimum) particulars of which are given.* (3) *Why all his signals are received in* 10° *of the total* 180° *of variation in this condenser.* (4) *Approximate wavelength in metres to which certain specified inductances will tune.*

(1) Quite a satisfactory type. The reaction coil should, of course, be coupled to the jigger secondary.

(2) You do not state the size of the plate, nor thickness of the dielectric, so we cannot calculate. If they are Marconi standard disc condenser sizes a condenser with 110 layers of dielectric will have much too high a capacity for a tuned circuit.

(3) You do not say which 10°; if the first, the explanation is probably given in (2).

(4) Your windings are of much too fine wire, and are quite unsuitable. Rewind as follows: A.T.I. ($14'' \times 5\frac{1}{2}''$), No. 22 wire; jigger primary ($7'' \times 2\frac{1}{2}''$), No. 22 wire; jigger secondary ($7\frac{1}{2}'' \times 3\frac{1}{2}''$), No. 30 wire. With a tuned circuit condenser of about ·007 mfds. these coils will then tune the set to about 4,000 ms.

AMATEUR (Watford) *asks* (1) *If his set, as sketched, would work, and, if so, would it receive C.W. spark and telephony.* (2) *What would be the maximum voltage of the H.T.* (3) *If his tuner is not right, would we give correct dimensions.* (4) *Would set reach* 6,000 *ms., and, if not, what would be the maximum wavelength.*

(1) Altered as in our sketch, (Fig. 3) the receiver should be quite O.K. for C.W., spark and telephony.

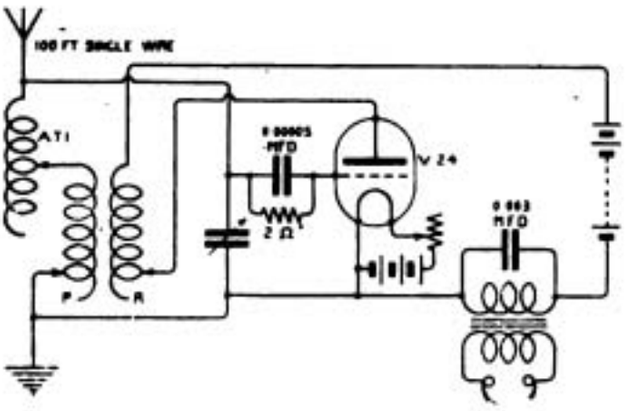

Fig. 3.

(2) Used in this way, about 30 volts.

(3) Coils are not very suitable. Rewind A.T.I. ($15'' \times 16''$) with No. 22, P. ($8'' \times 6''$) with No. 22, R. ($6'' \times 5''$) may remain No. 28.

(4) The set as altered should tune to nearly 6,000 ms. on a P.M.G. aerial.

H.W.F. (Acton) *has applied for a licence for a crystal set, and now wishes to use a valve. He asks* (1) *If he must inform the P.M.G. and if he must take out a new licence and pay a new fee.* (2) *For a good valve for a small plate and filament voltages.* (3) *The price of such a valve and where obtainable.* (4) *For a good, cheap battery for supplying the valve.*

(1) You must obtain sanction from the P.M.G. for the change in your set. A new fee will not be demanded.

(2) The Marconi V.24 should be very suitable, or see advertisements in the magazine.

(3) The V.24 can be obtained from the Marconi Company, who will quote the current price, about 25s.

(4) You will need a 6-volt accumulator, not less than 10 amp. hours continuous rating, for the filament, and a battery of small dry cells to give about 24 volts for the plate.

R.F.P. (Cambridge) *asks for details of number and size of sheets of tinfoil and paraffined paper required to construct condensers of approximate capacities* (a) ·00022 *mfd.*, (b) ·0022 *mfd.*, (c) ·0044 *mfd. The paper in question is the condenser paper as supplied by the Amateur Supply Association.*

We do not know the thickness of the paper referred to. If you measure this you can calculate suitable dimensions from the following formula:—

$$Cap.\quad Mfds. = \frac{1}{900{,}000} \times \frac{KAn}{4\pi d},$$

where K = about 2·2 for waxed paper;
n = number of sheets of dielectric;
A = active area of each sheet, in cms.;
d = thickness of dielectric, in cms.

J.C.H. (Manchester) *asks what would be the approximate inductance of a flat pancake coil wound with* 30 *layers, one turn per layer on a former* 2″ *diameter with* 24 *S.W.G. wire, and also if the inductance would be very efficient.*

About 95 mhys. Quite efficient.

1914 STAR (Bexley) *asks* (1) *If a reactance coil wound in pancakes, would be suitable for the inductance described in the issue of October* 16*th*, 1920, *page* 513. (2) *If fitted as sketch sent would set be suitable.* (3) *What gauge and number of turns for the reactance, if suitable, leaving the inductance the same as given in the instructional article.*

(1) and (2) This should be quite a useful arrangement.

(3) We cannot say very definitely without knowing something about the set you are proposing to use it on. For general purposes you might try rather fewer turns on the inductance using about No. 26 or 28 wire.

We regret that owing to the lack of space we are compelled to hold over a number of Questions and Answers.

SHARE MARKET REPORT.

Business in the Wireless Group continues to be very dull. Prices as we go to press, February 10th, are:—

Marconi Ordinary	£1 - 18 - 9
,, Preference	£1 - 18 - 9
,, Inter. Marine	£1 - 6 - 3
,, Canadian	6 - 6

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