The WIRELESS WORLD

VOL. VIII. No. 25, NEW SERIES]. MARCH 5th, 1921. [FORTNIGHTLY.

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

VOL. VIII. No. 25. MARCH 5TH, 1921 FORTNIGHTLY

THE MARK III TUNER

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

THIS well-known apparatus having a receiving wavelength range of 100-700 metres, has now come into extensive use by wireless experimenters owing to the disposal of surplus Government stocks accumulated during the war. Its essential features have already been dealt with in a past issue of this magazine*, but it may here be worth while to recapitulate the leading details. Briefly the instrument consists of two oscillating circuits containing inductance adjustable in steps and continuously variable condensers. One of these circuits can be joined in series with the aerial and earth connections, while the other is closed on itself and forms the tuned secondary circuit, which is coupled to the primary circuit by a variable coupling, and across which the detector is connected. A change-over switch is provided for connecting the detector alternatively across the aerial tuning coil ("stand by"), or across the secondary tuning condenser ("tune").

The limited wavelength range of the set, viz., 100-700 metres renders desirable its modification for the reception of longer wavelengths in order to fit it for more general experimental uses.

Such modification may be carried out in a number of different ways. These are not all equally efficient, while they also differ both in convenience and in cost of conversion, so that the choice of the one to be adopted will depend upon a number of factors, and is therefore best made by the experimenter himself. It will therefore be convenient here to outline more than one method.

Of the possibilities open to consideration, six only will be dealt with here :—

(1) The addition of an extra aerial-loading coil external to the instrument so as to increase the wavelength range on the "stand by" side, while retaining the maximum of 700 metres when on the "tune" connection.

(2) Rewinding the existing coils with finer wire.

(3) Same as (1), but with the addition of fixed condensers in the closed circuit so as to augment the wavelength range of that circuit as well, enabling both "stand-by" and "tune" positions to be used for wavelengths over 700 metres.

(4) The addition of a loading coil to the closed circuit, this loading coil being external to the instrument.

(5) A combination of (1) and (4).

(6) The fitting of loading coils as in (1) and (4) into the instrument, so as to form a compact unit having a greater wavelength range.

When the switch is in the "stand-by" position, the simplified connections of the instrument become as in Fig. 1, the detector

* See *The Wireless World*, 7, pp. 607-608, January 1920, and pp. 655-657, February, 1920.

D (either of the crystals) and the telephones T, with blocking condenser C, being connected across the aerial coil L.

(1) *Addition of a loading coil.*

To effectively insert extra loading inductance in the aerial circuit, it must be connected in such a position that the crystal and telephones (or valve, if one is used instead) remain across the whole of the inductance, and not merely across the part inside the box. If this is not done the received signals will be much weakened. The extra coil must not be inserted simply in the aerial or earth wire external to the apparatus, or this condition will not be complied with. The most direct way of attaining the desired result is to disconnect the wires from studs 18 and 19 of switch S_{11}, (Fig. 1)—the one marked A.T.C. on the instrument—and leaving wire 18 free, connect wire 19 to stud 18. Connect two new wires to studs 18 and 19 (both the new wire and the wire from the coil being on stud 18), and bring these out through small holes drilled through the top of the instrument. These wires may be connected to the external loading coil. If preferred, two new terminals may be inserted through the top of the instrument, and these two new connections made to the back-nuts of the terminals, so that the external connections to the loading coil may be more neatly arranged.

Perhaps the most convenient place for these extra terminals is on the left-hand side, alongside the coupling handle, Fig. 2. Two insulated wires should be brought across from them to the studs of the A.T.I. switch, taking care that they do not foul the potentiometer arm. The suggested positions

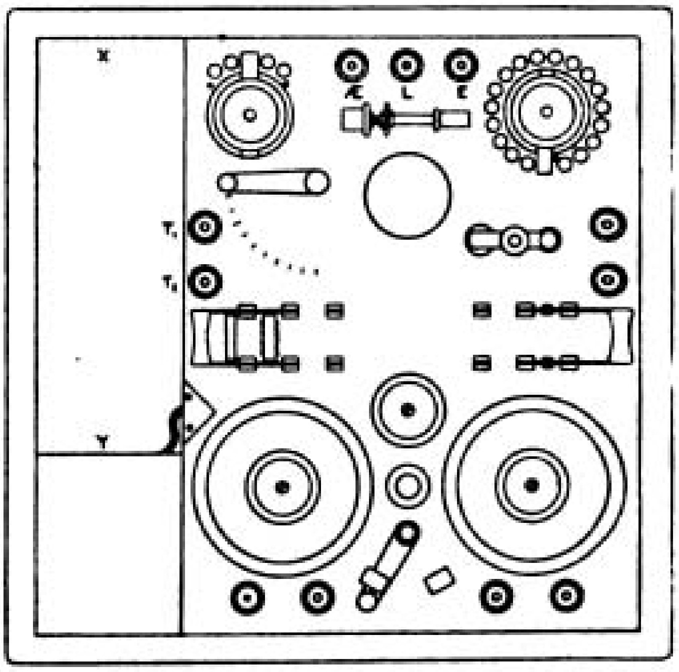


Fig. 2.

are marked T_1 and T_2 in Fig. 2, and the connections become as in Fig. 3.

Unfortunately it is not at all easy to get at the nuts on the back of contacts 18 and 19 of the A.T.I. switch, so that if preferred, the following alternative may be adopted :—Midway between the aerial (Æ) and the earth (E) terminals insert another one as at L in Fig. 2. On the back of the E terminal will be found two wires, one going to the left (when looking at the underside of the panel) to the arm of the A.T.I switch, and the other going downwards to the lower

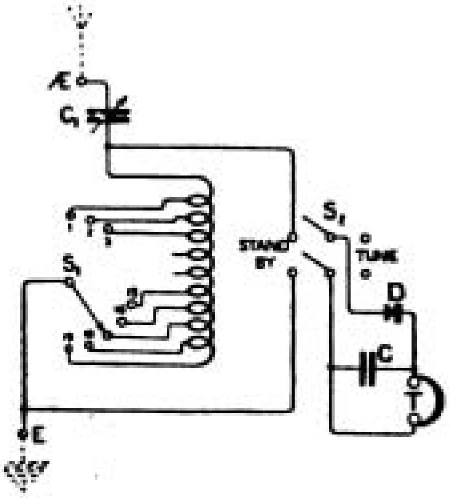


Fig. 1.

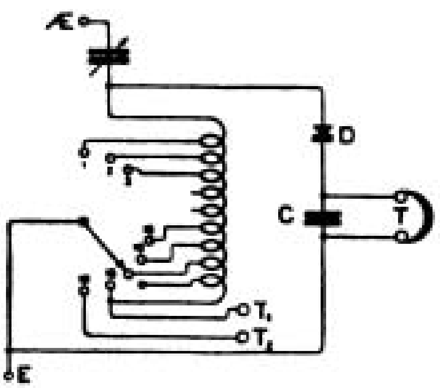


Fig. 3.

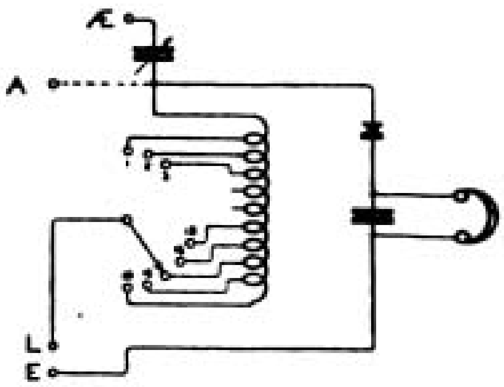


Fig. 4

stand-by contact of the "stand-by"—"tune" change-over switch. Release the former of these two wires from the E terminal and lengthen it so as to reach the new terminal L (Fig. 2), to which it should be connected. The second wire from the change-over switch should be left on the E terminal and screwed up tight. When wiring up the instrument connect the aerial and earth leads to the Æ and E terminals respectively, as usual, and connect the external loading coil between the new L terminal and E.

The connections now become as in Fig. 4. This second arrangement has some advantages over the first, as all the studs of the A.T.I. switch on the instrument may still be retained for fine tuning, whereas with the former, the external coil is only brought into circuit when the A.T.I. switch is on stud 19.

In either arrangement, the instrument may be used when desired without the external coil by connecting T_1 and T_2 together with a short piece of wire in the first case, or by similarly connecting L and E together in the second.

In either of these cases the external loading coil should be adjustable in value, either by a slider, or preferably by a multi-contact switch connected to tappings as in the case of the A.T.I. in the tuner itself. Any size of coil may be used for this loading inductance, although it will generally be convenient to limit it somewhat in size. The tapping points should be disposed so that the inductance between them increases in steps of about 250 microhenries, as then the contacts of the A.T.I in the tuner will form a fine adjustment and will overlap each step of the larger coil. As an example take a loading coil of 5,000 microhenries, which in conjunction with the coil in the tuner should load up an ordinary Standard P.O. aerial to about 2,500 metres. Twenty tappings will be required to comply with the above conditions as to overlapping, although in practice it would be found possible to dispense with probably half of these, and to rely on the aerial circuit condenser to cover the remaining range.

If the coil is wound with No. 26 D.C.C. wire, on a former 6" diameter, 225 turns will be required in all. Tappings should be made at the following turns :—30, 48, 60, 72, 84, 94, 104, 114, 124, 134, 144, and every ninth following turn to 217. This will give an approximately even inductance increment for each tapping.

The wavelength range covered by any given additional loading coil may be increased by arranging the connections so that the aerial tuning condenser which is normally arranged in series with the aerial, is changed over to be in parallel with the loading inductance for the longer wavelengths. To enable this to be done, still another additional terminal is required. This also may conveniently be placed between the Æ and E terminals on the tuner, as shown at A in Fig. 5. This diagram also

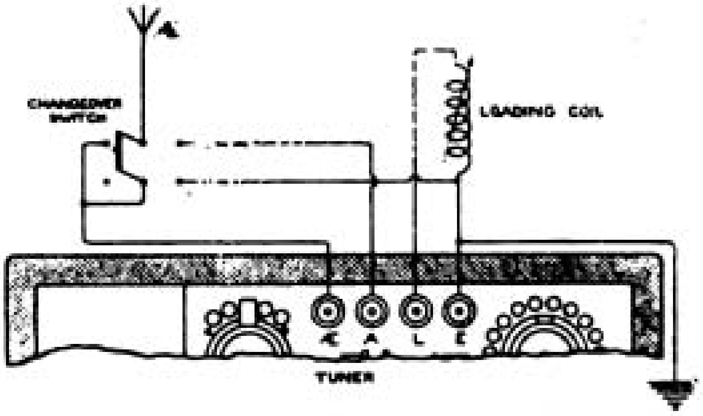


Fig. 5.

indicates how the external connections should be arranged to the loading coil and to a two-way double-pole switch. When this switch is to the left, the A.T.C in the tuner is in series with the aerial circuit as in the usual arrangement, but when the switch is thrown to the right, the condenser is put in parallel with both the external loading coil and the A.T.I. in the instrument.

The wavelength range (on the stand-by side only) will thus be increased up to about 6,000 metres when using the loading coil described above. With this arrangement the number of tappings may be reduced, as for example, by leaving out alternate tapping points, and using only a 10-way contact switch.

This extra terminal—marked A in Fig. 5—should be connected inside the Tuner to the terminal of the A.T.C that is connected to one end of the A.T.I. When looking at the underside of the panel, this is the right hand terminal of the left-hand (larger) condenser.

(2) *Rewinding of the existing coils.*

The diameters of the existing formers are 9 cms. and their lengths also 9 cms. If these are each rewound with a single layer of No. 30 D.C.C. copper wire, it will be found possible to put about 270 turns in each coil, which should enable the set to be tuned up to about 3,000 metres wavelength. If a double layer banked winding with the same wire is put on in place of the above single-layer one, the wavelength to which the set can be tuned will be nearly double the above figure, *i.e.*, approximately 6,000 metres.

When the coil formers are removed from the instrument it will be found that they have a deep screw thread cut in their surface in which the existing wire is wound. The presence of this screw thread will hinder the winding of the finer wire. It may either be turned off in a lathe, or it may be covered over by several layers of stout paper or similar insulating material secured in place by shellac, the grooves of the screw thread being also filled with shellac (or a hard wax) as far as practicable.

Tappings from the new windings may be brought out at the same places as in the existing coils—as shown by the holes drilled through the ebonite former—and should be connected to the studs of the contact switches in the same manner.

The extra terminal A (Fig. 5) may also be fitted with this modification to enable a better tuning range to be obtained in the aerial circuit, and to counterbalance variations in the size of the aerial with which the instrument is used. The external connections will be obvious from Fig. 5, omitting the terminal L and its connections to the loading coil, but retaining the change-over switch.

(3) *Addition of Fixed Condensers.*

Taking modification (1) above, in conjunction with the fitting of the extra terminals A and L, it has been shown that the aerial circuit wavelength range may become as much as 6,000 metres, approximately, but that with the arrangement there described the "tune" side would still not be available for wavelengths over 700 metres. This deficiency may be overcome by combining the use of the external loading coil, as already described, with a new winding on the secondary circuit (the pivoted coil) of the type described under (2). A range up to about 6,000 metres is thus obtainable on both "stand-by" and "tune." The maximum coupling obtainable between the two circuits is, however, much weaker, but will generally be found sufficient.

Alternatively, the same tuning range may be obtained by providing the secondary circuit with additional condensers, of fixed values, which may be connected in parallel with the existing variable tuning condenser. Since, however, the maximum inductance of the existing secondary coil is 280 microhenries, the capacity necessary to tune it to 6,000 metres will be 0·035 mfd., a capacity which is much too large for efficient working. Further, were such a capacity adopted, it would require to be subdivided into 70 parts if each section were to overlap the wavelength range obtainable with the existing variable condenser—*i.e.*, the capacity of each unit section of this added condenser must not exceed 0·0005 mfd.

As another alternative the existing secondary coil could be rewound with a single layer of No. 30 D.C.C. wire, as described under the first part of (2) above, when the necessary extra condenser value will be reduced to 0·00825. Even this value would require subdivision into 17 sections, with an appropriate switch for paralleling them when required. This modification, therefore, besides being inefficient, is cumbersome as well.

(*To be concluded.*)

TRANSATLANTIC AMATEUR WIRELESS

DISAPPOINTING RESULTS OF FIRST TESTS

As most of our readers are aware, in the early hours of the 2nd, 4th and 6th of February, twenty-five amateur wireless stations in the United States were scheduled to transmit signals with a power of 1 kW on a wavelength of 200 metres, for the purpose of establishing communication with enthusiasts on this side of the Atlantic. Over 250 wireless amateurs in the United Kingdom enrolled their names with Mr. Philip R. Coursey, B.Sc., the organiser of the tests in England, and by the closing date, for the reception of reports (February 14th), some 30 logs of signals received were forwarded to *The Wireless World.*

In order that the tests might be conducted as fairly as possible, the detailed programme of transmission was kept secret, known, as far as Great Britain is concerned, only to this magazine. The work of checking the logs against the transmission programme has just been completed, and in our next issue we hope to publish a detailed consideration of the results obtained. Meanwhile we may state that although every log has been carefully perused and checked, not one entrant has received a single word or signal which can *unquestionably* be attributed to an American amateur station.

In making this definite statement, however, it must be explained that a number of amateurs seemingly overheard the American signals but they were too faint to be read.

The two main difficulties with which the entrants had to contend, apart from the weakness of the signals, were—(1) harmonics from high power stations on long wavelengths, prominent amongst which were those which have been identified as from Nantes, and (2) jamming from other entrants, who in spite of urgent requests, and contrary to the conditions of their licenses, persisted in using self-heterodyne receivers, which radiated and completely spoilt the reception for any other amateurs in the vicinity. Practically all of the most promising logs contained emphatic protests on this point, to which we shall return at a later date.

Those amateurs who listened in on the evenings stated, will be interested to hear that the following programme was sent out. On the mornings of the 2nd and 6th—(in America, of course, these were the evenings of the 1st and 5th)—each station sent a special call, selected for the occasion, followed by its official station call. Each station was allowed 1½ minutes, and a half minute interval elapsed between two successive transmissions. Typical calls sent out on these nights were :—

3.30 a.m.	-	PXM	1 AW	(repeated)
3.52 „	-	NSV	2 DX	„
4.14 „	-	DFN	1 DA	„

These were, of course, sent out in Continental Morse, so that the American Morse, which several participants reported, must have arrived from other sources. On the morning of the 4th (evening of the 3rd in America) the stations took it in turn to transmit, each a portion of the following sentence :—

"For business as well as for social and political reasons it is extremely desirable that immigrants who are to make their permanent home here become Americans in mind and heart as soon as possible period The greatest evils of immigration are found in our large mining and industrial centres period Movements to secure a better distribution of the immigrants especially as farmers upon the land should be encouraged period The majority of these coming from Italy and Austria Hungary have been farmers period They should be encouraged to become farmers here period Again they need to know the English language to understand American political institutions to learn American customs of living and working that they may become an integral part of our nation period Efforts. . . . . ."

Each station concluded its portion by its official call signal. Thus at 4.00 a.m. station 2 BK, sent out the following—"Movements to secure a better 2 BK"—this portion of the phrase being repeated several times.

With this programme before them the judges have carefully searched all the logs and reports sent in, but, as stated before, they have failed to find any signals which correspond with those sent out. In one or two cases there was a similarity in the signals at certain times, but these were traced, in the main to harmonics from Nantes. Certainly there is little basis for the definite claims made by one or two provincial wireless societies, that they actually received the signals.

A remarkable feature of the competition is that comparatively few entrants have sent in their logs in anything resembling the form asked for, and this, of course, has hampered the judges in making their search. In view of the non-success in the reception of the signals no entrant has qualified for the prizes offered by firms for the most successful reception of signals, but the prize offered by Messrs. Burnham & Co., to be allotted in the event of non-reception of signals to the best description of the station and apparatus employed, will be awarded in due course, and an announcement in this regard will be made in our next issue.

DAILY MAIL EFFICIENCY EXHIBITION, OLYMPIA,

FEBRUARY 10th-26th, 1921.

STAND No. 62.

THE accompanying photograph gives a general impression of the stand arranged by the Marconi Companies at the Efficiency Exhibition, Olympia.

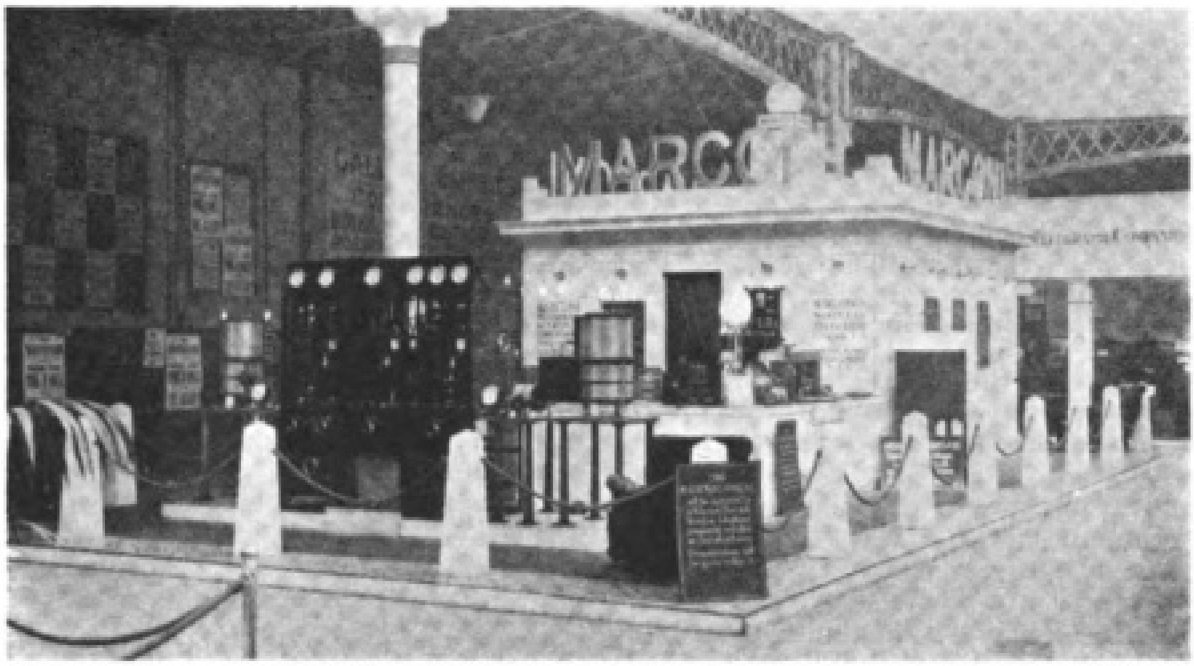
Two cabins were fitted with the latest types of marine sets, one comprising the 1½ k.w. quenched gap set and continuous wave panel together with receiving apparatus, including direction finder. This very complete installation is suitable for large passenger steamers, and represents the last word in marine radio outfits. The other cabin was fitted with a new type of ½ k.w. set suitable for cargo vessels, where it is desired to limit, as far as possible, the cost of the wireless installation.

A prominent feature of the stand was the 3 k.w. continuous wave transmitter, arranged for wireless telegraphy and telephony. This set was shown complete with aerial and closed circuit inductances, with coupling and reaction coil, and closed circuit condenser. The remote control unit, consisting of manipulating key, microphone and control switch box, was also shown.

Two complete portable wireless telegraph and telephone sets were on view on the counters, one being of the type YB1 (100 watts), the other type YA1 (20 watts). A portable engine-generator set for battery charging was exhibited complete with switchboard.

Considerable interest was aroused in connection with the radiomegaphone demonstrations given daily at the stand. This apparatus is a combination of the Marconi wireless telephone and the Creed stentorphone, by means of which signals, speech, songs and music transmitted by wireless can be heard by large audiences. For the purpose of these demonstrations a temporary wireless telegraph and telephone station was set up at Surbiton, Surrey, and an aerial and receiving apparatus on premises outside the Olympia building. The two radiomegaphones on the stand were connected with the receiving apparatus by means of ordinary cable.

The demonstrations consisted of programmes of speech and gramophone music received from Surbiton, and also time signals from the Eiffel Tower and Nauen. In addition, demonstrations were given of high speed printing telegraphy, the signals being transmitted from Surbiton and received and amplified at the receiving station, the current then being passed to the high speed printing apparatus on Messrs. Creed and Company's stand.



The Marconi Stand at Olympia.

The Marconi International Code Co., Ltd., showed a selection of their productions on the stand and the Marconi Scientific Instrument Co., Ltd., were also represented.

NOTES AND NEWS

AMATEUR CALL SIGNS.

2FA, 10 watts, 180 metres, spark and C.W. Hours of working, 1900 to 2100; Sundays, 1200 to 1300 and 1900 to 2000. Mr. F. G. Bennett, 16, Tivoli Road, Crouch End, N.8.

2GL, 10 watts, 180 metres, C.W. and telephony. Hours of working, 2100 to 2300. Mr. W. J. Henderson, 2, Hollywood Road, South Kensington, S.W.10.

2KF, 10 watts, 180 metres, C.W. and telephony. Hours of working, 2100 to 2300. Mr. J. A. Partridge, 70, Sydney Street, Chelsea, S.W.3.

2FQ is the call sign of Mr. W. W. Burnham's station, at 18, Blackheath Rise, S.E. At present he is experimenting with a new form of telephone transmitter, and is transmitting from 9.40 to 10 p.m. each Friday night.

DUTCH CONCERTS.

The Dutch concerts, transmitted by wireless telephone, under the call PCCG, are now being sent out on a wavelength increased from 1,030 metres to 1,150 metres, and the power has been increased, also, from 75 watts to 250 watts. In addition to the Thursday concerts, other concerts are announced for Sunday afternoons from 2.10 to 5.10 p.m. (G.M.T.). Messrs. Burnham and Co., of St. Paul's Wharf, Deptford, S.E.8, will be very glad to hear from readers of *The Wireless World* regarding the success they have in the reception of these concerts, as this firm is now appointed sole agents in the United Kingdom for the sale of apparatus manufactured by the Nederlandsche Radio-Industrie, who are conducting the concerts.

THE WIRELESS STATIONS OF THE BRITISH COMMERCIAL AIRWAYS

By Lieut. DUNCAN SINCLAIR, R.A.F.

(*Continued from p. 810 of the previous issue.*)

DISCUSSION.

The President: Ladies and gentlemen, the paper is now open for discussion. I know that we have got a great deal of detail thrown at our heads in quite an interesting manner, but still I am perfectly certain many of you would like to ask some questions of the speaker, which he would probably answer, and which would be of interest to the rest of the members of the Society as well as the questioner.

There was no response to this invitation.

The President: There are quite a lot of questions I could put myself, but I want to leave that to you.

Admiral Sir Henry B. Jackson: I will not put any questions, but I would like to thank the lecturer for the very interesting description of this wireless work with the commercial craft. A good many of us hear a great deal of it going on without knowing what it means. After to-night we have no excuse for not knowing what it means, for the lecturer has put a very clear exposition of the subject before us. The ability to get in touch at long distances and controlling the flight of aircraft in all weathers is of very great importance. I should like to ask him how the directional work is going on, whether there are any errors in the flight of the aeroplane—whether the errors increase with the height of flight? I do not want to criticise in any way. We ought to be very grateful, indeed, for an interesting lecture of what we hear so much of in our telephones.

The President: If no one has any further questions to ask, or remarks to make, I shall make one or two myself. First of all, I gather indirectly that some members would like to know where they can find the codes of the meteorological messages. I think they were published in the *Times*, but I really forget. Perhaps the reader of the Paper will tell us. Some want to know when they are likely to hear the telephone going. Of course, that happens when the machine is flying. There are some regular times and a good many irregular ones; perhaps the lecturer can tell us something also about that. If there are no further members wish to say anything, I will ask Mr. Sinclair to kindly reply to the points raised already.

Lieut. Duncan Sinclair: With regard to Admiral Sir Henry Jackson's query relating to directional work, I think that we have very rarely had any error bigger than three degrees. That is the biggest one I ever remember, and that has only been once—at Croydon. As a general rule, taking two bearings, I think we can say that we are accurate to almost a negligible amount. D.F. work, generally, as carried out by Croydon, is, I think, extraordinarily accurate. I do not know whether my views are borne out by the particular expert in charge of the D.F. at Croydon; I know he is here, and possibly he may like to inform us. With regard to the effects of height, I do not think you can consider those important; I do not suppose one will ever get to a height where a variation will be appreciable. Then we come to Major Erskine-Murray's points asking where the codes of the meteorological messages can be found. There is a very excellent system of publications known as "Notices to Airmen." I do not know that those are broadly published, but I believe they can be obtained I should imagine from the Stationery Office.

The President: That is in Kingsway, gentlemen—for those who do not happen to know.

Lieut. Duncan Sinclair: At any rate, I have distinct recollections of seeing a complete meteor code of some sort or another published in *The Wireless World*. It may possibly have been 1919; but in any case the same pamphlets, "Notices to Airmen," which are published as necessity arises, will give you every piece of information you require relating to all civil aircraft work. If you can obtain copies of these—I should think it quite possible—they will give you far more information than I can give. Then arises the question as to when can telephony be heard. Well, that is a very difficult thing to say, but I should think any time of the day, broadly speaking; particularly in the spring, summer, or autumn of the year. But, of course, a lot of chat, and not useless chat but necessary conversation, goes on between these civil stations. I should think everyone will hear Croydon and Lympne, I do not know whether you will hear Castle Bromwich well, and the rest, I think, you can neglect as far as London is concerned. But Manchester, in the North of England, is exceptionally clear with good speech. It is just a question, to my mind, of luck whether you hear signals or not on telephony, but what you do hear I think you will be at least satisfied with. I think that concludes my remarks. —(*Applause.*)

The President: Ladies and gentlemen, I think it only remains to give Lieut. Duncan Sinclair a hearty vote of thanks. You have already practically done so, but still it is right you should do so in a more formal manner.—(*Renewed applause.*)

AN EFFICIENT HOME-MADE RECEIVER

By Arthur Hobday.

PERSONALLY, I find the accounts of the work of other amateurs in *The Wireless World* one of its most interesting features, and hope that we shall be favoured with the methods employed and results achieved by many other readers.

In my own case I chose for aerial 100′ single wire, as, unless the alternative two wires are very widely separated, better results are obtained with the single wire. One hundred feet is not a great length of aerial for long-wave reception, but I manage to get a good deal from it using, at present, crystal detectors only.

Clifden is generally just nicely readable, whilst Nauen is rather on the loud side and Moscow is just readable. Upon one occasion only I was able to hear two transatlantic stations, but they were so faint that I could hardly be said to get them—Malta, Gibraltar, Las Palmas, and, of course, a great many others give good signals. Short waves are incessant, the Mediterranean 600 metre stations often being very loud considering their distance. The aerial lead-in consists of a two-foot length of glass tube. Placed near it is a lightning arrester composed of two bevelled edge brass plates, fixed $\frac{1}{32}$″ apart, upon an ebonite base. This arrester has a separate earth. Then follows a double pole change-over switch, the contacts on one side of which are shorted, giving a direct earth to aerial and disconnection of both aerial and earth lead from instruments, as will be seen from the diagram.

I use a pair of 4,000 ohms. Brown's reed receivers—the only piece of apparatus purchased—the remainder being constructed from materials in everyday use. After considerable experiment I can find only two detectors of real practical use—carborundum and zincite-bornite. Some time ago I set up four carborundum detectors of slightly different construction for experimental comparison, but not one has yet needed adjustment. The zincite detector is somewhat more sensitive, but not nearly so stable. It is only used when a station is very weak. I use a very small applied E.M.F. with it.

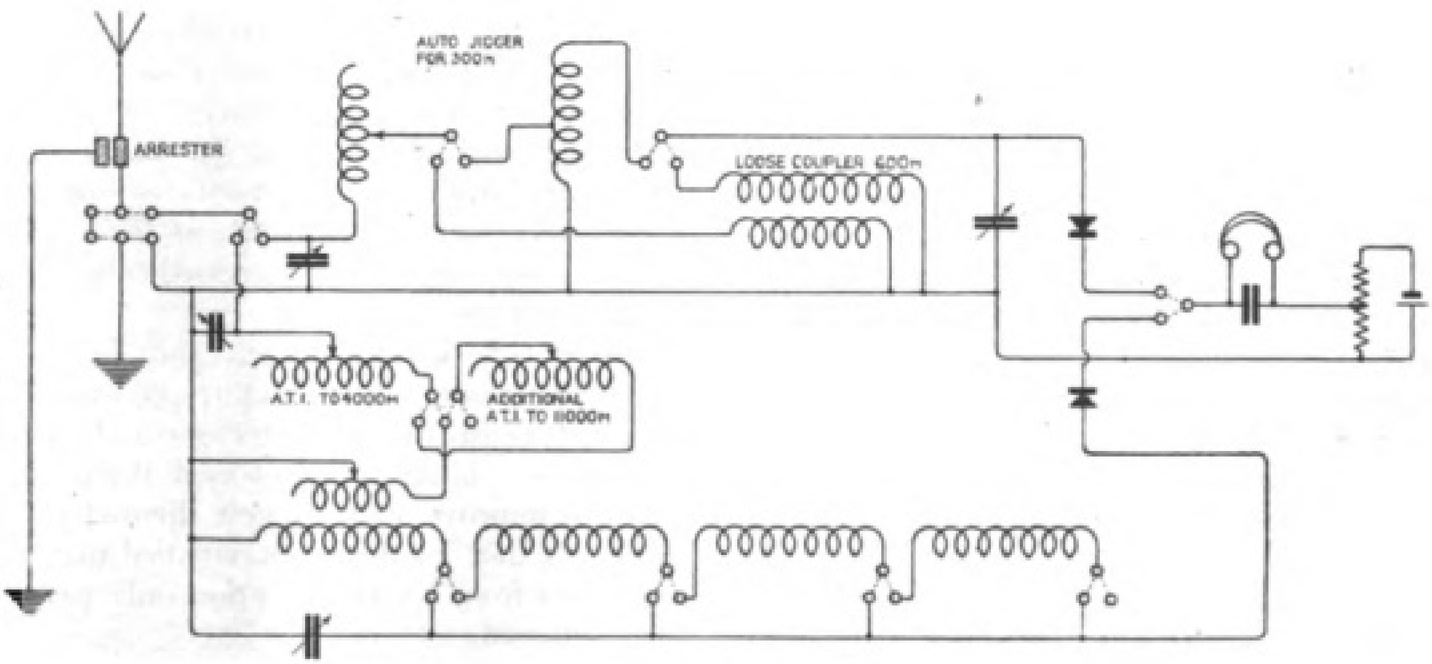


Fig. 1.

There seems to be no necessity for elaborate screw adjustments upon detectors, and I have scrapped all mine. A light coiled spring will give an easy and firm contact (all that is required), and is easier and quicker in adjustment. (See Fig, 2). I find that a phosphor bronze or hard brass point will give excellent results with carborundum.

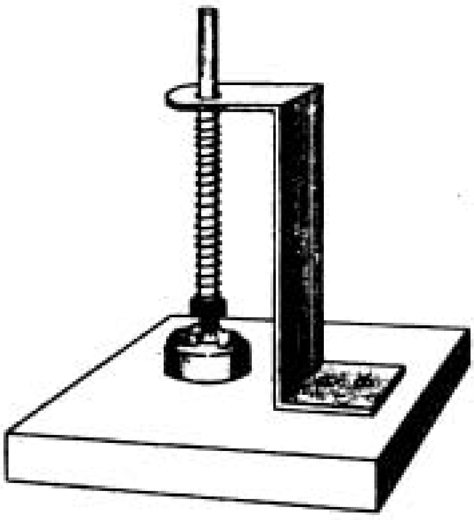


Fig. 2.

The potentiometer has about 200 ohms. total resistance, and is non-inductively wound as described in an old number of *The Wireless World.* Fifty studs are evenly spaced along this resistance, and this seems to be the minimum number it is advisable to use if the best adjustment is to be obtained with the full voltage of the cells. Generally, only one cell is used.

My variable condensers are of the tubular pattern, the tubes being 6" incandescent gas lamp chimneys. The outer coating is either thin sheet zinc or lead foil, and covers about one-half the chimney. The inner coating is a thin zinc cylinder, or a wooden cylinder covered with lead foil, and is the movable part. I find these condensers ample in capacity, and very easy to construct. They are very efficient in all respects.

Fig. 1 shows the general lay-out of the circuits. It will be noticed that the bottom ends of all secondaries as well as primaries are permanently earthed. There is no loss of efficiency by doing this, provided that certain precautions are observed, and it greatly facilitates the wiring and switching. The battery and potentiometer must be connected directly into the earthed part of the circuit, otherwise their capacity to earth would be harmful. Where a number of inductances must be grouped together a little ingenuity is required to so arrange them that they shall not interact unless they are required to do so.

I have a small auto-jigger for reception of 300 metre waves, which answers its purpose efficiently. For 600 metres there is a loose coupled jigger, the secondary of which is wound with 26 silk covered wire, until it tunes just under 600 metres, and a tiny tubular condenser gives a little added capacity as required. For long waves I made a large jigger which tunes from 1,000 to 12 000 metres. The primary and A.T. inductances are 22 enamelled wire. The secondaries are of 32 double cotton covered.

The formers are made of stout paper soaked in hot wax, and after being wound are again treated with wax. Both the A.T. inductances and secondaries can be switched in in sections, thus largely avoiding the bad effects of dead ends. All terminals and switches, which are not at the earthed part of circuit, are mounted upon ebonite, for which there does not seem to be any really good substitute.*

High insulation and close tuning appear to be the most important factors governing the performance of a wireless receiving station. It will be seen that I use variable condensers as a fine adjustment, in parallel with A.T.I.s, and provided that these condensers are of small capacity—large ones are quite unnecessary if the steps of inductance are not too large—an increased efficiency results from their use.

There is a battery switch and reversing switch in potentiometer circuit, also switches to select from various detectors and block condensers. I have not yet used thermionic valves as improvements suggest themselves so frequently that I am not yet satisfied that the best result from crystal reception only has yet been obtained.

* This is open to question.—Ed.

RESISTANCE COUPLED THERMIONIC AMPLIFIERS*

By William H. F. Griffiths.

THE theory and connection schemes of resistance coupled amplifiers have been very ably given in *The Wireless World* and elsewhere, by J. Scott-Taggart and others, and it is the object of this paper to enlarge upon, or perhaps I should say, more appropriately, amplify, several points which occur in the design of these aperiodic amplifying arrangements.

An ordinary resistance amplifier of 3 valves is shown in Fig. 1, in which the first two valves should function purely as amplifiers.

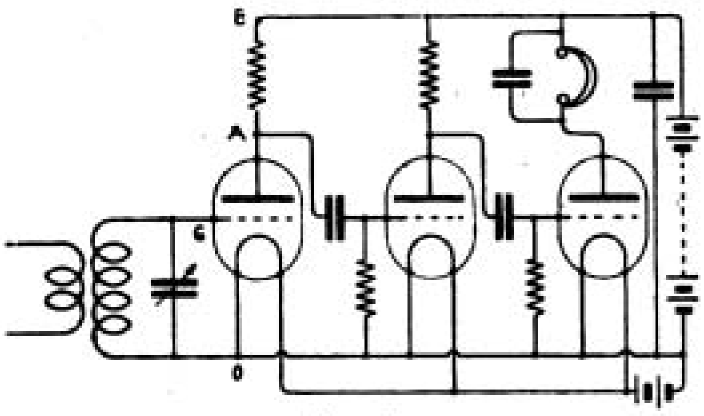


Fig. 1.

The object of these amplifying valves is to step up, in stages, the voltage of the oscillations which is initially taken from across the variable condenser and applied between the grid and filament of the first valve. Then, when the voltage of the signal oscillations has been sufficiently magnified by a series of amplifying valves, it is applied to the grid of the last or rectifying valve in order to control the telephone operating current in the anode circuit of the latter.

Fig. 2 is the anode circuit of the first amplifying valve redrawn to omit everything superfluous to the consideration of this circuit. The values of the resistance A B and the high tension battery voltage have to be arranged to obtain the highest oscillatory potential between the points A and O for a given oscillatory potential input between the points G and O. This amplified potential will be then ready for application between the grid and filament of the next amplifying valve, through the inter-valve condenser, the object of which will be referred to later.

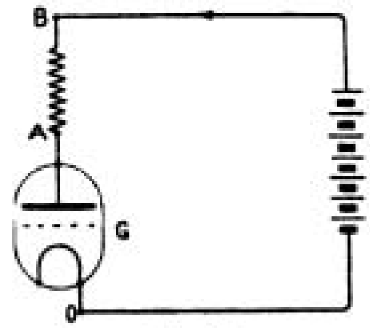


Fig. 2.

It should be clearly understood that there are two distinct components of current flowing round the anode circuit shown in Fig. 2. The first is the normal D.C. component, due to the H.T. battery and limited only by the resistance A B plus the resistance of the electronic stream flowing from the filament to the anode of the valve. This steady current is of the order of a milli-ampere, and flows in a positive sense in the direction of the arrow. It commences to flow in the anode circuit of any valve as soon as the filament is rendered incandescent, and, of course, cannot be detected except for the click in the telephones upon switching on, due to the sudden deflection of the diaphragm which then remains deflected.

The other component is the alternating current of radio frequency, which is superimposed upon the D.C. component whenever signal oscillations are applied to the grid. These two components of anode current are shown in Fig. 3, the A.C. component appearing as a ripple on the D.C. component.

In order to study more closely what is

* A Paper read before the North Middlesex Wireless Club on 12th January, 1921.

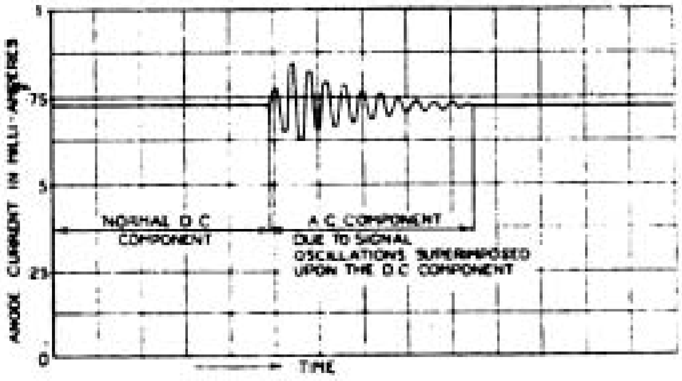


Fig. 3.

happening in this circuit, it will be better to work with actual numerical values obtained from the characteristic curves to which the average French hard type of four-pin valve, available to amateurs, conforms. These curves are given in Fig. 4.

The first value to determine is the potential at which the anode is to be normally maintained. This potential should be the lowest that will bring the straight steep part of the characteristic across the zero grid potential ordinate; this being necessary because, for a given change of grid potential, the corresponding change of anode current produced is greatest where the slope of the curve is most steep. The 25-volt curve just satisfies this condition.

The grid potentials, from which the characteristic curves have been plotted, are

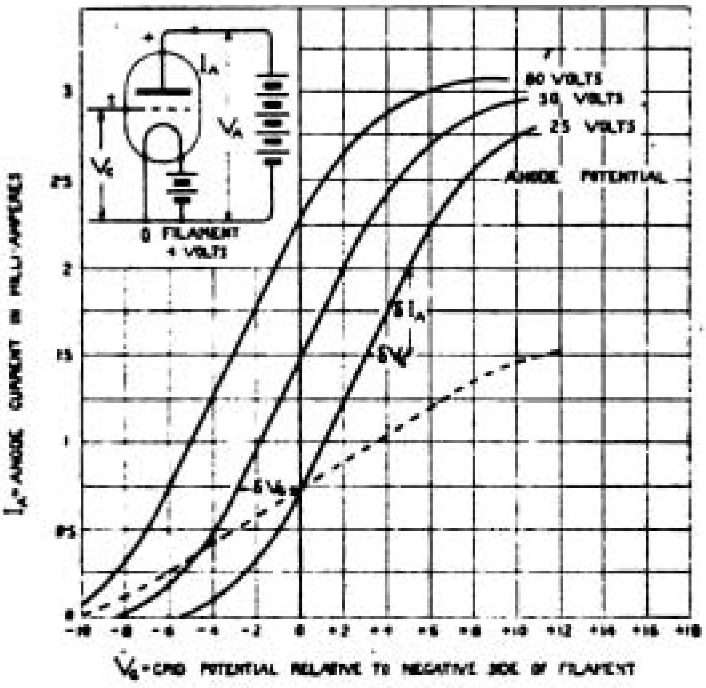


Fig. 4.

relative to the negative side of the filament battery. The normal potential of the grid is therefore zero since it is connected, through the inductance of the oscillatory circuit in the case of the first valve or through the grid leaks in the case of the subsequent valves, to the negative side of the filament battery. It will be observed that with the grid at this zero potential, the normal steady current flowing constantly in the anode circuit is 0·7 milliampere; this is the D.C. component.

Now, in order to ensure that the valve is functioning on this selected characteristic, the point A must be constantly maintained at a normal potential of $+25$ volts relative to the filament, and to do this, as the value of the resistance A B (Fig. 2) is increased, the voltage of the H.T. battery must be also increased in order to supply the voltage drop across it. For instance, if A B is 20,000 ohms, the voltage drop across it, due to 0·7 milliampere flowing through it, will be $I \times R$ equals $0{\cdot}7 \times 10^{-3} \times 20{,}000$ equals 14 volts, which voltage must be added to the 25 volts required to force the 0·7 milliampere D.C. component through the filament-anode path of the valve itself, making the total voltage of the H.T. battery 39.

Similarly, a resistance A B of 60,000 ohms would have a voltage drop across it of 42 volts, making necessary a H.T. battery voltage of $42+25=67$ volts, if the point A is to be maintained at plus 25 volts, and 0·7 milliampere is to flow normally in the anode circuit. The lowest voltages of H.T batteries which should be used in order to obtain the best results with any given value of resistance are given in Fig. 5.

If the value of the resistance is increased without a corresponding increase being made in the H.T. battery voltage, the valve will not be functioning on the straight steep portion of its 25-volt characteristic, but will be operating on the lower bend of a characteristic corresponding to a lower anode potential. This would result in a smaller change of anode current for a given change of grid potential.

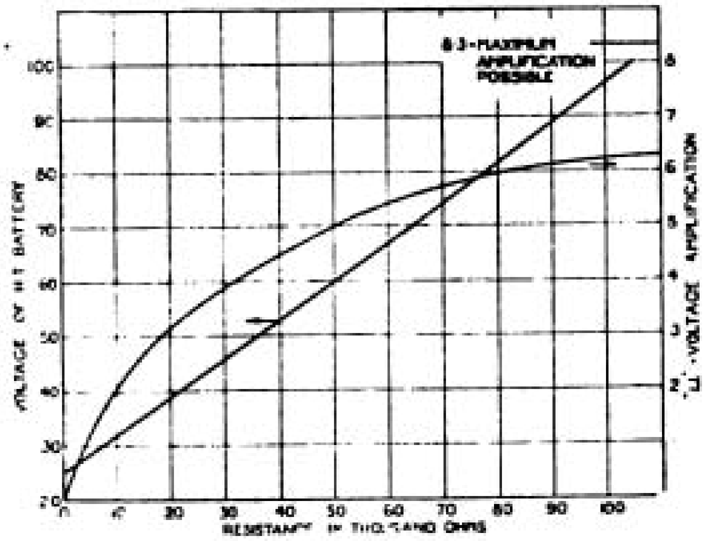


Fig. 5.

It should be stated here that it is not strictly true that the valve will be functioning on its 25-volt characteristic because, as will be seen later, the added series resistance will reduce the slope of the curve ; but if the value of H.T. voltage is computed in the above manner, it will ensure that the characteristic will cut the zero grid potential ordinate at a fairly high point (0·7 milliampere) on the latter, so that its bend is well to the left.

Up to this point only the D.C. components of anode current and voltage have been considered, but once it has been settled, by the suitable selection of H.T. battery for a given resistance, that the potential of the point A is normally maintained at +25 volts, and that 0·7 milliampere normally flows, these D.C. components may be ignored and the radio-frequency A.C. components of current and potential, which are superimposed upon them, only considered. These A.C. components will follow Ohm's law, quite independently of the D.C. components, since the anode circuit, for general consideration, contains no inductance or capacity.

A more careful study of the characteristics will show that on the straight parts of the curves, a given increase in the grid voltage (indicated by δV_g) causes an increase of anode voltage (indicated by δV_a) 8·3 times greater, this is termed the maximum voltage amplification factor of the valve, and is found by dividing the difference in anode voltage between adjacent characteristics by the difference between the grid voltages which give the same value of anode current on each characteristic. Considering A.C. components, therefore, an E.M.F. of 8·3 volts is "generated" in the anode circuit if one volt is applied to the grid, or $V_a/V_g = 8{\cdot}3$.

Further study will show that an increase in grid potential of one volt will cause an increase of anode current of 0·25 milliampere, or $\frac{\delta I_a}{\delta V_g} = 0{\cdot}00025$.

Therefore, considering only A.C. components, it may be stated that an alternating voltage of 1 volt applied to the grid will cause an alternating current of 0·25 milliampere, or 0·00025 ampere to flow in the anode circuit by the generation of an alternating E.M.F. of 8·3 volts ; this means that the resistance of the filament-anode electronic path through the valve is

$$\frac{8{\cdot}3}{0{\cdot}00025} = 33{,}000 \text{ ohms.}$$

Now, if there is no resistance A B in series with the valve, *i.e.*, if the anode and filament were short-circuited through the H.T. battery, the alternating E.M.F. of 8·3 volts would not appear across the shorted points O A, it being all absorbed in forcing the alternating current of 0·25 milliampere through the resistance of the valve. But if a resistance A B of, say, 60,000 ohms be inserted, the total resistance of the anode circuit becomes $33{,}000+60{,}000 = 93{,}000$ ohms, and the alternating current becomes reduced (by Ohm's law) to $\frac{8{\cdot}3}{93{,}000} = 0{\cdot}00009$ ampere, or 0·09 milliampere. The valve is now functioning on the dotted characteristic of Fig. 4, the slope of which has been lessened by the added resistance.

The A.C. voltage drop across the points A B is $I_a \times R = 0{\cdot}00009 \times 60{,}000 = 5{\cdot}4$ volts. The potential variations of the point A, therefore, are from $25+5{\cdot}4$ to $25-5{\cdot}4$, and as the point O remains constantly at zero potential, the A.C. voltage across O A, due to an alternating voltage of 1 volt applied to the grid, is 5·4 volts, a voltage amplification of 5·4.

Similarly, it can be shown that if the resistance A B is reduced to 20,000 ohms the alternating current in the anode circuit, due to 1 volt A.C. applied to the grid, is 0·000156 ampere, and the A.C. voltage drop across A B is 3·1 volts, a voltage amplification of only 3·1.

Again, with a resistance of 100,000 ohms a voltage amplification of 6·25 could be obtained, and with 300,000 ohms a voltage step up of 7·5 would be possible, always provided that the H.T. battery is of sufficient voltage to maintain the point A at +25 volts normal potential. The battery voltage would become too high for values of resistance above 100,000.

In Fig. 5 I have also plotted the voltage amplification or step-up μ, obtained with various practicable values of resistance R, if the correct values of H.T. battery voltage given by the other curve are used.

It is interesting to note that if the value of the resistance A B were increased to infinity and the H.T. battery was of infinitely high voltage to maintain A at the correct potential, then the full maximum alternating E.M.F. of 8·3 volts would appear across the points O A, because none of it would be required to force an alternating current through what would really amount to an "open" circuit, through which no anode current would flow.

If the resistance A B is zero, only 25 volts H.T. is required, but there will be only a negligibly small difference of potential between the points A and O because the resistance between them is negligibly small (only the resistance of the dry battery), compared with the internal valve resistance.

Now that it has been shown that the degree of amplification depends, to a large extent, upon the value of the external resistance A B, it will be easy to see why resistance amplifiers become inefficient when used on short wavelengths.

As is well known, the amplification of signals gradually diminishes for wavelengths below 1,000 metres or so, somewhat as shown by Fig. 6.

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

This capacity has the effect of shunting the resistance of the filament-anode path

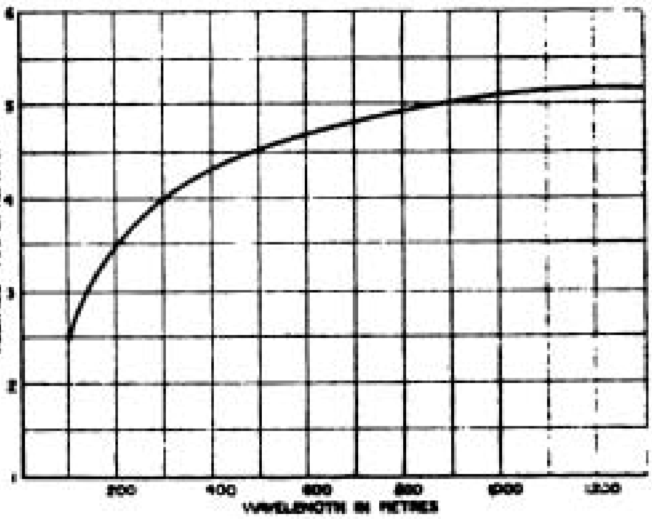


Fig. 6.

with a condenser, and, since B and O (Fig. 2) may be regarded as the same point for the consideration of A.C. components, this amounts to the same thing as connecting a condenser across the resistance A B, and thus providing an alternative path across it for alternating currents of very high frequency.

If the reactance of this capacity is sufficiently low to be of the same order as the resistance with which it is paralleled, it will appreciably lower the resultant impedance between the points A and B to alternating current, and, consequently, the A.C. voltage drop across these points will be correspondingly reduced; the voltage amplification will be therefore also reduced.

Assuming the parallel capacity to be 4 micro-microfarads, or 4×10^{-12} farad, its reactance, $1/C\omega$, to alternating currents of 300,000 frequency, corresponding to a 1,000 metre wavelength, is approximately 130,000 ohms, too high a value to very appreciably reduce the impedance across A B. It would, taking actual figures, only reduce the impedance of a 60,000 ohm resistance to 54,600 ohms.

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

The loss of amplification due to any reduction of external impedance can be read off from Fig. 5, and for a resistance of 60,000 ohms I have worked out the resultant impedance to currents of frequencies corresponding to various wavelengths, and have plotted the attendant loss of amplification in Fig. 6, the maximum amplification, if the capacity reactance was infinity, would be 5·4 and on wavelengths longer than those shown, this figure is practically attained.

If the conditions are such that the voltage amplification per valve is 6, then if two valves are used the resultant amplification will be 6^2, and for six valves would be 6^6 or about 46,600.

If, due to the unsuitable selection of H.T. voltage and external resistance, or to the reduction in the effective value of this resistance on short wavelengths, the voltage amplification per valve is only *four*, the loss of efficiency will not be great in the case of a single step-up, but if six valves are used, the loss will be enormous. Taking actual figures, the total amplification will be $\frac{6^6}{4^6} = \frac{46,600}{4,000} = 11{\cdot}4$ times less than that obtained if the voltage amplification factor per valve was *six*.

These figures do not, of course, take any account of reaction, the use of which still further increases the amplification, and is very useful for amplifiers using only a limited number of valves, but becomes difficult to control if many are used. Reaction will be referred to again later.

It should be remembered in this connection that, since the object of an amplifier is to step-up the A.C. voltage of the signal oscillations, the highest possible voltage must be initially applied to the first grid. To ensure this, the reactance of the capacity of the oscillatory circuit must be high in order to obtain a large voltage across it ($E = I/C\omega$) and to fulfil this condition the capacity of the variable condenser must be as low as is practicable in tuning, that is to say the ratio L/C must be large.

Once the magnified potential variations have been obtained at the lower end of the resistance A B, the problem becomes one of applying them to the grid of the next valve of the amplifier for further amplification.

But, if a direct metallic connection is made from the anode of one valve to the grid of the next, the latter will have a normal potential of +25 volts relative to its filament. This is more than sufficient to render the valve inoperative, since it will be functioning on the flat (saturated) portion of its characteristic, which means that the anode current would not be influenced at all by any potential change of the grid. But if a small fixed value condenser be inserted between the anode and the next grid it will effectively insulate the latter from the D.C. potential of the former whilst readily passing the superimposed high frequency oscillations.

The value of this inter-valve condenser for high frequency amplifiers should be about 0·0003 mfd. and its reactance, at, say, a wavelength of 3,000 metres (oscillation frequency 100,000) would be about 5,500 ohms. As this reactance is small relative to the resistance of the filament-grid electronic path through the valve, which will not be less than half a megohm, and to the resistance of the grid leak which shunts this path or even relative to the reactance of the inter-valve capacity with which this high resistance is shunted at high frequencies, the potential loss across it is negligible.

The reactance of a capacity of this value, however, is extremely high to current variations of an audible frequency (at 500 cycles its reactance would be about a megohm), and the volts drop across it would be very much too great if used on a low frequency resistance amplifier. The value of inter-valve capacity suitable for a low frequency resistance amplifier is about 0·05 mfd. (reactance 6,200 ohms. at a note frequency of 500 cycles).

For *very* low frequency resistance amplifiers used for amplifying signal currents of dot and dash duration, for syphon recorder or relay working, the inter-valve condenser should be of larger capacity still, in order to give the circuit a time constant of the order of the rate of sending of the signals being received. It should be about 1 mfd. for relatively slow hand-sent signals, whilst for automatically sent signals of 50 words a minute 0·1 mfd. would be sufficient.

It is of interest to note that this inter-valve condenser is not at all necessary if separate H.T. batteries and filament lighting batteries are used for each valve. A scheme of connections showing how to dispense with it is given in Fig. 7 although it is not of very great practical value. In this circuit, part of the H.T. battery, B X, supplies the D.C. volts drop across the resistance A B, and the other part, O Y, supplies the voltage across the valve O A. The two halves of the H.T. battery can therefore be adjusted to make A and Y equi-potential points and thus maintain the grid of the second valve normally at zero potential relative to its own filament.

As is well known, the function of the grid leak, a high resistance of the order of megohms, is to maintain the grid normally at a certain predetermined potential. During the period of impression of a wave-train or heterodyne " beat " of oscillations, a negative charge accumulates on the grid and on that side of the inter-valve condenser connected to it. The grid leak allows this charge to leak away, more or less rapidly, to a point of the same potential as that at which the grid is to be maintained in order to ensure the functioning of the valve at a suitable and unvarying point on the characteristic.

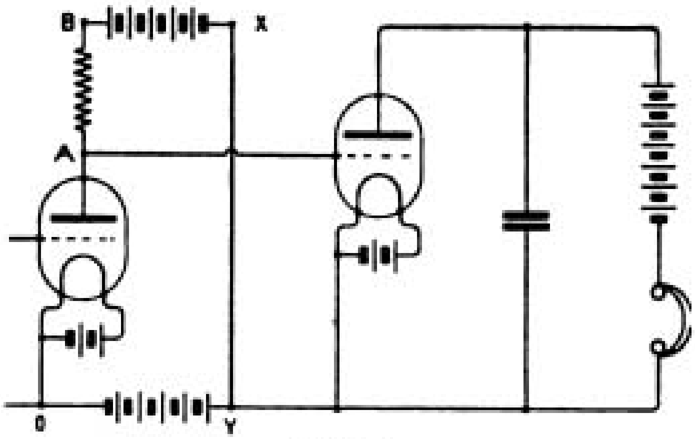


Fig. 7

As the stream of electrons, or negative ions, flows from filament to grid, the path between these electrodes may be considered as being conducting only to negative electricity in this direction. A positive current, or flow of electricity from positive to negative or from positive to less positive, can only take place from grid to filament, or a negative flow of electricity (as conceived by modern electron theory), can only take place from filament to grid. This being so, when the potential of the grid is made higher than that of the filament, by the positive halves of the impressed oscillations, a positive current can flow from grid to filament, and thus the potential between them is destroyed. When the grid potential is made lower than that of the filament, no positive current can flow from filament to grid, and so the grid and that side of the inter-valve condenser connected to it remain charged negatively unless a leakage path is provided.

If the leak were not used, the potential of the grid would therefore, at the termination of a wave-train, be slightly less than it was at the commencement, and there would probably not be a long enough interval between successive wave-trains for the grid to reach its normal potential before the commencement of the next group of oscillations. Thus after several groups had been impressed upon the grid, its potential would be considerably negative relative to the filament.

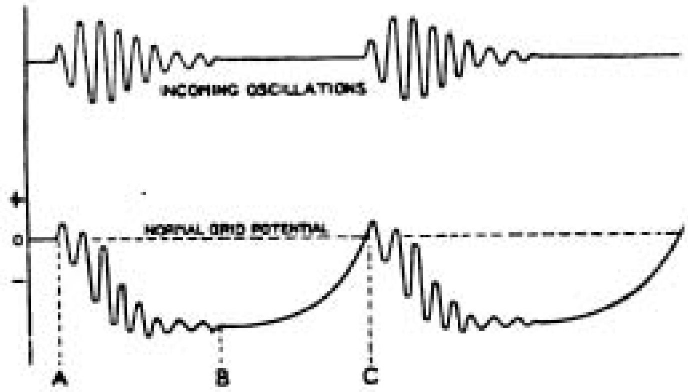


Fig. 8.

The grid leak speeds up the leakage of the negative charge sufficiently to restore the grid to its normal potential before the next oscillation group commences. This action is graphically depicted in Fig. 8, where the upper curve represents the incoming oscillation groups and the lower curve shows the potential of the grid gradually being lowered by accumulation of the negative charge from A to B and the normal potential being gradually restored by the negative charge leaking away through the leak from B to C.

On very short wavelengths, it must be remembered, the capacity reactance between grid and filament becomes sufficiently low to pass an appreciable current and so obviates to some extent a resistance leak.

For the further amplification of spark signals and for the self-heterodyning of C.W. oscillations, capacity reaction may be used in a high frequency resistance amplifier. The value of this capacity depends largely upon the number of valves between which reaction is taken, the greater the number of valves the smaller the reaction capacity required, because the reaction strength is proportional to the potential to which the capacity is charged, as well as to the actual value of the capacity. A very small capacity is therefore required to obtain reaction from the sixth valve as compared with that required from the second ; the capacities should be variable and their maximum values about 0·00001 and 0·0001 mfd. respectively. When the potential of the grid of a valve is raised, it will be seen from Fig. 4 that the anode current will be increased ; this being so, the potential difference across the constant external resistance A B (Fig. 7) will be increased, and the potential of the point A will be therefore decreased. This change of potential sign takes place at every valve, so that if the reaction condenser is connected from the anode of a valve back to its own grid or back to the grids of alternative valves, its effect will be to weaken the initial oscillations rather than to strengthen them. Care must be taken therefore to arrange *capacity* reaction past an even number of valves, *i.e.*, from the grid of first valve to the anodes of the second, fourth or sixth valves. It is useful, however, to provide for reaction to the other valves by means of a selector switch in order to lessen the tendency of the amplifier to oscillate when receiving spark signals.

The problem in multi-valve amplifiers often becomes one of preventing reaction rather than assisting it, as the reaction capacity required to set up self-oscillation is then so small that inter-lead capacities are quite sufficient for this purpose.

Since the potential variations of the anode of any valve of a resistance amplifier, depend upon the A.C. resistance between the points A and B, it follows that a coil of high inductance and comparatively low steady current resistance, may be substituted for the high resistance A B, provided the impedance offered by it to high frequency oscillations, is of the same value as the resistance. This method affects a considerable saving in the voltage of the H.T. battery since there will be no D.C. voltage drop across the anode circuit external to the valve to supply. The voltage of the battery need only be that of the potential at which the anode is to be normally maintained. As the reactance of an inductance is proportional to the frequency of the current passing through it, the inductance must be adjusted in value to suit the different wavelengths being received. The values of inductance for various wavelengths to maintain a reactance ($2\pi fL$) of 60,000 ohms are given in Fig. 9 in which logarithmic scales of inductance and wavelength have been employed.

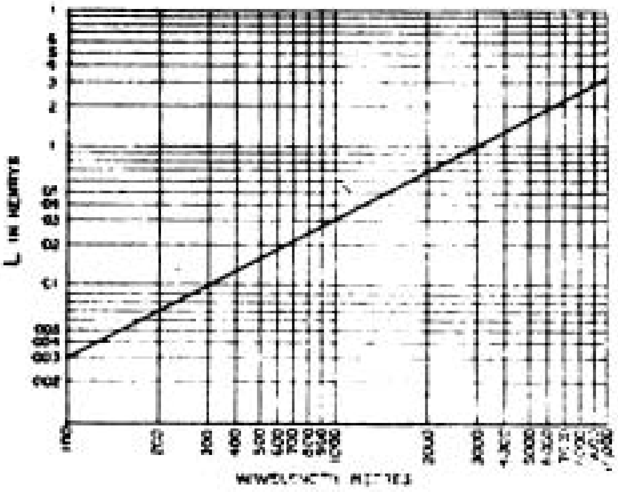


Fig. 9.

For any given wavelength, the required value of inductance is determined by dividing the reactance $2\pi f L$ which we are here keeping

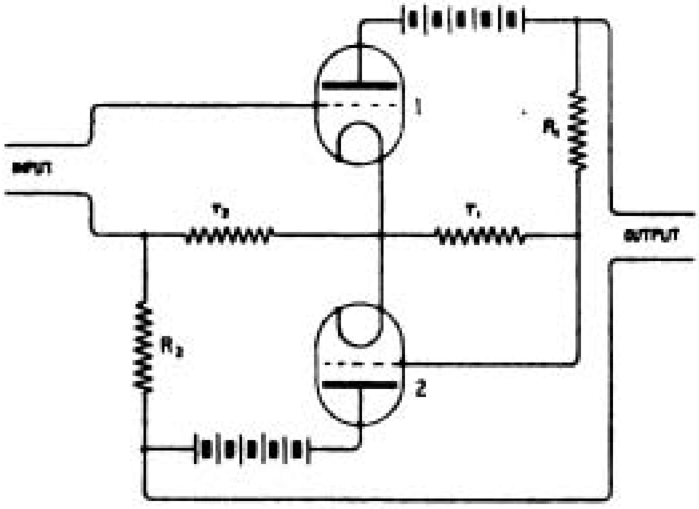


Fig. 10.

constant at 60,000 ohms. by $2\pi f$. Where f is the corresponding oscillation frequency

$$= \frac{3 \times 10^8}{\text{Wavelength.}}$$

If "reactance" coils are used the amplifier is not strictly aperiodic as the coil has a natural wavelength of its own for each inductance adjustment.

These notes would not be complete without mention being made of the aperiodic retroactive amplifier due to L. B. Turner.

In this arrangement (Fig. 10) small variations in the potential of the grid of the first valve, cause corresponding variations in the anode current, and consequent potential difference variations across the resistance r_1 across which the grid and filament of the second valve are connected. These voltage variations across the resistance r_1 are therefore impressed upon the grid of valve No. 2 and cause corresponding variations in the anode current of that valve which in turn produce much magnified potential difference variations across the resistance r_1, and, as this resistance is included in the grid circuit of the first valve, these magnified potential variations are retro-actively applied to the first grid ready to be magnified again. The usual change of potential sign takes place from the first grid to the first anode, but the sign changes again from the second grid to the second anode, and the final resultant magnified potential is therefore of the correct sign when re-applied to the first grid across the resistance r_2. The output magnified voltage which may be as much as 2,000 times the input voltage, is taken from the two anode circuits as shown in Fig. 10, and is then ready for application across the grid and filament of another valve in the anode circuit of which is connected the telephones or other current operated device.

With R_1 and R_2, 50,000 ohms and r_1

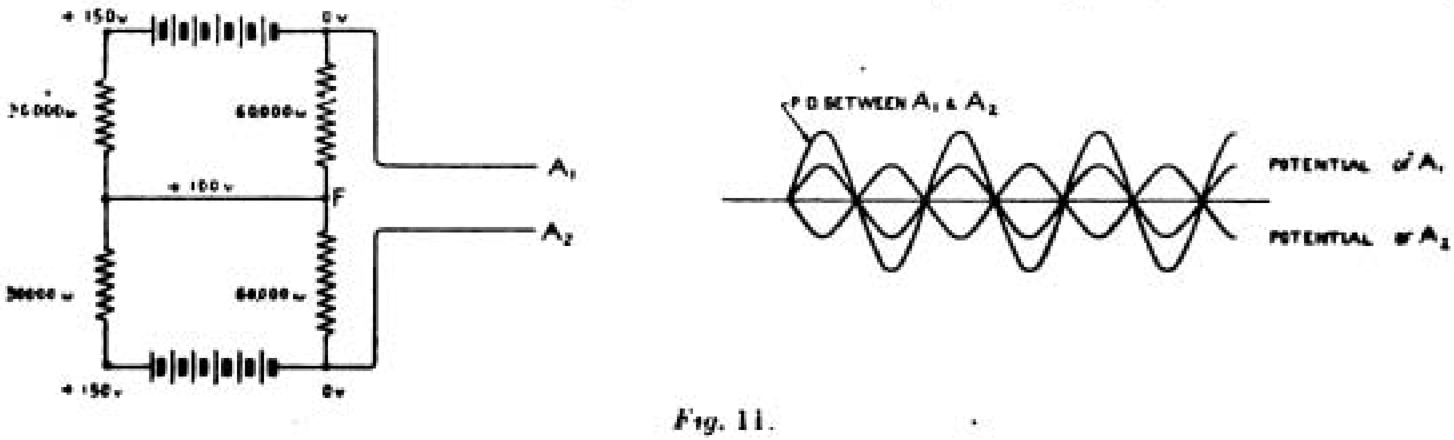


Fig. 11.

and r_2, 10,000 ohms, and the high tension batteries 150 volts, a magnification of 2,000 has been obtained. It would appear from Fig. 11, which is the arrangement of Fig. 10 redrawn, that the output is taken from two points whose normal D.C. potential is the same, but between which the instantaneous difference of potential, due to the A.C. components of their potentials, is a maximum.

Now clearly, since there is a difference of potential sign between the two anodes which amounts to a 180° difference of phase, when one anode is at a maximum potential the other is at a minimum, and there is therefore always an instantaneous *P.D.* between them equal to the sum of the potentials between each anode and the common filament connection.

WIRELESS CLUB REPORTS

Manchester Wireless Society.

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

On Wednesday, February 2nd, an ordinary general meeting held at the Albion Hotel, Piccadilly, Manchester. Mr. McKernan in the Chair.

The Society having decided, at a previous meeting, to carry out the Transatlantic test collectively, arrangements had been made by the Hon. Secretary, Mr. Y. W. P. Evans, to obtain the loan of two sets of special Receiving Apparatus from London.

It was also agreed that these instruments should be accepted under the following conditions :—

(1) That a suitable testimonial, according to merits, be given to the firm whose instruments were used.

(2) That no prize would be claimed by the Society in the event of successful reception, the tests being made purely in the interests of science.

(3) That any damage and overhauling costs be covered by the Society.

(4) That the instruments be returned within seven days after the completion of the tests.

The first instrument recived was the H.P.R. Short-wave Receiver, and it was decided to use this in conjunction with a seven-valve amplifier. Up to date the latter had not been received.

The second set received was a special short-wave receiver constructed for the transatlantic tests by Messrs. H. W. Sullivan, Winchester House, London. The particulars of this are as follows :—

Four high-frequency transformers, the primaries of which are variable by means of special air condensers.

The four valves are provided with separate filament and grid control.

The fifth valve, used as a rectifier, is also provided with separate control.

The small loose-coupler is designed to reach as near as possible a wavelength of 200 metres on the standard P.M.G. aerial.

Both primary and secondary are provided with a variable condenser, the former of which may be used in series or parallel with the aerial circuit, by means of a suitable switch.

The whole of this combination was elaborately laid out on a base board 3 feet by 2 feet, all the connections being visible.

Both sets were on view during the meeting, and the Chairman explained that it was proposed to allocate to members having the highest aerials most suitably situated. Dimensions and general conditions of the aerials owned by members present were then collected and after discussion the allocations were that Mr. P. G. Thomason, of Hazel Road, Altrincham, should have use of the H. W. Sullivan set, and that Capt. Andrew-Bolton, of Plymouth Grove, Longsight, should have use of the H. P. R. Short-wave Receiver, and the seven-valve amplifier. Failing the arrival of the latter, in time for the second test, a four-valve amplifier was being constructed by Capt. Andrew-Bolton, with the assistance of Capt. Siddons-Wilson.

During the meeting a small frame-aerial was erected by our Hon. Treasurer, Mr. Lamb, which consisted of a block of wood 3 inches square, with sockets, and four sticks to fit. Spacing pins were arranged ½ inch apart on the latter. This, together with a bobbin of No. 29 S.W.G enamelled wire could be made up in quite a small parcel. The time taken to erect the frame complete was seven minutes, and to dismantle the same eight and a half minutes, the wire being unwound from the frame on to the bobbin again. This operation was rendered simple by allowing the frame to lie flat on the floor and revolve slowly as the wire was reeled in.

With the frame aerial in circuit the H. W. Sullivan set was tested by means of a wavemeter, and good adjustments obtained on 200 metres.

These adjustments were recorded to enable them to be used as a rough guide by Mr. Thomason and fellow members during the tests.

The H.P.R. Short-wave Receiver was also given a test, and responded to the wave meter from 175 metres to 1,000 metres, using a variable condenser in parallel.

Final arrangements were then made as regards Friday's and Sunday's programme, after which the meeting closed.

On February 9th, an ordinary general meeting, held at the Albion Hotel, Piccadilly, Manchester.

The Chairman, Mr. McKernan, announced that arrangements were being made with a view to establishing the headquarters of the Society at the Albion Hotel, Piccadilly, and that an aerial would be erected on the roof, and facilities given by the management to allow of reception of signals by members of the Society at stated times. A transmitting programme will also be arranged allowing for at least one transmission each week.

He was very sorry to hear that the experiments carried out by members of the Society, in connection with the transatlantic tests, had not proved successful, but there was no doubt that, according to newspaper accounts which he had read that the Society had been watched very closely, and that excellent progress was being made.

Mr. McKernan then called upon the Hon. Secretary to make a few remarks about the business of the Society.

Mr. Evans announced that he had been studying very carefully the question of membership. He stated that the membership at the close of 1920 was 68, and associate membership 9, making a total of 77. He had now to announce that the total membership was 53, comprising 50 members and 3 associates. The chief reason of this loss was evidently due to the increased subscription, although several cases pointed to lack of interest. He was, however, confident that the present members were all keen, and could be counted upon to assist the Society in every possible way, and had no hesitation in confirming Mr. Mc Kernan's remarks, that we were making splendid headway.

The Chairman then called upon Mr. J. C. A. Reid to read his Paper on "Searchlights, and their work during the War."

Mr. Reid gave a very clear account of the work carried out by this section of the Army and Navy, and the many difficulties that were experienced, especially during the early stages of the war. The searchlights used at that time being of the oxy-acetelene type, and necessitated the transportation of heavy gas cylinders, which were difficult to recharge. These, he explained, were soon superseded by the Electric Arc type and it was chiefly with this latter type that Mr. Reid kept the attention of his interested audience, fully explaining the dangerous work of this practically unknown arm of the Service.

At the completion of this Paper, Mr. Reid invited questions, of which there were many and varied, and all of which Mr. Reid answered in a very lucid manner.

A hearty vote of thanks was proposed to the lecturer, and this was responded to with generous applause.—Hon. Secretary, Mr. W. P. Evans, 7, Clitheroe Road, Longsight, Manchester.

Edinburgh Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the above Club was held on February 9th.

The minutes of the previous meeting having been read and adopted, the Hon. Secretary proposed a motion to raise a special subscription for the purchase of extra apparatus. This was agreed to, it being decided at the same time to notify all members, in writing, of the decision.

The Hon. Secretary then expressed his appreciation of Messrs. F. O. Read's kind assistance in loaning amplification apparatus for a demonstration given by the Club before a large audience in Edinburgh.

A lecture on "Batteries" by Mr. D. G. Watson was announced for February 23rd, to be followed by others equally interesting in the near future.

It was proposed and agreed that a Club dance should be held before the end of the season, if convenient to be in conjunction with the Edinburgh Gipsy Club.

Before adjourning, the Hon. Secretary had pleasure in announcing that the membership total of the Club had now passed 40, which progress it was hoped would continue. Several schemes were put forward to increase the scope and membership of the Club. In consideration of the fact that our first year is not yet finished, we have reason to feel gratified with these figures.—Hon. Secretary, 9, Ettrick Road, Edinburgh.

Derby Wireless Club.

(Affiliated with the Wireless Society of London.)

On January 29th a Paper on "Radio Telephone Transmitter" was read by Capt. W. Bemrose, and was followed by a discussion.

On February 9th, Mr. E. V. Martin read a most interesting paper on "Simple Valve Receivers," outlining the theory of the thermionic valve, and describing the various means of using same.

Three members of the Club have now got licences to transmit, and good progress is being made with Wireless Telephony.—Hon. Secretary and Treasurer, Capt. W. Bemrose, Littleover Hill, Derby.

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

It is with deep regret that we announce the death of the late Hon. Secretary, Mr. W. P. Rogers, which occurred on January 27th, 1921, after a prolonged illness. Mr. Rogers founded the Society early in 1920, and worked untiringly in the development of its aims until late in the summer when, owing to ill-health, he was compelled to relinquish the office of Secretary. His keen spirit and interest in the Society and amateur movement generally until the last will be remembered with admiration by all to whom he was known.

A meeting of the Society was held in the Banner Room, Oddfellow's Hall, Queen's Road, Brighton, at 8 p.m. on Friday, February 11th, when a paper was read by Mr. C. H. Bingham entitled "Oscillations and Electromagnetic Waves." The lecture proved most interesting.

The Society has elected an Executive Committee and Technical Committee. The latter is introducing a system of "Questions and Answers," which promises to become very popular. Any members wishing to ask questions should submit the same to Mr. C. H. Bingham, 9, Wolstonbury Road, Hove.

The following change of office is recorded :— Mr. W. E. Dingle is elected to be President, and Mr. Magnus Volk to be Vice-President as from February 11th, 1921.

Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F.

Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full particulars as to membership.

North Middlesex Wireless Club.
(Affiliated with the Wireless Society of London.)

The fifty-eighth meeting of the Club was held on Wednesday, February 9th, at Shaftesbury Hall, Bowes Park, Mr. A. G. Arthur in the Chair.

It has been arranged that meetings shall be preceded by half-an-hour's Morse code practice, from 8 to 8.30. This was carried out for the first time on this occasion, and proved very popular, two buzzers being used of different notes, one for beginners, and one for advanced workers.

The Morse practice being finished, the Chairman opened the meeting, and after the minutes of the previous meeting had been read, he called on Mr. L. C. Holton to read his paper on his "Alterations to a Mark III* (converted) Receiver." Commencing by pointing out that it was inefficient to use one loading coil to cover a large range of wavelengths, Mr. Holton described the separate coils he used to go up in steps to, if necessary, 27,000 metres. The capacity and inductance of each coil was so calculated, and the coil wound with wire of such gauge (No. 24) that the greatest efficiency was obtained. With regard to the constructional alterations, these had been carried out in such a way as to allow for every possible experiment, the inductances, condensers, potentiometer, etc., being brought to terminals arranged round the edge of the base-board, and controlled by change-over switches, so arranged that each unit may be used separately, or cut out altogether, if required. At the same time, care had been taken in wiring up, that capacity between the various leads was reduced to a minimum. Mr. Holton drew a number of diagrams illustrating his points, while he had at the same time the actual set on the table, which the lecturer said, had already proved of great use and interest.

Great credit is due to Mr. Evans, who carried out the work to Mr. Holton's instructions, for the way he had disposed the switches, etc., in the somewhat limited space on a Mark III* set.

At the conclusion of his paper, a vote of thanks was proposed and carried with enthusiasm.

It has been arranged to held a Social Evening and Concert on Wednesday, February 23rd, Particulars of this and of the Club may be had from the Hon. Secretary, Mr. E. M. Savage, "Nithsdale," Eversley Park Road, Winchmore Hill, N.21.

The Wireless Society of Hull and District.
(Affiliated with the Wireless Society of London.)

This Society continues to go strong, and successful meetings have been held at the Metropole (Marlborough Room) on alternate Thursday evenings during the winter. At the meeting held on January 13th the question of obtaining permanent accommodation for Headquarters which could be used and fitted up as a workshop and laboratory, was discussed. A member had very kindly offered the loan of such premises, but the members, after hearing the Committee's view on the matter, decided that the time was not yet opportune for carrying out such an enterprising scheme. The meetings at present are taking the form of short readings and discussions from an American publication on Practical Wireless. This is followed each night by about half-an-hour of buzzer practice to enable the members to become proficient in reading the Morse code. Practically all the wireless amateurs in Hull and district have joined the Society, but the Secretary will be pleased to hear from any other persons who wish to join. The entrance fee is 1s., and the subscription is 10s. per annum, which may be paid at 2s. 6d. per quarter, in advance. The subscription for students, viz., under 18 years, is 6s. per annum, or 1s. 6d. per quarter. The dates of further meetings are February 10th, 24th, March 10th, and 24th. Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull.

The North London Wireless Association.
(Affiliated with the Wireless Society of London.)

The Association's tenth meeting was held on January 28th, 1921, Mr. G. D. Meyer in the chair. After the minutes of the previous meeting had been read and passed the usual buzzer practice took place, and at the conclusion Mr. Angel was called upon to give his lecture on "Elementary Principles." The lecturer commenced by saying he would have to somewhat skip a lot of what he had to say as the time was getting on, but he would do his best to give an outline of the chief principles of both sending and receiving. Many questions were asked which pointed to the keen interest taken in the lecture. At the conclusion a hearty vote of thanks was accorded Mr. Angel.

The eleventh meeting held on February 4th was an informal one, its object being to listen in for telephony trials from the "Lingestroom" at Amsterdam. The Association had the honour of a message of greetings from the Dutch Amateurs, Holland, being transmitted to it by C.W. from the "Lingestroom." Mr. Gartland was unable to be present at the meeting, but had succeeded in receiving the message on his own set, and kindly assisted the Secretary with his report.

The Association has been duly accepted for affiliation with the Wireless Society of London. Three more names have been added to its membership. The Hon. Secretary, Mr. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1., will gladly furnish particulars to anyone who wishes to join the Association, if they will communicate with him.

The Gloucester Wireless and Scientific Society
(Affiliated with the Wireless Society of London.)

Another very interesting evening was spent by this Club on February 3rd, on which date Mr. H. Hine (one of our members) gave a most instructive demonstration of the uses of X Rays. The lecturer showed a thorough knowledge of the whole set, and mentioned several modern applications of its use with stereoscopic slides, etc. Many objects were viewed through a fluorescent screen, and later some excellent photographs were obtained of the human hand and other things.

The Secretary also gave his second lecture of a series on Wireless theory. This was on accumulators and their management.

Some buzzer practice was also obtained during the development of the X Ray photographs.

Any particulars of the Club will be willingly given by the Hon. Secretary, Mr. J. J. Pittman, 1, Jersey Road, Gloucester.

Greenwich Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting of the Greenwich Wireless Society was held on Saturday, January 22nd, at the headquarters, the Ranger's House, Greenwich Park. This was the first informal meeting held according to the rules of the Society for the assembling of members, the discussion of ideas, and exhibition of wireless apparatus.

An excellent 4-valve amplifying set was shown by Mr. A. F. Bartle, and signals received from all quarters on the temporary aerial. Other apparatus was also shown and all members present had a very instructive evening, learning much from one another.

The second General Meeting was held at the same address on Tuesday, February 1st, the Astronomer Royal being in the chair. After the usual business had been conducted an interesting discussion was opened by Mr. A. F. Bartle on single-valve reception circuits in general, in which many of the members joined. Mr. Stanley Ward also very ably explained for the benefit of the junior members present the action of the three-electrode valve. Various types of valves were exhibited.

Meetings of the Society will be held on Saturday, February 19th, at 6 o'clock, and on Tuesday, March 1st, at 8.30 p.m. at the Ranger's house, Greenwich Park.

Glevum (Gloucester) Radio and Scientific Society.

(Affiliated with the Wireless Society of London.)

At our weekly meeting on Friday at the Royal Hotel our Chairman, Mr. G. Courtenay Price, gave a very interesting demonstration on his Read's one-valve long-and-short wave set and our Secretary's (Mr. J. Mayall) portable unit, in conjunction with a loud speaker; excellent signals were heard and press news taken down from Hornsea, Carnarvon, Lyons and transatlantic stations. Keen interest was taken in these demonstrations, and also in several types of Marconi instruments. A very enjoyable evening was spent and some new members were enrolled.

Arrangements have been made by our Secretary with the Marconi Co. to hold a demonstration in wireless telegraphy, etc., at the Guildhall, Gloucester, on February 17th, for the sole benefit of the unemployed.

This lecture and demonstration will be most interesting and will be eagerly looked forward to by everybody.

Bristol and District Wireless Association.

In addition to three meetings for business, four ordinary meetings of the Association have been held during the autumn and winter.

On October 15th, 1920, Mr. L. S. Palmer, M.Sc., lectured on C.W. Transmission. In referring to the two types of radiator the lecturer pointed out that until 1907 the ordinary induction field k/d^2 in the region surrounding a radiator had not been clearly distinguished from the radiation field $k/\lambda d$. The negative coupling of the circuits necessary for oscillation with a valve was discussed and it was shown how the H.T. battery became the source of the radiated energy. The effect of capacity in checking oscillation was referred to as a serious difficulty in producing radiation of short-wave lengths.

The lecturer dealt with the design of circuits with the necessary condenser by-passes for H.F. currents, and gave figures for power required both for telegraphic and telephonic communication to short distances. Methods of microphonic modulation of oscillations in telephonic work were described.

The lecture was illustrated by transmission of spark and C.W. signals, and telephony of speech, phonograph and penny whistle was achieved.

On November 26th Mr. E. C. Atkinson lectured on the "Functions of Wireless Societies." The exchange of ideas and intercourse between experimenters, which was their avowed object, was possible even in small societies, because their members tended to specialise in different branches of work, such as building apparatus, operating, experimenting or theory, so that most members had information to impart which was of interest to the rest. The lecturer urged that the success of a small society depended more on a high percentage of active members than on securing a series of distinguished visitors to provide the business of their meetings.

On December 23rd, Mr. J. Carpenter, of the Marconi Scientific Instrument Co., lectured on "Wireless Telegraphy and Apparatus," dealing mainly with the design of relatively simple and inexpensive apparatus, suitable for the reception of transatlantic messages. Experiments were made with basket-work coils as being compact and simple to build. It was found desirable to use a minimum of wax for cementing, to space out the coils and to use dead-end switches for cutting out coils not in use when working on the shorter wavelengths. An R valve was used with a 6 V accumulator, with 36-50 volts on plate circuit, rectification being secured by a leaky grid condenser. Suitable values for this resistance and capacity, as well as for that of the other condensers in the circuits, were given. On an aerial conforming to P.O. regulations signals from the more powerful transatlantic stations could be read without amplification. For weaker signals an L.F. amplifier was used. This was described and it was pointed out that a separate anode supply was necessary, and that it was important to keep the amplifier away from the other apparatus.

The lecturer dealt also with the merits and defects of resistance-capacity circuits, and with tuned plate circuits, as well as with frame aerials, referring in connection with these to observations of displacement of the reception plane at sunset.

On January 28th, 1921, Mr. A. E. Mitchell built up a circuit during the meeting from components brought by himself and other members. This was connected to an aerial wire stretched across the lecture theatre, and messages picked up from different stations were made audible to the meeting by a megaphone. The Secretary referred to the effect of "dead-ends" on wavelength, and showed how the mutual induction between such a dead-end and the rest of a (single-layer) coil could be read off from the induction curve of the coil.

Dartford and District Wireless Society.

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

The usual fortnightly meeting of the Society was held on Friday, the 11th inst., in the Physics Laboratory, Dartford Grammar School. The Society have been fortunate in obtaining this room for their headquarters, provisional permission for this occasion having been given by the Headmaster. G.P.O. permission to erect the aerial has been applied for and plans are already in operation. It is proposed electing the masters of the school honorary members. A crystal set will be used for tuition purposes.

Sixteen members were present at this meeting, and Mr. J. R. Smith, A.M.I.E.E. was elected Vice-President. This gentleman has promised to give the Society a lecture on "Wireless" in the near future, possibly illustrated by lantern slides.

The Society are sending a delegate to the Conference on March 1st; the progress of the Society is very satisfactory.

Several specimens of home-made apparatus were brought for inspection and a very excellent evening was spent. All persons interested can obtain full particulars from the Hon. Secretary and Treasurer, Mr. E. C. Deavin, 84, Hawley Road. Wilmington, Dartford.

Wireless and Experimental Association.

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

At a meeting of the above Society on February 2nd, it was moved by the Secretary, and seconded by Mr. Kloots, that Mr. Kennedy be appointed chief of the Club Installations Department, rendered vacant by the resignation, due to business pressure, of Mr. C. Sanders.

The Chairman described Pupin's method of eliminating atmospherics and Mr. Gosheron described a recent visit to the Croydon Aerodrome Wireless Station.

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

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held on January 28th, at the Municipal Technical College, Plymouth. Mr. R. S. Menhennet in the chair.

A most interesting and instructive lecture was delivered by the Secretary, Mr. H. P. Mitchell, on mathematical problems.

The lecturer made special references to the mathematical side of wireless telegraphy; it proved a success, especially to those members about to sit for the new P.M.G. Certificate.

At the close of the meeting Mr. Mitchell kindly consented to give a series of these lectures. Everyone present thoroughly appreciated the lecture, and in the usual way passed a vote of thanks.

A meeting of the Society was held on February, 4th, 1921, at the Municipal Technical College, Plymouth. Mr. R. S. Menhennet in the chair. A most interesting and instructive lecture was delivered by the Secretary, Mr. H. P. Mitchell, on mathematical problems; this being a continuation of the mathematical lecture of last week.

The lecture included logarithms and other interesting subjects included in wireless telegraphy. Everyone appreciated the lecture, and passed a vote of thanks to Mr. Mitchell.

Until further instructions, all correspondence should be addressed to Mr. F E. Allen, Assistant Secretary, Plymouth Wireless Society, Municipal Technical College, Tavistock Road, Plymouth.

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

At a meeting of the above Society held on Wednesday, January 26th, in the Y.M.C.A., North Shields, Mr. Robert Morley gave an interesting lecture upon "Detectors."

Mr. Morley dwelt for some moments on Branley's coherer, and in turn dealt with the magnetic, electrolytic, and crystal detectors.

During the evening some interesting experiments were carried out.

A vote of thanks to the lecturer for providing such a pleasant and instructive evening was proposed by the Hon. Secretary, seconded by Dr. James A. Hislop.

Hon. Secretary, Mr. L. L. Sims, Y.M.C.A., North Shields.

Walsall Amateur Radio Club.

Meetings of the above Club will in future be held weekly on Friday evenings (excepting the first Friday in each month), at 7 p.m. in the Brotherhood Institute.

A general business meeting will be held on the last Monday in each month.

A series of demonstrations of apparatus by members is being arranged to take place at the meetings of the last Friday in the month.

Hon. Secretary, Mr. E. W. Bridgewater, 17, White Street, Walsall.

Aberdeen and District Wireless Society.

On December 14th, Mr. R. D. Spence, of Huntly, Aberdeenshire, delivered a most interesting lecture on Valve Apparatus, which was illustrated by some 30 lantern slides. After the lecture Mr. Spence made signals from Clifden, Hanover, etc., audible over the whole room on a 3 ft. square frame aerial in conjunction with a French three-stage amplifier and two-stage note magnifier. The lecture was thoroughly enjoyed by all the members, and Mr. Spence was heartily thanked, on the call of the Chairman, Mr. Cartwright, for the trouble taken in arranging the lecture, and in bringing the apparatus in by car a distance of 45 miles.

Since the above date members have been busy fitting up new premises in St. Nicholas Lane, where an aerial has now been erected.

On Tuesday, February 1st, Mr. G. Benzie gave a lecture on construction of a Valve Set and signals were heard all over the room on a set, the details of the construction of which were given in his lecture. Mr. Benzie was heartily thanked by the members.

Each member is being supplied with a key so that constructional work, buzzer practice, etc., may be indulged at any time.

Folkestone and District Wireless Society.

A general meeting of the above Society was held at the Schools, Sandgate, on Wednesday, February 2nd, at 7.30 p.m., Mr. Ullyett, F.R.G.S., (Chairman) in the chair.

The minutes of the previous meeting having been read and confirmed, the proposed Rules were put before the Society, were amended and passed.

The following officers were elected for the year ending February 1st, 1922: President, Mr. T. Hesketh, M.I.E.E., etc.; Vice-President, Major Butler, R.E; Chairman, Mr. Arnold H Ullyett, F.R.G.S., etc.; Hon. Secretary, Mr. H. Alec. S. Gothard, A.F.Ae.Inst, etc. A Committee is in formation.

It has been decided to hold general meetings monthly, and an instructional lecture every week.

The Hon. Secretary will be pleased to hear from or interview anyone interested in the Society.—Mr. H. Alec. S. Gothard, 8, Longford Terrace, Folkestone.

Portsmouth and District Wireless Association.

Having obtained a new Club-room which is more central, and in many ways more comfortable, we have been able to reduce our fees.

The entrance fee is now 2s. 6d., the subscription 2s. 6d. per quarter, in advance, and 2s. 6d. per annum for corresponding members.

Several new members have been enrolled, and we are settling down to some good wireless work.

Hon. Secretary, Mr. R. G. H. Cole, 34, Bradford Road, Southsea.

Wimbledon and District Wireless Society.

A meeting was held at the Wimbledon Technical Institute, on Thursday, February 3rd, under the chairmanship of Mr. H. Nutton, A.M.I.E.E., A.I.M.E., for the purpose of forming a Wireless Society for Wimbledon and district. A Committee of ten members was formed and rules adopted.

It was decided that the Society be known as the Wimbledon and District Wireless Society, and that it consist of honorary, senior and junior members. Senior members to be over and junior members to be under 18 years of age. It is intended that the Society shall be a means of co-ordinating local amateur efforts. Ordinary meetings will be held monthly, any extra meetings being arranged, as required at the headquarters of the Society, which, by permission of the Wimbledon District Higher Education Committee will be established at the Wimbledon Technical Institute. An interesting syllabus of lectures, demonstrations and discussions is assured, and it is hoped that with enthusiastic co-operation among the members, a very successful Society will result. The annual subscription has been fixed at 10s. for senior members and 7s. 6d. for junior members, payable on entrance. A reference library will be established, apparatus acquired, and affiliation with the Wireless Society of London will be sought as soon as possible. The Hon. Secretary, Mr. W. G. Marshall, c/o Technical Institute, Gladstone Road, Wimbledon, S.W.19, and 48, Warren Road, Merton, S.W.19, or the Treasurer, Mr. G. W. Leach, 184, Barcombe Avenue, Streatham Hill, S.W.2, will be pleased to receive the names of intending members, and supply any further information.

Intending members are invited to attend the first monthly ordinary meeting, on Saturday, March 5th, at the Technical Institute, Wimbledon, at 7.30 p.m., when the President, Mr. W. A. Harwood, Principal of the Institute, will deliver his Presidential address, which will be followed by a social evening, to enable members to become acquainted with one another.

The Leeds and District Amateur Wireless Society.

Proceedings of a meeting held on Friday, February 11th, at 7.30 p.m. Mr. Tindall (Vice-President), was introduced by the Secretary, and took the chair.

The Chairman explained the absence of Mr. R. E. Barnett (President), and expressed to the meeting the latter's regret at not being able to be present.

The Chairman then discussed briefly the necessity of having a Society in order to bring together all those interested in wireless telegraphy. He also gave a short address on the history of wireless from its discovery up to the present time, and pointed out the vast field for experiment and research work for everybody to take up, and the great rewards awaiting those making new discoveries and improvements. The Secretary then read the minutes of the last meeting, which were carried by the meeting.

The Secretary explained that the question of a set of rules was being dealt with, and would be submitted to a later meeting.

The Chairman then stated that it was proposed to hold meetings every Friday evening at 7 p.m., the first and third Fridays in each month to be informal evenings, on which classes and lectures for beginners would be held. Morse practice would be given on these nights, from 7 to 8 p.m., and the Secretary had promised to give a series of elementary lectures on wireless telegraphy from 8 to 9 p.m. Discussions or lectures would also be arranged for advanced members on these nights.

On the second and fourth Fridays in each month formal meetings would be held, at which a full lecture or paper would be given. It was decided to take in various wireless periodicals for the use of members. Three members volunteered to undertake the duties of giving Morse practice.

The Chairman read a letter from Major Arthur Bray (Officer Commanding 49th (West Riding) Divisional Signal Company, expressing his regret at being prevented by military duties from taking an active part in the Society at present. Major Bray is one of the Vice-Presidents of the Society.

Mr. Tindall then stated that at the close of the meeting the Hon. Treasurer (Mr. Timms) was prepared to enrol members and issue membership cards.

Mr. G. P. Kendall proposed a vote of thanks to Mr. Tindall, seconded by Mr. Pettigrew, and carried by the meeting in the usual manner.

The meeting closed at 9 p.m. Over 40 members were enrolled.

Will any interested readers kindly send their names and addresses to Mr. H. T. Sayer (Hon.

Secretary), Wireless Dept., Central Technical School, Leeds.

Bishop's Stortford College Wireless Society.

A Society of the above name has been formed at Bishop's Stortford College, under the guidance of Mr. A. D. Hayward, M.A., B.Sc. There are now 19 members. The Society has two valve receiving sets at its disposal.

A meeting was held on February 9th, at which the following officers were elected. President Mr. E. M. Stienon; Treasurer, Mr. A. D. Hayward; Hon. Secretary, Mr. L. R. Rowlands; Committee, Messrs. W. R. Brackett and A. H. Blomfield.

After the rules had been read and approved, Mr. Hayward gave an interesting lecture for beginners on the "First Principles of Wireless." The meeting was concluded with buzzer practice, and Mr. Hayward promised to give a lecture at the next meeting on the "Oscillation Valve."—Hon. Secretary, Mr. L. R. Rowlands, Alliot House, Maze Green Road, Bishop's Stortford.

Lincoln and District Amateur Wireless and Scientific Society.

The opening of the Lincoln and District Wireless and Scientific Society was held on Thursday evening, February 10th, when intending members assembled at the general meeting to elect officers and to discuss the most efficient lines on which the Society should be conducted.

The officers elected were Mr. A. R. Cooper, A.Sc. (President), Mr. A. J. Yeates (Chairman), Mr. C. H. Friskney (Vice-Chairman), and Mr A. L. Astill (Secretary and Treasurer).

The desire was expressed to affiliate the Society with the Wireless Society of London.

Intending members should communicate with the Hon. Secretary, Mr. A. L. Astill, 168, West Parade, Lincoln.

Brighton Electric Traction and Radio Club.

A Club, under the above title, has been formed recently. Telegraphy, telephony and wireless are included under the Radio Department. Communications should be addressed to Mr. R. W. Maidlow (Chairman), "Homelea," 34, Bonchurch Road, Brighton.

The Huddersfield Wireless Society.

A Society has now been formed in Huddersfield and district for all those interested in wireless work; this Society is also affiliated to the "Huddersfield Model Engineers."

Will all those wishing to become members kindly communicate with the Hon. Secretary, Mr. J. Stanley Jowitt, "Harewood House," Wentworth Street, Huddersfield.

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

On Thursday, February 10th, the above Society held a meeting in the Y.M.C.A., North Shields, when Mr. G. Littlefield gave a lecture upon "Wireless Telephony."

The lecturer commenced by discussing some of the very early experiments performed by such men as Poulsen, Professor Varney and Dr. Fleming as early as the year 1899 up to 1914, when a message was sent across the Atlantic over a distance of 3,800 miles.

After citing several experiments Mr. Littlefield went on to describe the more up-to-date wireless telephone transmitters, also the wireless beam and the continuous wave transmitter.

At the conclusion of the meeting Dr. J. A. Hislop proposed a vote of thanks to the lecturer, seconded by Mr. H. Hutchinson.

Hon. Secretary, Mr. L. L. Sims, Y.M.C.A. Wireless Society, North Shields.

Aldershot, Farnborough and District.

We are requested to announce that a Wireless Society for the above district is now being formed, and application for membership should be made to Mr. J. H. Hill, Farnborough Road (near Queen's Hotel), Farnborough, Hants.

Wireless Club for Smethwick.

It is proposed by a few amateurs of this district to form the above-named Club. Would all those interested please communicate with Mr. R. H. Parker, Radio House, Wilson Road, Smethwick, Birmingham.

Proposed Wireless and Scientific Society for Lowestoft and District.

Will all interested please communicate with Mr. C. Chipperfield, Victoria Road, Oulton Broad, who is hoping to organise the above Society at an early date.

Upper Tooting.

Mr. W. Sharvell, of Church Institute, Wiseton Road, Upper Tooting, will be pleased to hear from any amateurs in that district who are interested in the formation of an amateur wireless club.

Tunbridge Wells and District.—It is proposed to form an amateur Wireless Society for the above district. All those interested are invited to communicate with Mr G. W. Howard, F.C.S., M.S.R.' 81, Calverley Road, Tunbridge Wells.

The Proceedings of the Annual Conference of Affiliated Wireless Societies will be reported in full, in a subsequent issue.

PAGES FOR BEGINNERS

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

WIRELESS TELEPHONY

THE essential requirements of a circuit for transmitting speech sounds by wireless can be summarised as follows :—

(1) A method of generating continuous oscillations to be radiated by the aerial during the whole time the set is working.

(2) A means of modifying these oscillations by sound waves caused by the voice.

The three-electrode valve provides a very suitable method of generating oscillations although some of the earlier experiments in this branch of wireless were conducted by means of arcs, notably by the Poulsen arc generator of continuous waves and by high frequency alternators.

The medium by which speech is made to affect the radiated waves is termed the *microphone*, an instrument which depends for its working on variations in its resistance caused by sound waves.

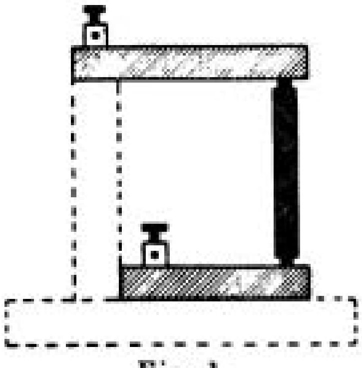


Fig. 1.

In its simplest form, the microphone consists of two blocks of carbon, between which a third block is loosely held (Fig. 1). If a battery and galvanometer are connected in series with the arrangement, a small deflection will be produced by the potential of the battery acting through the high resistance of the carbon blocks. If a sharp sound is made near the microphone, the sound waves will strike the loose carbon block, causing it to vibrate slightly. The pressure between it and the fixed blocks will thus be varied, corresponding variations in the resistance taking place. The galvanometer needle will therefore be deflected to a greater extent, thus recording the sound produced.

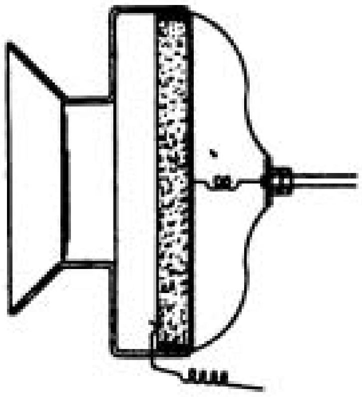


Fig. 2.

This crude form of microphone has been elaborated into the present type, shown in Fig. 2.

Two thin carbon discs are separated by a ring of felt or other insulating material, and the space between them is packed loosely with fine granulated carbon. In front of the carbon diaphragm is fitted a mouthpiece of the usual type.

A serious drawback which was encountered in this form of microphone was the tendency of the carbon granules to become wedged tightly at the bottom of the space between the discs, when the mouthpiece was in a horizontal position. This "packing" of the granules made the resistance of the arrangement more or less constant, and destroyed its sensitivity to slight sounds. The defect was remedied to a certain extent by cutting out a number of circular rings in the back carbon plate (Fig. 3), which kept the granules evenly distributed over the surface of the discs. The working of the microphone is further improved by occasionally shaking the granules about.

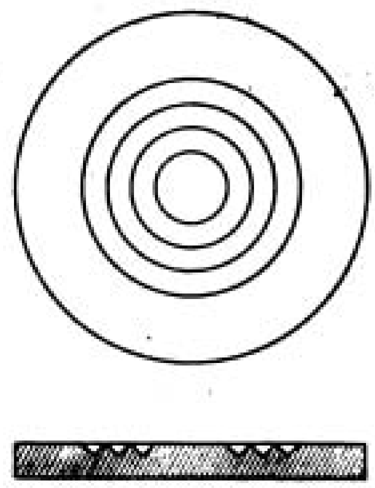


Fig. 3.

The continuous wave generator, as stated before, can either take the form of a Poulsen arc, H.F. alternator, or a valve. The earliest arrangement of apparatus was that sketched in Fig. 4. The oscillatory circuit was composed of a capacity and inductance connected in series across an arc formed between two electrodes—one of copper and the other of carbon. The microphone was connected directly in the aerial circuit, and the variations in resistance of the carbon caused a similar variation in the amplitude of the radiated waves. The obvious drawbacks to this direct method of control is that the aerial current is limited to a low value. The radiation could be increased by inductively coupling the microphone (see dotted lines in Fig. 4), but even in that case the control of large aerial currents becomes a difficult matter. If heavy currents are passed through the microphone the granules become heated and "pack," thus destroying the sensitivity of the apparatus.

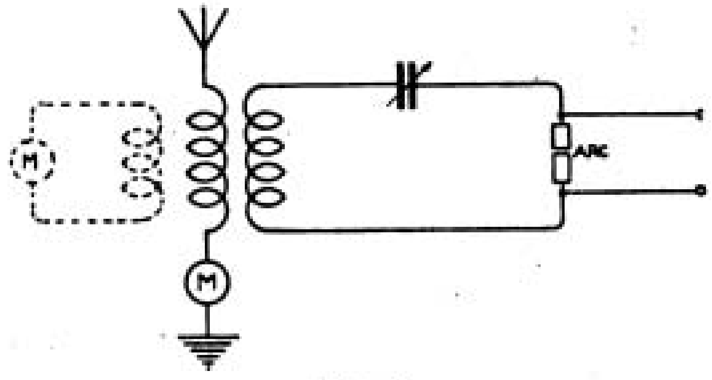


Fig. 4.

Certain special forms of microphone have been designed, with a view to overcoming this difficulty. In one type of heavy current microphone the carbon granules are continually moving between the two fixed plates. This circulation of carbon ensures that the granules are kept cool, and at the same time prevents the objectionable "packing" tendency.

The modern practice is usually that of combining the microphone with a valve amplifier relay, and coupling this in turn to the aerial circuit. For low power transmission, however, a simple circuit of the form shown in Fig. 5 is suitable.

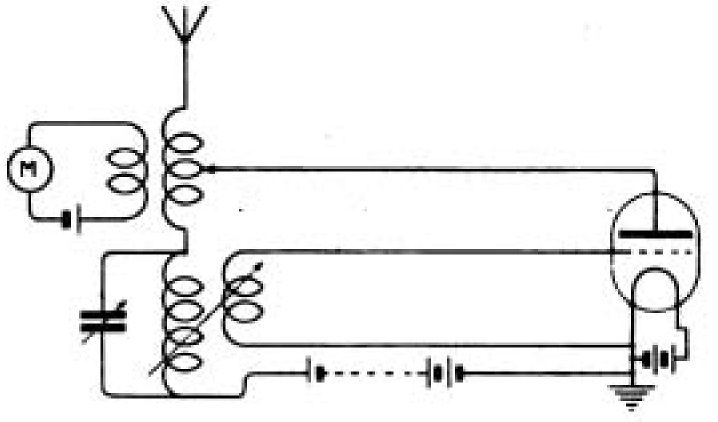


Fig. 5.

The similarity between this circuit and the transmitting circuits previously described will be noted. The anode oscillatory circuit is formed by part of the aerial inductance itself which in turn is coupled to the grid circuit coil. The valve itself should be as hard as possible, since the power of the set depends upon the potential which can safely be applied to the anode.

An ordinary pattern of receiving valve would serve for short distance transmission if the potential on the anode is of the order of 200-300 volts. The microphone could be coupled to the aerial inductance by a small coil. An alternative arrangement is to connect the microphone as a shunt to the aerial inductance. For a more sensitive adjustment of the oscillatory circuit, the grid potential could be varied by means of a potentiometer connected between the grid coil and the negative of the filament.

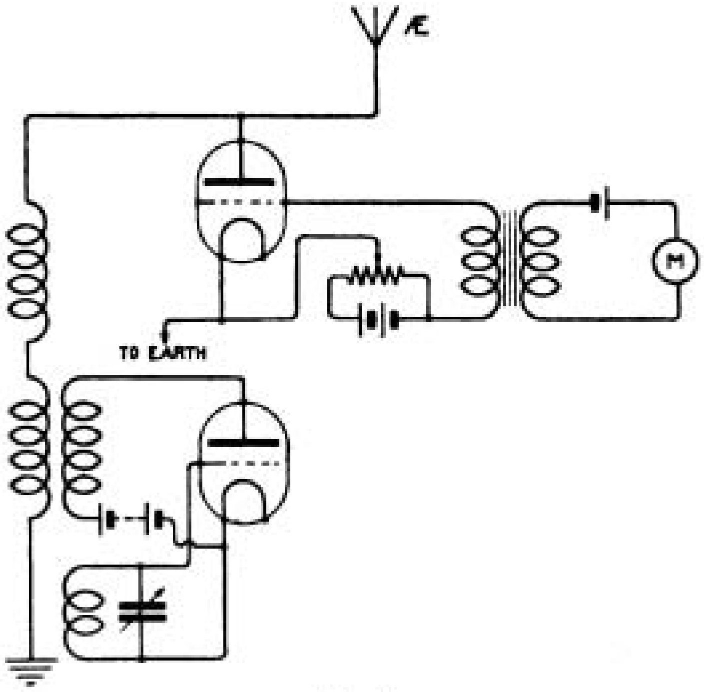


Fig. 6.

A form of microphone relay which can be used with any valve generator of continuous waves is shown in Fig. 6. The anode of the microphone control valve is connected to the aerial circuit, and thus derives its energy from the C.W. generator. When the microphone is not in use, the whole of the energy generated is radiated from the aerial. On speaking into the microphone the potential of the grid of the control valve is altered, and some of the energy in the aerial circuit is diverted into the anode of the control

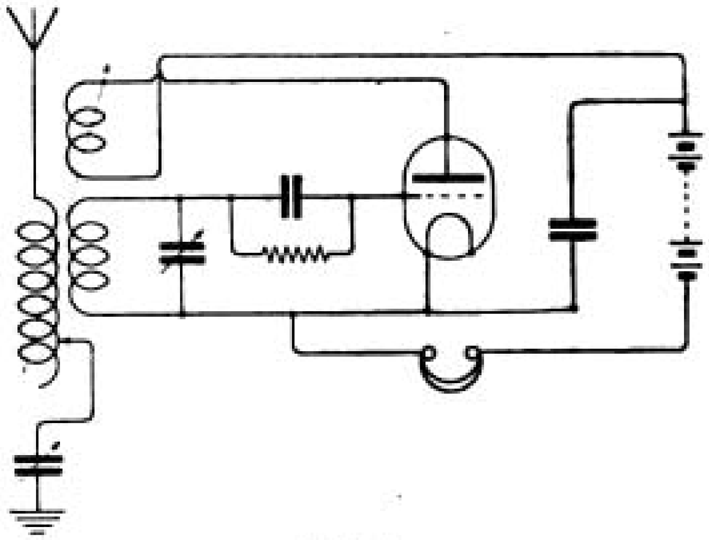


Fig. 7.

valve, thus causing a variation in the amplitude of the waves radiated.

The initial grid potential is adjusted by a potentiometer and battery. Since the frequency of the current caused by speech is low, the transformer used for stepping-up the microphone variations can have an iron core.

For the reception of wireless telephony any type of continuous wave receiver will be found suitable.

A heterodyne receiver is illustrated in Fig. 7. In order to produce "beats" for receiving continuous waves, the grid circuit must be slightly out of tune with the aerial circuit. This is accomplished by the variable condenser shown connected across the grid coil.

BOOK REVIEW

THE A B C OF STORAGE BATTERY MANAGEMENT.

By Ernest C. McKinnon, A.M.I.E.E.
London : Electrical Press, Limited. Price, 3s. 6d. net.

This book should make a strong appeal to wireless amateurs. Since the war almost all of us are using accumulators for valves, whether for reception only or transmission also, and many of us have not had the opportunity of practical training in the management of storage batteries. This little volume deals with the subject most thoroughly and is highly recommended.

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.**

CAPACITY (Peckham) *asks for details for constructing fixed capacity condensers out of pieces of copper foil measuring 1 cm. × 3 cm. with capacities of (1) ·005 mfd. (2) ·0005 mfd. (3) ·00005 mfd. (4) ·000005 mfd.*

(1) 24 plates overlapping 3 cms.

(2) 4 plates overlapping 2·3 cms.

(3) 2 plates overlapping ·7 cms.

(4) 2 plates ½ cm. wide overlapping ·6 cms.; four thicknesses of dielectric, which is supposed to be mica, 3 mils. thick; dielectric constant = 8.

A.C. (London) *asks, regarding a set which he proposes to alter (1) Whether the proposed alterations are correct. (2) Will a tighter coupling be required. (3) How much wire will be required for each coil.*

(1) Yes, but we should put the A.T.C. in parallel with the A.T.I. for long wavelengths.

(2) Yes, considerably.

(3) We cannot say, as you do not state the size of the aerial or the tuned circuit condenser. You may get some help from figures quoted in reply to various enquiries for long wave sets.

G.F.R. (Sleaford) *asks (1) Which is the correct way to connect a double slide tuning coil and variable condenser to a one-valve amplifier panel, using a variable condenser for the "beat" method of C.W. reception (sketch of panel enclosed). (2) What should be the maximum wavelength receivable by the set. (3) Would a loose coupler coil be better, and, if so, what size should it be for P. and S., to receive wavelengths of 400 to 5,000 spark, C.W. and telephony.*

(1) The panel is evidently designed for use with a two-circuit receiver, X and Y being connected to the terminals of the closed circuit, which are otherwise insulated. In your two diagrams you earth either the plate or the grid (through a condenser); both are fatal.

(2) Your information is insufficient; the space between the condenser plates is a critical factor in determining the capacity.

(3) Yes, certainly. We suggest that you make up A.T.I., coupling coil and jigger secondary, as in the April 17th article, but using your own circuit. This will give you a slightly longer range than you require, assuming that your condenser is much the same.

E.J.H. (Wareham) *sends a sketch of his set, and asks (1) Having omitted the grid leak, is it not strange that he has got excellent results. (2) Why could he not obtain variometer effect, or an appreciable change in signals. (3) What station and wavelength is SBG. (4) Is not formula 58, on page 36 of Nottage's "Calculation and Measurement of Inductance and Capacity" incorrect.*

(1) It is well known that signals can sometimes be received without a leak. Under these conditions strong signals and atmospherics are likely to give a strong negative charge to the grid, and therefore a leak is usually employed. You should regard this as a freak result.

(2) Your tuning trouble is entirely apart from the above, and points to resistance in the circuit or accidental reaction. Check connections and separate input and output ends of the valve: use short H.F. leads.

(3) s.s. Dristigheten, W/L unknown.

(4) The formula is quite correct. We cannot understand your objection.

W.A.S. (Hounslow) *asks (1) For a diagram of connections for adding two amplifying valves to his detecting valve. (2) What is the best method of receiving telephony. (3) The best way of utilising an aerial consisting of 1-22 D.C.C. hung on the picture rail round the room. (4) For formula for working out the capacity of tubular condensers.*

(1) See diagram Fig. 1.

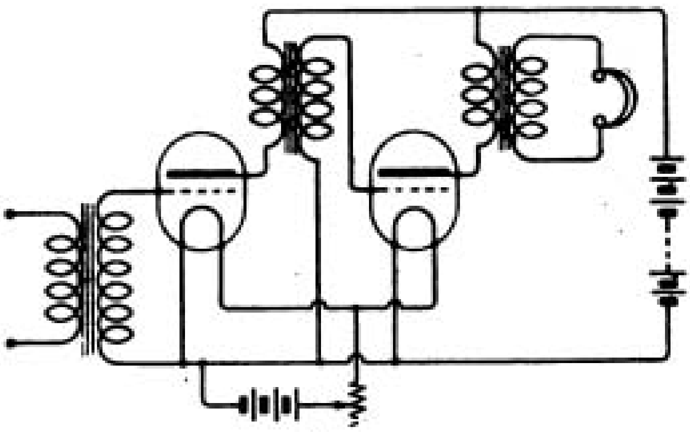


Fig. 1.

(2) Any good spark receiver is suitable for telephony; the requirements are almost exactly parallel.

(3) Put a small condenser across the terminals and use as a frame aerial. It will only be fairly efficient.

(4) Capacity in microfarads $= \dfrac{K\ l}{1{,}800{,}000 \times \log_{\epsilon} \dfrac{r^1}{r^2}}$

K being the specific inductive capacity of the dielectric, l the length in cms., r^1, the external radius, r^2 the internal radius.

C.W. (Leighton Buzzard) *sends a sketch of his set, and asks* (1) *Is the circuit correct, and could we suggest any improvements.* (2) *Size of coils and wire A and B to tune the set up to 4,000 ms.* (3) *Size of same coils to tune the set up to 8,000 ms., or size of additional coil.* (4) *Will the aerial sketched be satisfactory, and, if not, what is the cheapest aerial wire he could use.*

(1) The aerial circuit is correct; the closed circuit should be tuned with a variable condenser, and a crystal potentiometer should be differently arranged. See recent Answers to Correspondents, or, better, the article in the September, 1919, issue on Crystal Receivers.

(2) *A*, 7″ × 4″ diam., No. 22 S.W.G.
B, 9″ × 7″ diam., No. 22 S.W.G.
(with tuning condenser ·0003 mfd. maximum capacity.)

(3) *A* as before, with extra A.T.I., 16″ × 7″ diam., No. 22 S.W.G.
B, 16″ × 7″ diam., No. 28 S.W.G.

(4) Quite satisfactory.

EARTH (Tufnell Park) *asks various questions with regard to a two-circuit crystal receiver.*

(1) The circuit is quite satisfactory.

(2) The receiver will tune up to about 1,700 ms. a larger A.T.I. would increase the range of tuning.

(3) The aerial circuit is fairly satisfactory. The tuned circuit condenser should be about ·0005 mfd.

(4) The aerial is fairly satisfactory as regards dimensions, but will be much more efficient if raised to a greater height than 10 feet.

ES4-ite (Walsden) *sends a description of an aerial system, and asks* (1) *If the arrangement will be satisfactory.* (2) *If a sample of wire sent will be suitable for the aerial and earth.* (3) *If the earth plate should be copper or zinc, and if 33′ × 3′ is large enough for it.*

(1) The aerial is fairly good. The earth system shows a length of 50′ in the air to the ground, apparently followed by about 60′ more, mostly underground before reaching the earth plate. This is very bad: your results would be exceedingly poor. The 50′ length in the air is almost as long as your aerial. If possible, earth immediately under your window, either by a buried plate or by wire netting laid down on the ground, or to a water pipe in the house.

(2) The sample has not come to hand. Any copper or bronze wire, thicker than about No. 16, will do.

(3) Not important. This size will be big enough.

G.A.H. (Farnboro') *asks re a valve circuit* (1) *Does it make any difference to the signals the way in which the instruments are placed.* (2) *Why does he get stronger signals on certain adjustments when his hand is placed near the secondary coil of the loose coupler.* (3) *What is the best kind of insulated wire to use for connections, and should they be as short as possible.* (4) *The best kind and size of wire to use from the earth plate into the hut.*

(1) Not a lot, except as to how the coils are placed with regard to each other, the magnetic coupling between them depending on their relative positions.

(2) This effect is quite common, and, broadly speaking, is due to potential changes due to the capacity to earth introduced by the body.

(3) Two very good kinds are fairly stiff bare copper wire, run in air, and thin stranded cable, rubber insulated. The leads should generally be as short as possible.

(4) See reply to **ES4-ite**, above.

F.P. (Wembley Park) *encloses a diagram of his set, and asks* (1) *In cumulative rectification if the grid should be connected to the positive or negative of the filament.* (2) *If the connections should be reversed when using an A.T.C. in the earth lead.* (3) *If connection to the negative end means working at the bottom bend of the characteristic and to the positive at the top bend.* (4) *What are really the best values of the grid condenser and leak for average signals, and especially for speech, using a single French valve, in view of the discrepancies in text-books, etc.*

(1) It makes very little difference, according to our experience. It is impossible to raise the potential of the grid very much, owing to the grid current producing a volt drop across the leak.

(2) We do not think this can have any bearing on the point.

(3) No. See (1) above. The working point can in practice only be changed by altering the H.T.

(4) We can add nothing to previous replies; the point is largely one of personal preference by individual experimenters. There is no difference in the case of telephony.

S.E.C.C. (Manchester) *is constructing a receiver on the lines of that on page 477 of the October 2nd issue, and asks* (1) *The capacity of the variable condenser across the tuner, and also of the block condenser in the grid circuit.* (2) *What alterations and additions will be required to use this circuit as a telephone transmitter to work on a regulation wavelength of 180 ms. with a H.T. battery of 200 volts.* (3) *Where can he obtain a selenium cell or material for the same.*

(1) Tuning condenser ·0006 mfds. Grid condenser ·0003 mfds. (best variable). A leak of about 3 megohms may be an improvement.

(2) You might try a set on the lines of Fig. 1, page 316, of the July 24th, 1920, issue. We would advise you to include the whole of the inductance in the plate circuit of the valve, and to put your reactance in the grid circuit. This would necessitate the aerial and the earth being interchanged.

(3) We have no special information. Try any dealer in scientific instruments. Possibly Messrs. Barr & Stroud, Anniesland, Glasgow, might either supply you or give you the necessary information.

J.F.E.L. (East Ham) *asks* (1) *For information regarding a certain time signal given at 1930—1950 G.M.T.* (2) *Apart from strength, does it matter what gauge of wire is used for an aerial.*

(1) Fuller particulars are necessary to identify.

(2) The larger the gauge of wire used for an aerial the smaller is its resistance and the larger its capacity. Both points make for improvement in signals.

G.F.B. (Leeds) *asks* (1) *Approximate inductance of the following:—Primary, 1 slide, 6″ former,* *4½" diameter, 300 turns No. 26; Secondary, 7 sections 6" × 3½" diameter, 400 turns No. 30. (2) Can a reaction coil be fitted to the inductance shown in enclosed sketch for the reception of C.W. (3) What will be the approximate dimensions and amount of wire if a reactance coil can be fitted. (4) For an efficient circuit for spark, C.W., and telephony, using certain components.*

(1) Primary = 5,000 mhys.
Secondary = 11,000 mhys.

(2) Yes; put it outside the secondary. Avoid coupling with the primary more than necessary.

(3) Say 3" long by 4" diameter, wound with No. 28.

(4) See Fig. 4, page 697, in the issue for December. (A potentiometer is not necessary with a grid condenser and leak.)

RADIO (Norwich) *sends a list of gear which (1) He wishes us to combine into a receiver, and asks (2) For suggestions for alterations. (3) The probable wavelength range with a frame aerial. (4) For dimensions of frame aerial.*

(1) There are many possible circuits. A simple and fairly suitable one is that in Fig. 5, page 500.

(2) The set should be satisfactory as suggested, no alteration being necessary; any made can be dictated solely by your taste and the expense to which you are prepared to run.

(3) The expression "set of coils tuning to 30,000 ms." is misleading, and its use is to be deprecated. Any coil will tune to 30,000 ms. if you put a big enough condenser across it. The statement therefore conveys no information about the size of the coils, and we cannot say what your set will tune to. By making a fairly large frame you should, however, easily get to the efficient limit for one valve. Moreover, you will in any case find signals very weak with a frame and only one valve.

(4) See the issue for June 12th, and also the preceding issue.

ENTHUSIAST (Willesden) *asks (1) for the names of certain stations not given in the Year Book. (2) With reference to a circuit, the wiring diagram of which is enclosed, why the set does not receive on a certain tapping of the A.T.I. (3) Should he get the telephony from* PCGG. *(4) What types of winding are usually adopted on commercial sets.*

(1) OHD Vienna, IQZ Pola, FF Sofia, NGG ss. *Olympia*, NGI ss. *Chattanooga*; others not known.

(2) The presence of a short-circuited coil in the neighbourhood of a tuned circuit may have a very bad effect. Leave both ends entirely disconnected.

(3) Yes, if the aerial and earth are good and the set well made and adjusted.

(4) Various types of compact windings have been described recently in Mr. Coursey's articles; we do not know the particular windings which are employed in commercial apparatus of the kind you specify. Simple multilayer coils would in no case be used owing to their large self-capacity. Small coils have the advantages of portability and smallness of stray fields—otherwise none.

P.R.D. (Gray's Inn) *asks (1) For a diagram of a single valve receiving set consisting of certain components. (2) If a grid condenser is necessary.*

(1) For diagram see Fig. 2. A bye-pass condenser (·003 mfds.) also required across the telephones and the H.T. Construct as shown in the issue for April 3rd. (Wavemeter condenser.) Filament battery and resistance not known.

(2) Not necessary, but advisable for best results.

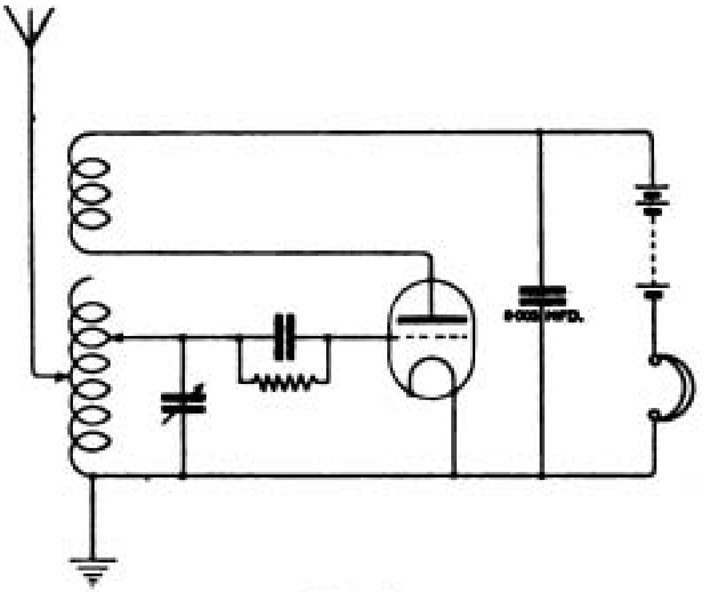


Fig. 2.

A.G.P. (London, N.4) *asks for a quantitative statement of the impedance and eddy current, and hysteresis losses in a relay, certain of the dimensions of which are given.*

We are afraid that the questions, difficult at any time, are rendered impossible of answering by the scantiness of the information you give. For instance you do not state the shape of the iron circuit nor the dimensions of the air gaps. Your losses will vary enormously with the types of iron used.

VERY INTERESTED (Middlesborough).—(1) (*a*) Quite useless.

(*b*) With a good amplifier you might get good results, but we should advise you to put your indoor aerial further from the roof, even if it has to be smaller.

(2) About 4,750 mhys. We cannot calculate the wavelength, as you do not give the distance between the plates of the condenser.

(3) See (2) above. The thickness of the dielectric must be specified. Try working it out for yourself.

(4) Your question is too general. Valves can be adapted to any circuit, the method depending on your requirements.

STUDENT (South Kensington) *has various units of gear which he wishes to make into a telephony receiving set. He asks (1) For a suitable circuit with connections. (2) What value of H.T. battery is required. (3) Should he be able to pick up the Dutch concerts.*

(1) Use a V. 24 valve as H.F. amplifier, and a Q as rectifier with filament resistance common to both. Your A.T.I. and coupler will enable you to construct a two-circuit receiver, your variable condenser being employed to tune the closed

circuit, the terminals of which should be connected to the potentiometer slider and to the grid of the V 24. One H.T. battery will supply both valves if its negative terminal is connected to the filament battery telephones and telephone transformer in the plate circuit of the Q valve, as in any standard circuit. You require, in addition, either an inter-valve transformer or a resistance capacity coupler between the two valves. Details of both have been given in *The Wireless World*. See, for instance, page 701 of the issue for March, 1920.

(2) 24 volts—better more with resistance coupling.

(3) This should be possible.

J.R. (Coulsdon).—(1) Your sketch gives no indications as to which is diameter and which is length in your coils, nor do you state the distance between the condenser plates. Wavelength estimations are therefore impossible. However, in any case 36 S.W.G. is much too small for aerial tuning purposes.

(2) Gauge of wire much more suitable, and certainly should not be smaller, but put the condenser across the whole of the A.T.I.

(3) See previous replies.

(4) Only trial and error as far as we know. Perikon detectors work without potentiometer. Most crystals can, however, be improved by its use, even if it is not essential.

W.L. (Stone) *asks* (1) *In a single circuit, double slide tuning inductance, consisting of a coil 14" long 7" diameter, of 3 S.W.G. in conjunction with one valve, will a reactance coil be advantageous. If so, what should be the dimensions of same to suit above.* (2) *In an aerial of two wires, should they be joined at both ends or in any other manner.* (3) *Will the reactance coil in No. 1 be required to traverse the full length inside tuning inductance, and if so will we give connections.* (4) *Are accumulators suitable for H.T. battery, and what voltage will suit an R valve.*

(1) Yes, if properly handled. The value depends on the efficiency of the valve, the nature of the circuit, and many other considerations impossible to account for. Try a coil 8"×4" diameter, also wound with 30 S.W.G.

(2) No. Disconnected throughout as great a part of their length as possible.

(3) This may be necessary, but it does not affect the connections. We do not understand your question.

(4) R valve works best on 70-80 volts, but 40-50 will do. Accumulators are suitable if a sufficiently high voltage battery is available. Large cells should invariably be used on the filament side of the plate circuit.

G.E.D. (Falmouth) *sends a sketch of circuit he intends to use for a three-stage amplifier, and asks* (1) *For criticism.* (2) *To make a tuner to receive wavelengths of 600-25,000 ms., would it be best to use two pancake inductances of 10,000 ms., the wavelength being varied by varying the degree of coupling.* (3) *Would a reactance with No. 2 S.S.C. on a cylinder, 12"×3", tapped off into sections working in another former, 14"×5", wound with No. 24 enamelled wire, work efficiently over the above wavelength, provided that the pancakes are in circuit.*

(1) (*a*) Put telephones in the last plate circuit only—other plates direct to H.T.

(*b*) Your valve filaments should be connected in parallel. See reactance below.

(2) No good; it is very difficult to make such a tuner. See forthcoming article.

(3) Your reactance is rightly situated to be coupled to the tuned circuit, but we cannot predict its value for such a large range of wavelengths.

J.H.S. (Liverpool) *asks* (1) *With reference to the article on capacity calculations (page 461, September 18th 1920, issue), if "A" should not denote the area of each plate and not the total area of all the plates. The latter is assumed in the first example worked out on pages 461, 462.* (2) *With reference to the second example, if the figure for Ax(n—1) (given as 441) should not be 33·5 square cms., and, further, if A=44·1 square cms., as stated, why should the area of each plate be 22·05 square cms.* (3) *With reference to the capacities of block condensers described in the article on page 404 of November 11th, 1920, issue, whether the standard formula is applicable, as the figures do not appear to agree with the results obtained by calculation.*

(1) You are quite right. A in the formula is most certainly the area of each plate.

(2) We agree with your calculations. The same mistake seems to have been made with regard to A.

(3) The formula should be applicable; the condensers in question appear to have capacity values far below the values stated in the article.

A.S. (Altrincham) *sends a specification of a honeycomb coil coupler with reactance, and asks if it will tune in anything going, or telephony.*

You have omitted a critical item in the specification of the coils, viz., the number of "spokes" per layer, on which the total number of turns depends. For a reasonable number of "spokes" the inductance of 30-layer honeycombs on a 2" core will be too great for the tuning of short-wave stations. Your set might possibly have a range of approximately 1,000 to 6,000 ms, but the exact values will, of course, depend on the condensers, etc., employed.

P.H.J. (Clapton Common).

(1) Yes, except for potentiometer, for connections of which, see Fig. 10, page 502.

(2) Maximum for aerial circuit about 1,000 ms, closed circuit 1,800 ms. You can bring up the wavelength of either circuit by adding a coil to it.

(3) Carborundum. It is not necessary to have different types for telephony and telegraphy.

(4) (*a*) Fairly (*b*) Very little,

W.E.W. (Trent Bridge) *sends a dimensioned sketch of a single valve set, and asks* (1) *If he could use a telephone induction coil for a telephone transformer.* (2) *If not, for instructions for making one.* (3) *If his circuit is suitable for a range of up to 5,000 ms.* (4) *How to connect up the telephone transformer.*

(1) The windings will most probably be quite unsuitable.

(2) See issue for March last.

(3) You will probably require more A.T.I.—or a small condenser in parallel with your present one. Otherwise O.K.

(4) Connect the high resistance side in the plate circuit, and the low resistance across the L.R. telephones.—(*N.B.*—If your telephones are 8,000 ohms, you should dispense with a transformer. There is very little risk of burning out H.R. telephones in series with the H.T. battery, except by rank carelessness.)

C.W. (Sunderland).

(1) Yes, except for potentiometer, for which see Fig. 1, page 662 in issue of December 11th.

(2) T = 8000 mfds.
C^1. = ·0005 mfds.—variable.
C^2. = ·0012 mfds.

(3) If you introduced an additional A.T.I., about 8″ × 6″ of No. 22, maximum about 3,500 ms., minimum uncertain.

(4) Set is of quite good type.

C.W. (Leeds) *sends a dimensioned sketch of a receiver, and asks* (1) *For criticism, and any suggested improvements.* (2) *What would be the maximum wavelength of set.* (3) *Could a single valve with batteries be inserted into the circuit to act both as amplifier and rectifier. If so, how.* (4) *Could both C.W. and spark be then received, and if not what alterations would be necessary for C.W.*

(1) Your wires are too thin. Primary of coupler should be about No. 24 and secondary No. 28, or No. 30.

(2) Add A.T.I. about 12″ by 8″ wound with No. 24. The wavelength will then be up to about 5,000 ms.

(3) See the constructional article in the issue for April 17th last.

(4) The set referred to will receive C.W. as well as spark.

G.A.H. (Farnboro') *asks* (1) *For the capacity of an aerial.* (2) *Will a 24″ cardboard former be suitable for use as a loading coil with the above aerial, and if so, what size enamelled copper wire should it be wound with.* (3) *Would a ·303 mfd. variable air condenser serve a better purpose if used in the aerial circuit instead of in the secondary, using a ·0005 mfd. for the latter.* (4) *To what purpose can he put a condenser fixed capacity ·05 mfds.*

(1) As you have omitted to state the length of aerial we are unable to say; moreover, with this shape it would be very difficult to calculate accurately. If full length, capacity is about ·00015 mfds.

(2) Fairly, if well shellaced, and if of diameter of less than 4″. Use about No. 24.

(3) We think you mean a ·0003 mfd. condenser, as one of ·303 mfd. capacity would be very bulky, ·0003 mfds. would be quite suitable for the circuit.

(4) Possibly as a blocking condenser for telephones.

S.K. (Altofts) *asks for a good circuit for transmission of C.W. or telephony.* (2) *Is an ordinary H.T. battery sufficient to give 10 watts, if not, what is the best method of obtaining this.* (3) *Details of a good microphone. Can a suitable one be purchased.* (4) *Approximate wavelength range, using 1 R valve transmitter (good aerial) and 1 R valve receiver (short portable aerial).*

(1) See article on page 316, July 24th issue.

(2) We doubt if you will get 10 watts easily with an R valve. We should prefer a B or other high tension valve. However, a battery for the H.T. will be quite capable of supplying all the power the circuit will take.

(3) We have not space for a detailed description. Suitable microphones can certainly be purchased. Consult advertisers.

(4) Almost impossible to give a figure; possibly up to a dozen miles.

GOYLOS (Wembley).—(1) Yes, use as thin ebonite as possible.

(2) Probably, though ebonite is by no means necessary.

(3) The windings you suggest will be satisfactory. 2,500 yards of No. 44 will have a resistance of about 7,500 ohms.

(4) We are afraid this is outside the scope of these columns.

N.N. (Newcastle) *asks for a diagram of a simple Telefunken set to tune to say from 300 to 6,000 ms., using an electrolytic detector.*

Apart from recent valve developments the usual Telefunken receiver for fairly long waves was of quite normal crystal type, similar to many given in these columns. Special connections were used for short wave lengths (see Stanley's *Wireless Telegraphy*, Vol. I, page 357). You can of course use an electrolytic detector in place of the crystal if you prefer it.

MIDGE (Chelmsford).—(1) You do not state the shape of the plates, if semicircular, and figures are diameters.

A = ·00025 mfds.
B = ·00013 mfds.
C = ·00029 mfds.

(2) See page 65 of the issue for April 17th last—obtainable from the Wireless Press.

(3) We think not.

A.F.G. (Kettering) *gets poor results from a crystal set, and asks* (1) *If it is due to a wire net earth, 3′ × 3½′, buried 1′.* (2) *The inductance of a coil 12½″ × 4″, wound with No. 28.* (3) *How results would be improved by the use of a valve for rectification.*

(1) Very probably—use a valve for plate this size or considerably more netting. Or try about 40 square yards of fine mesh netting laid on the ground.

(2) 17,000 mhys.

(3) On a set of this type one valve instead of a crystal will not improve matters very much.

J.T. (Bridlington).—(1) The inductances are—primary, 7,500 mhys; secondary, 12,500 mhys. The expression "wavelength of a loose coupler" is meaningless.

(2) 28″ by 14″.

(3) Yes, in parallel with the A.T.I. Condenser ·003 mfds. Inductance, 12″ × 7″ of No. 26.

(4) If the set is working excellently we should leave it alone. If you want a change, try a different type of circuit altogether.

R.C. (Belfast) *sends a sketch of a proposed set for criticism, and asks* (1) *Would good results be obtained from it, and what would be the probable wavelength range.* (2) *Suitable capacities for the* *aerial circuit condenser and stopping condenser.* (3) *Required potentiometer resistance for cutting down current from dry cells.*

(1) (*a*) Your aerial is unsatisfactory; the two inside wires are not worth putting up in your present arrangement, and your aerial circuit will only tune to about 1,000 ms., whereas your closed circuit tunes to about 6,000 ms. Try the same length of wire, twin or single.

(*b*) Your detector circuit is not satisfactory. It is far better to put the "stopping condenser" across the telephones and the crystal in series with the telephones and potentiometer. See many circuits shown in *The Wireless World.*

(2) Aerial tuning condenser —·01 mfds. Stopping condenser —·003 mfds.

(3) About 300 ohms.

G.A.H. (Farnborough).—(1) We assume your closed circuit condenser is ·0003 mfds. and not ·303 mfds. The latter value being quite impossibly large under these conditions. You should receive signals of 1,000 ms. wavelength and under. Your set is correct except for the 8 pancakes in the anode circuit of the valve. These fulfil no useful purpose unless they are coupled to the closed circuit, and one small coil alone is sufficient for this purpose.

(2) "Step up" far too big. A good "prescription" is ½ oz. and 1½ oz. of No. 44 S.W.G. for the primary and secondary windings respectively.

(3) It depends on the wavelength. You might add a loading inductance in the closed circuit.

(4) Yes, they can be used with a telephone transformer, but they will be somewhat insensitive.

E.W.L. (Liverpool) *asks various questions about a valve and crystal receiver.*

(1) and (2) You cannot do better than use the circuit of page 65, of the issue of April 17th, which you say you have already seen. You will need all the apparatus there shown, except possibly the A.T.C., which is not essential. Your coils will do for the aerial circuit, but you will require a new closed circuit coil as described in the article.

(3) The wavelength range will be about as in the receiver described.

(4) About 12″.

J.W. (Halifax) *asks for further details as to the construction of a loud speaking telephone as described for* **"GRID" (Manchester)** *in the issue of October 16th, page* 530.

We regret that we have no further details of this instrument, but do not think it should be hard to arrive at suitable values by experiment. For instance, we should, for a start, try a mica diaphragm say 3″ in diameter with a moving coil of No. 44 wire in a flat pancake, fastened by flake shellac, using as many turns as can be carried without unduly loading the diaphragm.

J.T. (Venlo, Holland) *asks* (1) *If a certain diagram is suitable for a receiver, using honeycomb coils.* (2) *If we can give a more efficient diagram.* (3) *When* MPD *and* BYC *transmit.*

(1) Yes, in principle, quite sound, but see (2) below.

(2) Your secondary coil should be placed on the same side of its switch as the secondary tuning condenser—it will then be thrown completely out of circuit when you are receiving with the aerial circuit only. You should further use a grid leak and you might advantageously put your blocking condenser also across the H.T. battery.

(3) MPD at 12 noon and 8 p.m.

BYC, 12 noon, 8 p.m. and 12 midnight.

H.B.D. (Brod.) *asks* (1) *For the inductance values of certain pancake coils.* (2) *For a formula for calculating the inductance of this type of coil.*

(1) Coil A = 4,000 mhys.
B = 3,300 mhys.
C = 4,300 mhys. } Approximately.
D = 3,500 mhys.
E = 15,700 mhys.

(2) The inductance is roughly equal to that of a cylindrical coil of the same number of turns, wound on a former whose diameter is a mean of the internal and external diameter of the coil.

INVITA MINERVA (Liverpool) *has bought one copy of "The Wireless World" and asks two questions, re the set in Fig. 17, page 614, of the issue of November 17, and* (2) *for the capacity of two condensers.*

(1) and (2) In the letterpress to this diagram you will find references to recent numbers, which will give you all the information for which you ask. We are quite unable to find space to reproduce a large amount of matter, which is so easily accessible and to which the necessary references have been given.

(3) About ·0001 mfds. each, suitable for C1, but not for C2.

F.P. (Wembley Park) *asks* (1) *The natural wavelength of a single wire P.M.G. aerial.* (2) *If the capacity is ·0002 mfds. what is the inductance.* (3) *If the placing of a condenser in parallel with an inductance added to an aerial is equivalent to having the capacity of the aerial and the condenser in parallel across the total inductance of the aerial and coil.*

(1) About 130 ms.

(2) Generally about 60 mhys. N.B. The formula is not applicable to a circuit of this type in which the inductance and capacity are distributed.

(3) For values of the added capacity and inductance, which are likely to be used in practice, this method gives results sufficiently nearly accurate to be quite useful.

W.E.U. (Fleetwood).—(1) You do not state the S.W.G. of the wire, so we cannot give the wavelength. Apart from this, your diagram shows the crystal in parallel with the telephones. This is incorrect. They should be connected in series.

(2) Yes

(3) It should not be very bad.

SHARE MARKET REPORT.

Business in the Wireless Group has been quiet during the last fortnight. Prices as we go to press, February 24th, are :—

Marconi	Ordinary	£1 - 17 - 6
,,	Preference	£1 - 16 - 3
,,	Inter. Marine	£1 - 4 - 4½
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The WIRELESS WORLD

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THE WIRELESS WORLD

THE OFFICIAL ORGAN OF THE WIRELESS SOCIETY OF LONDON

Vol. VIII. No. 26. MARCH 19th, 1921 Fortnightly

THE MARK III TUNER

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

(*Continued from page* 826.)

IN addition to the methods that have already been considered for modifying the Mark III tuner, we have to deal with Nos. 4, 5 and 6 on the list given in the first part of this article. (*See* last issue of *The Wireless World*).

(4) *and* (5) *Addition of two Loading Coils.*

Under section (1) in the first part of this article it was pointed out that a loading coil of 5,000 microhenries would be required to directly load up the aerial circuit to 2,500 metres, or that, if the aerial condenser was placed in parallel with this coil, as shown by Fig. 5 on page 825, the maximum wavelength would be increased to 6,000 metres.

If we require to tune up the closed circuit to the same wavelength value, the inductance required will be 20,000 microhenries. A coil of this inductance would be inconveniently large if wound as a single-layer solenoid, so that a multilayer winding must usually be adopted. A "honeycomb," or "duolateral," winding may be adopted, as also could the winding described on page 635 of *The Wireless World* for December 11th, 1920,* whichever is preferred.

A somewhat simpler coil winding for calculating purposes is that illustrated in Figs. 6 or 8 of the article on "Multilayer Windings" in *The Wireless World* for October 16th, 1920. In our case we should obtain sufficient inductance if we wound a pancake type of coil with No. 36 S.C.C. wire, using a thread of thickness equal to that of the insulated wire (viz., 0·011 inch) between adjacent turns, and a layer spacing of the same amount, with a mean coil diameter of 10 cms. and 36 layers of 11 turns per layer (Fig. 6). The spacing between the layers may, if desired, be a uniform layer of thread of the same thickness as used for separating the turns on each layer, or, better, a layer of oiled silk tape or similar insulation of the proper thickness (0·011 inch) may be wound on over each layer of wire.

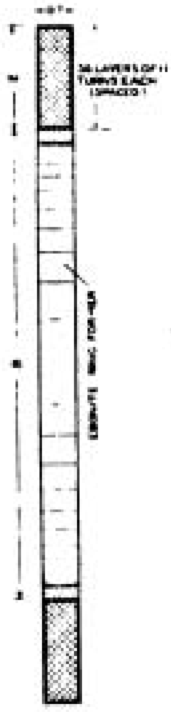


Fig. 6.

This coil, or a similar one, must be inserted into the closed circuit between the existing inductance and condenser. A convenient place is to cut the wire joining the switch arm of the C.C.I. switch to the top right hand contact of the "tune" side of the change-over switch (looking at the panel from underneath). The ends of the cut wire may be brought out to the new coil (which may, if desired, be housed in the telephone space X Y, Fig. 2, page 824), or, if the terminals T_1 and T_2,

* Coils wound in this manner are marketed in this country under the trade name of "Burndept" Coils.

described in connection with the above-mentioned Fig. 2 (in the first part of the article) have not been used, these two wire ends may be connected to two terminals mounted in the positions T_1 and T_2 shown in that diagram.

Tappings should be brought out from this coil at the ends of the fourth and twelfth layers to a 4-way switch, so that either 0, 4, 12 or 36 layers may be inserted in the circuit at will. The capacity range of the closed circuit tuning condenser serves to cover the wavelength range between the tapping points.

This coil gives a wavelength range of 6,000 metres in the closed circuit. If, however, it is desired to increase this range still more, the value of the inductance required can easily be calculated from the approximate formula—

$$L = 0{\cdot}00056\,\lambda^2$$

where λ is the maximum wavelength required in metres, and the inductance L is in microhenries. A multilayer coil or coils can then be built on the lines described above, or a coil of the proper inductance can be purchased.

(6) *Mounting in the Instrument.*

The most convenient place for mounting the extra coils is in the space to the left of the instrument that is primarily intended for the storage of the telephone receivers. This space is marked X Y in Fig. 2 in the first part of this article. This position is also convenient for their connection to the terminals inserted near the "tune"—"stand-by" switch, as mentioned above. The coil of approximately 20,000 microhenries, of which details are given above, could be mounted in this space, but would project slightly into the recess of the lid. This could be avoided by reducing the internal dimension of the coil (Fig. 6) from 9 cms. to 7 cms., and at the same time increasing the number of turns per layer to 14, leaving the total number of layers the same as before. A piece of ebonite can then be fitted over the pace so as to enclose the coil, and the four-way tapping switch for the coil mounted on its top.

The extra aerial loading inductance, described in connection with the first part of this article, could also be mounted in this same space, if instead of constructing it as a single-layer solenoid it is built up in the same way as the above closed-circuit inductance, on the same size former, and using the same size of wire and spacing thread, but winding only 13 layers of 14 turns per layer. This coil also should be provided with four or five tapping points, disposed approximately uniformly throughout the coil and connected to a multi-way switch, so that the whole wavelength range may be covered between the lowest and the highest by means of the aerial circuit condenser fitted in the instrument.

If loading coils such as the above are fitted into the instrument it will be found that unless some additional coupling is provided between them, the existing coupling coils included in the instrument will be insufficient to provide adequate coupling between the aerial and closed circuits. This additional coupling may be obtained by mounting the two coils near one another in the space XY, as described, but provision should be made for varying the coupling by altering the relative positions of the coils.

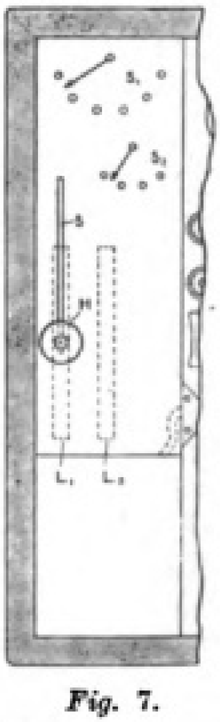


Fig. 7.

One way in which this may be effected is to mount the extra coil for the secondary in a vertical position close up to the partition between the space X Y and the remainder of the instrument, and to mount the aerial coil on a carrier so that it can be moved past the end of the fixed coil by means of a handle running in a slot (Fig. 7). In this diagram the fixed coil is indicated by the dotted lines L_1, and the movable coil (in the aerial circuit) by L_2. This coil can be moved along the slot S by the handle H. The positions of the multi-way switches for the aerial and closed circuit coils are indicated by S_1 and S_2 respectively.

Other ways in which the coupling may be suitably varied will be obvious to the user of the instrument.

Another slight variation on this arrangement may be effected by entirely scrapping the existing coils in the instrument and replacing them by two pancake or multilayer coils of the type just described, fixing one in the position of the original fixed coil and mounting the other on the coupling handle, so that it can be rotated relatively to the first coil, so as to vary the coupling between the two. Tappings from these coils could be brought out to the A.T.I. and I.C.C. switches as in the case of the existing coils.

Although the conversion of this tuner to extremely long wavelengths has not been considered in this article, the method that may be adopted is merely an extension of that described, the necessary inductances for the secondary circuit being calculated from the formula given above for the closed circuit, and the results thus obtained being divided by 3½ to obtain the values of aerial circuit inductances.* If required, approximate dimensions for the coils may be calculated by the curves published by the present writer, which were reproduced in the September, 1919, issue of *The Wireless World*. The curves there given are *approximately* correct for most ordinary forms of multilayer winding.

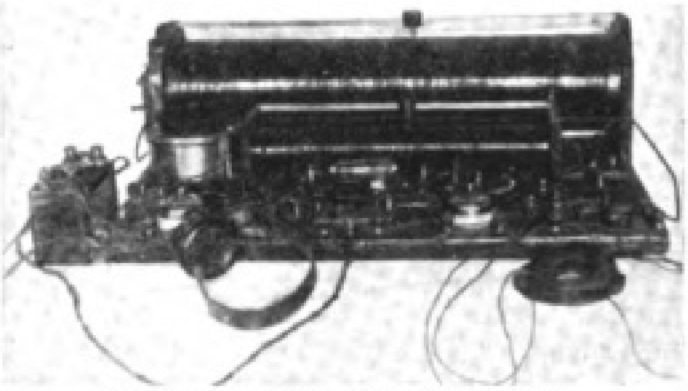
It is not, however, recommended that too high a wavelength range should be aimed at for a single instrument, as it is more efficient to employ a number of separate instruments (two or three at least) for various wavelength ranges, each set being designed so as to be most efficient for its own range of wavelengths.

AN AMATEUR'S RECEIVING STATION AT SOUTHEND-ON-SEA

THE illustration shows a receiving set made and fitted up by Mr. F. C. Anderson, of Southend-on-Sea, who is 15 years of age.

With the large tuning coil a wavelength of 4,000 metres can be reached. For higher wavelengths it is used in series with a slab inductance (in the right-hand corner), and a variable condenser (on the left) of ·0005 mfds. This condenser can be used in parallel or series by a switch. The small coil is for low wavelengths. The valve is a Marconi V24, with a plate voltage of 24, and filament 4. The two tumbler switches are for filament and plate batteries respectively. The grid condenser is of ·00005 mfds. (on the right), no grid leak being used The telephone was a low tension of 70 ohms, but rewound to 4,000, and has given satisfactory results.

The set has received Moscow, Budapest and Paris, and Nauen time signals can be read daily. There are two aerials, outdoor and indoor. The former a single line,



The arrangement of the Apparatus.

28 feet one end and 16 feet the other in height and 100 feet in length. The latter is a three-lined loop 33 feet long in all. Good results are obtained on both.

* Assuming that the aerial condenser change-over switch has been fitted as already described.

A ROTARY FILAMENT RHEOSTAT

By E. W. Kitchin, A.M.I.C.E.

A ROTARY resistance for controlling the filament current in a valve circuit is much more convenient than the usual sliding type. The following design rotates a coil of resistance wire against a fixed but springy contact, a very smooth-working instrument being produced, which will allow of very close adjustment of the current. With a slight modification in the construction a potentiometer can be made.

A length of 8 to 10 ft. of No. 25 S.W.G. Eureka resistance wire is required, or similar wire, having about the same resistance. The wire should be coiled tightly and evenly round a piece of metal rod, $\frac{1}{8}$ of an inch in diameter, and should be wound so that adjacent coils touch. The winding is best done in a lathe; indeed, that tool is essential for the construction of the instrument here described. After being wound the coil will spring out to a slightly larger diameter, and can then be easily removed from the rod. Turn up a piece of hard wood to about the dimensions and section given in Fig. 1. If appearance is to be considered

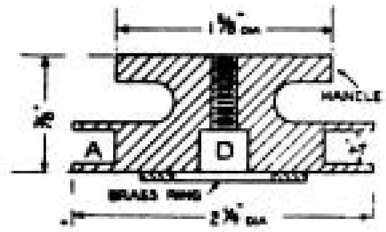


Fig. 1.

ebonite may be used, or an ebonite handle and top may be made separately and attached to the lower wooden portion. The groove A (Fig. 1) is to be filled later with heat-resisting material to carry the coil. A flat ring of brass, $\frac{1}{16}$ in. thick, should be screwed, as shown, to the underside, the screw heads being countersunk.

A piece of straight metal rod, about $\frac{5}{16}$ in. in diameter and screw-threaded about $\frac{3}{4}$ in. at one end, is screwed into the handle from underneath; it should be a tight fit, and any excess projecting is cut off and the end slightly riveted over. If it does not fit tightly it will be necessary to insert a set-screw to hold it fast. The lower end of this rod should project about $\frac{1}{4}$ in. below the brass ring, and should be threaded for nearly this length, so as to take a nut. The rod forms a spindle for the apparatus to rotate on.

The base for the rheostat may be of ebonite, and should have a hole drilled right through the middle, large enough to allow the nut on the end of the spindle to be turned. Two terminals are fixed on the base in convenient positions. From one runs a piece of brass $\frac{1}{16}$ in. thick, with a $\frac{5}{16}$ in. hole for the spindle to pass through. This piece of brass makes contact with the flat brass ring, and should, therefore, be of suitable width for the purpose. It should be screwed firmly to the base, as the hole in it forms a bearing for the spindle.

Having proceeded thus far the coiled wire may next be fitted. The groove marked A in Fig. 1 should be filled quite full with best plaster of paris, made into a thick paste: it should be pressed well in and allowed to harden. When set the whole should be placed in a lathe, a rounded groove to fit the coiled Eureka wire turned in the plaster, and the edges turned true. The wood at the sides may with advantage be turned down now, so that the plaster projects $\frac{1}{8}$ in. or more beyond the wood.

If available, perhaps better than plaster of paris is a certain make of fire-clay; this can be purchased in tins, in the form of a paste, and it sets very hard without any baking. If this be used the groove for the coil must be turned in it *before* the material has set too hard.

Now drill two holes radially right through the plaster and into the wood, about half-an-inch apart; tap them, and screw into each a short length of brass wire with a screw-thread the whole of its length, allowing it to project at least $\frac{1}{4}$ in. above the bottom of the groove in the plaster. These have attached to them the ends of the wire coil, and they also act as stops.

It is necessary next to form a solid metal end to the wire coil, so that the coil may be cut out when no resistance at all is required in the circuit. Take a piece of brass wire of the same gauge as the external diameter of the coil, and shape it, as in Fig. 2 (*a*), noting that it must follow the curve of the groove in the plaster and lie snugly therein.

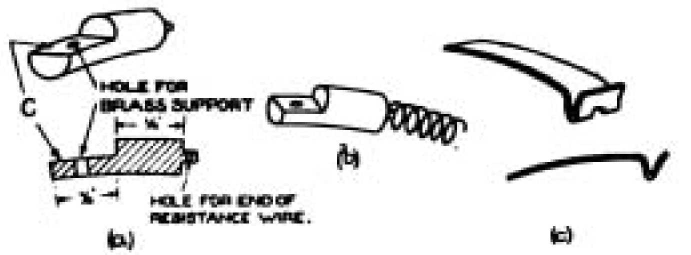


Fig. 2.

Thread one end of the wire coil through the hole indicated, and twist it round the short brass neck so as to make it hold firmly (Fig. 2 (*b*)). Place the end C (Fig. 2 (*a*)) on one of the radial supports, and fasten it on with a small nut.

Now, keeping sufficient tension on the coiled wire to separate its turns slightly, lay it gradually into its position in the plaster groove. When the other radial support is reached twist the wire round it and screw on a small nut, cutting off any coiled wire in excess of requirements.

Connection must be made between the coil and the flat brass ring underneath : to do this run a wire of about No. 22 S.W.G. from C (Fig. 2 (*a*)) to the ring, flatten the end of the wire, and push it under the ring, having previously loosened the screws. Screw the ring tight, and do not allow the wire to raise the ring appreciably higher on one side than the other. Should it do so, either sink the wire somewhat in the wood or pack up the ring equally in two other places.

The coil on its support is now ready to be assembled on the base. A fairly strong spiral compression spring, about $\frac{5}{8}$ in. long, is required ; it should fit loosely on the spindle and be capable of entering the recess D (Fig. 1).

Force the rotary portion on to the base, compressing the spring, and screw a nut on the end of the spindle from the underside of the base. The top should now be attached to the base, and capable of rotation on the spindle when the handle is turned.

A contact has now to be made to press against the coiled wire. This will need a piece of springy brass about 2 in. long, which should be shaped somewhat as in Fig. 2 (*c*), the V-shaped end being grooved out with a round file to accommodate the coiled wire. The width of metal to bear on the coil should be about $\frac{1}{8}$ in., and the edges should be rounded off so that the actual bearing will be less than that. The other end of the spring brass strip may be screwed to, or soldered in a slot in, a vertical metal pillar fixed in a convenient position on the base ; a wire or metal strip connecting the pillar to the second terminal.

The contact should only press on the coil with sufficient force to ensure that it touches, and it should be as smooth as possible.

This design of rheostat will be found very convenient to use and smooth in action, and lends itself admirably to incorporation in a complete receiving set where compactness is desired.

As stated at the beginning of this article a potentiometer may be constructed on similar lines. To do this add a third terminal and take the two ends of the coil to *two* flat brass rings underneath. As these will be concentric the inner one must be connected to its terminal by a wire under the base.

THE NODON ELECTROLYTIC RECTIFIER*

By H. Lloyd.

I HAVE no doubt that there are many who, like myself, feel the need for something more reliable and less expensive than the pocket lamp batteries generally used for supplying current to the plate circuit of valve receivers. It is not very often that I want to give a demonstration at home to non-wireless friends, but more than once have I been let down by the vagaries of the "B" battery, as the Americans call it.

If you are fortunate enough to have the town electricity in your house, it is somewhat tantalising to feel that close at hand there is any amount of the stuff you require, if only you could get it into a suitable form, and I hope to convince you that, given an A.C. lighting supply, it is possible to dispense for ever with the dry battery for plate current. The apparatus is of compact form and quite portable, the actual construction being quite within the capacity of any amateur.

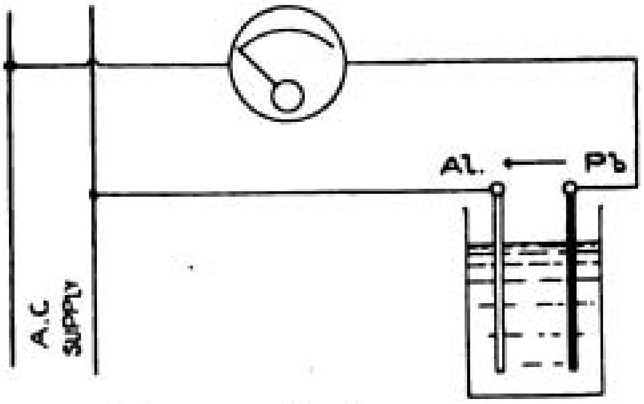


Fig. 1.

The simplest Nodon rectifier consists of a pair of plates, one being aluminium and the other preferably lead, immersed in an electrolyte (see Fig. 1). With a suitable solution, such a cell possesses very marked unidirectional conductivity. Current passes quite easily through the cell from lead to aluminium, but practically none will pass in the reverse direction. To try to explain how this is, would be to plunge into colloid chemistry, but it is sufficient to say that whilst for voltages between 30 and 60, a solution of a salt of a dibasic acid is satisfactory, for higher pressures up to 200 volts, trivalent ions, such as phosphates, citrates or borates, become necessary for efficient working.†

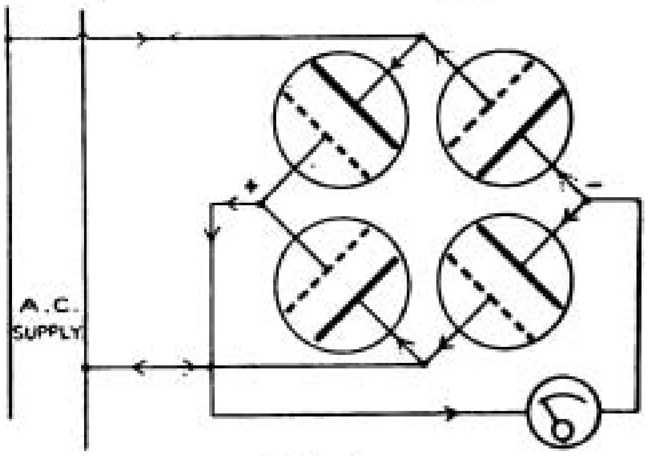


Fig. 2.

In a circuit containing one of these cells, and supplied with alternating pressure, a pulsating unidirectional current will flow, one-half of each current cycle being almost completely suppressed.

Full-wave rectification can be obtained by using four cells connected in a meshwork as shown in Fig. 2. Following out the circuit it can be seen how, from an alternating supply, a direct current may be obtained, which, although not steady, can be used to charge accumulators.

Using a saturated solution of sodium phosphate, and a full-wave rectifier made up in four jam jars, an average efficiency of 50 per cent. has been obtained for a charging rate of about 2 amperes. The A.C. pressure was 100 volts. The chief trouble experienced

* *A Paper read before the Sheffield and District Wireless Society, on February 4th, 1921.*

† *A Solution of Ammonium Phosphate is commonly employed.*—Ed.

was the rapid heating of the electrolyte, and this could be overcome, either by using larger cells, or by water cooling. The maximum efficiency seems to be reached at a temperature of about 30°C., and above this value it begins to fall off rapidly.

As a solution to the plate current difficulty, however, I have found the aluminium rectifier a highly interesting and satisfactory proposition. A battery of accumulators, lent to me by Mr. Jackson, has been in use for many months. The cells shown in Fig. 3 are made up in test-tubes, embedded in paraffin wax, and the tops of the tubes have also been dipped in melted wax to prevent creeping of the acid. The elements are strips of lead, and the acid is the regular accumulator acid of 1·2 specific gravity.

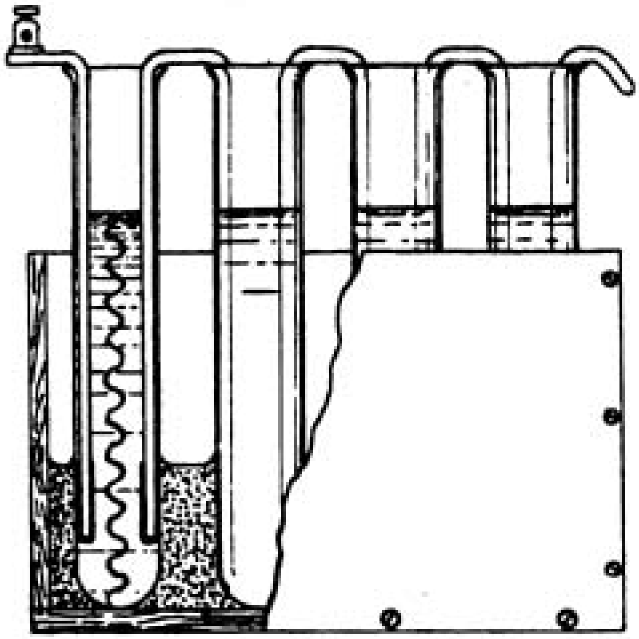


Fig. 3.

There are 24 cells in this battery. Initially, the battery was charged and discharged several times to form the plates. The lead strips should be waxed not only at the tops, but also at the lower extremities for a short distance. This reduces the disintegration of the plates, and if the strips are of such a length that they do not reach quite to the bottom of the tube, internal leakage is minimised, and the cells do not have to be cleaned out so frequently.

The rectifier, which I shall describe, charges this accumulator from the town mains in about five minutes, and the charge is sufficient to supply three valves for half-an-hour.

The rectifier is supplied from a small transformer, which reduces the pressure from 200 volts to 70 volts. The transformer core is of laminated soft iron of

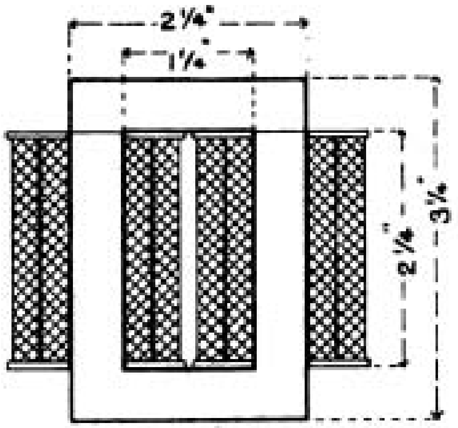


Fig. 4.

cross section, ½" square, and other dimensions as shown in Fig. 4.

The bobbins are built up from presspahn sheet, and on each bobbin, half the primary winding is wound, and then half the secondary. The windings are separated by a layer of Empire cloth, and are impregnated with shellac varnish and baked. The primary winding is of 36 gauge silk-covered wire, the total number of turns being 6,000. The secondary is 28 gauge wire and 2,200 turns.

The rectifier is made from an old

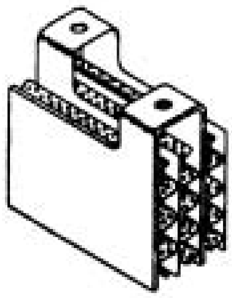


Fig. 5.

accumulator case, fitted with celluloid partitions dividing it into four compartments.

The sketch, Fig. 5, shows the assembly of the plates in each cell, with corrugated ebonite separators between. I use for the electrolyte, a saturated solution of sodium hydrogen carbonate. With this rectifier it is possible to dispense even with the accumulators, and I have made up a high-tension unit which works quite satisfactorily (see Fig. 6).

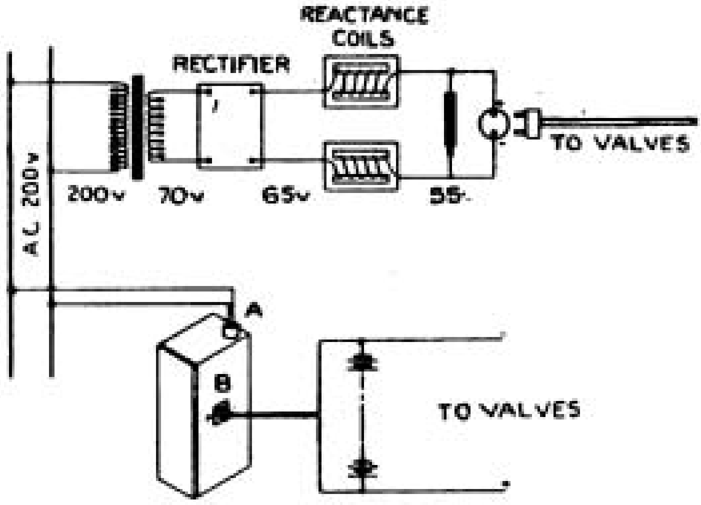


Fig. 6.

The box contains the transformer, the rectifier, and, in addition, a condenser and two reactance coils. Each reactance consists of 1 lb. of 40-gauge enamelled copper wire, wound on a closed iron core, and one coil is connected in each of the D.C. leads from this rectifier to the output terminals. Across these terminals the condenser, of 4 mfd. capacity, is also connected.

At any rate, I do not intend to buy any more pocket lamp batteries, and at present I find that the arrangement shown in Fig. 6 gives absolutely everything I want. For normal listening in, the rectifier is kept working, so as to keep the battery on charge, and if I wish to reach a particularly faint station, I pull out the D.C. plug "B" and run on the battery alone. This is very rarely necessary, however, but is useful for faint telephony and spark, as the A.C. noises are more pronounced when working off the oscillation point of an autodyne circuit.

This seems to be the case with ordinary induced A.C. noises, and it would be interesting to hear of any theories formed as to the reasons for this.

TRANSATLANTIC AMATEUR WIRELESS

Award of Prize for Best Description of Receiving Apparatus.

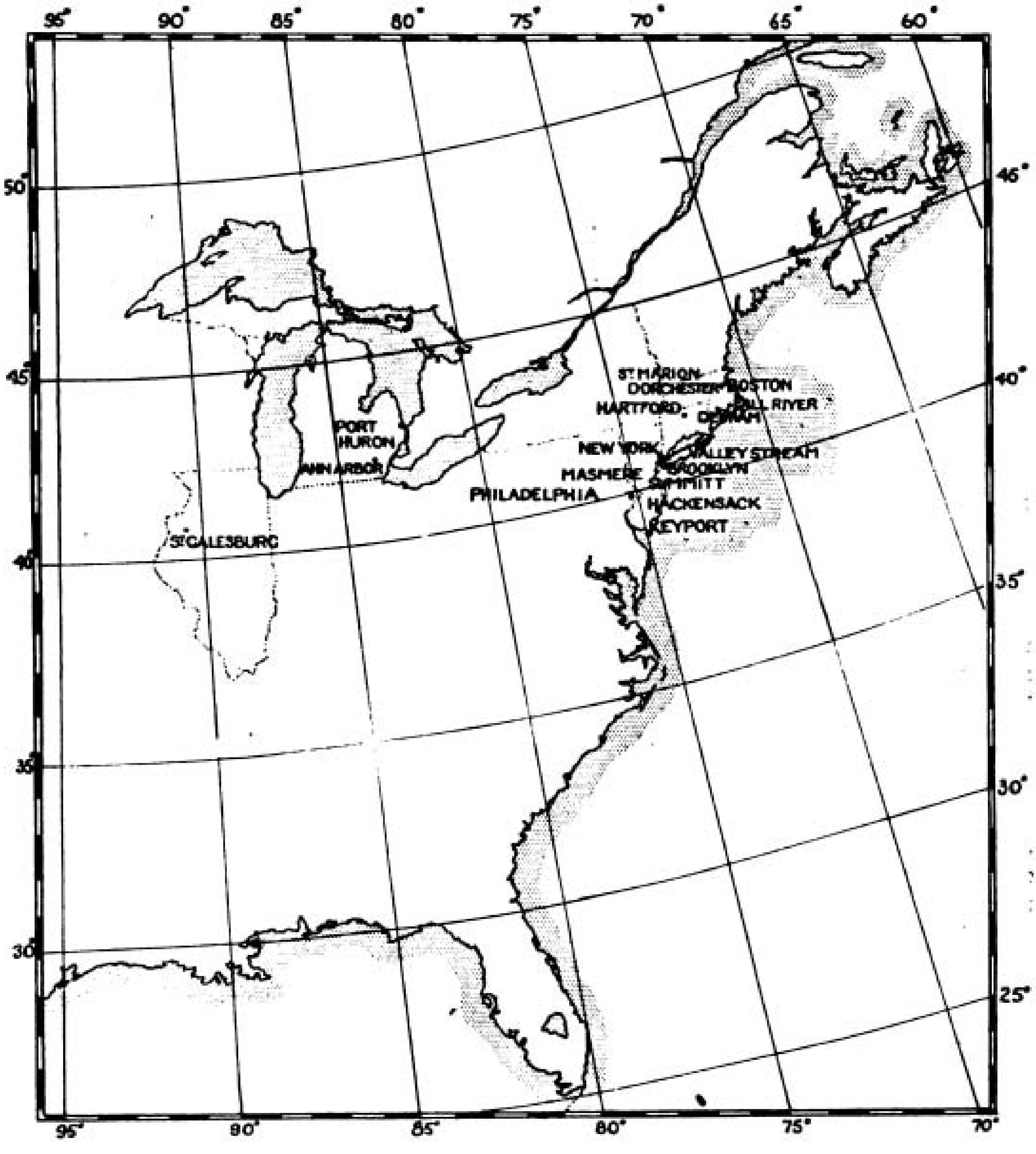
As we have already announced in our last issue, no competitor was successful in receiving the trans-Atlantic test signals transmitted by the American Amateur Wireless Stations on the 2nd, 4th and 6th of February.

In addition to the prizes offered for the actual reception of the signals it will be remembered that Messrs. Burnham & Co. offered their prize of a three-valve amplifier for the best description, to be published in *The Wireless World*, of apparatus used in the attempt, should no competitor be successful in the reception of the signals.

In the opinion of the judges this prize has been easily won by Mr. W. R. Wade, M.I.Mech.E., A.M.Inst.C.E., of 6, West Mall, Clifton, Bristol, a description of whose station, with a photograph and diagram of connections, will be published in an early issue.

Not only is Mr. Wade's description of the station well drawn up, but also his report covering the period of the tests is equally well compiled. The fullest possible particulars are given, and jambing and atmospherical disturbances are also recorded.

Mr. Wade, in common with many other entrants, protests against the practice of using receiving circuits which are capable of radiating. This is a selfish practice, and caused very great inconvenience to others. Needless to say, the set used by Mr. Wade was of a non-radiating character. Though this was a factor in his favour, it was not



considered in judging the competition, since no stipulations had been made as to the nature of the receiving circuits which were to be used in the tests.

We reproduce a map of the seaboard of the United States, giving the locations of the transmitting stations. In some cases there were several stations taking part, all situated in approximately the same location, in which cases it has not been possible to show each station separately.

A VALVE TRANSMITTER FOR THE EXPERIMENTER

By Cyril T. Atkinson,

Vice-President Leicestershire Radio Society.

NOW that it is possible for the private experimenter, equipped with reasonable knowledge, to obtain a permit to use radio sending apparatus of low power, the writer feels sure that the following article will be of interest to all those intending to take up transmitting.

Before actually commencing the description, it would be as well to review the various systems which might be used. From the point of view of a person of reasonable means, there appears to be three : *i.e.* (1) "Damped Wave Transmission," using the well-known spark method ; (2) "Pure Continuous Wave," using the valve supplied with high voltage direct current, from either batteries, or a small dynamo ; or (3) the so-called "Tonic Train," using a valve supplied with pulsating high voltage direct, or even alternating current.

The spark method possesses the charm of simplicity, and before the War was the one almost universally used, but with the advent of the valve-generated continuous waves, there seems little doubt that the progressive amateur will require something a little better now.

The second method might possibly be considered as the system *de luxe*, but it is, to say the least, expensive, as the source of direct current requires to be at least 400 or 500 volts. (Exception may possibly be taken where the electric current at about this pressure is already laid on). So that system three, or the tonic train method, seems to be the only one left.

With the above reasoning in mind, I commenced to experiment, and finally evolved the set which will now be described in detail.

Fig. 1 shows a typical circuit used for valve transmission. It will be seen that the anode is connected to the positive side of the D.C. supply, *via* the aerial inductance, and that the grid-filament circuit is magnetically coupled to it by the coil "R." When this coupling is correctly adjusted, the valve will oscillate and an alternating current will flow in the plate circuit, the frequency of which will be determined by the values of L, C, and the aerial and earth system which is connected to L. Adjustment of either L or C will vary this frequency, and, therefore, alter the length of the emitted wave.

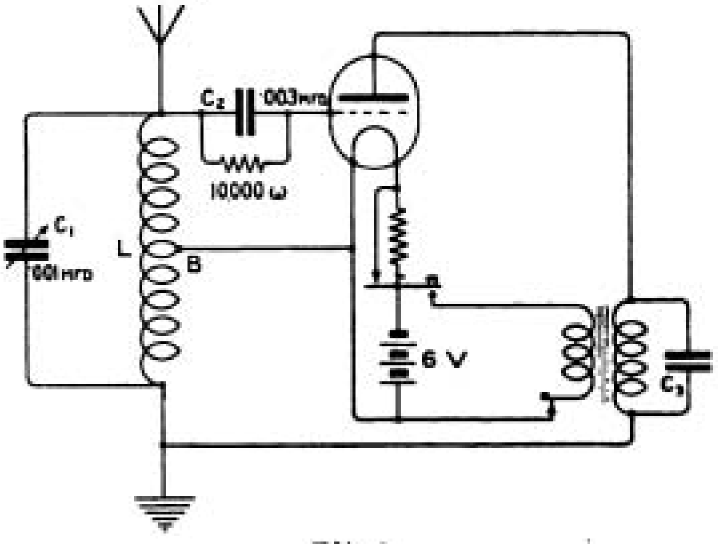


Fig. 1.

Due to the fundamental principle of the valve, for which, if not understood, my readers must be referred to the many past articles in this magazine, the valve will only oscillate when the plate is positive with regard to the filament. If alternating instead of direct current be used, it is evident that the valve will oscillate during the half-cycle which makes the plate positive, while, during the other half cycle it will not oscillate.

The duration of the positive charge on the plate will be seen to be one-half the period of the A.C. supply, so that if we take this as, say, 500 periods, the duration will be 0·001 second. Therefore, if the set were tuned to a wavelength of 200 metres, the periodicity of the H.F. current will be 1,500,000, and sufficient time elapses while the plate is charged positively to enable the valve to make 1,500 complete oscillations. Practically the oscillations begin when the plate reaches about 30 volts positive, so if the effective source of the current is about 500 volts, very nearly the whole of the 1,500 possible oscillations will be produced. Waves emitted by this type of transmitter are very little damped, and lend themselves to reception by the efficient heterodyne method. They have carrying properties closely resembling pure C.W., but do not, of course, give a pure musical note in the receiving telephones.

The finally evolved diagram is shown in Fig. 2, and will be seen to differ slightly from the one previously shown, although the action is similar and need not be described again.

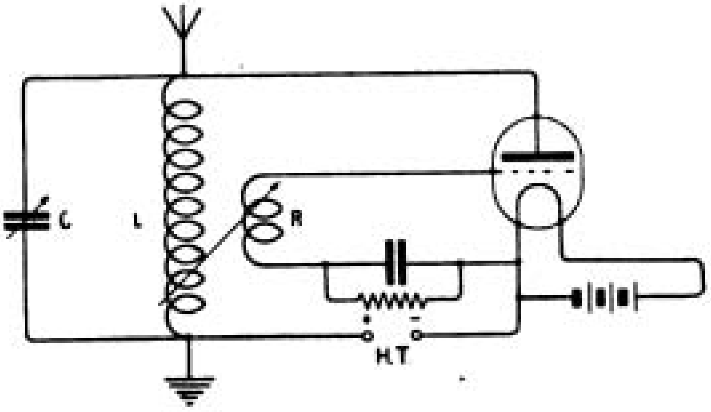


Fig. 2.

To supply the high voltage, an induction coil can be used. It should be selected with a very thick secondary winding. A long spark is not necessary, but what is required is a voltage of 500 volts when supplying a current of 20 to 25 milliamperes.

For the inductance "L" take a strong cardboard tube, 4" in diameter, carefully dry, and give several coats of shellac varnish. Wind this with 24 turns of heavy gauge wire, say 18 S.W.G., but Litzendraht would be better. Tap at the 13th turn for the connection B.

The condenser C_1 should be variable with a capacity of, say, 0·001 mfd. The grid condenser should be made as Fig. 3, and mica should be used. The grid leak should be preferably purchased, but can be made by means of a pencil line drawn between two terminals. This can be adjusted by means of a Wheatstone Bridge to 10,000 ohms.

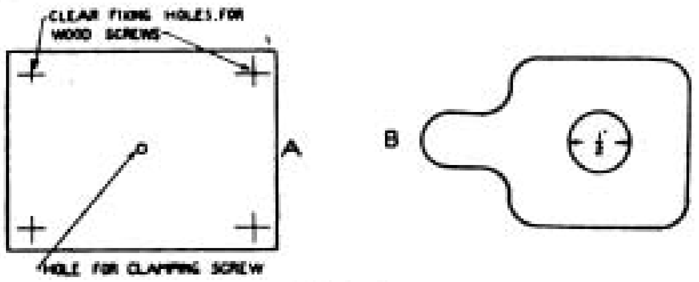


Fig. 3.

The condenser C_3 should be of either mica or glass, and its capacity should be about 0·001 mfds. Its function is to complete the radio frequency circuit across the high inductance of the coil, which, without it, might be so high as to stop the tube oscillating.

The connections are such as to enable one accumulator to supply both valve filament and coil. The valve can be a standard "R" type, as these are quite hard, and suitable for this low power. Alternatively, an E.S.4, made by the Ediswan Co., can be used. In order to prolong the life, a resistance should be inserted in the filament circuit, which is shorted on depressing the key. The shorting contacts should be arranged to "make" just before the primary of the coil is energised. As is well known, the coil will produce a much stronger pulse of current at the "break" so the connections should be arranged to utilise this.

The arrangement of the various parts into a complete set will, more or less, depend on the individual fancy of the constructor, and, no doubt, many ways will suggest themselves.

The points to be remembered are that all connecting wires should be kept as short and straight as possible, and consist of heavy gauge or multi-stranded wire. Great care should be taken with regard to insulation, and a good valve must be selected.

The main procedure in adjusting a set of this type is as follows :—

First see that the "aerial" and "earth" leads are connected to their proper points, also the transmitting key and accumulator, which should be a 6-volt one, about 40 A.H. See that the valve burns dimly when inserted, and brightens up when the back contacts of the key "make" and short circuit the resistance. The vibrator should operate when the front key contacts come together. A hot-wire ammeter placed in the "earth" lead will serve to show when the system is radiating, and by careful adjustment of the coil contact breaker, the best point will be found. This should combine quick and ready operation with minimum sparking at the contact points, and a maximum aerial current.

The condenser C_1 should be adjusted to give the wave it is intended to use, and possibly the tap B may require slight variation of position.

In conclusion, the writer feels sure that the completed instrument will well repay any trouble taken in its construction, and give louder signals with sharper tuning than the usual "spark" set, with corresponding freedom from interference and jamming.

WIRELESS TRANSMISSION PHENOMENA*

By J. WILLIAMSON.

I WAS much interested in the notes on the above subject contained in your issue of October 16th, with regard to Aden's fading, proving this phenomenon to be independent of movement of the receiving station. The difference between the fading on 600m. and 2,000m. wavelengths might indicate that it is due to a varying angle of refraction, this being an inverse function of wavelength, but when the other station at Aden shows no sign of the phenomenon, although its waves would have to take a similar, if not the same, path, through the atmosphere in order to be refracted or reflected to the same point, it seems probable that the cause does not lie outside the station at all. Certainly, lower atmospheric conditions cannot suffice as an explanation ; in contrast with the fading, these vary with direction from Aden, and seasonal changes, and would affect other stations in his vicinity.

Being unaware that this difference existed between the two stations, I was led to state (see *The Wireless World*, August 21st, 1920) that Aden did not fade when received in the Gulf of Aden—outside of this area I was dependent on the high power station for observations, whilst, being within it only for a few hours at a time, I went chiefly by the low power station's more frequent transmissions.

Whatever the cause in Aden's case, there certainly are examples apparently explainable only by some kind of irregularity in the upper atmosphere. Mr. Humphries cites one or two, and I understand signals between New York and Montreal are similarly affected. Doubtless other instances are to be met with.

I cannot agree that transmission appears equally good, both towards and from the Persian Gulf, and the evidence of ship transmissions already given is supported by that of the high-power stations at Basrah (VTC) and Aden (BZF). The latter comes in quite readable on a crystal at Basrah, yet on none of a good many passages round this coast have I heard the former at Aden or within 300 or 400 miles either way from there, although I have picked him up when half-way between Aden and Ceylon, which shows it is not a mere difference in range—figures are not available, but I should fancy there is little to choose between them in the

* Comments on an article on the same subject by Mr. R. A. Humphries, published in *The Wireless World*, October 16th, 1920.

matter of power radiated. VTC is directional towards N.W. and S.E., and BZF somewhere around E. and W., thus favouring the former if anything.

I have had these points confirmed by other operators, and fail to see any other explanation than in some peculiarity of the land affecting a wide area, the land formation being the only one apparent. I suggested that the line of transmission might be such that a mountain area would act as an obstruction in one direction only, *i.e.*, when near the receiving station, but this can hardly be so, as it would require that the waves travel at an altitude not high enough to reach a refracting or reflecting medium (only night transmissions are being dealt with), which they must do, in order to reach a distant point.

Perhaps it is that the irregular ground has high resistance and affects a receiving station in proportion to its proximity, owing to the downward-slanting direction of the waves—I have pointed out that in the Red Sea reception seems best after a good stretch of water, and Port Sudan lies nearly 200 miles from the Arabian Coast—much farther than the shipping track.

WIRELESS CLUB REPORTS

The Wireless Society of London.

The Second Annual Conference of Wireless Societies affiliated with the Wireless Society of London was held at the Royal Society of Arts, London, on Tuesday, March 1st, at 3 p.m., Major J. Erskine-Murray, D.Sc., President of the Wireless Society of London, being in the chair.

At the conclusion of the Conference tea was served, following which parties adjourned to Marconi House, Strand, where a cinematograph demonstration of matters connected with wireless telegraphy took place, and to Messrs. R. M. Radio Company, where Mr. Rivers-Moore gave a demonstration of new apparatus manufactured by that Company, and other matters of a wireless interest.

An informal dinner at Romano's Restaurant was arranged for 6.45 p.m.

A meeting of the Wireless Society of London was held on the same evening at 8 p.m. at the Lecture Theatre, King's College, Strand, when Major J. Erskine-Murray, D.Sc., gave his Presidential address.

Detailed proceedings of the Conference and the meeting of the Wireless Society of London will appear in subsequent issues of *The Wireless World*, whilst a full report of the Conference and of the Presidential address will also be published.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

The meeting of the North Middlesex Wireless Club held on Wednesday, February 24th, took the form of a concert and social evening, and was well attended by members and their friends, the accommodation of Shaftesbury Hall being taxed to the utmost. The concert, as announced on the programme, was divided into two parts, which, as befitted a Wireless Club, were called Primary and Secondary. It had been arranged that the interval, or "Stand-by" period, should occur at the time the telephony for the Olympia Exhibition was sent out, and the Club's installation, in charge of Mr. L. C. Holton, was brought into use, and the speech and the gramophone record were clearly audible to the whole audience. The freedom from distorting noises was very marked. After this refreshments were served, and the second half of the programme proceeded with. The vocal and instrumental talent was provided by members and their friends, and all artistes were accorded a hearty reception. The thanks of the Club are due to Mr. A. J. Dixon, who undertook the duties of Hon. Secretary of the sub-committee, assisted by the President, Mr. A. G. Arthur, who is always well to the fore when work has to be done.

The annual general meeting of the Club will take place on Wednesday, March 23rd. Will all members make a special effort to attend, so that the election of the officers and committee for the ensuing year may be effected by as full an attendance as possible.

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

Cardiff and South Wales Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting of the above Society was held on February 24th at the South Wales Wireless Training College, St. Mary Street, Cardiff, by kind permission of Lt. Commander J. R. Schofield, M.B.E., R.N.V.R.

A large number of enthusiastic amateurs were present.

An extremely interesting lecture was given by Mr. N. M. Drysdale on "The Poulsen Arc." After briefly outlining the development of wireless, Mr. Drysdale explained the fundamental principles on which the arc worked when used as a transmitter in Radiotelegraphy. The lecture was profusely illustrated by lantern slides showing the construction of Poulsen Arc sets. Among the slides were views of the stations at Honolulu, Annapolis, and Horsey. After the lecture, members were shown the working of Quenched and Rotary Gap Sets. Mr. Drysdale also delighted the members by some high frequency experiments, taking spark discharges of high frequency currents through his body without apparent discomfort.

On March 10th, 1921, at the Cardiff Technical College, Room 305, a lecture was given by Mr. A. E. Hay, entitled "Atmospherical Phenomena and Freak Wireless Signals East of Suez to the Antipodes."

This session promises to be an exceptionally good one, and new members will be most welcome.

All communications should be addressed to the Hon. Secretary, Mr. W. G. J. Howe, 25, Plasturton Gardens, Cardiff.

City and Guilds Wireless Society.

(Affiliated with the Wireless Society of London.)

The Society has now been affiliated to the Wireless Society of London, and is progressing very favourably in its activities.

A meeting was held on January 19th, with the President, Prof. G. W. O. Howe, D.Sc., M.I.E.E., in the chair. Prof. Howe gave his Presidential address, taking as his subject the emission of electro-magnetic waves from an aerial, and the radiating power. A most interesting and very much appreciated lecture was followed by a discussion by past and present students of the College. At the end of the meeting, which was well attended, the Secretary announced the election of Mr. T. M. Colebrook as Chairman of the Society.

Another meeting was held on January 26th, when the first part of a very clear Paper on the Thermionic Valve was read by Mr. A. Wust. The author dealt with the electron theory, the development of the three-electrode valve, and its various functions. A valve panel was very kindly exhibited by Mr. H. W. Sullivan.

The Paper was concluded at a meeting on February 2nd. Mr. Wust devoted his attention to the applications of valves to practical receiving and direction-finding, and then followed a demonstration of a frame aerial receiver using nine valves by a representative of the Marconi Scientific Instrument Co., to whom the Society is much indebted. Both lectures were well illustrated by slides kindly lent by the Marconi Wireless Telegraph Co., and the B.T.H. Co., Rugby, to whom also our thanks are due.

Other lectures have been arranged for March 2nd, 9th, and 16th.

On January 22nd a party from the Society visited the works of Messrs. Siemens Bros. and spent a most instructive and entertaining morning examining the construction, assembling, and testing of their various wireless sets. We could not help but come away with a very great respect for the quenched spark system.

We saw the other side, however, on February 26th, when a party made a most interesting visit to the Chelmsford Works of Marconi's Wireless Telegraph Co.

Besides going through the works, we saw the transmitting station where messages were being sent automatically to Paris by land line from Witham some 20 miles away.

Great thanks are due to both these companies and their representatives for their kindness and the trouble they took in showing us all there was to be seen.

All communications from old Centratians are gladly invited, and should be sent to the Hon. Secretary at the College.

Newcastle and District Amateur Wireless Association.

(Affiliated with the Wireless Society of London.)

At the meeting held on February 21st our usual programme was adhered to. The lecture for the evening dealt with the working out of the formulæ for the determination of wavelengths of circuits and their inductance and capacity. This was shown in a very lucid manner by the lecturer. Several members afterwards confessed to their having worked by "rule of thumb" methods as they had been afraid of delving into the mathematical side. They stated they would have no such fear in future. At the meeting the members present had the pleasure of receiving into their midst their first lady member. (Have any other clubs any lady members ?) The lady in question, Miss Gilbert of Gateshead, is a genuine "amateur," who has applied for her own licence, and is constructing her own station.

The meeting of February 28th was postponed till March 3rd in order that Society members could attend the lecture on "Thermionic Valves" given by Mr. Owen, at the Armstrong College, on February 28th.

The lecture was well attended, and very successfully carried out. The lecturer gave a large number of demonstrations, one in particular being the operating of a post office sounder by signals received from LP (Koenigwusterhausen). This showed very impressively the amplifying power of the vacuum tube.

Applications for membership to be addressed to the Hon. Secretary, Mr. Colin Bain, 51, Grainger Street, Newcastle-on-Tyne.

Glevum (Gloucester) Radio and Scientific Society.

(Affiliated with the Wireless Society of London.)

Arranged by the Glevum (Gloucester) Radio Scientific Society and the Gloucestershire Engineering Society, a lecture and demonstration in wireless telegraphy was given at the Guildhall, Gloucester, on Thursday evening, by Mr. T. F. Finucane, of the Selborne Society and Marconi Company. There was a large audience, over which the Mayor (Councillor J. O. Roberts) presided.

The Mayor, in introducing the lecturer, said that he (Councillor Roberts) knew practically nothing about wireless telegraphy, and he was looking forward to the lecture with great pleasure.

The lecturer showed some very interesting lantern slides, including the first message sent to Australia from England (12,000 miles), diagrams of Preece's wireless system and Hertz's waves, illustrations of the Fleming valve, and diagrams of the developments of Marconi. Speaking of the Fleming valve, Mr. Finucane said its possibilities in wireless telephony were tremendous.

It was by wireless means that the air raids over London were at last put an end to.

Mr. Masters, the lecturer's technical assistant, then tuned his instruments, and messages in Morse code were heard from Chelmsford, Clifton (Ireland), the South of France and Germany. The Eiffel Tower Station, ticking out the seconds from 9 o'clock to 9.15 to the ships at sea, was distinctly heard, and at 9.30 the great station at Poldhu, Cornwall, was heard transmitting the weather forecast to all stations.

It was hoped to have picked up wireless telephone messages from a London station, but the generators at the Gloucester Corporation Electricity Works made this impossible with the apparatus available. The lecturer, however, promised that the first chance he had of letting a Gloucester audience hear a wireless concert he would make necessary arrangements.

The Mayor cordially thanked Mr. Finucane for his extremely interesting and lucid lecture, and his promise as to the concert, the audience supporting the Mayor with enthusiasm.

We are now associated with the Gloucestershire Engineering Society, making a total membership of over 300. We are looking forward to excellent lectures and demonstrations. A wireless concert has also been promised us, to which the general public will be admitted.

The Corporation has kindly granted us the lecture hall at the Municipal Technical Schools as our official headquarters, and many interesting lectures have already been arranged in wireless telegraphy, telephony, radiography and other scientific subjects. Mr. Sidney Bird, one of our members, has invited us all to Sharpness for field days during the summer months. Other enjoyable outings have also been arranged and the Society generally is making extraordinary progress.

We cordially thank the Gloucestershire Engineering Society for their help in making our demonstration such a huge success. Particulars as to membership and free demonstrations will be gladly given by the Hon. Secretary at his private address or at each weekly meeting.

Sheffield and District Wireless Society.

(Affiliated with the Wireless Society of London.)

On January 21st Mr. Adcock read a Paper, the subject being "Directional Wireless."

The author, who has had considerable experience in this class of work during the war, pointed out that all wireless propagation is really directional, and illustrated his point with the help of a theoretical consideration of the Hertzian Oscillator.

Until the advent of aircraft, wireless was practically confined to one plane.

The two main objects of directional wireless were to communicate with the minimum power and interference, also for accurate direction finding.

He described the radiation from a vertical earthed conductor, and the theory of wave propagation.

The radiation and reception of two vertical aerials placed at a distance apart were then considered, and the relationship between them and a loop aerial was established.

The latter part of the Paper was confined to a description of several of the different methods of direction finding, including the Bellini-Tosi, and Marconi systems.

After the discussion, Mr. Adcock demonstrated with the help of a seven-valve amplifier, the directional qualities of a large loop aerial.

On February 4th, three short Papers were read before the Society as follows:—

(1) "Comparative Inductances," by Mr. F. Gilberthorpe.

(2) "The Nodon Valve Rectifier," by Mr. H. Lloyd. *(See page 862 of this issue.)*

(3) "The Tungar Rectifier," by Mr. A. Horton.

In the first Paper Mr. Gilberthorpe, after describing the theory of inductance, gave an interesting comparison between a pancake coil and a single layer coil of the same dimensions. By calculation it was found that the inductance of the pancake coil was approximately 22 per cent. greater than that of the single layer coil, whilst the wavelength by calculations and also by testing with a wavemeter, the difference was only 10 per cent.

The author pointed out that discrepancy between these results was because the self-capacity of the single-layer coil was greater than that of the pancake, and that whilst the wavelengths of the two types of coils were very similar, the advantage was certainly in favour of the pancake coil in so much that the wavelength was created more by inductance than with the single-layer coil, a condition which gave greater efficiency at any rate in reception work.

Mr. Lloyd, in describing the Nodon Valve Rectifier, related some very interesting research work which he had carried out so that the town electric supply of 50 cycles 200 volts could be employed for applying plate voltage on a valve.

He concluded his Paper with a practical demonstration in which excellent results were achieved.

Mr. Horton gave a clear and concise description of the Tungar Rectifier as applied to the charging of accumulators from the Corporation alternating current mains.

All the above Papers were illustrated by means of lantern slides.

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The regular fortnightly meeting of the Society was held on Friday, February 25th, at the Society's new headquarters, Dartford Grammar School. Dr. Miskin presided, fourteen members being present.

The Vice-President produced and explained a drawing of the aerial mast, stating that the necessary materials were ready. Arrangements were made for the erection of this mast on the next day, the 26th inst.

Mr. Lyne, a member of the Wireless Society of London, kindly brought for inspection a small crystal and valve set for two wavelengths. The circuits used, in conjunction with many others, were excellently demonstrated by means of blackboard drawings, the members being invited to ask any questions they desired.

The physics lecture room at the school provides excellent accommodation, and it is anticipated that before the next meeting the aerial will be in position.

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

Three Towns' Wireless and Model Engineering Club.

(Affiliated with the Wireless Society of London.)

At the meeting held on February 2nd a lecture was given by Mr. Voss on Frame Aerials. The historical side was first dealt with, followed by a talk on the theory of the subject. Several types were then described, and approximate dimensions for various wavelengths given.

On the following Saturday the Club aerial was erected on the roof of the premises in which the Club-room is situated.

On Wednesday, February 9th, a detecting valve and a three-valve L.F. amplifier were used on the Club aerial, and good results obtained, Poldhu's 21.30 weather report being audible to all in the room. It was decided to appoint a Treasurer, and Mr. Skinner was elected.

At the weekly meeting held on February 16th a paper was read by the Secretary on "The Electron Theory and its Application to the Working of the Thermionic Valve." The molecule, the atom and the electron were dealt with in detail, comparative ideas of their size being given. The movements of the electrons and their control by the positive nucleus were explained. The effect of heat on the velocity of the electron was described and so the action of a positively charged sheath surrounding the filament of an incandescent lamp deduced. The action of the Fleming valve was then easily apparent. The introduction of the grid and how it enabled amplification to be obtained was finally dealt with.

On February 23rd a demonstration was given by Mr. Currah of his single-valve honeycomb coil set, with which he can read Annapolis. On being connected to the Club aerial numerous C.W. and spark stations were heard.

Particulars of the Club and its activities will be gladly furnished by the Hon. Secretary, Mr. G. H. Lock, 9, Ryder Road, Stoke, Devonport.

Manchester Wireless Society.

(Affiliated with the Wireless Society of London.)

On Wednesday, February 16th, an Ordinary General Meeting was held in the College of Technology, Manchester. Chairman, Mr. Alex Marr.

The Chairman, in his remarks, expressed satisfaction at the attendance, and hoped that they would enjoy the lecture on "Colour Photography," by Mr. J. McKernan, which was then delivered.

In conclusion, the Chairman outlined the aims of the Society, for the benefit of those present who were not members, emphasising the fact that the subjects discussed were not confined to Wireless alone, and also that the membership did not call for expert knowledge in that science, but was open to anyone (ladies or gentlemen) interested in scientific subjects. A hearty vote of thanks to the lecturer was responded to with generous applause, after which the meeting closed.

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

Southport Wireless Society.

(Affiliated with the Wireless Society of London.)

Meetings of the above Society are held weekly (Tuesdays) at 74a, Kensington Road.

During this month the first of a series of monthly lectures was given by Mr. A. E. Lomas, on "Hints for Amateurs" and "Measurement." During the lecture Mr. Lomas explained the measurement of capacity and inductance in a circuit. Mr. Lomas also explained the action of a wavemeter.

This lecture was very interesting and helpful. A vote of thanks was passed to Mr. Lomas for his useful lecture.

Prospective members are invited to make application to the Hon. Secretary, Mr. H. Sutton, 68b, Marshside Road, Southport.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At the meeting of the above Society on February 9th, the Secretary, for the benefit of the less technically trained members, gave a discursive lecture on voltmeters and ammeters and their interconvertibility. Mr. Voigt cleared up one or two little points about pancake coils and their use. Mr. Nicholson reported hearing the Dutch concert, badly jammed on the 3rd inst, and Mr. Kennedy, the installation officer, reported progress.

At the meeting on February 16th, Mr. G. Horwood was advanced to the post of general manager, rendered vacant by the resignation of Mr. C. Sanders, and Mr. Seldon was elected to the post of assistant general manager *vice* Mr. Horwood. The Secretary read an interesting letter from the President, Mr. Wm. Le Queux, which he received with a gift of books for the Club library. A hearty vote of thanks was passed to the President. A sum was voted from the General Fund to assist in acquiring Club receiving apparatus.

Mr. Nicholson introduced the subject of the oscillating crystal, and several Club members promised to follow up the research.

The Wireless Society of Hull and District.

(Affiliated with the Wireless Society of London.)

At the last meeting of members, under the chairmanship of Mr. G. H. Strong, the President, an interesting discussion was held on inductance and capacity and wireless receivers generally. The discussions took the form of readings from an American publication on Practical Wireless Telegraphy, and were initiated by Mr. H. Strong. The use of blackboard diagrams was found very helpful.

During the evening Mr. H. Strong exhibited some useful types of disc inductance coils which he had made. Mr. Featherstone, who is an expert G.P.O. telegraphist, gave the members an opportunity of some buzzer-reading practice which was taken advantage of.

Meetings are held fortnightly on Thursdays at the Metropole (Marlborough Room) at 7.30 p.m., when any person residing in Hull or district who is interested in wireless will be welcomed. Full particulars of membership can be had from the Hon. Secretary, Mr. H. Nightscales, 16, Portobello Street, Hull.

WIRELESS CLUB REPORTS

Bradford Wireless Society.

(Affiliated with the Wireless Society of London.)

A meeting was held on February 18th in the Club-room, the chair being taken by the Vice-President (Mr. Ramshaw).

A letter was read from Mr. Liardet, presenting to the Society a switchboard complete with variable high and low tension batteries and arrangements, whereby three complete sets could be wired up simultaneously, and any one selected at will by means of the switches.

A vote of thanks was proposed by the Secretary and seconded by Mr. A. Bever.

A Committee for the management of the apparatus was elected as follows: -Mr. Liardet, Mr. Bever, Mr. Ramshaw.

Mr. Liardet was very cordially thanked for his gift, and his continued generosity to the Society, as it is to his great kindness that we owe the great privilege of the use of our rooms rent free.

The Society then adjourned to the receiving room.

Leicestershire Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting was held at the Vaughan College, Leicester, on February 14th, Mr. Yates in the chair.

Arising out of the minutes, the question of raising the annual fee was discussed, and the Committee's recommendation was adopted, viz., members to pay 7s. 6d. yearly subscription, with an entrance fee for new members of 1s. Associate members under the age limit at a fee of 5s.

Mr. C. T. Atkinson was then called on to give his lecture on "The Progress of Wireless."

The early work of the wireless pioneers was touched upon, and the evolution of the present day Marconi System explained.

The advances were each dealt with and fully illustrated by an excellent set of slides. Several photos were projected showing views of aerials and apparatus of the leading wireless stations such as Poldhu, Clifden, Carnarvon, and a a testimonial was projected showing the record transmission from the latter station and the reception of the messages on a non-commercial set in New Zealand, a real triumph of wireless engineering.

Numerous different types of valve sets were shown, and also Chelmsford's giant telephone transmitters.

A very enjoyable evening was spent, and the little discussion, that was necessarily short through lack of time, showed how the members appreciated the illustrations and lecture.

A hearty vote of thanks was passed to Mr. C. T. Atkinson, and the meeting then broke up.

The date of the next meeting will be March 14th, when Mr. S. Skeet will talk on "Radio Theory and Amateur Application."

Four new members were proposed. Intending members should communicate at once to Mr. Dunt, 45, Baden Road, Leicester, for information, etc.

East Kent Wireless Society.

(Affiliated with the Wireless Society of London.)

Major Martin gave an interesting demonstration of the theory and working of the thermionic valve at the monthly general meeting, held on Wednesday, February 23rd. A further lecture on this subject will be given on March 2nd, when the phenomena described will be illustrated with suitable apparatus.

The construction of the Club's receiving apparatus is proceeding satisfactorily, and it is hoped to have one particular set working at a very early date.

Hon. Secretary, Mr. V. Palmer, Manor House, Maxton, Dover; from whom all particulars regarding the Society may be obtained.

Liverpool Wireless Association.

On February 9th a lecture and demonstration on the subject of the B.T.H. portable set was given by Mr. McMullen of the British Thomson-Houston Company. Regarding signals from the Dutch East Indies one of the members, Mr. Lovering, received about two months ago two pages of Dutch matter from the station at Bandoeng. This was taken with one valve and a crystal only, but must be regarded as an instance of "freak" reception, as subsequent attempts to take the same station have been unsuccessful. It is, however, worth recording as an instance of long-distance reception.

At the meeting on the 23rd the President, Professor Marchant, delivered a most interesting and instructive lecture on the theory and practice of valve reception. An exhibit was also made, by a friend of a member, of a number of duo-lateral wound coils. The method of winding these coils was fully explained and the former on which they were wound was also produced for inspection. The elementary lectures, which usually occupy the first portion of the proceedings, have been continued by Mr. Hyde, and the members are much indebted to him for the kind way in which he is always ready to place his extensive knowledge of radio theory and practice at their disposal. Mr. A. N. Hill, of the Laboratories of Applied Electricity, Liverpool University, has been appointed as Assistant Hon. Secretary. Hon. Secretary, Mr. J. Coulton, 98, Ampthill Road, Liverpool.

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held on February 11th, 1921, at the Municipal Technical College, Plymouth, Mr. R. S. Menhennet in the chair.

A most interesting and instructive lecture was delivered by Mr. J. K. A. Nicholson, A.M.I.E.E., on the fundamental principles of the three-electrode thermionic valve.

The lecturer described in a clear and concise manner, by the aid of physical analogies, the actions of the filament, grid and plate.

Everyone appreciated the lecture and passed a vote of thanks to Mr. Nicholson.

Canterbury and District Wireless Society.

The first meeting of the Canterbury and District Wireless Society was held on Wednesday, February 9th, when Mr. A. Lander, J.P., was elected President of the Society; Mr. W. G. Fagg (Science Master, Langton Boy's School), Vice-President; Mr. C. R. Whinfield, Treasurer; and Mr. R. Moat, Secretary. The Society has launched out very well with a membership of about 30, and it is hoped that many others who are interested in Wireless will join. The subscription fee is 2s. 6d., with a special concession for school-boys, scouts, etc., between the ages of 14 and 16, who pay 1s. only. All intending members should communicate with the Secretary at "Fernleigh," Sturry.

The West London Wireless and Experimental Association.

On Thursday, February 24th, at 7 p.m., the Society held its weekly meeting.

A very efficient three-valve amplifier was lent by one of the members which he constructed himself. Excellent signals were obtained and were made audible to all present by means of a loud speaker constructed from a Brown's telephone receiver and a cardboard horn. POZ, YN and FL came in extraordinarily loud, it being impossible to hear the telephone.

During the evening excellent telephony was received from the station 2AO at Surbiton, and was listened to with great interest by all present.

The Society has been presented with a complete receiving set by Mr. F. O. Read, M.I.R.E., who is one of our most active members of the day. This set will be installed permanently in the Club-room and placed at the disposal of the members.

The Society is now going strong, and members will afford a hearty welcome to all interested at the Society's rooms, Belmont Schools, Chiswick (near Chiswick Park Station) on Thursday evenings at 7 p.m.

All communications should be adressed to the Hon. Secretary, Mr. S. J. Tyrrell, 2, Providence Road, Yiewsley, Middlesex.

Bishop's Stortford College Wireless Society.

A meeting of this Society was held in the Lecture Room on Tuesday, February 15th, when Mr. A. D. Hayward, M.A., B.Sc., gave a lecture on the "Oscillation Valve." Starting with the electron theory, he went on to describe many practical applications of the thermionic valve, profusely illustrating his remarks by diagrams on the black-board. A very hearty vote of thanks was accorded Mr. Hayward.

A short period of buzzer practice ensued, and the meeting was then adjourned.

A short meeting was held in the Lecture Room on Wednesday, February 23rd, there being no lecture.

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

Excellent progress is being made in the above Society. Although the institution is comparitively young, keen interest is being taken in the work of the Society, and a large and varied programme of lectures and demonstrations, etc., is being keenly followed by the members.

It has been decided by the Committee to hold an exhibition of wireless telegraph instruments for two evenings some time in April for the benefit of the Society and other technical institutions.

At a meeting held on February 23rd Mr. Triggs, of the Marconi Company, gave a highly interesting practical demonstration on a three-valve set. The President of the Society, Mr. J. E. Burnett, took the chair at the meeting, 22 members being present.

During the demonstration Mr. Triggs dealt fully with the advantages and disadvantages of indoor and frame aerials, and at a request from the members explained and illustrated various efficient valve-receiving circuits.

The demonstration proved to be a great success, many long-distance stations being heard, including Malta, Rome and Lyons.

At the conclusion of the meeting the President proposed a hearty vote of thanks to the demonstrator for providing such an enjoyable and instructive evening, which was endorsed by the members in an appreciable manner.

Hon. Secretary, Mr. L. L. Sims, Y.M.C.A. Amateur Wireless Society, Y.M.C.A., North Shields.

Leeds and District Amateur Wireless Society.

The first of a series of lectures delivered every fortnight was given by Mr. H. T. Sayer on Friday, February 25th, at 23, Great George Street, Leeds.

The lecturer started with the first discovery of wireless telegraphy, and then outlined the various steps in the steady progress of this science. The lecture was illustrated by drawings on the black-board, so as to make things as clear as possible, even to a beginner. The meeting was well attended and the lecturer had a most attentive and interested audience.

Hon. Secretary, Mr. H. T. Sayer, Central Technical School, Leeds.

Sunderland and District Amateur Radio Society.

A very interesting meeting of this Society was held on Friday, February 25th, the Chairman, Mr. W. Rowe, presiding.

After the usual business one of the members exhibited a long wave receiver, which attracted much interest.

The Hon. Secretary, Mr. H. Burnley, 8, Briery Vale, Sunderland, will be pleased to hear from anyone interested.

The Walthamstow Amateur Radio Club.

At the Committee meeting of the above Club on February 23rd, it was decided that a three-valve amplifier should be made up by the Club from the various parts. Membership is increasing so rapidly that already the Club has had to shift into a larger room, and in consequence, meetings will be held on Thursdays instead of Wednesdays. Mr. Williams delivered one of his interesting lectures, this time dealing with the behaviour of the thermionic valve under various conditions.

The Hon. Secretary is Mr. R. Hardy, residing at 58, Ulverston Road, Upper Walthamstow, E.17.

Nantwich Wireless Society.

A Wireless Society for Nantwich has recently been formed and it is desired to increase the membership. Full information can be obtained from the Hon. Secretary, Mr. A. M. Chalmers, 34, Pillory Street, Nantwich, Cheshire.

The CONSTRUCTION *of* AMATEUR WIRELESS APPARATUS

A SINGLE-VALVE LONG-RANGE RECEIVER

(Conclusion.)

THE panel on which all the parts are mounted should be made of ebonite $\frac{1}{4}$-inch thick and $8\frac{1}{2}$ inches square. The sketch Fig. 4, which is a scale drawing, shows the centres of all the holes which have to be drilled in it. No definite sizes are given for the holes, they may well be left to the discretion of the man making the set, who can use sizes suitable to the material at hand.

The five holes in the top right-hand side are for the inductance reaction unit—four for the fixing screws, and the centre one for the spindle. The four holes in the top left-hand side are for the condenser. The condenser for which the windings are designed, is the 0·0015 mfd. air condenser described in these columns in the issue of August 21st, 1920, and the three holes on a $1\frac{5}{32}$-inch radius are correct if it is desired to mount the condenser directly on to the ebonite top. If the condenser is mounted on a separate top first and then mounted on to the main panel, this radius of $1\frac{5}{32}$-inch must be increased to suit the size of the condenser top, and also it may be necessary to move the centre hole inwards a quarter of an inch or so.

The question of building a condenser as described, or buying one ready made, should be decided before these holes are drilled. The four holes in the bottom right-hand side are for the V24 valve holder clips. Next to the valve clips are seven holes for the four stud inductance switch—four holes for the contact studs, one for the contact arm stud and two for small stop pins, which are fitted to limit the travel of the contact arm and which should be drilled and tapped after the contact arm is made and fitted. Above the valve clips and inductance switch is a small two-contact switch *(not shown in* Fig. 3) for changing from the short to long-wave reaction coil winding.

In the bottom left-hand corner are four holes for the filament resistance, and between this and the inductance switch are four holes for mounting the 0·0015 mfd. condenser. Centres for eight terminals are shown.

The Filament Resistance.

The construction of this unit is illustrated in Fig. 5, and it is similar to the resistance made for the amplifier recently described. Its value should be approximately 2 ohms. Wind 60 turns of No. 22 or 23 bare Eureka wire on a lead pencil. When freed its diameter will be approximately $\frac{5}{16}$-inch. Pull out the spring of wire thus formed to between $5\frac{1}{2}$ inches and 6 inches long and place it round the grooved wood block, as shown in the Fig. 5. Make the two ends of the wire fast to two small screws, screwed into the wood block. The wire will then be held in position and the turns pulled apart so that they do not touch one another. A sliding contact arm should be fitted, mounted on a spindle, as shown in Fig. 5.

Valve Clips.—Spring clips suitable for this purpose were fully described on Page 626 of the present volume, and reference should be made to this for particulars.

The Change-over Switch is shown in Fig. 6. The switch blades may be made of strip brass $\frac{3}{8}$-inch wide $\frac{1}{16}$-inch thick and about 2 inches long. The four outside contacts should be made just like the grid and plate clips for the V24 valve, and the two centre contacts to which the switch arms are pivoted should be the same as the filament clips of the valve.

The Inductance Stud Switches.—The contacts may be made of cheese-head screws and

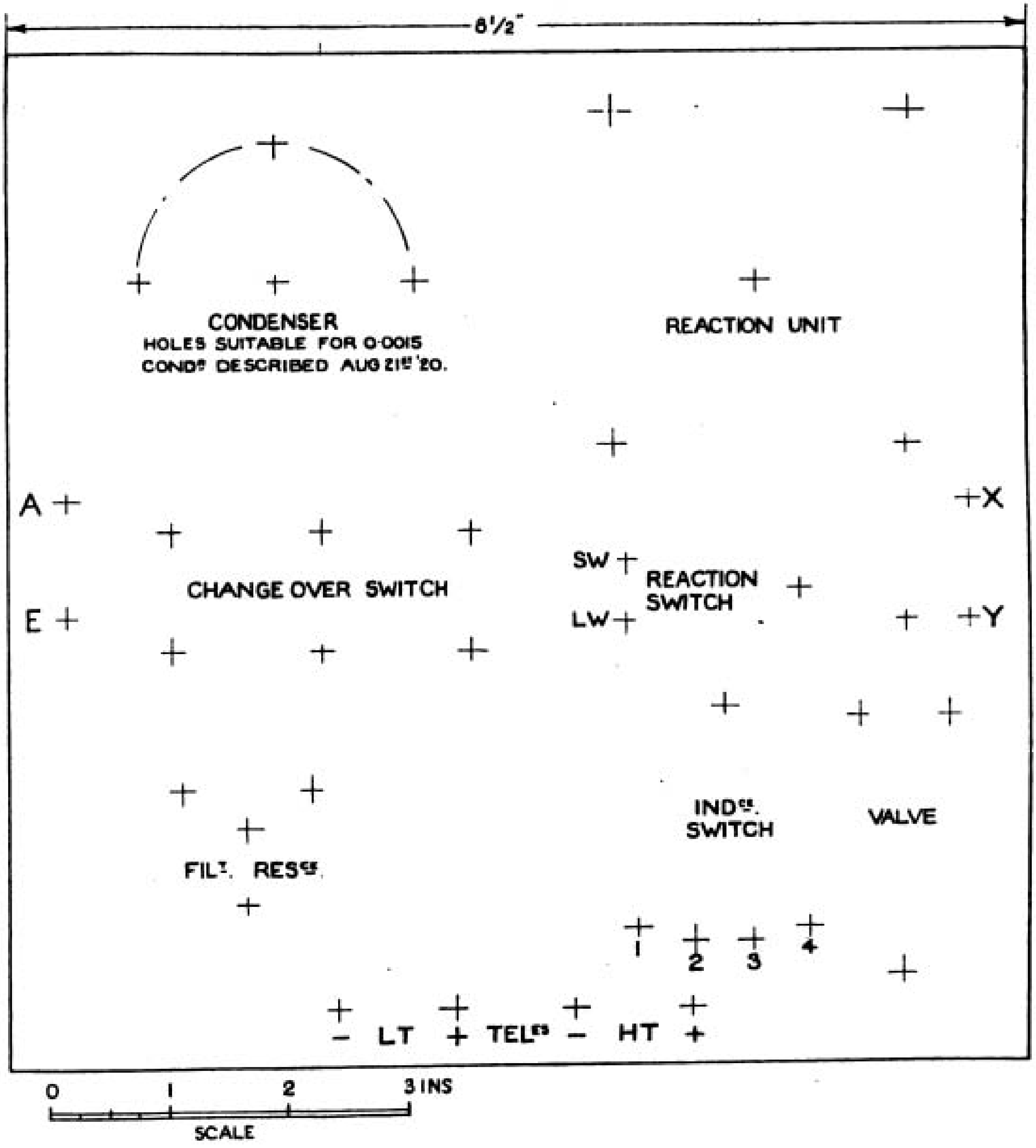


Fig. 4.

the contact arms of strip brass $\frac{1}{32}$-inch thick and, say, $\frac{3}{8}$-inch wide, with a small ebonite or metal knob mounted as shown in Fig. 3. If the contact studs are $\frac{1}{16}$-inch above the ebonite a brass washer of the same thickness should be mounted under the pivoted end of the contact arm. The pivot screw should be sufficiently long so that two locknuts and a spring washer may be placed on it, on the under side of the panel. If a slight set is given to the contact arm before mounting, the locknuts may be so adjusted that continuous good contact on the studs is assured.

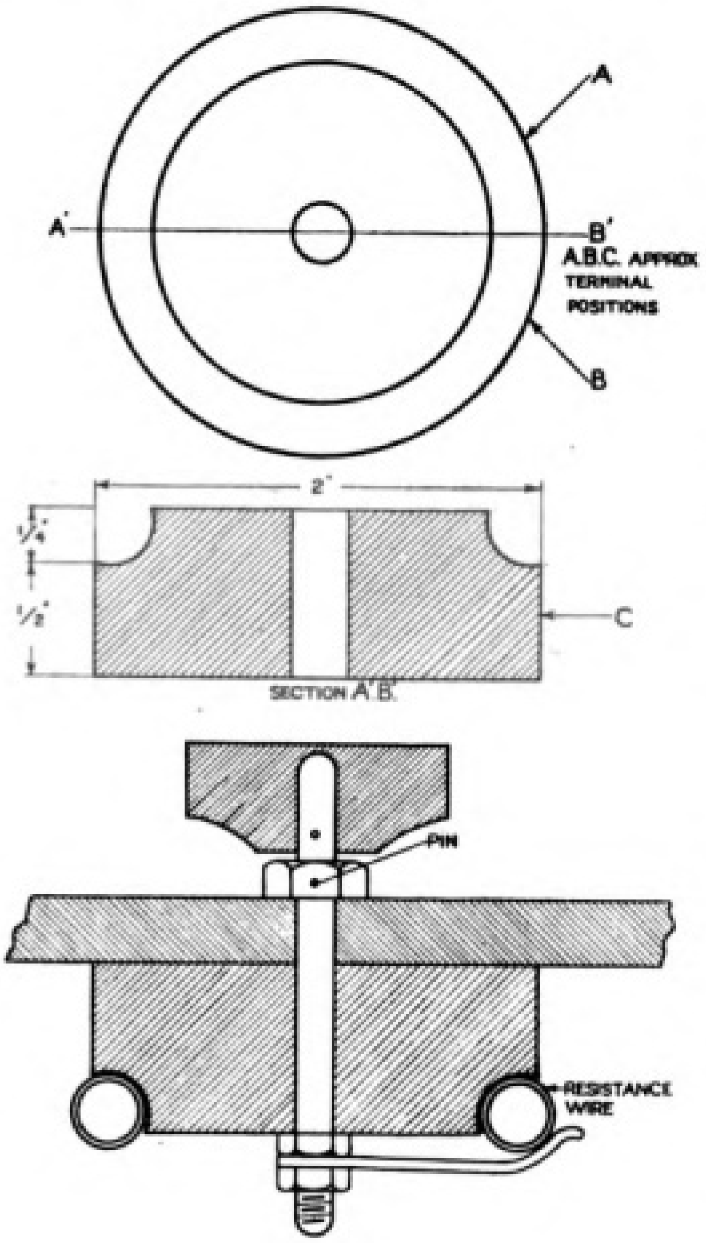


Fig. 5.

The Condenser 0.0015 mfd. fixed may be made of thin copper foil ½-inch wide and cut into strips 2¼ inches long. The mica for the dielectric should be 0·001 to 0·002 inch thick, and be cut into strips ¾ inch wide and 1⅞ inch long. When making up the condenser the foils should overlap one another 1½ inches. The number of copper foils used should be 9 or 10, say 5 each side. This will give a capacity slightly in excess of the required value, which, however, does not matter.

The condenser when completed should be mounted on a small wood block ¼-inch thick and 1⅛ inches wide and 2 inches long, which can be screwed on to the panel in the position previously given.

When all the parts are finished the set may be finally mounted up. Join the two windings of the reaction coil together—the finish of the inside winding to the start of the outside winding—and note that both windings run in the same direction. On one side mount two small terminal pins to which leads can be soldered, and connect the middle point of the two windings to one pin and the free end of the "piled" winding to the other pin. Fix a pointer and handle to the reaction coil and set the pointer to 0 (see Fig. 3), when the reaction winding is at right angles to the fixed winding. Then, when the pointer is indicating 90° on either side of the zero, the moving coil will lie in the plane of the fixed coil. This means that the coupling can be increased from a minimum to a maximum in either direction. Two stop pins should be fitted to limit the travel of the moving coil beyond 90° each side of zero.

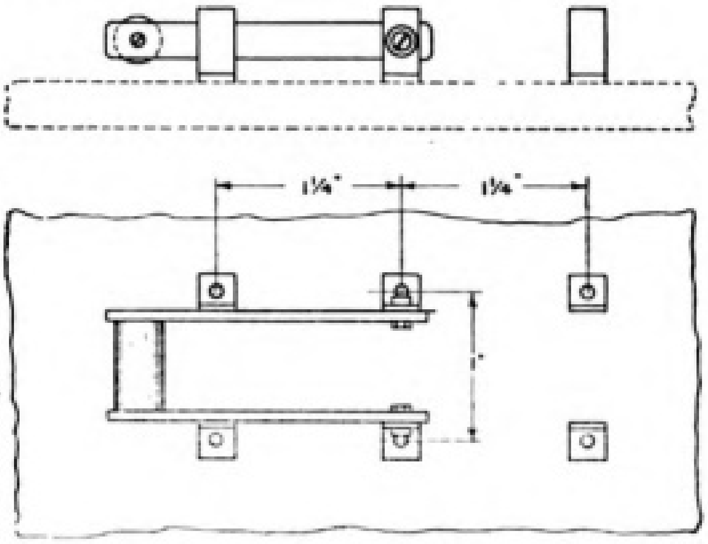


Fig. 6.

When mounting the condenser the pointer should be set so that minimum capacity is obtained at 0 and maximum at 10. Mount the change-over switch, inductance switches (two stud and four stud), valve clips, filament resistance, block condenser and terminals. See that all screws and nuts are tight. If soldered connections are to be made, all screw ends and wires should be well tinned.

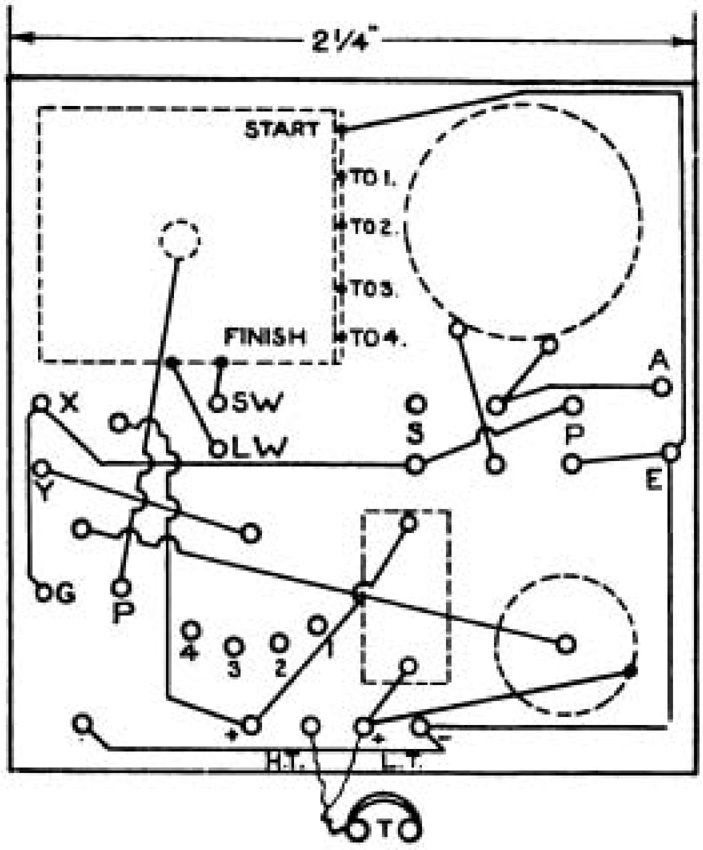


Fig. 7.

A wiring diagram is shown in Fig. 7. This is self-explanatory, and all that need be said is about the reaction winding. The free end of the single layer of winding on the reaction coil is connected to the bottom spindle, which has the contact spring bearing on it, and a lead taken from this point to the anode terminal lug P. The middle point of the reaction windings is taken to the S.W. contact of the two-stud switch, and the free end of the piled winding to the L.W. stud. These two connections should be made of flexible wire. All the other connections should be made of stiff wire, No. 18 or 20 gauge, and Cistoflex insulating tubing slipped wherever connections cross and are liable to touch.

Unit No. 2 for Long Waves.

The No. 1 unit has a wavelength range of 300 to 3,500 metres, approximately, and for wavelengths above this it is necessary to use the No. 2 unit in conjunction with No. 1. This unit provides additional inductance in series with the No. 1 inductance and additional capacity in parallel with the variable condenser on unit No. 1.

The sketch Fig. 8 shows a general arrangement of this unit, and Fig. 9 a diagram of connections.

The top is made of ¼-inch wood or ebonite, and it should be 8¼ inches square.

For the inductance make a wood former 7 inches square and 4 inches deep. The wood should be ¼-inch or ⅜-inch thick.

Wind this former with a three-layer pile

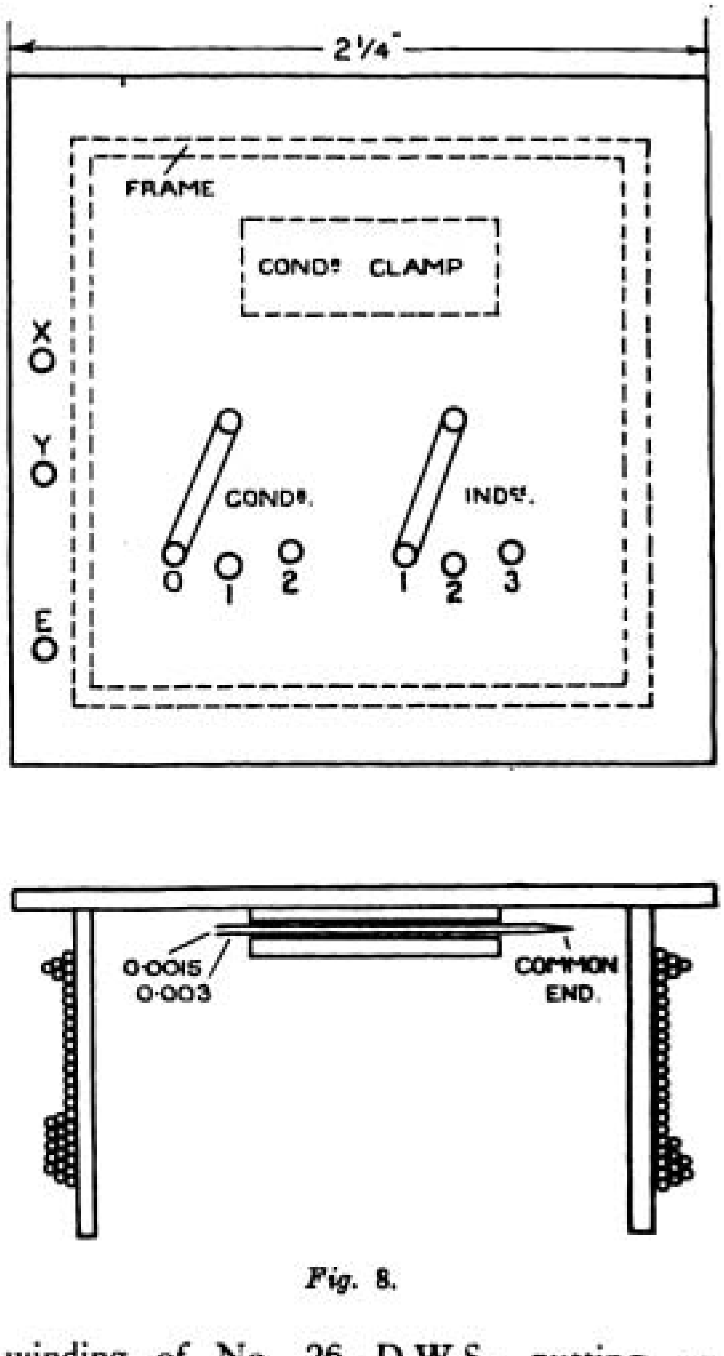


Fig. 8.

winding of No. 26 D.W.S., putting on 350 turns in a space of 3 inches winding depth. The amount of wire required is approximately ¾ lb. Make a tapping at the 100th turn and one at the 200th turn.

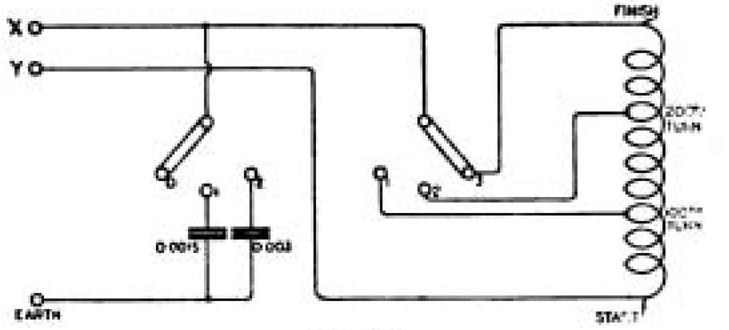


Fig. 9.

A three-layer pile winding is obtained by winding first three turns over the base, then two turns over the three and one over the two turns, then the turns are wound one over the other—three high—all along the former. Keep the wire pulled tight, otherwise the piling will be uneven. The total inductance of this winding will be, approximately, 30,000 microhenries.

The condensers—a 0·0015 mfd. and 0·003 mfd. fixed—may be made up as described for the number 1 unit. Use copper foil and mica sheets 0·001 to 0·002 inch thick and mount both condensers in one clamp. For the 0·0015 mfd., 5 copper foils will be required, 3 one side and 2 the other. For the 0·003 mfd. 9 copper foils will be required, 5 one side and 4 the other. Two three-stud switches will be required, which can be made up from brass strip and cheese-head screws.

To use the two units together, join terminals X to X, Y to Y and E to E, and the two-stud switch on unit 1 to L.W.—long wave. The Series-Parallel switch should be at P. The set will then be suitable for the reception of all wavelengths between 3,000 and 26,000 metres.

For wavelengths below 3,000 disconnect the No. 2 unit entirely and short circuit terminals X.Y. on the No. 1 unit and set the two-stud switch to S.W.—short wave. High resistance telephones should be connected between the H.T. negative and L.T. positive terminals, or low resistance telephones used in conjunction with a telephone transformer.

The anode voltage for the valve should be 30 to 35 volts.

CORRESPONDENCE

HARMONICS IN C.W. TRANSMISSION.

To the Editor of *The Wireless World.*

Sir,—With reference to Mr. Barnes' letter on the above subject, may I be permitted to disagree in one or two details with him, and to give my views, though with all due respect to Mr. Barnes.

I am in entire agreement with Mr. Broadwood as to nomenclature, and believe "that a wave at three times the frequency of the fundamental is a third harmonic," etc., etc. In music a double frequency is (I believe) a first harmonic, and a triple frequency a second harmonic, but this is *not* the case in electrical work.

Mr. Barnes also refers to "his" and "my" harmonics, and although of course his set is in all probability generating harmonics, especially if tightly coupled, surely his reception of a 1,800 metres signal on 5,400 metres is more likely to be due to the fact that the transmitting station is generating that frequency also.

With reference to Mr. Rees' (a friend of mine) experiments, receiving OUI on 20,000 and 30,000 metres, but not on 5,000 metres, this is merely due to the fact that the distance is too great, as Mr. Barnes has stated, though it (*i.e.*, 5,000 metres) comes through occasionally as I have myself heard it.

The ease with which it can be received on 20,000 and 30,000 metres is undoubtedly owing to the fact that it is a Goldschmidt Alternator Station, and this type of alternator has arrangements for tuning in the harmonics, produced by the teeth, and reaction, with the flux of the field, the armature being driven at a speed to produce a certain frequency. This is multiplied by placing tuned circuits across the brushes multiplying the frequency several times over till the required frequency is arrived at, but, of course, it is only reasonable to expect that the lower frequencies shall also radiate waves.

May I congratulate Mr. Barnes on his calibration method, and trust he will not be offended at my criticisms.

Yours faithfully,

(Signed) O. S. PUCKLE.

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.**

PADDINGTON (London) *asks* (1) *Is it possible to use the current passing between plate and filament of a 3-valve receiving set to work a Morse inker, or an ordinary telegraphic relay.* (2) *The approximate number of milliameters passing when using a valve, filament 4 v. plate 60 v.*

(1) You should be able to work a telegraphic relay wound to 10,000 ohms. on strong signals, but will not get enough current for an inker without the use of a relay.

(2) You should get about ½ milliamp. from strong signals.

A.F.H. (Bishop's Waltham) *asks* (1) *Would about 200′ of 16/3/32 braided silicon bronze wire be suitable for an aerial (frame), flat pancake type.* (2) *How is the inductance of a square solenoid calculated.* (3) *What is the dielectric constant of gelatine, such as is used in place of glass for photo negatives.* (4) *Would not stranded wire, such as is used for portable electric lamps, be more suitable for winding coils than ordinary wire.*

(1) Yes.

(2) The inductance is, approximately, 1·23 × inductance of the inscribed cylindrical solenoid.

(3) The material of a photo film is celluloid, thinly coated on the surface with gelatine. The S.I.C. of celluloid will probably be from 2·0 to 2·5.

(4) The advantages, if any, would be small, as the strands are not insulated from each other.

H.B.D. (Yugoslavia).—(1) Coil A = 1,100 mhys. (about).

(2) Wind to a depth of 3½″ with 22 S.W.G.

(3) Coil B, 2,700 mhys. (about). Wind to a depth of 2¼″ with 28 S.W.G. Condenser C (variable), ·01 mfds. (maximum capacity).

(4) Yes. They are about as good when properly handled. A Q valve requires more H.T. and a V valve somewhat less than a French valve.

A.T.I. (Wandsworth Common) *asks* (1) *To what wavelength—in conjunction with the maximum P.M.G. aerial—will the following coil tune: Coil 6″ diameter and 12″ long, wound with 30 S.W.G. enamelled wire.* (2) *How many tappings do we advise.* (3) *How many dead-end switches.* (4) *Would this coil be more efficient than a multilayer coil for the same wavelength.*

(1) 6,000 ms.

(2) About 24.

(3) Six should be ample.

(4) Yes, if the multilayer coil were also wound with No. 30, which, as repeatedly pointed out, is not good in an aerial. We should prefer a pile-wound coil of the same number of turns of, say, No. 22 on the same former.

R.S. (Ilford) *wishes to use D.C. mains for the high tension of a valve set, but is in trouble owing to the fact that his mains are the earthed neutral and the negative of a 3-wire system. He asks for advice.*

Theoretically you could, of course, work by putting a condenser in the earth lead, but this is inadvisable, as a breakdown of this condenser, or any fault in the aerial, would short the power mains. A far better solution is the use of a grid circuit inductively instead of directly coupled to the aerial. This should work all right, but is open to the objection that the L.T. battery, resistance, etc., will be charged at a high potential to earth, and will need careful insulation and handling.

D.H.F. (South Kensington) *asks* (1) *What day or evening schools provide classes in wireless engineering.* (2) *For a diagram including measurements, capacities, etc., for obtaining H.T. for transmitting from a transformer giving an output at 2,500 volts and 50 v. of 2 K.W. and also from a ½″ spark coil.*

(1) London University. City and Guilds Technical College.

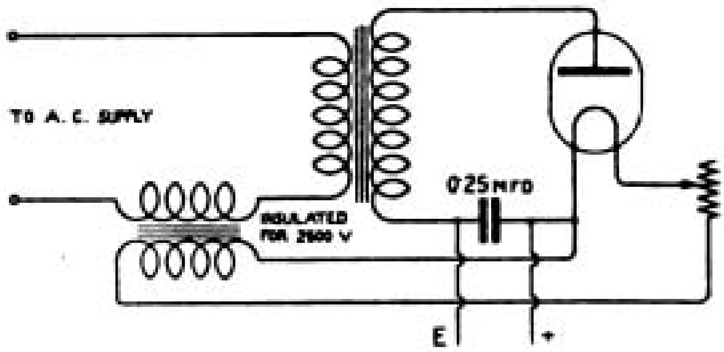


Fig. 1.

(2) See Fig. 1. For use with a coil the circuit should be similar, but with a battery for the valve filament. The battery should be insulated to the pressure given by the coil.

W.W. (Edinburgh) *asks why his set howls when he adds capacity to increase the wavelengths above its normal value* (14,000 *ms.*).

Without full details we cannot state exactly why this happens, but it is quite a common phenomenon. Try altering the disposition of your apparatus; in particular, keep the input leads, etc., remote from the output.

W.P. (Finsbury).—(1) Yes, but not very well, as your windings are of too fine wire.

(2) Possibly, but remove the tubular condenser or place it across both coils.

(3) The only alterations we can suggest are the use of equivalent windings of coarser wire, say, 24 and 30 S.W.G.

P.P. (York) *asks* (1) *How he can best add a two-valve amplifier to a circuit (sketched).* (2) *What are the limits of wavelengths with the circuit sketched.* (3) *What are the quantities and sizes of the windings for an intervalve transformer.* (4) *Would the H.T. battery used for the rectifying valve do for the amplifying valve as well.*

(1) In place of the telephone transformer, as in the circuit given to **W.A.S. (Hounslow)** recently.

(2) Probably up to about 5,000 ms.

(3) For an L.F. transformer windings may be ¼ and 1½ oz. of No. 44 S.W.G.

(4) The same battery may be used, provided that it is placed on the earth side of the reaction coil and windings of the intervalve transformers.

MORSIST (Fenton) *sends a sketch of a receiver and asks* (1) *If a double slide inductance,* 18″ × 8″, *wound with No.* 30 *would be suitable.* (2) *For dimensions of condensers, using square zinc plates.* (3) *Probable wavelength ranges, using P.M.G. aerial.* (4) *If he will get FL,PCZ and KAV.*

(1) We have repeatedly pointed out that wire thinner than about No. 24 is undesirable in an aerial circuit. You will get plenty of inductance on such a former by using No. 22.

(2) The tuning condenser may be about 16 plates, 12 cm. sq. spaced 3 mms. apart in air—the capacity should be made variable. A.T C. is not necessary.

(3) Up to about 5,000 ms.

(4) You should, if your set is reasonably well made.

A.L. (Stoke-on-Trent) *asks* 12 *questions under three headings, relative to mutual indurtance formulae and calculations and the wavelengths of aerials.*

We regret that we must keep to our rule. Broadly speaking we may say however, of—

(1) There is no formula of such a kind for mutual inductance that we know of. The self-inductance is a property of the coil itself, and does not alter with its position.

(2) The mutual inductance has a secondary effect on the tuning of an oscillation transformer, both circuits being detuned.

(3) If the aerial itself is oscillating, its swings will affect its tuning and change the beat note. If a "non-radiating" circuit is being employed, this effect will not be obtained. Both cases are possible.

R.N.V.R. (Catford) *asks* (1) *Is a coupler of dimensions* 10″ × 6·5″ *diameter (primary) and* 9″ × 4·75″ *diameter (secondary) loose enough.* (2) *Why are condensers of paraffin wax paper and tinfoil unsatisfactory for receiving purposes.* (3) *Is glass a good dielectric for condensers.* (4) *Should the loose coupler be wound as in a diagram given.*

(1) Yes, as far as we can judge, but you do not state the number of turns or wavelength.

(2) Waxed paper condensers have indifferent insulation, and are therefore disadvantageous. Other condensers of a similar kind, *i.e.*, mica condensers, have the objection that they are not continuously variable, and are not handy for tuning purposes.

(3) Yes, for fixed condensers—not otherwise.

(4) The sense of the windings is of no importance.

G.P. (Crouch End) *asks* (1) *For suitable dimensions for a reactance coil or a single valve receiver, sizes of which are: Primary,* 10″ × 5½″, *wound with No.* 20 *enamelled wire; Secondary,* 8½″ × 4½″, *wound with No.* 30 *enamelled wire.* (2) *For a suitable diagram, showing the best values for the condensers.* (3) *The approximate maximum wavelength.* (4) *The length of wire suitable for a potentiometer for crystal working.*

(1) Say 6″ × 3″, wound with No. 30.

(2) See Fig. 4, page 697, of the issue for December 25th, omitting the A.T.C, and grid condenser, if desired. The tuned circuit condenser may be ·0004 mfds., the A.T.C ·005 mfds., the grid condenser ·00005 mfds.

(3) 3500 ms.

(4) About 50′.

ACNE (London) *sends a sketch of his set, and asks* (1) *Is this a good circuit for both C.W. and spark reception.* (2) *Is the circuit suitable for working all wavelengths of the de Forest honeycomb wound coils.* (3) *Should the reactance coil be of the same size as the primary and secondary on all wavelengths.*

(1) Quite a good circuit. The tuned circuit condenser might with advantage be larger, say ·0005 mfds. The A.T.C should be much larger, say ·005 mfds.

(2) Yes.

(3) The exact best size of the reaction coils depends on many more or less unknown factors. If you make R as long as S you should be quite safe as regards having big enough coils. Arrange so that the coupling can be quite loose when desired.

D.H.S. (Lytham) *asks* (1) *For a diagram of the best circuit for telephony, using* (a) *double slide inductance;* (b) *valve;* (c) *high and low tension batteries;* (d) *grid leak and condenser;* (e) *blocking condenser;* (f) *telephones.* (2) *Any improvements to the set.* (3) *Are there any stations which send out telephony regularly.* (4) *To what wavelength will an inductance coil* 21″ *long* × 5″ *diameter wound with No.* 26 *enamelled copper wire (P.M.G. aerial).*

(1) Connect as in Fig. 3, page 629, of the November 27th issue, using your two-slide coil in place of the tuned aerial circuit shown.

(2) The circuit exactly as shown would be some what better.

(3) Various stations such as Hounslow, Croydon, and Cricklewood, transmit regularly. There is also the Dutch station PCGC.

(4) About 6,000 ms.

VANELLUS (Newcastle-on-Tyne) *asks* (1) *If a certain circuit will be O.K.* (2) *In what back No. of "The Wireless World" was a complete single-valve set described giving full details of construction.* (3) *Is the set described by Mr. Kitchen in November 27th issue, worth making, and was there no A.T.I. for the set.*

(1) Quite O.K. As you may not use more than 100 feet of wire, make up the length with rope.

The angle will not matter if not much more acute than in the sketch.

(2) See page 65 of the issue for April 17th.

(3) This set is of quite good type. No additional A.T.I. is required.

P.S. (Lowestoft) *asks various questions re the construction of a spark coil transmitter with a range of 50 miles.*

We think that it is so extremely unlikely that you will obtain a permit for a set of this kind that it is hardly worth while to answer your questions in any detail. For such a range on a P.M.G. aerial you would need a set similar to the Marconi 10″ coil emergency set—taking perhaps 15 watts—as against the 10 watts usually allowed with sharply tuned C.W. sets. You would not be allowed a range of 150 to 2,000 ms for transmission

F.W.F. (Ilford) *asks* (1) *For a simple way of connecting up a valve set,* (2) *For a 2-valve receiver.* (3) *The plate voltage required for an R valve.* (4) *If two sets of H.T. and L.T. batteries are required for a 2-valve receiver.*

(1) See page 662, December 11th issue.

(2) See Fig. 2, page 755, of the Jan. 22nd issue.

(3) About 75 volts.

(4) No. See reply (2) and many other circuits in these columns.

A.K.H. (Birmingham).—(1) and (2) Your wavelength range will depend entirely on the sizes of your coils, of which you say nothing except that they are "slab" inductances as advertised in the magazine. This is not enough information for us to identify them.

(3) Fig. 2, page 662, December 11th issue, with the addition of a grid condenser and leak, if desired, should be quite suitable.

H.S. (Cricklewood) *sends a diagram of his set and asks* (1) *If the crystal circuit sketched is correct.* (2) *What dimensions and size of wire should the aerial tuning inductance have in order to tune from* 100 *to* 1,000 *ms.* (3) *Could signals from the Cricklewood Aerodrome Station be received on an indoor loop aerial without altering the apparatus. (Note.—The Station is only* 300 *yards away.)*

(1) Yes, quite.

(2) 8″ × 4″ wound with No. 22 should be sufficient.

(3) We should think so.

L.P. (Stoke-on-Trent).—The coil sketched is of useful type. You do not, however, state the size. For a suitable circuit see Fig. 3, page 629, of the issue for November 27th.

For licence apply to the Secretary, G.P.O. London.

AMATEUR (Newbridge) *has a former* 6″ × 30″ *which he proposes to wind for an A.T.I., using tappings to a multiple stud switch. He asks* (1) *If this will be suitable.* (2) *What wire to use.* (3) *How to arrange the tappings.*

Answers to (1) and (2) depend largely on the type of set used, about which you say nothing. If the set is of simple crystal type try winding with No. 22—say about 5 lbs. weight. This should give you up to about 5,000 ms.

(3) Use as many studs as possible, and arrange roughly so that total turns in circuit is the same for each stud.

NOVICE (Abertridwr).—Your receiver appears O.K. and the coils of suitable dimensions. The only doubtful point appears to be the condenser in parallel with the A.T.I. This will give very poor results unless very small—say ·0002 mfds. Your earth to a lead pipe is very poor. The aerial could, with advantage, be higher, but should give some results. The crystal may possibly be a bad one. A condenser ·0005 mfds. parallel with the jigger secondary would improve results.

H.P. (Stoke Newington).—Connect up as in the usual and well-known 2-stage L.F. amplifier, and try a small condenser between the grid of the first valve and the plate of the second. Reaction is not desirable on such a set, and you will probably find it have no effect or else start a howl. A grid potentiometer is not necessary with such a set, if reasonably suitable H.T. voltages are used.

RELAY (Boscombe) *asks* (1) *Whether an induction hum in the telephones from an A.C. supply is likely to interfere with L.F. amplification* (2) *Which we prefer for long wave reception:* (a) *2 H.F. amplifications, followed by crystal rectification, or* (b) *1 H.F., then crystal rectification: finally, L.F. amplification, reaction being used in each case.* (3) *For a circuit for double amplification with one valve.* (4) *Where he can get particulars of the Orling jet relay.*

(1) Yes, probably seriously.

(2) (a) Should give better results in difficult conditions, either of interference or weakness of signals; (b) Would, however, be easier to construct and handle. If you are troubled with induction use (a). See Fig. 4, page 663.

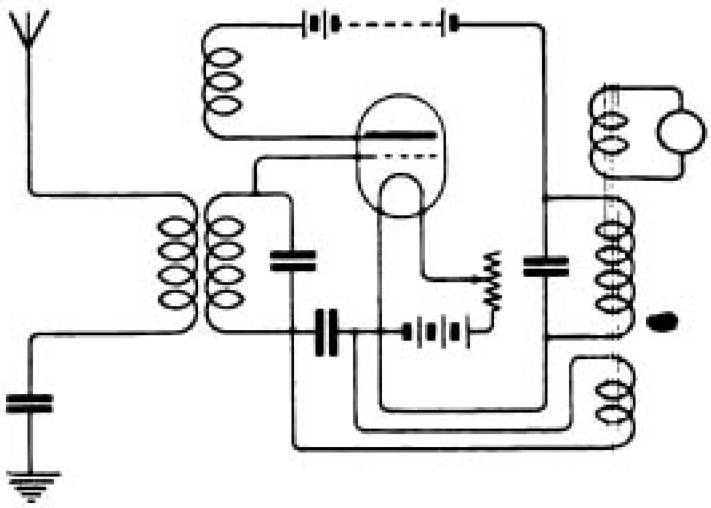


Fig. 2.

(3) See Fig. 2.

(4) See *Eccles Handbook*, 1918 edition, page 328.

H.M.T. (Newcastle-on-Tyne).—(1) Your sudden failure to get results previously obtained can only be due to a breakdown in your apparatus, or possibly to damp. We can only advise you to continue to test different parts of your gear. Are you sure of your valve and your H.T. battery? The former may have grid and filament in contact Your set seems quite sound.

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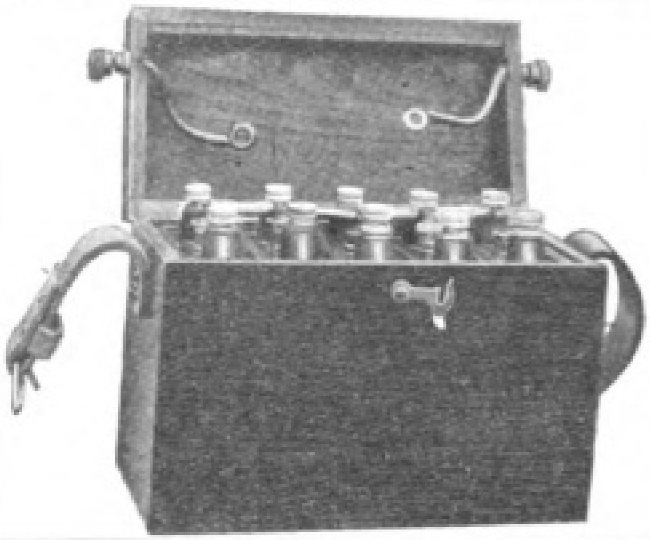

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(2) The suggested arrangement is quite sound. Use No. 26 S.W.G. for A.T.I. coils, 30 S.W.G. for the reaction coil, and either, but preferably 26 S.W.G., for the closed circuit coils. It is very difficult to say the range of wavelength which could be obtained with such a design; broadly speaking, it is best to be content with a small range with each set of coils and to build more than one set. The rest depends on the wavelength you wish to work on.

E.D.M. (Sheffield).—Your diagram seems unnecessarily complicated. We give dimensions of all necessary parts, and advise you to omit the remainder. A=20 ft., E=60°, G=2 ft., H=2 ft. 6 ins, J=6 ins., K=1 ft. 6 ins., L=4 ft. The pegs should preferably be of iron.

FULLERPHONE (London) *asks* (1) *If short-circuiting a dead end of inductance in a coil instead of cutting it out of the circuit would be effective.* (2) *For a good circuit for receiving spark and C.W. in conjunction with a 3-valve H.F. amplifier.* (3) *and* (4) *For certain further particulars regarding the above.*

(1) No; it would be better to leave it open as it would increase the effective resistance of the circuit if shorted, owing to currents induced in it.

(2) You could use an ordinary 2-circuit receiver with a reactance coil inserted in the plate circuit of your first valve of the amplifier. Typical circuits of this kind have frequently been given in *The Wireless World*.

(3) We suggest a secondary 10″ × 4″ diameter. This would require a ·001 mfd. condenser to tune to the same wavelength (7,000 ms.) as the aerial circuit.

(4) If you employ a series condenser (·01 mfds.) in the aerial circuit and a shunt condenser of the above value across your closed circuit, very few tappings will be necessary. We would advise 9 on the A.T.I., and 5 on the secondary.

The condenser you specify is of very low value (·00006 mfds.), and unsuitable for a long wave receiver. We think that your figure (⅛″) for the distance between the plates is large. This should be the distance between the faces of the adjoining plates for calculation purposes.

NEMO (Selby).—(1) Hard.

(2) Not necessary.

(3) Yes.

(4) It depends on the circuit. 24 volts is sufficient both for (a) and (b) under average conditinos.

THYRYA (Worcester Park).—(1) A.T.I.= 3,000 mhys. Condenser=·0003 mfds. maximum. You should also have a ·01 mfds. condenser in series with the aerial to reach low wavelengths. (N.B.—The potentiometer is wrongly connected: it should be in series with the crystal.)

(2) A.T.I.=9,000 mhys. Jigger secondary= 1,000 mhys. Closed circuit condenser ·0003 mfds.

(3) The H.T. battery in series with the plate of the valve.

(4) It depends on the H.T. and the L.T. voltages available. Practically any value is equally suitable. See the advertisement pages of *The Wireless World*.

MUG (North Finchley).—(1) Yes.

(2) Connect the grid to the disconnected end of the A.T.I., or better to an additional slider. No further improvements suggest themselves with a single circuit receiver.

(3) See answer to query (4) of **THYRYA (Worcester Park).**

(4) In general H.F. amplifiers have transformers without iron cores—L.F., with. Exceptional cases are, however, met with and can then only be tested. Your suggestion as to action is more or less correct; the large self capacity of L.F. coils also washes out H.F. currents.

H.W.F. (Acton) *sends a sketch of a 2-circuit receiver and asks* (1) *Is it correct.* (2) *What gauge wire and how much for primary and secondary* (3) *What would be the dimensions of a loading coil, and what gauge of wire.* (4) *The capacity of a suitable fixed condenser.*

(1) Quite correct, except that the tuned circuit condenser should be variable.

(2) Primary No. 22, about ½ lb.; Secondary No. 26, about ¼ lb.

(3) About 9″ × 6″ of No. 22 would be suitable.

(4) The variable condenser should be ·0005 mfds. at maximum.

J. W. (Leith) (1) *quotes a formula of Prof. Howe relative to the electric field strength due to an aerial in which it is stated to be inversely proportional to the distance from the aerial. He asks why it is not inversely proportional to the square of the distance from the aerial.* (2) *Asks, assuming that the direction of wave incidence on a horizontal frame aerial to be horizontal, what E.M.F. will be induced in it.* (3) *Asks for the trigonometrical expression for great circle distance between two stations having given their latitude and longitude.*

(1) You are neglecting the directional properties of a vertical wire. No energy is radiated by such an aerial in a vertical direction; hence the inverse square law does not hold good.

(2) On your assumption, no signals will be picked up. Your contention (*a*) is correct; (*b*) is wrong, because it only applies for the component of the electric field whose direction is parallel to the plane of the loop—in this case zero. The article in *The Wireless World* (pp. 187 and 188 of the issue for June 12th) evidently takes into consideration the distortion in the direction of incidence of waves, an effect which is by no means negligible.

(3) If latitudes are a_1, a_2, the difference in longitude$=B$, the great circle distance$=d$.

Then $\cos d = \sin a_1 \sin a_2 + \cos a_1 \cos a_2 \cos B$.

To obtain great circle distance in nautical miles multiply d by 60.

H.W. (Osmanlie).—(1) Honeycomb and basket coils, if properly constructed, are nearly as efficient for all purposes as ordinary types.

(2) The second valve in such a circuit would be the rectifier. It need not necessarily have a grid leak and condenser; a Q valve with 25 to 30 volts H.T., and the grid connected to the negative of the filament rectifies without.

(3) Your intervalve transformer looks a trifle dubious, but you give no constructional details. Why not use resistance-capacity coupling.

(4) See (3) above. It requires a very special construction of transformer to be efficient over such a large range of wavelength.

J.R. (Leominster).—(1) Capacity of glass condenser, 8 sheets of glass, 2½″ × 2″ × 1/16″ thick will probably be about = ·0009 mfds., but may differ considerably on either side of this value, depending on the S.I.C. of the glass.

(2) The circuit should tune to at least 7,000 ms. on either arrangement, but if theory disagrees with experimental fact, it is of course the fact that must stand. Probably some of your dimensions are inaccurate.

(3) We do not think there are other spark stations sending English Press as well as Poldhu.

(4) Your set appears to be giving good results. We cannot suggest any likely improvements. If you wish to do so there is no objection to your trying a tikker.

J.W. (Glasgow) *asks about a dozen questions under four headings. The following are replies to a selection:—*

(1) For a ·0015 mfds. condenser see the issue for August 21st.

(2) The wire of your telephones is No. 24. We cannot give the exact resistance, but it will be fairly high, and the telephones will probably work best without a transformer.

(3) A 4-volt 10-amp hour battery will not be very suitable for the amplifier panel described in the November issues Six volt, and not less than 20 amp. hour would be desirable.

(4) Sizes of samples are:—(1) No. 36; (2) No. 26; (3) No. 32; (4) No. 20; (5) No. 28; (6) No. 28; (7) No. 30; (8) No. 26.

G.S. (Leeds) *asks* (1) *to whom to apply for an extension of a pre-war license.* (2) *Is the sketch he encloses of an aerial suitable for receiving.* (3) *For a diagram of a single valve set employing a loose-coupled inductance.*

(1) The Secretary, G.P.O., London.

(2) Yes.

(3) See Fig. 3, page 629 of the issue of November 27th, and others in recent issues.

C.E.G.B. (Kensington) *asks for help with regard to a set which will not work.*

We cannot see any reason why you should not get results. All your circuits should be O.K. if the proportions of the parts are suitable, as they appear to be, as far as we can judge, although the sketches do not quite agree with your list of parts. We can only suggest that your valve may not be junctioning—possibly by the displacement of an electrode.

J.J.F. (Portsmouth).—(1) Hardly thick enough for mechanical strength, otherwise O.K.

(2) Not more than 60 ohms., we think.

(3) Yes.

(4) The set is quite wrongly connected; see many diagrams in *The Wireless World.* Your inductance would tune a P.M.G. aerial to about 8,000 ms.

AMATEUR (Normanton).—(1) We cannot state the wavelength as your figures are not consistent. The number of turns and size of formers lead to lengths of wire widely different from your stated values. A loose coupler on formers 1″ in diameter would be very inefficient; 0·00006 mfds. is too small for a tuned circuit condenser, and 0·000018 mfds. is too small for a telephone blocking condenser.

(2) A crystal circuit can be adapted for C.W. by the use of a tikker, but this is not in general convenient. The usual method is by means of a valve.

(3) The place shown for the A.T.C. is correct.

W.S.M. (Penzance) *asks for the currents in line and each arm for three arrangements of batteries of six cells of one volt each, the internal resistance one ohm each, and the line resistance 20 ohms.* (*See Fig.* 3.)

(1) Current through 20 ohms = 6/23 amps.
Current through each battery = 3/23 amps.

(2) Current through 20 ohms = 0
Current through each battery = 1 amp.

(3) Current through 20 ohms = 1/11 amp.
Current through each of batteries (1) and (2) = 23/33 amp.
Current through battery (3) = 43/33 amp.

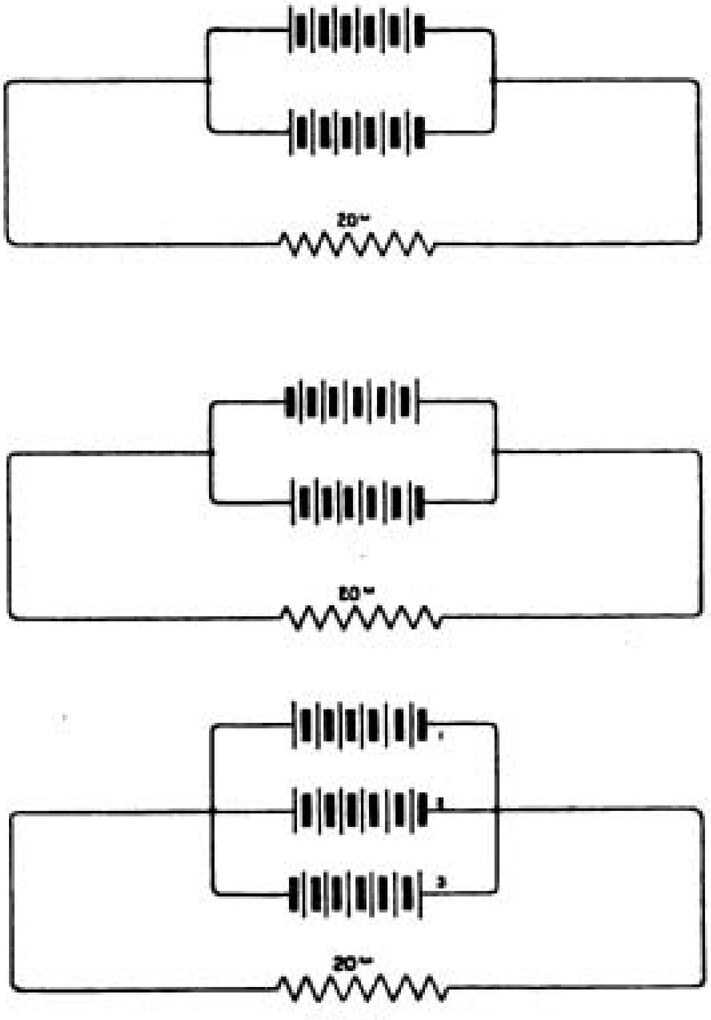

Fig. 3.

C.B.T.M. (Birmingham) *wishes to add another valve to his receiver and asks* (1) *What is the most suitable circuit.* (2) *What additional instruments are required.* (3) *Criticism of the circuit sketched.*

(1) We should advise L.F. amplification, the connections of the second valve being essentially as in Fig. 2, page 755 of the issue for January 22nd.

(2) An intervalve transformer and a telephone transformer. The latter, though desirable, is not absolutely essential.

(3) The circuit is quite satisfactory if the A.T.C. is small, except that a blocking condenser is desirable across the primary of the telephone transformer.

E.W.W. (Streatham Hill).—(1) *See* Fig. 4, page 756 of the issue for January 22nd.

(2) You do not give enough data for us to state the wavelength. A glass test-tube condenser will probably have too little capacity to be useful. You will get bad results with L.R. telephones and carborundum unless you use a telephone transformer.

(3) We cannot say, for reasons as above.

(4) The "Wireless Year Book" (1921 Edition, just published) gives the most complete list.

AMATEUR (Tamworth).—(1) Your diagram is not very helpful, *e.g.*, you show a box marked resistance coil, showing four terminals but no windings. You give size of one winding. This apparatus will, however, not work as shown unless it possesses two distinct windings. No. 36 wire is too fine for the aerial circuit. You show the H.T. on the plate of the first valve. We have not used the L.F. amplifier referred to but should imagine that the input should be to the terminals L and L 2. We cannot give the wavelength range as you give no particulars of the aerial or the A.T.C.

J.C. (Burley-in Wharfedale) *sends a sketch of a set and asks* (1) *If it is suitable for the reception of C.W. and spark, and what would be the probable wavelength range.* (2) *Is it possible to use instead of an A.T.I. with tappings and switch, a variometer of equal inductance, and would finer tuning be possible.* (3) *Could two similar pancakes act as a variometer if connected in series and the degree of coupling varied by altering the angle between them.* (4) *What is the most suitable valve for this circuit.*

(1) The set is O.K., except that B should not be more than 0·001 mfds., and D is unnecessary. As amended the wavelength range will be about 4,000 ms.

(2) Yes, and yes.

(3) Yes. The maximum inductance of two pancakes close together will be about three and a half times the inductance of each.

(4) V.24 or any other valve of a similar type.

BEGINNER (Newton-le-Willows) *asks* (1) *For criticisms of a crystal circuit.* (2) *For inductances of coils (a) primary 10″ × 5¼″ of No. 22.* (*b*) *Secondary, 9″ × 4½″ of No. 32.* (3) *For capacity of condenser consisting of 17 plates, 2¼″ radius, dielectric, of air.* (4) *If 8,000 ohm telephones can be used with a transformer, or if he should get L.R. telephones for a valve set.*

(1) Quite satisfactory. The secondary is rather larger than necessary; it might have been wound with No. 28. Mica 1-32″ thick is very unusual in a condenser; the usual value is about 1-300″ for receiver purposes.

(2) (*a*) 7,000 mhys. (*b*) 22,000 mhys.

(3) ·0003 mfds.

(4) Not efficiently. For a valve set H.R. telephones may often be used without a transformer; or telephones of about 120 ohms. may be used with a transformer.

J.K.H. (Rotherwood) *sends further remarks on his question answered on p. 738. He does not think that the disturbance is due to mechanical causes, and asks for a further opinion.*

We are afraid we cannot give you much more help without a personal examination of the case. Magneto discharges are a possible explanation, but appear very unlikely at a distance of 600 yards. Action from a lorry at this distance, either by induction or by mechanical vibration, is so strange as to verge on the inconceivable.

E.B.M. (Clapham) *asks* (1) *Using a frame aerial, will he get good reception if he uses a crystal as detector and valve amplification, or would it be better to use two valves and crystal rectification.* (2) *For capacities and inductances, also connections of the set.* (3) *What modifications would be necessary to receive spark messages.* (4) *Is a license necessary to use a loop aerial, as well as the ordinary permit for a receiving set.*

(1) Use two valves for H.F. amplification, followed by crystal rectification.

(2) See Fig. 1, page 730 of the January 8th issue, substituting a tuned circuit with usual telephone and crystal arrangements for the telephone transformer and telephones shown. The aerial circuit coil might be 8″ × 6″ of No. 22.

(3) None, except to reduce the setting of the reaction condenser (·00001 mfds.)

(4) No additional license is necessary, but approval of the arrangement must be obtained

G.M. (Windlesham) *asks* (1) *For criticism of a set sketched.* (2) *Can basket coils be used with crystals with good results.* (3) *Is an aerial of the following dimensions any good: 20′ high, 70′ long, lead in 20′.*

(1) The circuit is all right, except that you will find it desirable to connect more than one point of your jigger primary on to the aerial circuit. For aerial connections see Fig. 1, page 755 of the January 22nd issue.

(2) Yes, do not use too fine wire, say No. 24 for the A.T.I. and No. 28 for secondary.

(3) Yes, fairly good; increase the height, if possible.

RADIO (Whitley Bay).—(1) The circuits A and B should prove satisfactory for both. Circuit C is incorrect, as the plate and grid circuits are not completed to the filament. Circuits A and B should have a blocking condenser across the telephones and H.T.—this is only shown in C.

(2) Circuit A is the best, as a potentiometer adjustment is always desirable in a single valve set. You should certainly use an additional A.T.I. in series with your aerial, as with the present arrangement you cannot weaken the coupling without taking the inductance out of the aerial circuit.

(3) With the limitations you specify, circuit A is the best we can think of.

(4) About 4,500 ms.

PUZZLED (Swindon).—(1) The reason that your set will not oscillate on very long wavelengths in wet weather is probably due to considerable variations in the grid leak resistance at such times, and possibly also to leaks on your coils to some extent. We are afraid that your description of the dry weather irregularities is not clear enough for us to explain the trouble.

(2) and (3) A crystal used with the valve would improve results if properly connected, but your way of introducing it is useless. You will have to use an arrangement as in the April 17th issue, or one of the similar ones sketched from time to time in these columns.

(4) Your condensers are about ·00004 and ·00005 mfds.

W.H.K. (Fulham) *asks for a diagram of a good valve receiver with approximate L and C values.*

See Fig. 4, page 697 in the issue of December 25th, 1920, for a diagram. As regards L and C values the A.T.C. should be about ·01 mfds., and the closed circuit condenser about ·0003 mfds. for nearly all wavelengths. The inductance values depend on the wavelengths you require. For 2,000 ms. try 6,000 mhys. A.T.I., 3,500 mhys closed circuit.

J.L.L.M. (Purley) *asks* (1) *For dimensions of condensers for capacities* (a) ·00004 *and* (b) ·00086 *mfds., dielectric to be mica* ·001″ *thick and plates not bigger than* 1″ × 2″. (2) *If P.M.G. allows the use of frame aerials in addition to the ordinary type.*

(1) (*a*) For this use two metal plates only, overlapping 1 square cm. and use 10 thicknesses of mica.

(*b*) Use two metal plates only, overlapping portions 3 cms. × 2 cms., with two thicknesses of dielectric.

(2) Yes, but sanction must in each case be obtained before using.

W.G.B. (Chester).—(1) It is useless to put a crystal in series with the grid of a valve. The correct principle on which to employ a crystal and valve in conjunction is shown in the constructional article in the issue of April 17th last. We note that you can get signals from FL, but we expect you would get far better results with the crystal and the ·0003 mfd. condenser omitted.

(2) Yes, this is quite the right way to increase your range. In any case an additional A.T.I. in series with the aerial will enable you to weaken your coupling and increase your selectivity on shorter wavelengths.

(3) We think you may quite well hear the "clicks" from a C.W. station with a crystal receiver at a short distance, and possibly also the hum of the generator. This does not affect the general principle. Unless you can alter the note of signals by manipulating your apparatus you are doing nothing remarkable.

(4) The capacity of the aerial is increased by spreading twin wires further apart. Three feet is fairly satisfactory, but six would be much better.

H.B.D. (Finchley) *has a simple one-valve set which gives good results, but the telephones—H.R. in series with the H.T. battery, both shunted by a condenser—have repeatedly broken down. He asks* (1) *For the probable reason.* (2) *If it matters on which side of the H.T. battery they are connected.*

(1) Your receiver is of quite normal type, and should not give trouble. The breaking down is probably due to a short circuit putting the whole voltage of the battery on to the telephones. It may be (1) in the condenser, which is not very likely, if it is of glass; (2) in the valve holder, which is most probable; or (3) in the leads.

(2) As regards breaking down, no; but for safety from shocks and to keep down stray capacity effects, put it on the negative side.

H.S. (Acton) *asks* (1) *For information as to who in London handles the Omnigraph.* (2) *If we know of any other useful mechanical device for teaching reception.* (3) *If the Marconi Telephony concerts from Chelmsford are to be resumed.*

(1) We do not think the makers (The Omnigraph Mfg. Co., 26B, Cortlandt Street, New York) have agents in this country, but try Gamages, of High Holborn. You will find a cut of the apparatus in the most recent issues of the "Journal of the American Institute of Radio Engineers," which is fairly accessible in this country.

(2) We do not know of any, except the gramophone records, of which you say you possess some. Why not make other records yourself if you have a receiver and a gramophone.

(3) We have no official information, but do not think anything has been arranged at present. There is little prospect of a resumption to any extent for some time.

J.E.S. (Guildford) *asks* (1) *For a circuit for two valves, the first as a resistance amplifier and the second as a detector.* (2) *Why a two-valve circuit (sketched) will only work on one setting of each adjustment.*

(1) See Fig. 1, page 730, of the issue for January 8th, substituting any ordinary receiver circuit for the closed frame aerial circuit as desired.

(2) This is difficult to say. Your circuit, though of rather freak type, should work. Your A.T.C. is much too small. Use not less than ·005 mfds. Your inductances, if given in microhenries, are also too small. The maximum wavelength will be only a few hundred metres, and the set will not be efficient even at this with such small coils.

A CORRECTION.—Resistance Coupled Thermionic Amplifiers.—In our issue for March 5th on page 840, line 19, col 2, r_1 should read r_2.

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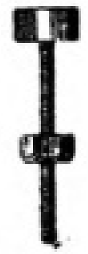

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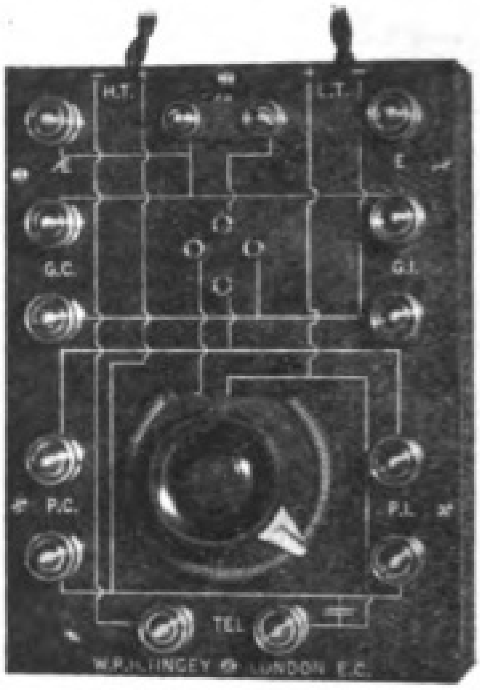

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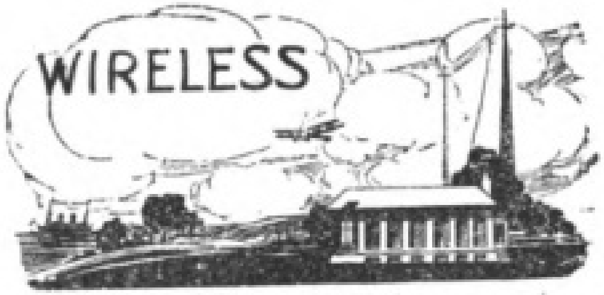

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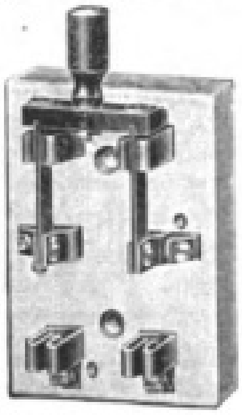

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THE RADIO REVIEW

CONTENTS OF MARCH ISSUE, 1921.

"THE EFFECT OF IMPURITIES ON THE IONISATION POTENTIALS MEASURED IN THERMIONIC VALVES." By L. S. Palmer, M.Sc.
In our last issue was published a short article by B. S. Gossling and J. W. Ryde dealing with the subject of gas ionisation in three-electrode valves. Many more results of a similar nature are given in this article, which includes a number of curves setting out the experimental results.

"THE PARIS RADIO CENTRAL."
An illustrated description of the proposed extra high-power wireless station for the Paris district. This station is to comprise two transmitting stations for medium and long-distance work respectively and a number of receiving centres. Details of the proposed arrangement are set out in this article with some particulars of the apparatus that is to be installed. The London-Paris Wireless Service recently opened is to form a portion of this scheme and some details of the arrangements now in force are included at the end of this article.

"A NOTE ON THE THEORY OF THE THERMIONIC TUBE." By J. A. Fleming, M.A., D.Sc., F.R.S.
In the original equations expressing the flow of thermionic current through a vacuum tube, as given by I. Langmuir, a misprint appeared which has been copied in a number of publications. This article by Dr. Fleming gives an alternative method of proving this emission equation. At the end of the article an editorial note by Professor Howe gives also the full proof of Langmuir's equation.

"MEASUREMENTS OF RADIATION OF RADIOTELEGRAPHIC AERIALS." By G. Vallauri.
A continuation of the article commenced in the February issue.

"THE EFFECT OF MODULATION WAVESHAPE UPON RECEIVED SIGNALS." By A. S. Blatterman (Signal Corps, U.S. Army).
The oscillatory currents set up in the circuits of a receiving station do not have the same wave form as those in the transmitting aerial. This difference introduces a distortion effect in the characteristics of the received signals and the magnitude of this distortion is discussed for different methods of modulating the output of the transmitting aerial.

THE PHYSICAL SOCIETY'S EXHIBITION.
A continuation of the description of the exhibits of radio interest. The Davis Pletts Slide Rule for the calculation of complex mathematical quantities is briefly described and illustrated.

NOTES.
Notes of commercial, scientific and personal interest, including information with regard to recent changes in message rates and coastal taxes for wireless traffic in various countries. A novel arrangement of "radiophare" is also described and some particulars are given with regard to recent developments of high-tension insulators for supporting the aerials of high-power stations.

REVIEW OF RADIO LITERATURE.
Abstracts of Articles and Patents.

CORRESPONDENCE.
"Inductance Calculations," by N. Lea, describing a form of slide rule calculator based on Nagaoka's formula for the calculation of the inductance of coils.
"Mica Condensers for Radio Work," by W. J. Henry, of the Wireless Speciality Company (U.S.A.), describing their developments of mica condensers.

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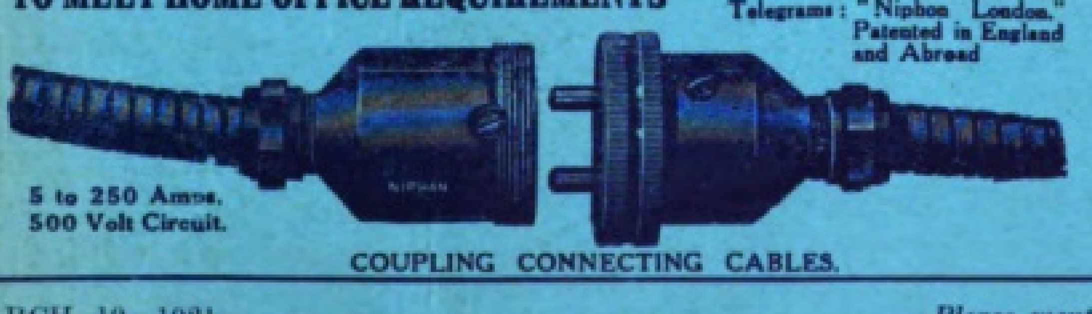

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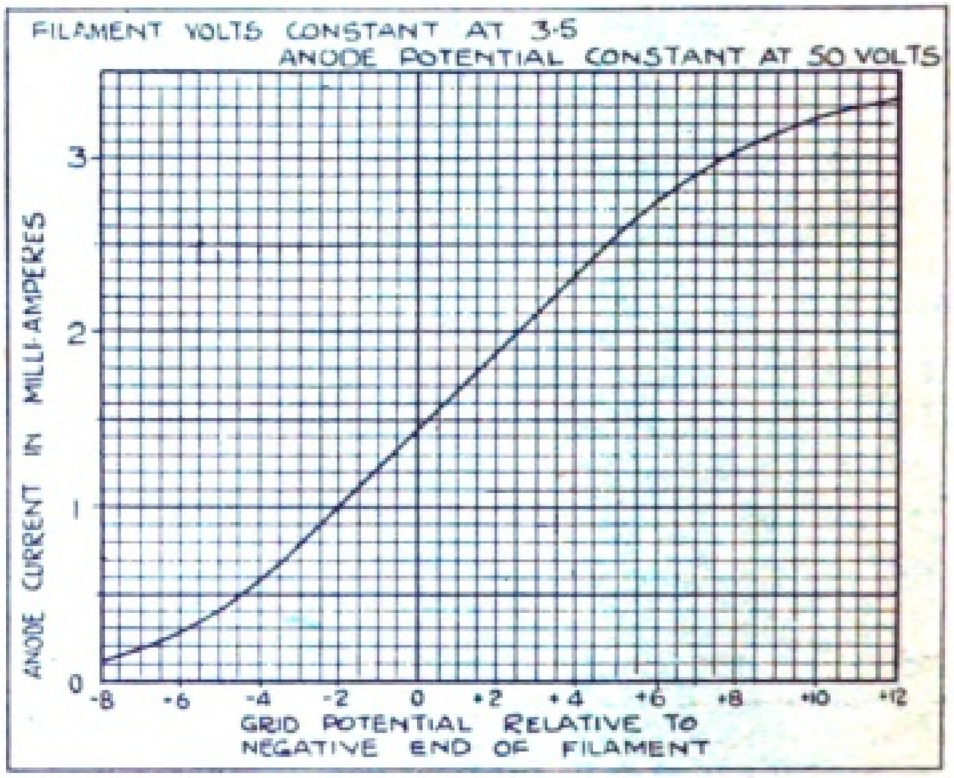

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