The WIRELESS WORLD

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THE WIRELESS WORLD

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NOTES ON RECEPTION OF THE DUTCH CONCERTS

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

AS there appear still to be many amateurs unable to get the Thursday and Sunday Wireless Concerts, sent out by PCGG from the Hague, Holland, perhaps the following notes may be of interest and assistance.

There should really be no difficulty in receiving this music, especially now that the transmitting power has been increased; and no doubt there are some, who, with the writer, have for a long time been able to get it and also the rest of the weak telephony which is to be heard. To such these remarks are not addressed.

For the benefit of beginners it may be as well to state that it is hopeless to expect such reception when only a crystal is used as detector, it is not nearly sensitive enough: at least one valve with reaction is necessary.

Assuming the latter is being used, it is very probable that failure to receive such weak telephony or music is due to what may be termed "overlap" in the reaction. The meaning of this will become apparent as the reader proceeds. In order to receive telephony without distortion it is essential that the circuits, or as some prefer to say, the valve, should *not* be oscillating; and yet if the telephony be weak, the coupling of the reaction coil must be as tight as possible. In other words, the reaction coupling must be adjusted so that the valve is *just not* oscillating. It should be noted that, if only a little off this desired point, weak speech will probably be quite inaudible.

Now, unless the filament current and the H.T. voltage have just the right values relative to each other, it is most difficult, if not indeed impossible, to adjust the reaction coupling and keep it on the point at which we are aiming. Even if it can be set to that point, the arrangement is most unstable, so that an atmospheric is sufficient to upset the balance and start the system oscillating.

An easy way to tell when the H.T. voltage and filament current have the correct relation to each other is to test for "overlap" in the reaction coupling. If overlap be there, reception of PCGG or any other weak telephony is most unlikely, since the effect is as follows:

Begin with the reaction coupling loose and the valve not oscillating. Tighten the coupling slowly until oscillation starts; note this position of the coupling pointer or handle, and then slowly loosen the coupling again. If overlap be present, the oscillations will not cease at once; but at some point farther on the "loose" side than that at which they commenced.

Now, the greater this overlap, or distance between the points where oscillation of the valve begins and ends, the more difficult it becomes to receive weak telephony. The ideal to aim at is so to adjust the value of either H.T. voltage or filament current that oscillation begins and ceases at *exactly* the same point in the coupling. The easier of the two is to vary the filament current by means of a small rheostat, leaving the H.T.

voltage at its normal value. The rotary pattern of rheostat described in detail on page 860 of *The Wireless World* for March 19th, 1921, will be found a very convenient pattern to use. It is quite likely that attention to this adjustment alone will help many to get the Dutch Concerts who have hitherto failed.

A useful, although not essential, refinement is a variable condenser of very small capacity connected across the reaction coil ; it gives a much finer adjustment than can be obtained by altering the coupling handle alone. Addition of capacity is equivalent to tightening the coupling.

To *find* the Hague music search round about 1,000 metres with the valve oscillating, and as soon as its unbroken C.W. is heard, loosen the reaction coupling, at the same time adjusting the aerial tuning condenser so as to keep on the silent point of the C.W. at either side of which the note rises in pitch. Directly the valve ceases to oscillate leave the coupling as it is, and put in a little of the reaction coil variable condenser until the oscillation almost begins again. If no reaction condenser be fitted, get as near to the oscillation point as possible by means of the coupling. Maintain the adjustment throughout at the silent point of the C.W., and do not use more of the reaction condenser than is necessary.

The above remarks apply to a self-heterodyne set with reaction coil coupled to the aerial tuning inductance, which is very simple to adjust, but should be carefully used so as not to cause interference. To judge by the number of "birds chirping" when PCGG music is coming through there must be many amateurs ignorant of the fact that the valve must not oscillate if it is desired to listen to the concert, and that in allowing oscillation to continue for some time they are interfering with others without serving any useful purpose.

As regards the strength of PCGG music, the writer gets it ten miles south of London quite nicely, audible with a single valve ; and with three note magnifiers added it is quite loud in the telephone headgear and can be heard across the room. Probably H.F. amplification would improve upon this.

A POWER BUZZER

By W. J. Fry.

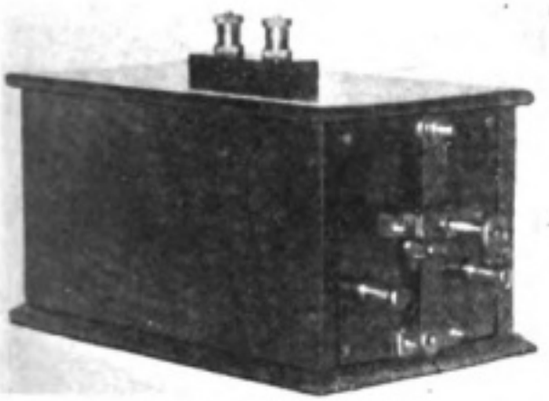
IN these days of small aerial input for amateur transmissions, limited in most cases to 10 watts, it is important not only that the efficiency of the receiver should be of the highest, but also that the greatest possible care should be taken to make the very best use of the transmitter.

It is well-known that spark coils, giving short heavy discharges, are much more efficient transmitters than those giving long thin sparks. The amateurs of America use the power buzzer a good deal for transmitting. The power buzzer has the advantage that high efficiency can be obtained with quite low input power, even primary cells of the type used for electric bell-ringing answering perfectly as a current source.

In the power buzzer to be described good signals can be obtained from eight to ten miles on a power consumption of 2·5 watts, using the usual P.M.G. aerial. This efficiency is obtained using single valve receiver.

When selecting the type of primary cell to be employed care should be taken, as there is an infinite variety of types to choose from and the quality is equally varied. After a considerable experience, I myself have selected the "Dania" cell, which I consider the best. These cells are manufactured by

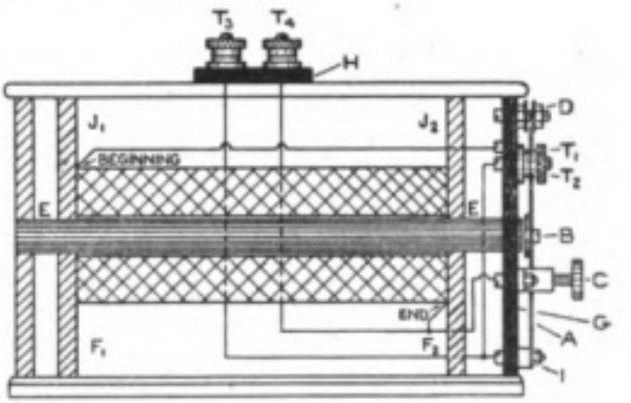
the Atlas Carbon and Battery Company, of Southwark Bridge Road, S.E. These cells, when new, will fuse a 5-ampere fuse wire, and the cells have the additional advantage that they will not deteriorate with keeping.



The completed Instrument.

I will now proceed to give the necessary details for the construction of the buzzer. The following is a list of articles that will be required. A box constructed from ½-inch wood, preferably mahogany, to the pattern shown in the photograph ; a piece of ebonite, ½-inch thick by 5 inches square, for the front panel (G) ; another piece of ebonite, 3 inches long by 2 inches wide by ½-inch thick, for the top terminal block (H) ; 1 lb. of 18 S.W.G. annealed iron wire for the core (E), which should be cut into 9-inch lengths and assembled to form a bunch 1 inch in diameter ; a few yards of electrician's black insulating tape ; 1 lb. of 22 S.W.G. double cotton-covered copper wire ; a piece of 20-gauge sheet steel, 4½ inches long by ⅝-inch wide, for the armature (A) ; a brass bridge piece, for the contact screw (C) ; a brass block, 2 inches long by ½-inch wide and $\frac{3}{16}$-inch thick, for the armature fixing at base (I) ; four terminals (T1, 2, 3 and 4) ; a ¼-inch Whitworth screw, for damper, 1½ inches long with two hexagon nuts in brass (D) ; two rubber washers ¾-inch in diameter, and $\frac{1}{16}$-inch thick, very flexible (D) ; four B.A. brass screws 1½ inches long with four hexagon nuts, for holding breaker block and contact bridge, as shown in the sketch ; ½-inch of No. 14 gauge silver wire, for contacts ; an iron disc ⅛-inch thick by 1⅛-inch diameter, for hammer (B) ; two blocks of wood, ⅝-inch thick by 5 inches square, having a 1-inch hole bored through the centre of these to take the core J_1, J_2.

The coil can now be constructed. Place the core within the centre holes of the wood blocks, as shown in the diagram, and wind three layers of the black tape over the core inside the cheeks. A little paraffin wax run over the tape will improve the insulation. A small hole, parallel with the top of the core, should be made through the wood cheek at one end to bring out the starting of the coil, the wire can then be wound on, and, when finished, should be steeped in hot paraffin wax. The rest of the construction can be easily followed from the sketch, and the details are the same as would be the case in the construction of a spark coil, except for the absence of the secondary coil. Two shunt wires should be brought up to the top terminals, one from each of the break contacts, as shown.



The Power Buzzer shown diagrammatically.

When completed, the buzzer can be connected up to an ordinary circuit in the usual way, and the wavelength read by means of a wavemeter. For the authorised wavelength of 180 metres I find that approximately two turns of inductance wound on a former of 2 foot diameter, with a condenser of 0·005 mfds., is correct for the closed circuit. The best condenser value will be found by noting

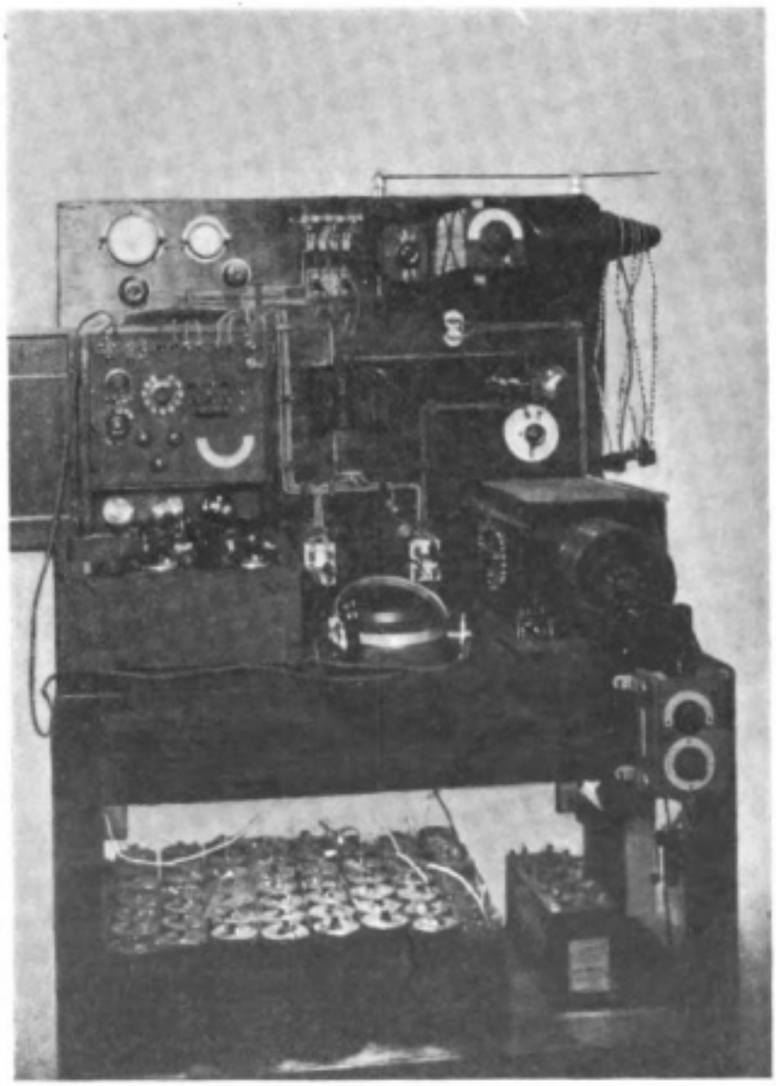
the reduction of arcing across the contacts of the break. If insufficient capacity is employed, a scraggy note will be produced instead of the clear musical one which should be obtained.

The buzzer should be operated at 25 volts, and will take about 0·10 amps., or a little more, according to the break adjustment. On the best aerial adjustment about 0·30 amps. will be recorded. A 4-volt 0·30 amp. flash lamp is a useful indicator, if placed in series with the aerial or earth.

A PRESCOT AMATEUR WIRELESS STATION

THE accompanying photograph shows an amateur wireless station just completed, of which the following description is given.

The aerial, a two-wire P.M.G., is lead in to a heavy lead, secured to insulators screwed to the top of the board. The lead-in terminates in a bussbar having four spring clips. Below are four more spring clips, which lead to the following circuits : (1) loose-coupler, seen on right of table, (2) to experimental circuits, and also to plug board for connecting in honeycomb coils, (3) trial circuits, (4) to aerial terminal of detector amplifier, seen on left of back board.



A comprehensiue view of the finished station.

Below the aerial lead-in will be seen the 0·001 condenser and series-parallel switch.

Connections are made to the aerial by means of ebonite-handled links of brass, which slide into the spring clips.

On the right of the board is seen a single valve, which can be used with the loose-coupler, or with the slab coils. The valve has a grid condenser of 0·0003 mfds., and grid leak of 3 megohms.

The detector-amplifier can be used as a one-valve detector, with two valves for amplification, or simply as a three-valve transformer coupled amplifier. Each valve is fitted with a separate filament control.

An interesting detail is the switch used to cut out one or two valves. As each valve is cut out a definite resistance is inserted to prevent the usual rise in the filament voltage on the remaining valves.

The batteries for low and high tension are placed on the shelf under the instrument table, and this arrangement facilitates changing and connecting up without disturbing the rest of the apparatus.

A PRESCOT AMATEUR WIRELESS STATION

All the wiring is kept clear of the instrument table and the wall by employing ebonite cleats.

A Mark III receiver is seen on the left-hand side of the table, and this can be used in conjunction with the amplifier for short wavelengths.

The whole set took about nine months to complete, and is the work of Mr. James Nelson, of Prescot, Lancashire, assisted by his son. Mr. Nelson formerly held a commission in the Navy, and was engaged in electrical work on H.M.S. *Vernon* and also on H.M.S. *Renown*.

THE LIGHTING MAINS AS A SOURCE OF CURRENT FOR VALVES

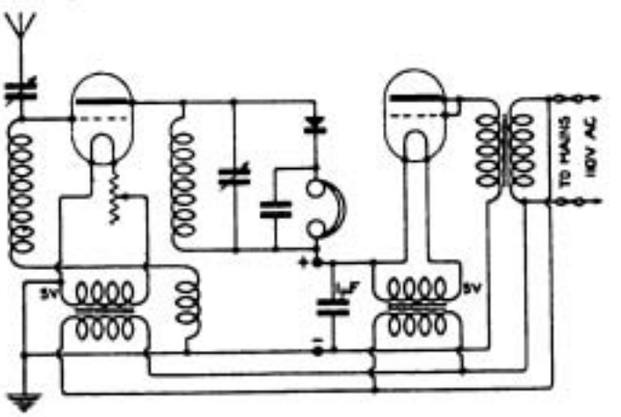
IN response to numerous requests from readers, Professor M. Moye, of the University of Montpellier (France), who contributed the note published on page 24 of the April 2nd issue of *The Wireless World*, has kindly forwarded the following more detailed description of a means of utilising the A.C. mains for supplying both high tension and low tension voltage to valves.

Professor Moye states that since contributing the note referred to above he has found it possible to dispense with high-tension batteries also, and the instructions he gives are as follows :

First, connect the A.C. from the supply mains (110 volts 50 cycles) to the primary of a one to one transformer of a fairly high resistance (300 to 500 ohms). One terminal of the secondary winding goes to the filament of the amplifying valve, and the other terminal to the plate of a rectifying valve. The rectifying valve can be an ordinary French "R" type valve, with the grid and plate connected together as indicated in the figure. You then have a two-electrode rectifying valve, powerful enough for your purpose.

The filament of the rectifying valve is lighted through a bell-ringing transformer in exactly the same manner as the voltage is applied to the amplifying valve.

A connection is taken from the filament of the rectifying valve to the plate side of the receiving set as indicated in the diagram. A condenser of 1 mfd. is inserted across the terminals of the rectifying apparatus for the purpose of smoothing out the fluctuations of the rectified current, and providing an easy path for radio-frequency oscillations. No other condenser or choke coil is necessary.



The circuit diagram.

The working efficiency of this arrangement as compared with the employment of the ordinary H.T. batteries is practically the same, but it must be emphasised that a tuned circuit on the plate side of the receiver, with detector and telephones in shunt, is absolutely essential, otherwise the humming of the A.C. generator would be unbearable.

A CABINET SET OF AMATEUR DESIGN

THE photograph shown in Figure 1 illustrates the unusually neat receiving set, due to Mr. H. J. Hinks, of Palmer's Green. From the photograph it will be observed that the cabinet is an ordinary writing bureau, in which the ebonite panel is placed. The telephone headpiece is placed within the front of the cabinet when the latter is closed. The panel is 21 ins. long by 8 ins. wide, and is of ¼-in. ebonite. The dimensions will be seen to be the smallest consistent with ease of manipulation and simplicity of arrangement. The valves, selector switch arms for the long and short wavelengths, tumbler switches, the condenser and reactance knobs, the high frequency transformer (having an adjustable iron core) and a watch holder, are all mounted on the front of the panel, together with a four-way telephone switch for transferring the rectifying and amplifying circuits for the long wave to the short wave coils, and *vice versa*. The coils are adapted for use with the standard 100-ft. single wire aerial permitted by the G.P.O. The short wave coils cope with wavelengths up to 1,000 metres, whilst the long wave coils under similar conditions cope with wavelengths from 1,000 to 20,000 metres. The coils are tapped at the required intervals, and the leads are taken to studs under the arms of the selector switches mentioned above.

Fig. 1. *The Receiver Panel showing the arrangement in the Cabinet.*

The low frequency transformers, together with the batteries, are placed upon the shelf within the lower part of the cabinet. This is a very convenient arrangement, as the batteries may easily be renewed when required without disturbing the other apparatus. The lowest portion of the cabinet may be used for the storage of sundry apparatus or for the reception of books.

Along the lower edge of the panel a series of three pairs of sockets is provided for the reception of plugs attached to the leads from the telephone receivers, loud speaker, etc., whilst a fourth pair of sockets is provided, connected directly to the aerial and earth terminals, which are mounted at the back of the cabinet and are insulated therefrom by means of ebonite collets and washers. Tumbler switches, mounted on the front of the panel, are provided for breaking the high and low tension circuits and the connections to aerial and earth terminals. From the diagram of connections, shown in Fig. 2, it will be seen that, although the apparatus situated upon the panel may be out of use, the aerial and earth sockets remain connected to the aerial and earth terminals respectively, so that it is quite easy to experiment with other apparatus without disturbing the apparatus upon the panel.

The following further particulars and descriptions of some of the units comprising the set may be of interest.

Approximate height above sea level: 250 feet.

Situation: on side of hill facing S.E. by E.

Range of wavelengths: 200 to 20,000 metres.

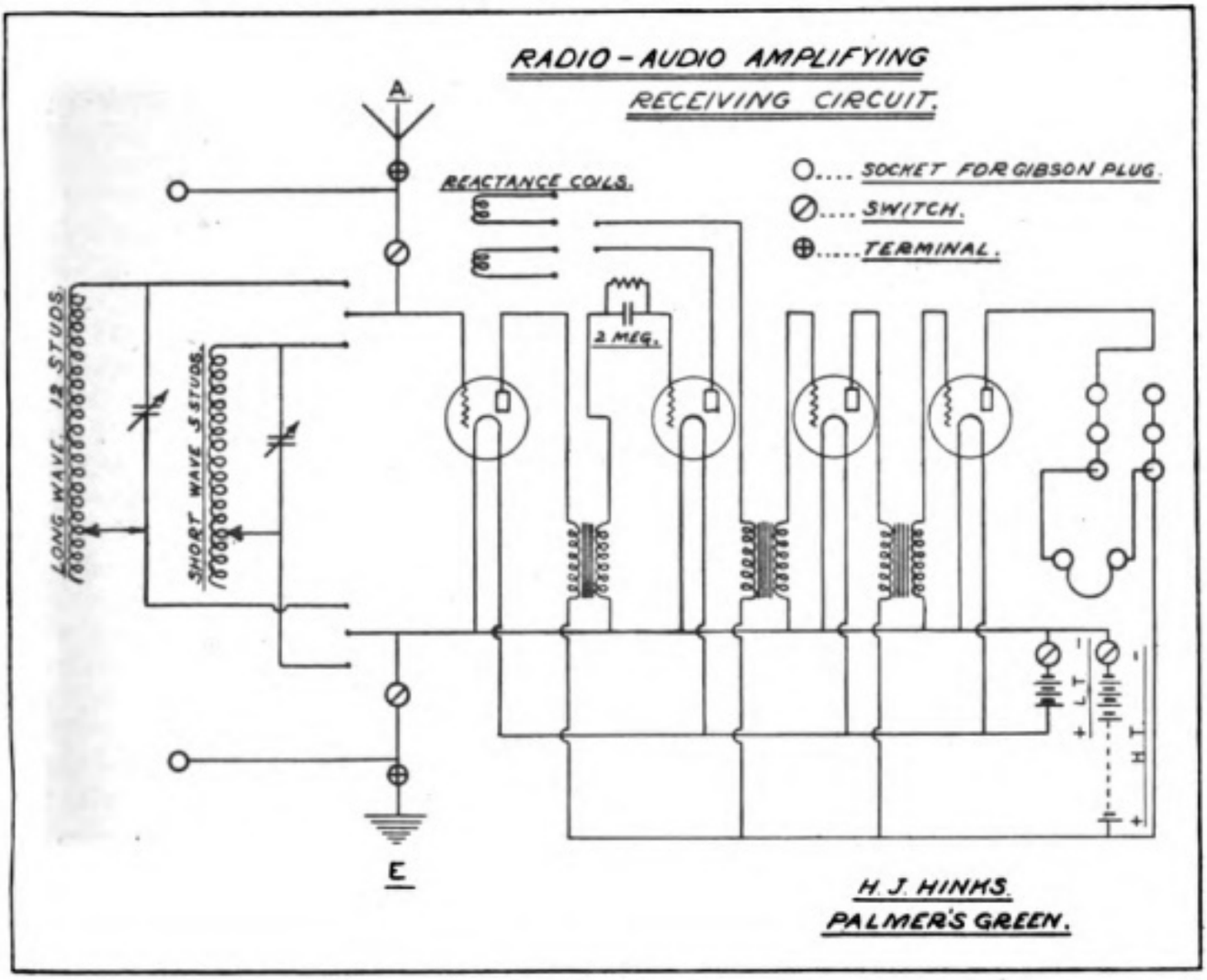


Fig. 2.

Aerial : 100 ft. (including lead in), single phosphor-bronze strip. Minimum height, 6 ft. Maximum height, 20 ft. Average height, 13 ft. Direction, S.E.

Earth : water pipe.

Valves : four in number, F. O. Read & Co.'s R.V.30.

Telephones : Messrs. S. G. Brown's, 4,000 ohms resistance.

Power, low tension : two 4-volt. 40 amp. accumulators in parallel. High tension : 60-volts, four Messrs. Siemens' 15-volt. batteries.

Accessories : home-made loud speaker ; Morse inker (suitable relay now under construction).

CLUB REPORTS

The attention of Secretaries of Wireless Clubs is invited to the note which precedes the Reports of Club Meetings published in this Magazine. The Editor would much appreciate compliance, on the part of Secretaries, with the requests contained in the note referred to.

A MULTIPLE ROTARY SWITCH

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

THE switch here described was designed by the writer for special purposes in wireless reception and experimental work, and is quite easily constructed.

It consists in a solid ebonite cylinder or barrel of small diameter, supported at each end on a simple bearing and capable of being rotated thereon ; the bearings are fixed on a flat base of ebonite.

The barrel carries contact pins passing right through from one side to the other, and projecting sufficiently on both sides to make contact with strips of springy brass arranged vertically in a row at each side, each strip being connected to a terminal.

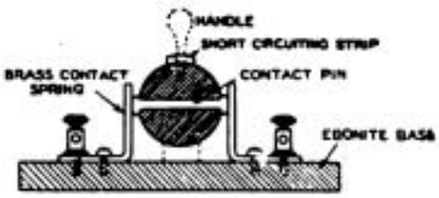


Fig. 1.

Fig. 1 shows a cross section of the switch. It will be seen that if the barrel be rotated through a small angle by means of a suitable handle, a number of contacts can be simultaneously made or broken.

This pattern of the switch, shown in Fig. 2 (plan view), can be used for cutting off during transmission, both sides of crystal and telephones used for reception ; and by the addition of a brass strip fixed longitudinally on the cylinder, can be made also to short-circuit both instruments when the cylinder is in the "off" position.

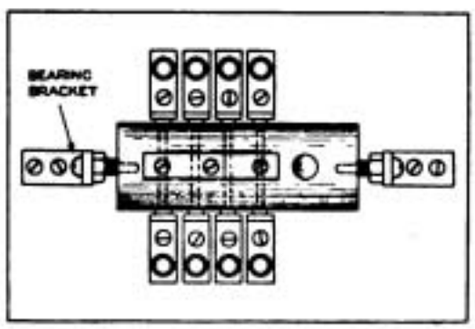


Fig. 2.

By modifying the contacts a different form of the device is produced, which is capable of changing over a whole set of instruments from one circuit to another.

For example, a crystal circuit and a simple regenerative valve circuit can be readily interchanged, the secondary coil of the former becoming the reactance coil of the valve circuit. This is of use in cases where it is not easy to get accumulators charged ; the listening in can be done on a crystal circuit, and when the desired station is heard an immediate change over to the valve circuit can be made. In this way a considerable economy in battery current can be effected ; and should the accumulator run down unexpectedly the crystal can be used, whilst recharging is being carried out, without any wiring having to be altered, excepting in so far as this is done by the switch.

In this second pattern, Fig. 3, the contact pins are not all parallel to each other as they

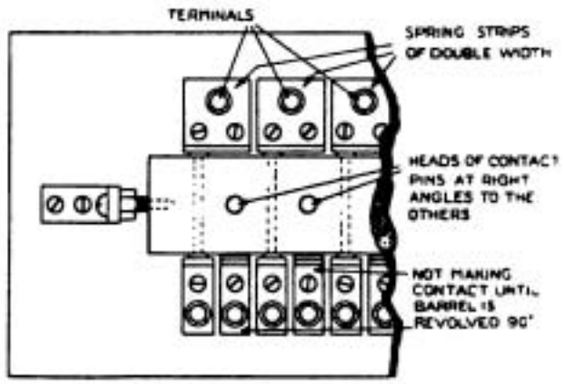


Fig. 3.

are in the first, but some are arranged at right angles to the rest, and some of the brass contact strips on *one* side are made wide enough to cover two adjacent pins, those on the other side being of single width as before.

Each of these double-width strips will make contact with two different pins, but, of course, not at the same time, because the pins are at right angles. Consequently, each of the double strips, and, therefore, any wire connected to it, can be electrically

connected at will to either of the two single-width strips opposite to it by revolving the barrel through an angle of 90 degrees. It follows that the wire on one side can be switched on to either of two other wires.

If, therefore, a sufficient number of these contacts is provided two whole circuits can be interchanged by one movement of the switch.

It should be noted that every contact will not necessarily be of this two-pin character, but only those where the "run" of a wire is to be changed. Other wires in the circuits may need to be cut off, but for these a single contact pin and a single-width strip on each side will suffice.

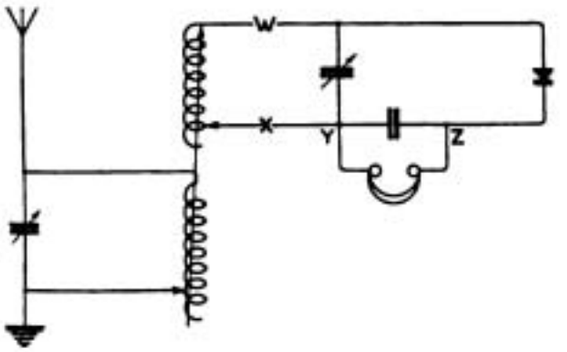


Fig. 4A.

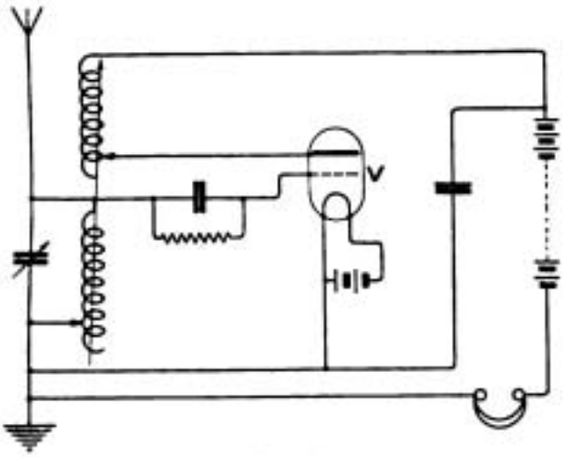


Fig. 4B.

A convenient diameter for the cylinder is ¾ inch, and the gauge of the contact pins may be No. 12 S.W.G. The holes for these should be slightly countersunk before the pins are riveted over; and the riveted heads can, with advantage, be trued up in a lathe so that they all project the same distance from the barrel. A projection of $\frac{1}{16}$ inch is sufficient.

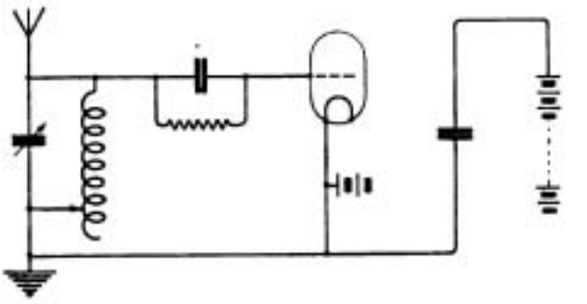


Fig. 5.

The springy brass contact strips may be made of thin material which should be softened if necessary before bending into a right angle. Stops should be provided to ensure that the cylinder is turned properly into the two positions where the contacts engage; and a handle of convenient size and shape, which may be of metal, should be screwed into the barrel, preferably at one end.

Each switch must be designed for the particular circuits which are to be interchanged, in order that the contacts may be sufficient in number, and single or double as required. The length of the barrel will, of course, vary accordingly.

Having selected the two circuits compare them carefully and note how many wires will have to be altered in their "run," and how many merely broken. Each of the former will then need a double contact, and each of the latter a single. Other wires may be noted which require no alteration, either because they will not function in the other circuit if left as they are, or because the same position will suit both circuits.

As an illustration take the case referred to above, and suppose that it is desired to connect up the switch to interchange circuits A and B of Fig. 4, the former being a quite usual crystal and the latter a simple regenerative valve circuit, having as its reactance coil the secondary of the crystal circuit. An inspection of the two will show that :—

(1) The primary portion is common to

both circuits, and need not be considered in regard to the switch.

(2) It will not affect the working of circuit A if all that portion of B shown in Fig. 5 be not disconnected, so that this may also be regarded as common to both circuits.

To change over then from A to B with one movement of the switch we must provide one single pin contact at V (Fig. 4, B), and four of the double pin contacts at the points W, X, Y and Z (Fig. 4, A). These must be arranged as shown diagrammatically in Fig. 6.

Other uses for the switch may, perhaps, be found; and possibly, if constructed on a larger scale, it would serve as a means of rapidly changing from one wavelength to another in a transmitting circuit, whilst with contact pins making a smaller angle with each other than 90 degrees, and strips on one side covering more than two pins, it could interchange more than two circuits.

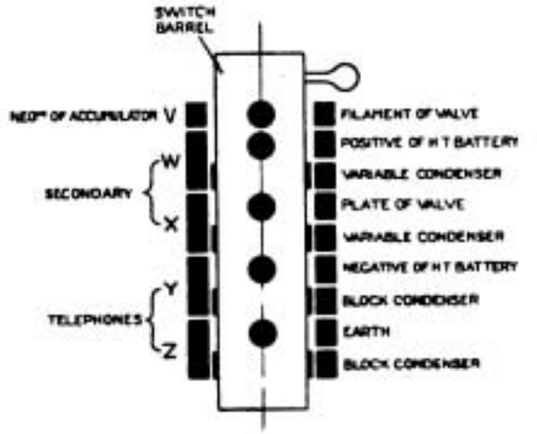


Fig. 6.

A SUGGESTION FOR A NOVEL TRANSMITTER

THE following is a description of an interesting transmitting arrangement—Fig. 1 shows the arrangement of the transmitting station, with the coupling coil of the closed circuit in one position, and Fig. 2 shows the same transmitting circuit with the coupling coil of the closed circuit in another position.

Referring to the figures it will be seen that the leads G are taken from the source of high-frequency oscillations to the inductance coil L′, which is shunted by the condenser C. The coil L′ is capable of rotation through 90 degrees, so that it may give maximum or minimum coupling with the aerial circuit inductance L as required.

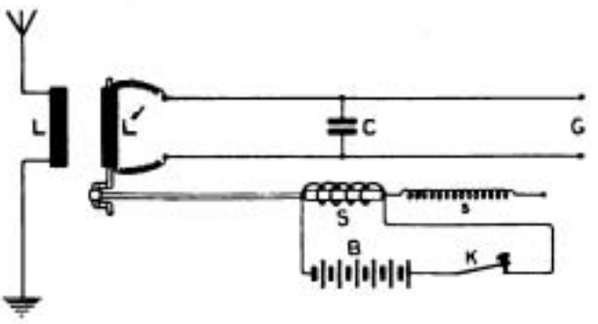


Fig. 1.

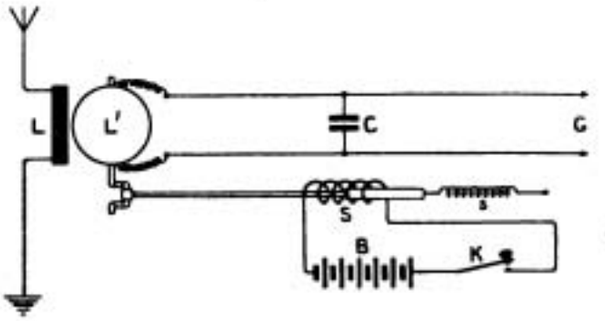


Fig. 2.

When the key K is depressed (Fig. 1), the solenoid S is operated by the battery B, and a bar of soft iron I, affixed to the crank lever is drawn inwards, and, by its action, rotates the inductance coil L′ so that it gives maximum coupling with the aerial coil L. As soon as the key is lifted, as in Fig. 2, the solenoid circuit is broken and the spring s brings back the crank lever so that the inductance L′ is in the position of minimum coupling.

WIRELESS CLUB REPORTS

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies.

The Wireless Society of Hull and District.

(Affiliated with the Wireless Society of London.)

This Society continues to make headway, and new members are being enrolled at each meeting.

On March 31st, Mr. Hy. Strong, F.C.M.S., M.I.M.E., read an interesting paper on Valves and their application to Modern Wireless Telegraphy. In order to make his remarks more instructive he exhibited a large number of diagrams of circuits, and characteristic curves of valves, which he had carefully sketched. His account of the various peculiarities of the different types of valves was listened to with much interest by the members. Then on April 14th Mr. Charles F. Gates gave a paper on "Some Wireless Experiences Amongst Aircraft." Mr. Gates, who served during the war as an observer in the R.N.A.S., treated the members to a comprehensive description of the various types of wireless apparatus in use in connection with aircraft, and traced the various developments which had taken place since the wireless section of this service was formed—a few months prior to the outbreak of war—down to the time of the armistice. He mentioned the fact that while signals from the spark type of apparatus could be plainly heard at an altitude of about 3,000 feet, signals from continuous wave apparatus were not distinctly audible until a height of from 8,000 to 10,000 feet had been obtained. Several questions were answered by the lecturer.

Mr. G. H. Strong (President) occupied the Chair on both occasions.

Further members are required for this Society, also students, who must be under 18 years. Mr. Harry Nightscales (Hon. Secretary), 16, Portobello Street, will be pleased to give full particulars to those interested. The meetings are held fortnightly on Thursday evenings at the Metropole (Marlborough Room).

Brighton Radio Society.

(Affiliated with the Wireless Society of London.)

A meeting of this Society was held on the 24th March at 8 p.m., Mr. W. E. Dingle in the Chair.

A suitable membership and rule card was put before the members present and ultimately decided upon. These cards have now been issued to all members.

The question of electing a new member to attend the meetings of the London Wireless Society, vice Mr. O. G. Sandford, resigned, was then discussed, when Mr. J. Skinner proposed Mr. W. E. Dingle for the office. The proposal was finally approved, and Mr. Dingle signified his willingness to attend.

The Society is growing rapidly and becoming very popular. It is now in possession of a nice Club-room and library.

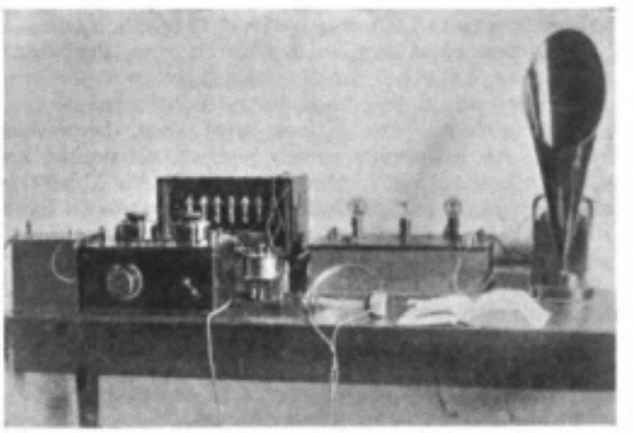
Any gentlemen interested are invited to communicate with the Hon. Secretary, Mr. D. F. Underwood, 68, Southdown Avenue, Brighton, who will be pleased to furnish full details as to membership, etc.

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

(Affiliated with the Wireless Society of London.)

On March 31st a very successful social gathering was held by the above Society. Members and friends spent a very enjoyable evening which was voted a fitting termination to the winter session.

On April 7th and 8th the Society held its first Exhibition of Wireless Apparatus. A good selection of instruments representative of the progress of the science from the coherer to the valve were on view, and on both nights visitors had the pleasure of hearing many high power stations, both spark and C.W., through the medium of a Brown's Loud Speaker connected to the 7-valve set shown in the photograph.



The Society's Apparatus.

On the Thursday night we endeavoured to pick up the Dutch concert, but without success.

Our best thanks are due to the Marconi Scientific Instrument Co. for the loan of the Type 55D 7-Valve Amplifier, to the North Eastern Instrument Co. for a Short Wave Tuner and Single Valve Audio Amplifier, and to the North Eastern Schools of Wireless for a C Mark III 3-Valve Amplifier All these instruments gave splendid results on the Society's aerial. We have also to thank our President, Mr. Burnett, our Vice-President, Mr. Todd, and several members for the loan of the rest of the apparatus. The exhibition aroused considerable interest in the borough, and was well attended both nights.

On April 18th a general meeting of the Society was held to discuss the progress made during the winter session, and to decide upon our summer programme. Dr. J. A. Hislop took the Chair, and read a letter from the Treasurer apologising for his absence. He reported a substantial balance in hand. It was decided to hold an Outing or Field Day once a month, the details to be left in the hands of the Committee. A transmission licence is to be applied for in connection with the proposed Field Days. Intending members should join now for the summer session. Application

to the Hon. Secretary, Mr. L. L. Sims, Y.M.C.A., Bedford Street, North Shields.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At a meeting at the Central Hall on April 13th, the article of *The Wireless World* of March 5th on a Resistance Coupled Thermionic Amplifier was brought up for discussion by Mr. Kennedy. Mr. Voigt modified the diagram slightly so as to use a lower voltage in his plate circuit without sacrificing much of the efficiency. A general discussion then arose on the making of resistance units and the relative merits of wet cotton and an Indian ink line. Mr. Johnson described how he cured his amplifier of the objectionable habit of howling. Morse trials showed a steady progress in the efficiency of the members.

At a meeting of the above on April 20th, the Secretary reported that he had, with the assistance of several other members, overhauled the Club aerial, and it was hoped that a marked improvement would be noticed in received signals. Discussion then ranged round the matter of disturbance caused by autodyne receivers, and though the Peckham Family lives together in somewhat close quarters, no member could say that he had been interfered with by others. A critical trial was, however, arranged for a certain evening when all would be listening in together at the close of the Air Ministry weather report, and if Smith could manage to hear and identify Jones' valve, the latter would be forfeit.

It is curious that after the instance of the 4-inch spark coil mentioned by Mr. Knight in his remarks on No. 1 item of the Agenda of the second annual conference, our Secretary has again been able to take to task another offender and exact from him a promise not to repeat his offence.

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

The usual meeting of the above Society was held on Friday, April 8th, 1921, at Dartford Grammar School.

Dr. Miskin presided, seven members being present.

The minutes of the last meeting were read and confirmed, and it was arranged that the Society endeavour to obtain the services of Captain Tingey on Friday, May 6th, 1921, to give a demonstrative lecture on Wireless. Informal discussions on various matters appertaining to wireless transmission and reception occupied the greater part of the evening.

All persons interested are invited to communicate with the Hon. Secretary, Mr. E. C. Deavin, 84, Hawley Road, Wilmington, Dartford, who will be pleased to furnish full details as to membership.

Folkestone and District Wireless Society.

(Affiliated with the Wireless Society of London).

The monthly general meeting of the above Society was held at the Sandgate Schools on Wednesday, April 6th, at 8 p.m., Mr. Arnold H. Ullyett, F.R.G.S., A.C.P., in the Chair.

The minutes of the previous meeting having been read and confirmed, the meeting at once proceeded to the usual business.

The meeting was followed by a most interesting and instructive lecture on the "Three Electrode Valve," delivered by the Vice-Chairman, Mr. A G. Mills. At the conclusion of the lecture, Mr. Mills was accorded a hearty vote of thanks by the Chairman on behalf of the Society.

The officers wish to tender their thanks to the officers of the Birmingham Experimental Wireless Club for their assistance in offering suggestions in connection with our forthcoming Exhibition. Further suggestions will be greatly appreciated.—Hon. Secretary, Mr. H. Alec. S. Gothard, 8, Langford Terrace, Folkestone.

The Radio Scientific Society.

(Affiliated with the Wireless Society of London.)

At a meeting of the Society held on April 6th, a discussion on resistance amplification was followed by experiments with a 5-valve resistance amplifier coupled with Brown and Post Office relays. Very satisfactory results were obtained, and readings up to four and a-half milliamps were recorded in the telephone circuit.

A meeting was held on April 13th, when a Paper was given by Mr. G. G. Boullen on "Honeycomb Coil Winding."

Mr. Boullen pointed out the advantages of these coils over the single layer coils as regards increased inductance, along with minimum resistance and capacity, as well as a great saving of space.

Mr. Boullen then explained and demonstrated an ingenious machine of his own design for winding these coils.

N. S. Rly. Wireless Society.

(Affiliated with the Wireless Society of London.)

The Society have just concluded their first series of lectures given by Mr. J. A. Cooper, of Edgbaston University, Birmingham.

The lectures have been most instructive and enjoyable, the members sole regret being that the whole series could not be concluded owing to the closing of the Technical School—where the lectures were held—for the summer months, but it is hoped that Mr. Cooper will be able to resume the course in the autumn.

The Society held their first whist drive and dance on April 7th, when a very enjoyable evening was spent. We were pleased to see our Chairman, Mr. F. T. Scragg, present, having sufficiently recovered from his illness to be able to do so.

East Kent Wireless Society.

(Affiliated with the Wireless Society of London.)

Some members of this Society have recently been devoting themselves to perfecting their arrangements for receiving the concerts from the Hague, with a gratifying measure of success in most cases. This district is well favoured in regard to telephony, being adjacent to aircraft routes and close to the Continent.

At the meeting held at North Brook House, Biggin Street, Dover, on April 13th, members were able, through the courtesy of Mr. Vaughan (who has temporarily provided apparatus) to hear signals from Moscow and most of the other Continental stations. Mr. Stanley exhibited an extremely neat pocket set, the construction of which revealed several ingenious "gadgets."

The Club welcomes enquiries from persons interested in the progress of the science, whether experienced or not. Details as to membership may be obtained from the Hon. Secretary, Mr. V. Palmer, Manor House, Maxton, Dover.

The North London Wireless Association.

(Affiliated with the Wireless Society of London.)

The eighteenth meeting of the Association was held on Friday, April 8th, 1921, the President in the chair. After the minutes of the previous meeting had been read and confirmed, Captain W. R. H. Tingey was called upon to give the first of his series of lectures, the subject being "The Electron Theory." Captain Tingey commenced by saying that the old theory of the existence of about eighty elements, of which the smallest part that could exist alone was an atom, had been overthrown by the proof of what is generally known as the "Electron Theory."

Following his lecture Captain Tingey asked for any questions, the result of which being many requests for information.

The subject, which is a very complex one, was explained with great simplicity and with several touches of humour, which made a pleasant evening pass all too quickly. The Association is looking forward eagerly to the next lecture on the relation between the aether and the electron.

The Association's first field day was held at Cuffley on the 23rd April. The Postmaster-General's necessary permission has been obtained.

The Association's membership is rapidly increasing, but there is still room for more. All enquiries will be answered by the Hon. Secretary, Mr. J. W. S. Prior, c/o Superintendent, Peabody Buildings, Essex Road, N.1.

Glasgow and District Radio Club.

(Affiliated with the Wireless Society of London.)

The usual fortnightly meeting was held on Wednesday, March 30th, at the Club room.

After the confirmation of minutes of the previous meeting the Secretary read some correspondence relating to the Club's demonstration of wireless apparatus, arranged for April 13th.

Mr. T. Senior then favoured the members with a discourse on "Aerials." Mr. Senior was well qualified to speak on this subject having had about 10 years' practical experience in the erecting and fitting out of wireless telegraph stations. The various types of aerials in general use were illustrated by blackboard diagrams and the advantages and disadvantages of each were emphasised.

The different kinds of wire which could be used, ohmic resistance, skin effect of high-frequency currents, the necessity of good joints for efficiency, were dealt with in turn and fully explained.

The most effective methods of insulation, the necessity for preventing swaying of the aerial wires, and the vexed problem of whether the free ends should be joined or left open, were discussed.

Mr. Senior then answered numerous questions on aerial problems to the satisfaction of those members who asked them. To judge by some of the queries it would appear that a few members have had sleepless nights worrying over their "best arrangement of wires."

The lecturer was accorded a hearty vote of thanks.

The members of Glasgow and District Radio Club always thought that their organisation was fairly well known, locally at any rate, but it came as a surprise to them to hear that the Hon. Secretary had received a letter from a Russian gentleman in Rue de Brousse, Pera, Constantinople.

If any of our local friends desire particulars of the Club they may obtain all information from the Hon. Secretary, Robert Carlisle, 40, Walton Street, Shawlands, Glasgow.

Cambridge University Wireless Society.

Three meetings were held during the Lent Term. The first took place on January 30th, in Mr. Beale's rooms, in Trinity College. Mr. Beale described and demonstrated a three-valve amplifier, a universal tuner and various other instruments of his own design and manufacture.

The other two meetings, to which all members of the University were invited, were held in the Engineering Laboratories, by kind permission of Professor Inglis. At the first of the above, held on February 7th, Admiral Sir Henry Jackson delivered a Paper entitled "The Educational Value of the Study of Wireless." At the conclusion of the lecture Professor Sir Ernest Rutherford, in proposing a vote of thanks to the lecturer, made a strong appeal to all scientific members of the University to take an intelligent interest in wireless. Eighty members and visitors were present.

The third meeting was held on February 28th, Major H. P. T. Lefroy, D.S.O., R.E., delivering a lecture on Wired Wireless. Sixty members and visitors were present.

The Society has been fortunate in obtaining, also due to the generosity of Professor Inglis, an excellent room in the New Engineering Laboratory, and it is hoped that next term an aerial and instruments will be forthcoming.

The Hon. Secretary, C. C. A. Hines, 13, Park Parade, Cambridge, will be pleased to supply full particulars of the Society to intending members on application. Subscription, 2s. per term.

Plymouth Wireless Society.

At the Plymouth Technical College on Friday, April 15th, 1921, Mr. S. H. Day related to a well-attended meeting of the above Society his experience connected with Wireless Telegraphy while serving in H.M. Navy during the War.

Mr. W. J. Lewarn occupied the Chair. After describing briefly the various methods used for transmission and reception, the different aerials used, etc., he went on to explain more fully the methods used for transmission and reception adopted aboard submarines when submerged.

He concluded by detailing some thrilling experiences in the battle of Jutland, and while serving on mine sweepers.

Everyone present thoroughly appreciated the lecture, and a vote of thanks was passed to Mr. Day.

An opportunity occurred to members of the Society to grasp fully the practical side of aerial fixing on Saturday, April 16th, when a field day was held at Devonport.

Liverpool Wireless Association.

On Wednesday, April 13th, the above Association held its annual "open night" and exhibition of apparatus. This year the meeting was made a joint affair with the Liverpool Microscopical Society, several members of which brought along their instruments and numerous slides to add to the display. Some of the latter were extremely interesting, particularly those showing minerals viewed by polarised light.

On the wireless side the exhibits were many and varied.

Through the kindness of our President, Dr. Marchant, and the Mersey Dock Board, we were enabled to give the audience a fine display of telephony specially sent out by the Bar Lightship, distant some 15 miles, a description of life aboard the vessel, concluding with a song by the Master, being quite clear in the loud speaker. The receiver was a 4-valve Marconi amplifier lent us by the University of Liverpool through Dr. Marchant. Mr. Lowey again exhibited his 3-valve home-made amplifier with his usual success, practically all the long wave European stations being brought in by it on the Club's indoor aerial (which was also used for the Telephony).

The B.T.H. Co. exhibited one of their portable sets and gave demonstrations, while amongst minor exhibits were several home-made basket coils, condensers, etc.

Mention must also be made of a most ingenious electric clock, giving visible lamp signals at set intervals, exhibited by Mr. Henderson.

In the unavoidable absence of our President in London the Secretary addressed a few words to the audience, numbering about 60, during the course of the evening, a reply being made by the President of the Microscopical Society.

Altogether the meeting was an unqualified success, and should bring about much useful intercourse between the members of the two Societies.

The Secretary of the Association, from whom all particulars regarding membership may be obtained, is Mr. J. Coulton, 98, Ampthill Road, Liverpool, and meetings are held fortnightly in rooms at the Royal Institution, Colquitt Street.

Manchester Wireless Society.

On April 5th, at the Headquarters, Albion Hotel, Piccadilly, Mr. Alexander Marr (the Vice-President) read a Paper on "The History of the Telephone." The lecturer gave us the benefit of his long experience of the science of telephone engineering, and sketched the history of the development of the telephone from the time of its invention by Alexander Graham Bell up to the present day.

On April 6th, by the courtesy of the North-Western Section of the Institute of Electrical Engineers, members of the Society were enabled to hear a lecture by Prof. Marchant on "Recent Developments in Wireless Telegraphy."

On April 9th a very successful whist drive and dance was held at the Headquarters, nearly a hundred members and friends being present. This social event wound up the winter session, and from April 7th meetings will be held fortnightly. Visits to works and outings in the country are being arranged for the summer. The first of these is on April 30th, when experiments will be conducted with portable receiving sets.

Hon. Secretary, Mr. E. Samuels, 1, Parkwood, Victoria Park, Manchester.

Birmingham Experimental Wireless Club.

A meeting was held on Wednesday, March 30th, at the City School of Wireless Telegraphy, Dr. J. R. Ratcliffe, M.B., in the chair. There was an attendance of sixty-five ladies and gentlemen.

The Chairman commented on the exceptional interest of wireless telephony to the enthusiastic amateur, and alluded to the various amateur transmitters which had become well-known to Birmingham experimenters. He then called upon Mr. P. R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E., M.R.I., to deliver his lecture on "Wireless Telephony for Amateurs."

Mr. Coursey said that the subject of wireless telephony had been one of great interest for many years, but more especially since the introduction of the thermionic valve The main essential difference between the apparatus for continuous wave transmission of Morse signals, and that for telephony, was in the method of modulating the high frequency aerial energy. The usual methods of effecting this modulation were described in detail, the lecturer illustrating his remarks with many blackboard diagrams. Some useful constructional hints were given, and an extremely illuminating lecture concluded with comments on suitable receivers.

Dr. Ratcliffe then proposed a hearty vote of thanks to Mr. Coursey, and having commented on the great value of the lecture to those present, called upon the Hon. Secretary to second the motion. The Hon. Secretary remarked on the fact that two ladies and several members of other wireless societies were present, including the Hon. Secretaries of the Luton Wireless Society and the Walsall Amateur Radio Club respectively.

The vote of thanks was unanimously carried with acclamation, and the meeting closed with a discussion.

The Club is now established in more commodious and convenient headquarters at the Digbeth Institute, Birmingham. During the summer months meetings will be held fortnightly, on Fridays, at 7.30 p.m. The meetings will thus be coincident with the publication of the *Wireless World*. The membership has greatly increased during the past three months, but the new club-room has accommodation for over one hundred, and the Hon. Secretary, Mr. F. S. Adams, 110, Ivor Road, Sparkhill, Birmingham, will be pleased to hear from intending members.

Exeter and District Wireless Society.

At the fortnightly meeting of the above Society held at the Queen's Hotel, Exeter, on Friday, April 15th, a demonstration was given by Messrs. H. E. Allcock (Hon. Secretary) and A. A. Brooking (Hon. Treasurer) on automatic printing of signals received by means of wireless telegraphy (see page 117 of this issue).

Mr. Allcock gave a brief description of the apparatus that would be used in the experiments that

evening, defining the functions of the various relays employed to enable printing to take place. After emphasising the necessity for members to maintain secrecy in regard to messages other than weather reports and time signals, he proceeded to record Nauen, Lyons, Paris, Clifden, Poldhu and other continental and home stations. The tape, as it came from the printing machine, was passed to the nearest member and thence on around the thirty odd members present, again reaching the demonstrators, who took charge of same. The whole of the evening the signals were recorded from any high power European station, and the apparatus behaved in a very genial manner, giving no trouble from the moment signals were received, and recorded them in a perfectly clear manner.

The whole of the apparatus, with but two exceptions, viz., inker and relay, was made by the demonstrators, and although a great deal of time was expended in the design and construction, the results obtained are most satisfactory. Further experiments are taking place daily, and the results are brought forward and members kept fully alive to any new improvements.

The Secretary spoke of the position of the Club. Although but a few months in existence, it has made vast strides. It possesses now a membership of fifty, and is making arrangements for the early opening of their workshop. The hut, ground to erect same on, lathe, tools, and several parts of necessary apparatus are among the promised items from various enthusiastic members.

The meeting closed with a hearty vote of thanks to Messrs. Allcock and Brooking for the trouble they had taken in placing such a fine collection of apparatus in front of them, and complimented them on their achievement.

The Wimbledon and District Wireless Society.

The monthly meeting of the above Society was held on Saturday, April 16th, at the Wimbledon Technical Institute, the President, Mr. W. A. Harwood in the chair. The minutes being read and adopted, the chairman called upon Mr. A. Onwood to give his promised Paper on the "H.P.R. Receiver."

The nature of the questions asked and the subsequent discussion was a good indication that the Paper was much appreciated. The apparatus exhibited, which included a complete H.P.R. receiver, an experimental H.P.R. receiver, together with a telephony transmitting panel, also proved of great interest to all present. A vote of thanks, proposed by Mr. Marshall and seconded by Mr. Ballhatchet, was duly accorded to Mr. Onwood.

All information concerning this Society can be obtained on application to the Hon. Secretary, Mr. W. G. Marshall, c/o. Technical Institute, Wimbledon, S.W.19, or 48, Warren Road, Merton, S.W.19.

Leicestershire Radio Society.

An exhibition of radio apparatus, etc., was held by the above Society at their headquarters on April 2nd, and attracted quite a large gathering. The exhibits covered a very wide field, and practically all systems of reception were represented.

The trade section was particularly good, including exhibits from Messrs. Sullivan, Burnham, Gent & Co., and the well-known Marconi Scientific Instrument Co. The latter's 7-valve amplifier continually receiving and rendering audible to the crowd around the stand signals from all the well-known British and European stations.

Turning to the private section, the President, Mr. Cyril T. Atkinson, had on view a complete receiving installation for all wavelengths with honeycomb coils, and three-valve amplifier, practically the whole being of his own construction, while the same applies to Mr. S. Skeet's three-valve set and the sets of Messrs. A. E. Ball, J. Pallett, R. Crawley, Sharman, Knight and Spiers, all of which attracted much attention and were highly praised.

Other gentlemen contributing by apparatus, and incidentally by a great deal of very helpful assistance, were Messrs. H. E. Dyson, L. Pratt, C. Morton, C. Challifour, W. E. Dunt and others.

In conclusion, a word should be said for the President's radio telephone, which, although hastily constructed only the week previous, transmitted throughout the day, gramophone selections and speech, to the delight of patrons, some of whom were moved to indulge in an informal waltz, while the vacuum tubes and wireless control gear of Mr. Morton was another interesting feature of the day.

Sunderland and District Amateur Radio Society.

A very interesting meeting of the above Society was held on April 1st, Mr. W. Rowe presiding.

There was quite a good number of sets and parts exhibited by some of the members, including a single valve long wave receiver of which Mr. Rowe gave full details of its construction, afterwards concluding the evening with a short lecture on the valve. Mr. H. Burnley, Hon. Secretary, would be pleased to hear from anyone interested, also from any gentleman who could help the Society by promising a lecture.

City of London School Wireless Society.

The above Society was established on Tuesday, February 1st, and has already made great progress. The officials of the Society consist of a president, hon. secretary, hon. treasurer and five committee officials. Meetings are held regularly every fortnight, when elections and other business is carried out. The Society has been lucky to collect quite a good amount of apparatus, and will commence activities when the G.P.O. permit comes along. At a meeting held on Tuesday, April 5th, Mr. J. A. Chapman, Hon. Treasurer, demonstrated a four-valve amplifier, in conjunction with the Society's receiving set. The amplifier was kindly lent by the R.M. Radio, Ltd., of 5, Chancery Lane. The signals obtained without an aerial were really marvellous, and were made audible to every one in a large lecture room by means of a Brown's Loud Speaker. R.M. Radio also lent us a compact receiving set, using one valve, and this also gave great satisfaction as its efficiency was so high.

Hon. Secretary, Mr. J. H. Gawler, City of London School, Victoria Embankment, E.C.4.

South East Sussex Wireless Club.

A meeting was held on March 29th at Mayfield,

Wickford, Essex, for the purpose of forming a Wireless Club for the South East District of Essex.

Gentlemen present were:—Sir Bertram Jones, Mr. W. Day, Mr. H. Day, Mr. F. A. Mayer, Mr. A. Carter, Mr. R. Haylock.

The Club was formed and the following officers were elected:—Sir Bertram Jones, President; Mr. W. Day, Vice-President; Mr. F. A. Mayer, Hon. Secretary; Mr. H. Day, Hon. Treasurer.

A Club-room was kindly offered by Mr. W. Day at the above address. Meetings have been arranged for every Monday evening at 8 p.m. General meetings will be held on the first Monday of each month. The name of the Club will be the South East Essex Wireless Club. Applications for membership should be addressed to Mr. F. A. Mayer, Stilemans, Wickford, Essex.

Worcester and District Radio Association.

This Society was formed on April 15th, when twenty members were enrolled, several of whom are well known and experienced in radio science. A series of lectures will be given at a later date and practical work will be carried out. Any one wishing to become a member should communicate with the Secretary, Mr. C. C. Hannay, 59, Waterworks Road, Worcester.

St. Austell Wireless Club.

A Club has been formed and a single valve receiver has been installed. We have the proud distinction of being the first Club in Cornwall Land's End and Air Ministry seem to be two awkward stations to get. Should like to know if any other stations have experienced the same difficulties. All communications should be addressed to the Hon. Secretary, Mr. H. Whetter, 26, Fore Street, St. Austell.

Bromley by Bow.

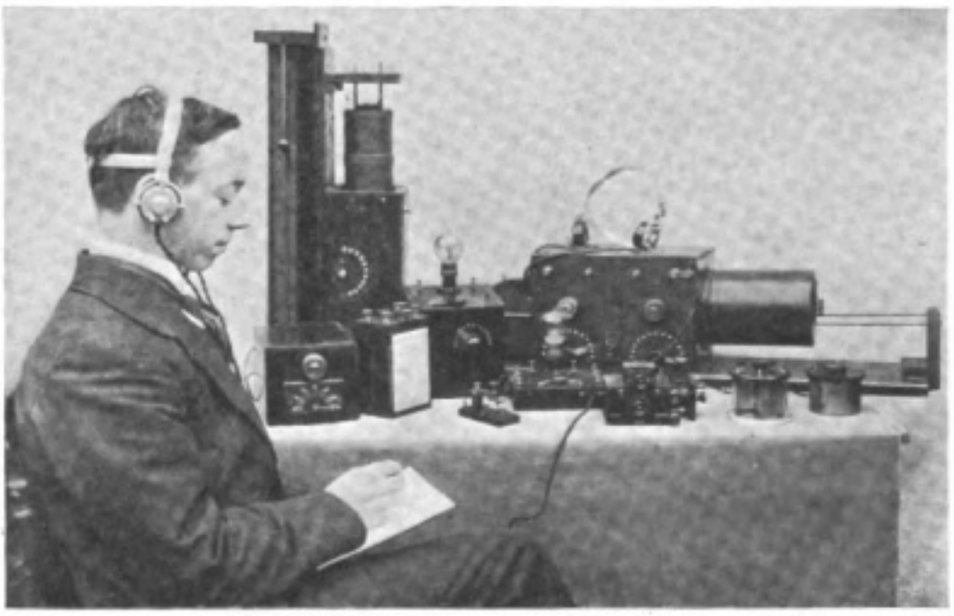
It is proposed to form an amateur wireless club in Bromley-by-Bow. Will those interested please communicate with Mr. W. G. Claxton, 29, Zetland Street, St. Leonard's Road, Bromley-by-Bow, E.14.

Willesden Wireless Society.

A wireless society has now been formed in Willesden. Any interested residents of Willesden and district should communicate with the Hon. Secretary, Mr. F. A. Tuck, 87, Mayo Road, N.W.10.

A CHELTENHAM AMATEUR STATION

THE accompanying photograph shows Mr. W. G. H. Brown, a Cheltenham amateur, with the apparatus comprising his receiving set.



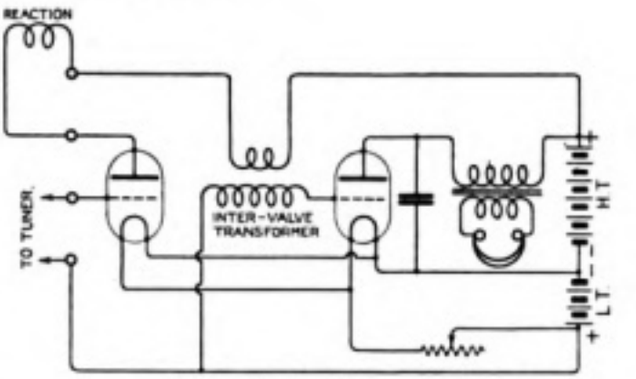
Mr. W. G. H. Brown with his Receiver.

Nearly all the apparatus is home-made, and with two valves in use stations such as Horsea, Paris, Poldhu, Nauen, etc., can be read easily when at a distance of 20 feet from the telephones. Brown's 8,000 ohm telephones are used, and also a pair of Brown's 60 ohm telephones in conjunction with a telephone transformer.

The aerial loading coil and transformer, seen standing on end at the left-hand side of the photograph, were the first instruments to be constructed. The loading coil is 3 feet

long and wound with 1 lb. of No. 26 enamelled wire on a diameter of 3½ ins. The transformer has a primary wound with 1 lb. of No. 24 enamelled wire, whilst the secondary is wound with No. 30 single cotton-covered wire and slides upon two brass rods. The primary has twelve tappings and the secondary six. The transformer, seen on the right, is of more recent construction, and has two dead-end switches. The body of this transformer and of the other instruments is constructed of three-ply wood, which Mr. Brown strongly recommends on account of its strength and lightness.

The diagram shows the method of connecting up the set.



The circuit diagram.

THE PLYMOUTH WIRELESS SOCIETY

THE Plymouth Wireless Society is fortunate in having had placed at its disposal the wireless installation of the Plymouth Technical College, through the kindness of the Principal (Mr. W. S. Templeton, M.A., B.Sc., A.M.I.E.E.). The two photographs here reproduced show the 1·5 k.W. rotary discharger transmitter, and

Photo by Mr. J. J. Beckerlegge.

The 1½ k.W. Transmitter.

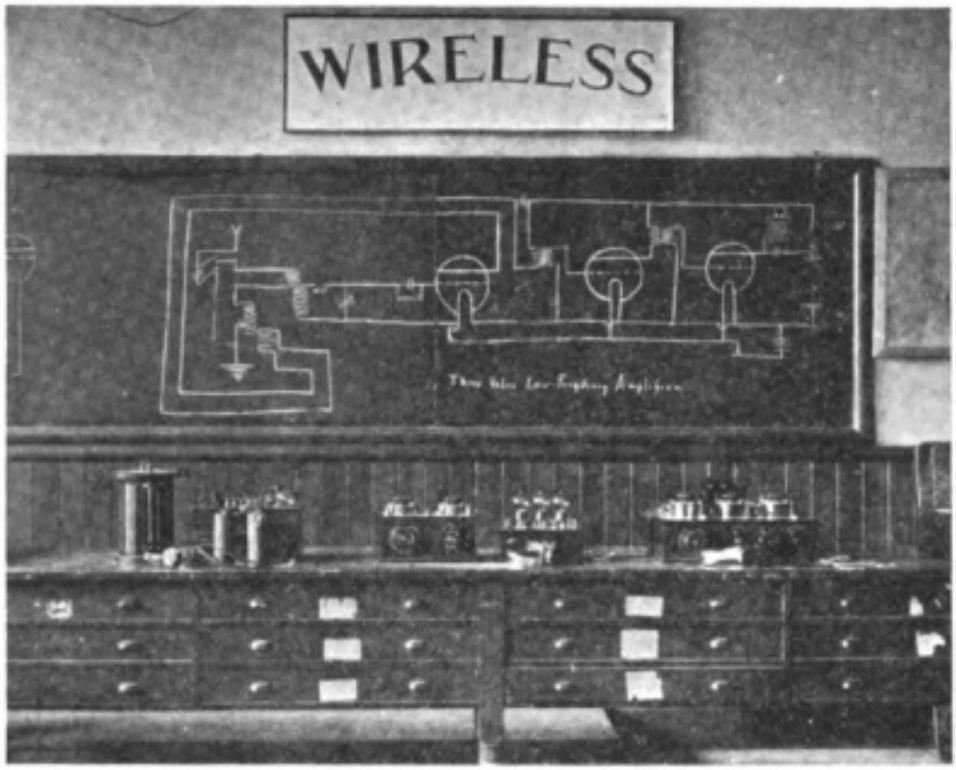


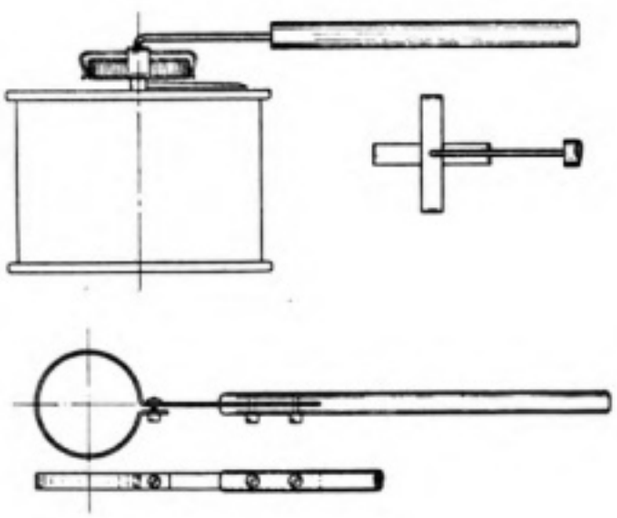
Photo by Mr. J. J. Beckerlegge.

Receiving Apparatus.

the three receivers in use, viz., Marconi multiple tuner, crystal receiver and a 3-valve low-frequency amplifier. Demonstrations are frequently given on these instruments for the purpose of illustrating lectures delivered before the Plymouth Wireless Society.

EXTENSION HANDLES TO TUNING CONDENSERS

EVERYONE who uses valves experiences the trouble that is evident when the hand is brought too near the tuning condensers in making fine adjustments, more especially when receiving C.W. signals by the heterodyne method. The sketches reproduced here show two methods by which detachable extension handles can be affixed to the ebonite handles of condensers when required. One method is to solder together two strips of spring brass at right angles, as shown, having their ends bent so as to clip on to the handle. Another method is to utilise a strip of spring brass, bent to go round the condenser handle and tighten by means of a screw. The handle (of insulating material) may be made of any convenient length.



AUTOMATIC PRINTING OF SIGNALS RECEIVED BY WIRELESS*

THE apparatus described below is the result of many months of hard work in the workshop and wireless room on the part of Mr. H. E. Allcock and Mr. A. H. Brooking, but the results obtained have amply justified the time and trouble expended.

The apparatus is comprised of the following units. A seven-valve amplifier, the design of which differs somewhat from the usual type of high resistance coupled amplifier. Instead of the usual resistance of about 80,000 ohms. in the plate circuit and grid leaks in each valve, a resistance of about one-third of this value is used, with only one grid leak and intervalve condensers of somewhat larger capacity than usual. The sixth and seventh valves will be seen from the circuit diagram (Fig. 2) to be magnetically coupled, with closed iron core transformers with primary 1,000 turns and secondary 10,000 turns of No. 50 double silk covered. The tuning arrangements are two separate items. The first covers 600 to 4,000 metres and the second overlapping 4,000 metres to 25,000 metres. The first is a pile-wound coil and the second is wound in V-shaped grooves on ebonite formers. Aerial tuning condenser may be placed in series or parallel with the aerial, as required.

Reactance is obtained from the plate of any one valve to the grid of the first by means of a variable condenser of very small capacity (0·00005 approximately).

The output signals may be passed, either through the telephones or by means of a change-over switch through a Brown's microphonic relay, the output from the latter being carried to the loud speaker. The heterodyne method of reception is also employed by means of a separate valve oscillator.

Signals thus obtained are remarkably clear, and the noise usually complained of when high amplification is obtained can be brought to

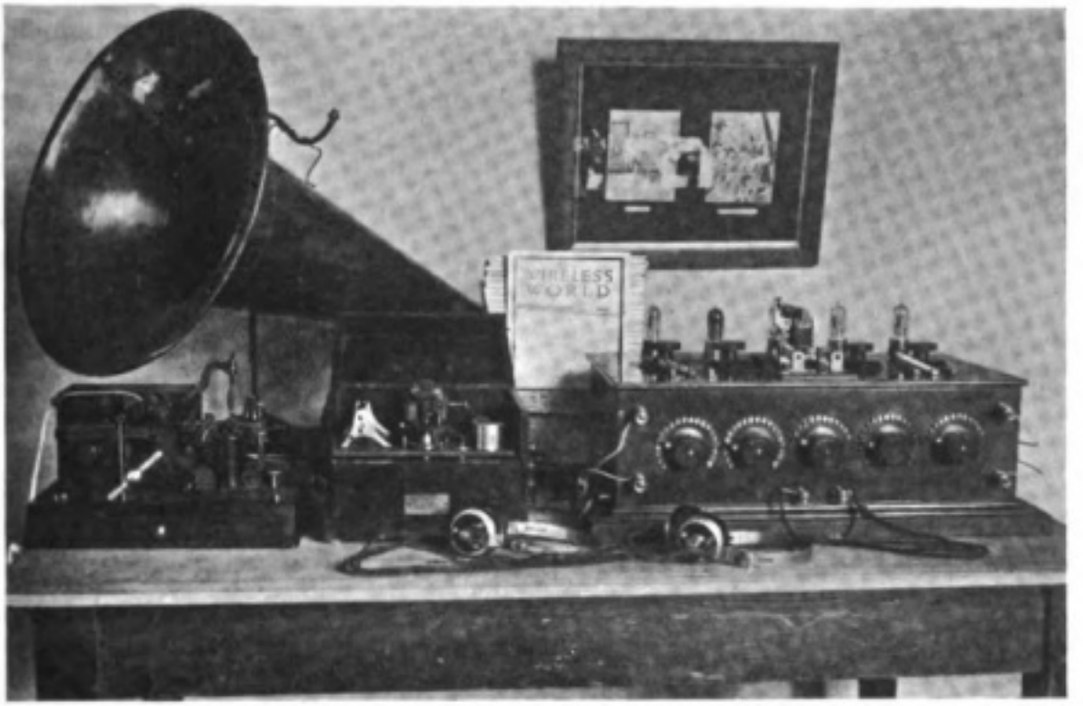


Fig. 1. The Receiving Apparatus and Morse Inker.

*Report of a Demonstration conducted before the Exeter and District Wireless Society on Friday, April 15th, 1921.

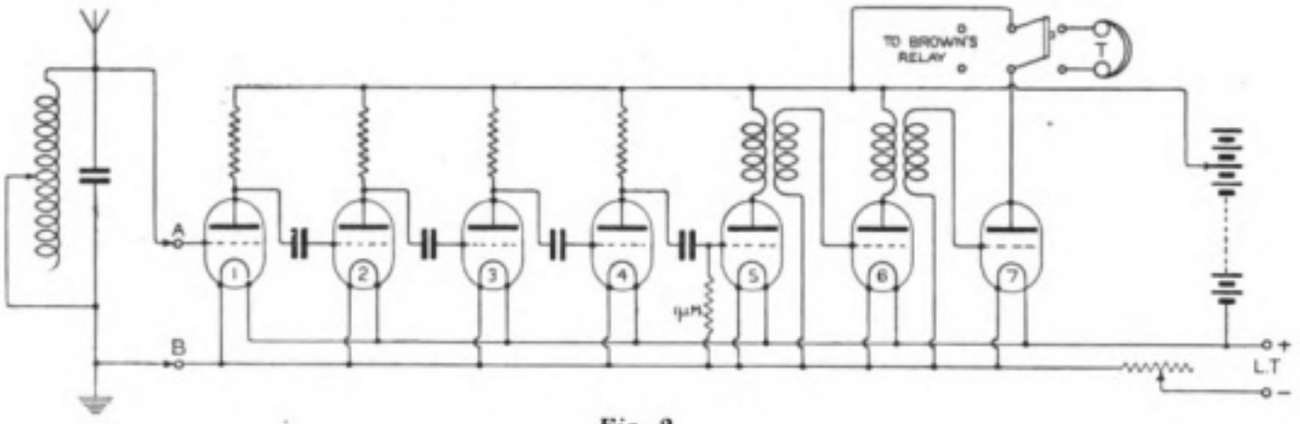


Fig. 2.

an almost negligible quantity by skilful adjustment.

Proceeding now to the unit which permits of the printing of wireless signals. The circuit known as the "Turner" valve relay is employed. An excellent description of this relay was given in *The Wireless World*, in the report of a meeting of the Wireless Society of London, on page 160 of the issue for May 29th, 1920. This relay circuit gives perfect response to the incoming signals, and with the Morse inker which is being employed at present a speed of approximately 40 words per minute is obtained. But this is the limit, and must suffice until a high-speed printer can be obtained.

THE SWITCHING OF A VALVE AMPLIFIER

By 2CM.

WHEN using a cascade of valves it is desirable to arrange the switching so that any number of valves may be used at will. This, at first sight, seems to require quite a complex switch. It is, of course, possible to tap in the telephone transformer across any intervalve transformer primary without much alteration, but we then have a shunt on our telephone circuit which lowers the efficiency. Fig. 1 gives a simple system of switching which does not have this disadvantage.

It will be seen that, with the switch B in position 1, the first valve plate feeds the

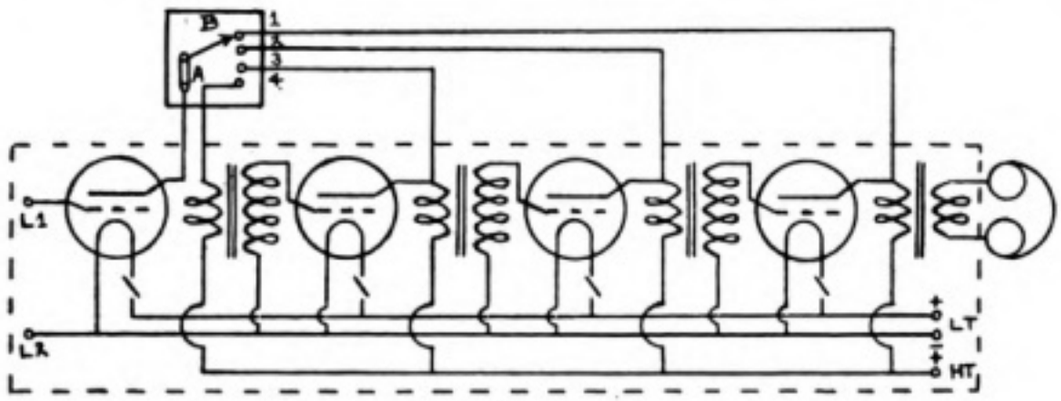


Fig. 1.

telephone transformer direct, giving us one valve alone. The plate of the last valve being on the circuit does not affect the signals, as the valve in question is out.

In positions 2 and 3 the first valve plate feeds the primaries of the intervalve transformers, passing to the fourth and third valves respectively, thus giving two or three valves; while, in position 4, we get the usual connections for four valves.

The valves are switched on in the following order: 1, 4, 3, 2, and we can thus retain our best valve always first for detecting or oscillating.

The arrangement has several advantages. Firstly, very little alteration in the wiring of the amplifier is necessary, as most of the connections can be made outside. Secondly, any alteration in the type of intervalve "pass-on" does not affect the switching. Thirdly, the method uses no special switches. All that is required is the single-pole switch

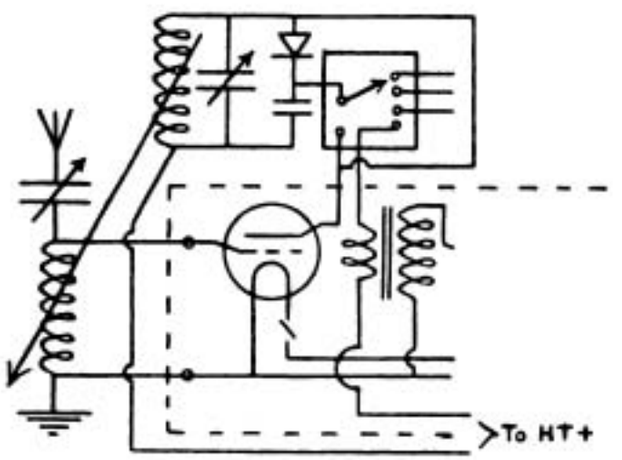


Fig. 2.

B, with as many ways as there are valves. The valves not in use are either switched off or taken out.

If it is desired to use a reaction circuit, the coupling coil is connected to terminals (A) and the bridging strip broken.

We can also use crystal detection after the first valve as in Fig. 2, which shows the first valve circuits only.

BOOK REVIEW

SMALL SINGLE-PHASE TRANSFORMERS.

By Edgar T. Painton, B.Sc., Eng.Hons. (London), A.M.I.E.E.

London: Sir Isaac Pitman & Sons, Ltd. Price, 2*s.* 6*d.* net.

As the title implies, this little volume is prepared with the object of describing the design and construction, more particularly of quite small transformers. The book, therefore, as the author explains in his preface, has been written with a view to assisting the amateur to design and construct transformers to suit his own requirements. The methods of design indicated are the cheapest possible, with the employment of the minimum material consistent with high efficiency. This book should appeal strongly to wireless amateurs and students.

W/T, R.N.V.R., RE-UNION.

During the war, all R.N.V.R. W/T Operators passed through the R.N. Depôt at the Crystal Palace. Normally some 300 joined up at the Wireless School every month, and 200 were drafted monthly as W/T Operators to the Fleet. There were usually about 1,200 men under instruction at the School where the feeling of comradeship and good fellowship ran strong as was again shown so clearly at the third annual re-union dinner and smoking concert which were held on April 23rd at the Talbot Restaurant in London. The Chair was taken by the O.C., Lt.-Col. C. G. G. Crawley, R.M.A., Deputy Inspector of Wireless in the Post Office, and a most successful and happy evening was spent by the "old boys" who "rolled up" in large numbers.

Next year's re-union was fixed again for the day of the Football Cup-Tie Final, and all "old boys" whose addresses are not with Mr. N. J. Babbage are asked to communicate with him at 13, Bow Lane, Finchley, London, N., so that the arrangements for next year may be notified to them in due course.

QUESTIONS AND ANSWERS

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

C.H. (Nunthorpe) *asks (1) If a fairly thick covering will be harmful on wire intended for an aerial. (2) Which is generally best, 100′ single or 70′ double for an aerial. (3) The objections to bringing a lead in for a considerable distance indoors. (4) If it is usual to use insulated wire for the indoor portion of the earth lead.*

(1) The covering will not give undesirable effects electrically, but will soon rot and look unsightly. It would be better and cheaper to use uninsulated wire of heavier gauge.

(2) It is almost immaterial. Use whichever is more convenient.

(3) Chiefly the useless extra resistance involved.

(4) This is often done, but it is not essential.

J.B.K. (Cambridge).—(1) and (2) In both circuits substitute an intervalve transformer for your telephone transformer, and arrange this so as to take the place of the telephone transformer shown on page 735 of Vol. VIII.

(3) The uprighting relay referred to is necessary as the spacing and marking contacts of the relay shown in the diagram are used for the quenching device. In the case of the uprighting relay they are available for working an inker.

(4) Inductance required is about 37,000 mhys. Exact calculation of such coils is difficult. We should recommend making a number of basket coils, say, of No. 26, of, say, 5″ external diameter, and placing them side by side until you have sufficient inductance. You will probably require from 8 to 12 of these coils.

F.J.D. (Liverpool) *asks (1) For the design for a 7-valve amplifier to conform to certain conditions. (2) For data for the intervalve transformers. (3) Sizes for honeycomb coils, on formers 1″ in diameter, 1″ between sided, and with 30 pegs per side, to tune a P.M.G. aerial to 600, 6,000 and 15,000 ms.*

(1) and (2) The detailed design of such sets is quite outside the scope of these columns. See articles by Scott-Taggart in the issues for December 1919, February, 1920, *et seq.*

(3) This is difficult to calculate exactly. Try
for 600 ms.....25 layers of, say, No. 22;
for 6,000 ms.....25 layers of No. 26;
for 15,000 ms.....40 layers of No. 26,
using small parallel condensers if necessary.

E.W. (Northampton) *has a crystal receiver with valve amplifier and wishes to use a Weston relay with the set. He asks (1) How to do this. (2) If he must have a L.F. transformer to use with it. (3) The reason for howls when he is tuning in. (4) If a filings coherer would be sensitive enough to be affected by the more powerful stations.*

(1) Try connecting the relay as shown in figure 1, balancing out by means of a potentiometer as indicated.

(2) No; as the relay works on D.C.

(3) This howl is due to too tight coupling between the grid and the plate circuits. Try reducing this coupling considerably.

(4) The coherer would probably be sensitive enough, but would only follow very slow sending.

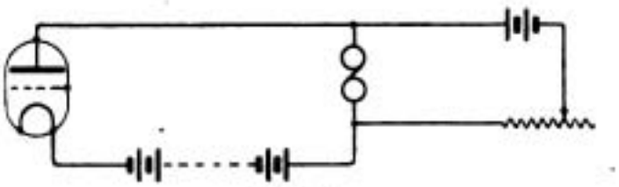


Fig. 1.

W.M.C. (Preston).—(1) C_1 = 0·005 mfds.
C_2 = 0·001 mfds.
C = 0·002 mfds.
Put it in parallel with the telephones, and omit L.

(2) You will find it difficult to get such a long range with one set of coils. For 15,000 ms. L_1 should be 18″ × 10″ wound with No. 26, with a small parallel condenser (0·001 mfd.), short-circuiting C_1. L_2 should be 12″ × 8″ wound with No. 32.

(3) V 24, or similar type, obtainable from the Marconi Company, and most dealers.

(4) Not suitable for tuning purposes. Capacity = 0·013 mfds.

F.A. (Addlestone) *asks (1) For a diagram of connections for two valves with resistance capacity coupling. (2) If it is possible to light the filaments from a small transformer, not rectifying the current, and, if not, would a chemical rectifier be efficient enough to rectify the current from the output of the transformer. (3) Would No. 24 enamelled copper wire do for winding the primary of a step down transformer for 200 to 6 volts, and No. 16 for the secondary. (4) The wavelength of a certain circuit.*

(1) We have given many circuits of this type recently—for example, see Fig. (1), page 730, of the January 8th issue.

(2) We should recommend using A.C. supply and rectifier to charge the accumulators, then using the accumulators for the receiver.

(3) It could be used if carefully wound, but we do not recommend it.

(4) About 5,000 ms.

CHU CHIN CHOW (Newport, I.W.) *asks (1) The best number of volts to work an R valve. (2) What amps does an R valve require. (3) Are American and Australian stations possible for an*

English amateur to receive on a single valve, or a two-valve amplifier. (4) *Is a circuit sketched workable.*

(1) About 70.

(2) 0·65 — 0·7 amps.

(3) American stations are possible for a good set well used, but Australian—NO. We doubt if any Australian station has ever been heard in this country with any size aerial or type of apparatus.

(4) Yes, quite good.

ATOM (Surrey).—(1) 6 ozs. of No. 30 S.C. for low resistance, and 3 ozs. of No. 44 S.C. for high resistance winding. See an article in the March, 1920, issue for full details.

(2) You do not give sufficient information for us to help you. To calculate inductance we require to know the length of winding on a former, and also the number of turns on a pancake coil.

F.G.K. (Poplar).—(1) Obtain the P.M.G.'s sanction to the proposed changes; no extra fee is required.

(2) Yes. Transformer about 1½ oz. and ¼ oz. of No. 44 wire, wound on an iron core ½" in diameter.

(3) Yes, we prefer it to the former, but you should put the H.T. battery on the plate side of the closed circuit.

(4) A loud speaker could be introduced if desired in either case.

A.V.G. (Worcester) *asks* (1) *What valve we recommend for general reception work, with the battery voltage required.* (2) *Which would be the best valve if only 4 volts were available for the filament battery.*

(1) There is very little to choose between any of the better known hard receiving valves in average performance. If comparative tests are made on circuits of different type the order of merit will generally be found to be different in each case.

(2) Here, again, it is difficult to say. For instance, a V 24, Q or R, valve can each be induced to oscillate on 4-volt filament batteries with suitable circuits. A 6-volt battery is always preferable, however, partly because the battery can only give its full rated volts when fully charged; and also because often in receiving it is desirable to use circuit conditions, which are not the best for the production of oscillations.

H.T.I. (Birmingham).—(1) We are afraid we cannot give much information about the coils from the fact that they are stated to have a wave-length of 10,000 to 15,000 ms., which means practically nothing. We should recommend using the slide coil as a loading coil in series with the frame aerial, which will give sufficient wavelength without the pancakes, which are not wanted for a set of this type.

(2) and (3) See diagram on page 730 of the issue for January 8th for circuit, with additional apparatus indicated.

G.T.O. (Stafford) *asks* (1) *If the circuit sketched is the best possible with his apparatus.* (2) *Is the following aerial suitable: 80' of No. 10 copper wire, sloping from 17' to 45' high, with lead in from the centre.* (3) *Earth from the top of the house through water pipes. Is this suitable.*

(1) Your circuit has several bad features. A parallel A.T.C. should not be greater than about 0·0005 mfds. The arrangement of battery and potentiometer is quite wrong—see many recent crystal diagrams in these columns.

(2) Not very. Bring the lead in from the lower end, if possible. If not, try to get the heights of the two ends more nearly equal.

(3) Yes, fairly.

SIMPLICITAS (Lenham).—(1) Apply for particulars to the Postmaster-General.

(2) See Amateur Clubs Section of this Magazine and various particulars of stations published from time to time.

(3) We think it is very unlikely you will obtain a permit to transmit with a set of sufficient power to cover 100 miles over land. The problem you submit would be fairly easy of solution for telegraphy, amplifying the signals received from your lodgings at your friend's house, the amplified signals being arranged to operate an electro-magnetic relay controlling the higher powered transmitter. A solution for telephony would be possible on similar lines, with the substitution of a suitable transformer for the relay; but the practical difficulties to be overcome would be very considerable. We are afraid we do not know of any paper dealing with such a problem from the practical point of view.

A.B. (Edinburgh) *is making a variable tubular condenser, of capacity 0·0003 mfds. He asks—The length of the tubes, diameter of tubes, the dielectric, and its thickness.*

Dielectric of ebonite—one tube 2" in diameter, 4" long, thickness of wall $\frac{1}{16}$" (approximately 1 mm.).

Metal plates to be good sliding fits over and inside this tube of dielectric.

J.A.S.W. (Rugby).—(1) You will not obtain satisfactory results with a frame aerial and only one valve. You will find full instructions for the construction of a suitable set of this type with several valves in Nos. 16 to 21 of Vol. VIII. There have also been several diagrams of sets of this type in these columns recently.

(2) A convenient way of making an 80,000 ohm. resistance is to bind wires tightly round a slate pencil at points about 1" apart, and rub pencil lead on to the slate between these points until a suitable resistance is obtainable. You can tell when you have rubbed in sufficient either by testing with a very sensitive galvanometer, or by the results you have with the resistance in a set.

B (Smethwick).—The dimension given on page 782 is correct as stated.

(1) The capacity of the condenser may be 0·002 mfd.

(2) No; as you are using a grid condenser and leak for rectification and, therefore, can adjust all valves to the best magnifying points by means of a single filament resistance.

(3) Resistance values are not absolute indication of the suitability of a transformer for a telephone receiver, but it is usual to make the resistance of the telephone and the telephone winding of the transformer approximately equal.

(4) You will do much better by making a separate

inductance unit for 200 ms., and so avoid detrimental end-turn effects.

BEGINNER (Derby) *asks* (1) *Is the wireless receiving set as described in "The Amateur Mechanic" satisfactory for a beginner to start on and make.* (2) *Can the same be improved,* i.e., *any alterations to wiring of condensers, etc.* (3) *The best size of aerial to use with it.* (4) *Can telephone messages be received with this set if valves, etc., are used.*

(1) This is a very good set, and is just the one for a beginner.

(2) Not usefully. It has a very good wavelength range, up to 7,000 ms.

(3) Use a twin wire aerial—wires spaced say 5' apart, as high and long as possible (not more than 140' of wire in a twin wire aerial is allowed by the P.M.G.).

(4) Telephony is usually somewhat weak on crystals. You will probably require one or two valves as low frequency magnifiers.

W.H.H. (Tonbridge).—(1) The maximum wavelength will be approximately 2,000 ms.

(2) Not quite correct. One side of the crystal should be connected to the top end of the secondary winding, the other to the potentiometer slider. Connect the middle point of the battery to one side of the telephones, and the other side of the telephones to the bottom of the secondary inductance. You will get good results with zincite-bornite without a battery and potentiometer.

(3) In coaxial tube condensers the one tube slides over the other—which cannot very easily be done with an air dielectric. A 0·0015 mfd. condenser across the telephones will improve the circuit.

(4) Yes, quite suitable.

J.T.R. (Derby).—(1) This is not at all clear, and is not the usual experience. NBA wavelength is 9,000 ms. and UA 11,000 ms.

(2) Latest information (June, 1920), Bandoeng 9,000 ms. C.W., call PKX, time of sending 4 to 11 p.m. Amsterdam time.

(3) A separate heterodyne should give better results, with strong and weak stations (especially with weak) than self-heterodyning, as the adjustment is far more flexible. Your heterodyne must be too strong if it does not give good results with weak stations.

N.L.Y.F. (Reading).—(1) The coils you wish to use will be very inefficient, and are quite unsuitable for a receiver current. Your requirements are not sufficiently stated for calculation.

(2) One of the conditions upon which you will be allowed to use valves is that you have a non-radiating circuit. In any case the strength of oscillations you would radiate would be very weak, and would require a multivalve amplifier to detect.

(3) This would most probably not be allowed, and would also be impossible owing to the weakness of the radiated oscillation.

(4) There are a number of good French valves on the market at a very cheap rate now, and we believe they are quite reliable.

S.S. LORD BYRON. (1) The circuit is not quite correct. The grid and filament of the first valve should be connected across the tuning condenser so that the maximum voltage charge comes on the grid. At present you only get the voltage across the reaction inductance, and not that across the frame. The condenser across the telephones and anode battery should be of greater capacity than 0·0002 mfds. Try 0·0015 to 0·002 mfds. You give no information regarding the reaction, and so we cannot say if you have either too much or too little. Neither can we estimate the wavelength range. The frame alone with the condenser will give a range of 3,000 to 7,000 ms. approximately, if its inductance is as you say, 20 millihenries. You omitted the gauge of wire on the frame.

(2) The changes we have suggested may improve this.

(3) Yes, at the bottom of the condenser.

NOVICE (Aberdeen) *asks* (1) *Which are the most efficient for crystal reception of wavelengths from 600 to 1,000 ms.—pancake, honeycomb or single-layer coils.* (2) *How many turns should there be on a pancake coil to get 600 ms. on a P.M.G. aerial.* (3) *Is a loose coupler of any advantage, if the primary is made to slide over and away from the secondary.*

(1) The most efficient coils for any wireless reception are single-layer coils. When magnification is available coils which are less efficient can be used.

(2) You will do much better to use a single-layer coil. Try a cardboard former 4" in diameter, wound with 6" of No. 22 D.W.S. and fitted with a rubbing contact.

(3) As its name implies, a loose coupler should be capable of providing a variable coupling between two circuits. One winding should be made to slide in and out of the other.

C.E.W. (New Cross).—(1) Probably about 2.

(2) Your calculation is quite correct.

(3) The "Armstrong Feed Back" circuit is very similar to the reaction circuit continually described and discussed in these columns.

(4) The description of the receiver has now been completed. You should have sufficient information to complete the set.

W.J.T. (Norbiton).—(1) Darien time signals, 0955 to 1000 and 1755 to 1800 G.M.T. Dots are sent out every second with the following exception:

The 29th second of each minute.

The 50th to 59th second of each of the first four minutes.

The 50th to 59th second of the last minute.

The final signal at 1000 and 1800 is a dash after the longer break.

(2) Stations unknown, probably PCGG.

(3) This question you have probably seen answered in the March 5th issue of *The Wireless World* in an article describing the American tests.

G.N.C.S. (Torquay).—(1) There is not much telephone transmission at the present time. Listen on 900 ms. for aircraft and ground stations working at all hours of the day. Also watch advertisers' announcements in this journal.

(2) Yes; signals should be stronger. Increase the height at the lower end as much as possible.

(3) No.

(4) Should not this be MGZ, which is used to indicate Greenwich Mean Time.

W.C.J.H. (Twickenham).—(1) The Olympia Telephony was sent on 750 ms.

(2) Mark III short wave tuner; aerial condenser 0·0015 mfd.; closed circuit, 0·0005 mfd.

(3) Note that a spark receiver will also receive telephony. The circuit of Fig. 1, page 755, will oscillate and detect quite satisfactorily. The addition of a grid condenser and leak might possibly improve the rectification, but is not essential.

(4) None that we know of.

H.L. (Tottenham) *asks* (1) *In a valve receiving circuit with reactance and a certain plate voltage he understands that the local oscillations generated must have a definite strength. Can these local oscillations be increased in strength up to a certain limit, and what benefit or otherwise would result.* (2) *If these local oscillations can be increased would the strength of the wave from the aerial depend partly or wholly on their strength* (3) *Is any use made of the Edison effect in the ordinary receiving valve.*

(1) For self heterodyne reception the reaction coupling must be properly proportioned. If the local oscillations are too strong they will wipe out the incoming oscillations altogether. By arranging a variable reaction coupling the signal strength can be adjusted up to a maximum.

(2) The radiated energy depends absolutely on the strength of the oscillations generated in the aerial. If the reaction coil couples up the secondary inductance and not into the aerial inductance, there will be much less radiation from the aerial.

(3) Yes, the Edison effect underlies the principle of action of all valves.

S.M.D. (Loughborough).—(1) Yes. Put the potentiometer and battery between the crystal and the telephones. Connect one side of the crystal to the potentiometer slider, and two dry cells across the potentiometer winding wire. The middle point of the dry cells should be connected to the side of the telephones which you have at present connected to the crystal.

(2) Quite suitable.

(3) Your method of testing with a buzzer does not appear to be correct. At present you hear only direct induction from the buzzer and not oscillations set up by it. If you have not got a separate wavemeter connect the buzzer and cell across the A.T.I. and with the coupling very loose tune up the secondary and adjust the crystal. In this manner the buzzer sets up oscillations in the aerial, the wavelength of which is governed by the inductance and capacity of the aerial circuit, and the secondary circuit receives them.

(4) You do not give the capacities of your condensers. The wire in your aerial circuit is too fine. You should rewind it with No. 24. Assuming the capacity of your secondary condenser is 0·005 mfds., your maximum wavelength should be about 5,000 ms.

J.S. (Exeter) *asks* (1) *Size of the largest practicable coil, with size of wire for the set described in the issues of April and May.* (2) *For a diagram showing how to add a R.N.A.S. 3-valve amplifier to the above set.* (3) *Will the above set receive long wavelengths with the condenser where it is shown.* (4) *Will 54 volts be sufficient for the usual R valve.*

(1) You will do well to keep to the windings given in the article named and make up a new set for long wavelengths as recently described in our Constructional Article columns—"A Single Valve Long Wave Receiver."

(2) We are sorry that we have not a diagram of T b. amplifier to hand. We will publish one as soon as possible.

(3) See question (1).

(4) Yes. See that good contact is made between each of the units of the battery. You cannot use the battery for the valve while it is being charged—if you do you will be troubled with commutator noises.

H.C.F. (Moseley) *asks* (1) *What distance would a Mark III Tuner receive on an aerial* 80′ × 50′. (2) *Would the coils have to be rewound in using a valve in the set.* (3) *What alterations would be necessary for receiving telephony.* (4) *What is the best type of headgear for a crystal set.*

(1) The Mark III Short Wave Tuner has a wavelength range of 100 to 700 ms. The Mark III Long Wave Tuner goes up to about 5,000 ms. You do not say what type yours is. If it is a S.W. set you will only get ships weakly as you are in the middle of the country. If it is a L.W. set you should get Eiffel Tower, Poldhu, Nantes, Cleethorpes, Nauen, and others, in addition to ships.

(2) No. These sets have terminals and switch arrangements for connecting on a valve as a magnifier.

(3) None. It is not very well understood that spark receivers are quite suitable for the reception of telephony. In telephony a continuous wave is radiated from the aerial. This wave is varied in amplitude by the speech waves, which are of audible frequency, and correspond to spark frequency in spark telegraphy, so that a receiver suitable for one is also suitable for the other.

(4) The best telephone is probably the Brown L.R. telephone, but they are expensive. Good results will be obtained by using Sullivan H.R. telephones, or Sullivan or Brown L.R. telephones with a transformer.

W. E. W. (Ilfracombe) *asks* (1) *The hours for Press, weather reports for Paris, Poldhu and any other spark stations likely to be heard in Ilfracombe.* (2) *Which is the more sensitive detector, silicon-copper or silicon-platinum, and how does this compare with zincite-copper pyrites.*

(1) Poldhu MD, wavelength 2,800, weather forecast and navigation warnings 9.30 a.m. and 9.30 p.m. and Press 1 a.m. Eiffel Tower FL, wavelength 3,200; Press in French, 11 a.m. on wavelength 2,600; weather report 2.45 a.m. and 7.30 p.m.; weather forecasts, 11.30 a.m.; time signals, 9 a.m. and 9.30 p.m. Nantes UA 2,600 ms., navigation warnings, 9 p.m. Nauen POZ on a higher wavelength, 5,500, weather report in code, 7.40 p.m.; all times are G.M.T.

(2) We have not actually tried the detector you mention so cannot say definitely. A great deal depends on the quality of the crystals obtained, and also upon the adjustment. You cannot do much better than use a good zincite-copper detector.

H.A.M. (Leatherhead).—(1) Your aerial is too angular. Try and increase the height at the tree end by means of a 10′ pole fastened on to the tree. The lead-in should be taken from the house,

and not from the tree. If this is done the lead-in will be almost at right angles to the aerial.

(2) Capacity approximately 0·0002 mfds. and natural wavelength about 100 ms.

(3) A valve set with 1 H.F. magnification and a crystal reception will be more efficient than a valve set in which the valve functions as a H.F. magnifier and rectifier combined.

N.M.S. (Wimborne).—(1) Your aerial is not high enough for crystal reception. You should increase the height at the 12′ end as much as you possibly can. Your signals will all be weak The connections of the secondary circuit as given in your diagram are all wrong. The secondary condenser should be connected across the inductance with the detector and telephones across the condenser. They should not all be connected in series as you show them. The circuit will then be suitable for spark telephony. You will get better results with a zincite-bornite crystal.

(2) Your circuits are badly proportioned: the aerial circuit will only tune to 2,600 ms., while the secondary will tune to 60,000 ms. Your tubular condenser has a capacity of 0·009 mfds. approximately. It is far too big for the secondary circuit of a crystal receiver. Make a new condenser or reduce the length of the present tubes to 5″. The capacity will then be approximately 0·0005 mfds. and the maximum secondary wavelength a little over 4,000 ms. Rewind the A.T.I. and primary coils with No. 24 D.W.S., which will increase the aerial wavelength to about 4,000 ms.

(3) The circuit should be made to generate continuous oscillations by means of a valve and reaction coil, or a separate heterodyne could be used. See constructional article in the issues of June, 1920.

(4) Yes. This is a L.F. amplifier which magnifies the rectified signal currents passing through the telephones. Secondary winding should be 12,000 ohms., and not 1,200 as given on page 760.

LADY RADIO (Highbury).—(1) The S.I.C. of glass varies considerably, but we think you will obtain the required capacity if you use 7 plates, 4 one side and 3 the other.

(2) For 0·0005 mfd. use 4 plates, 2 each side.

(3) You should get signals on an aerial 40′ long and 25′ high, but the bigger and higher the aerial the better the results you will obtain.

(4) You may test the set if you have a wavemeter which you can energise by means of a buzzer, and set up oscillations, but the best test and adjustment can only be made on signals received on an aerial.

AVAN ROOD (Belgium).—(1) When winding the telephone transformer, wind first from left to right, then from right to left—it is not necessary to go back to the left-hand side each layer.

(2) Waxed paper—papier de parafin—is thin paper (such as that upon which you wrote us), which has been placed in a bath of liquid paraffin wax and impregnated with wax.

(3) The probable explanation is that the vaseline on the studs has an effect similar to the quenched spark gap, so that the oscillations in the primary are quenched out after the first one or two.

(4) Probably they have already tried this.

W.S.N. (Shoreditch) *asks* (1) *What is the diameter of the reactance former and size of blocking condenser for the short wave receiver described by Mr. F. O. Read in the issue of October 2nd.* (2) *The correct drawing and sizes of condenser plates in the article "Frame Aerial Receiving Sets" in the issue for December 11th.* (3) *In the second article on the same set (November 30th) should not the condenser sheets be 0·001″ thick (mica) and 0·002″ (copper) instead of 0·01″ and 0·02″.* (4) *Is it better to make a telephone transformer with a closed iron core.*

(1) The article in question states that the reactance former should be made to slide over the A.T.I.; therefore it should be barely 2¾″ inside diameter.

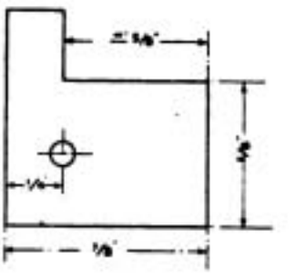


Fig. 2.

The condenser should be, approximately, 0·00005 mfds.

(2) The condenser plates should be made as per diagram (Fig. 2.) They should overlap each other by ½″.

(3) Yes.

(4) Yes, if you can conveniently make it so.

SHARE MARKET REPORT.

There has been a continuation of good business in the Wireless Group and Marconi Shares have again improved during the fortnight.

Prices as we go to press, May 6th, are:—

Marconi Ordinary	£2 - 12 - 6
,, Preference	£2 - 11 - 0
,, Inter. Marine	£1 - 10 - 0
,, Canadian	8 - 0
Radio Corporation of America:—	
Ordinary	9 - 6
Preference	11 - 3

The WIRELESS WORLD

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THE WIRELESS WORLD

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VOL. IX. No. 31. MAY 28TH, 1921 FORTNIGHTLY

A MODEL RECEIVING STATION

THE reports which we have received from time to time of the receiving station of Mr. J. Kenneth Hele, of Plymouth, persuaded us that, if a description of the station and a photograph could be obtained, this would be of very great interest to readers of this Magazine.

The photograph here reproduced, then, illustrates Mr. Hele's station, a glance at which will show that it is far more pretentious than the average amateur wireless station that one comes across. The results obtained from this set, too, amply justify its being classed amongst the best amateur stations in this country.

The aerial lead-in wire is seen extending parallel with the supporting batten on the right of the bench and coming to one plate

The Operating Bench and Instruments

of the micrometer spark gap, which is shown affixed to the supporting batten and just above the level of the bench. The earth lead from the other plate of the micrometer spark gap is not visible in the photograph.

The lower of the two coils of large diameter seen on the right is the coupling coil in the primary circuit, connected on the low potential side of the primary loading coil, which is at the other end of the room and consequently not visible in the photograph. The upper coil is the secondary coil which is connected across the condenser, seen just to the right of the 7-valve amplifier, which is itself connected across the condenser by the leads which are just visible against a background of white curtain.

Referring again to the large diameter coils on the right it will be seen that the upper section is divided into three parts, the lowest part being used for short waves, whilst for the longest waves the whole of the coil is employed.

The condenser with extension handle, seen on the far right of the bench is the primary condenser, which, by a switch on the back of the containing box, can be put in series, or in parallel with the aerial circuit, or cut out altogether.

In each of the condensers, the fixed plates are connected to the high potential side of the circuits.

At the back of the bench, and to the left of the 7-valve amplifier (Marconi 55D), is a separate control panel for the detecting valve. Just in front of this panel is a special switch box, designed by Mr. Hele, carrying two switches; the purpose of this is that by means of one of the switches, the output current from the amplifier may be passed to (1) either of the telephones shown, (2) to the 3-valve R.A.F. amplifier (low frequency) seen just at the window edge at the back, (3) to the 2-valve Marconi note magnifier at the back, just to the left of the R.A.F. amplifier; by means of the other switch, the current from either the 3-valve R.A.F. amplifier or the 2-valve Marconi note magnifier can be passed into either of the two pairs of telephones.

On the extreme left of the bench is seen a wavemeter, and on the wall above this is a loading coil for use with the wavemeter in calibrations from 1,000 up to 20,000 metres.

On the wall at the back is seen a voltmeter for testing the H.T. batteries, and directly underneath this, on the front of the bench, is a separate oscillator for heterodyning continuous wave signals.

In connection with the arrangement of the set, the following points are worth noting. The oscillator has been placed in the position shown in order that it may have the greatest effect upon the transformers of the 55D amplifier nearest to the detecting valve, and will affect the tuning coils as little as possible, this arrangement is found to tend to equalise the strength of strong and weak signals in the telephones, and also to reduce heterodyne radiation from the aerial. The connecting leads between parts of apparatus are all laid out so as to be as short as possible, and where possible, are placed neatly out of sight.

The station is extremely selective, and as a proof, it may be stated that Marion WSO is always readable in daylight, even though Rome IDO and Stavanger LCM may both be sending at the same time, and Bandoeng, Java, has been *read* with the telephones lying on the table.

Probably the most room for improvement in the station lies in the direction of the aerial, which is unfortunately badly affected by the proximity of a metal roofing, whilst it is also badly screened from the west by the hilly country of Cornwall. In this respect, Mr. Hele is somewhat handicapped in competition with other experimenters.

It might also be mentioned that Mr. Hele is entirely self instructed in wireless telegraphy, aided by his own experiments and theory studied from technical publications.

EXPERIMENTAL WIRELESS TELEPHONY*

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

THE subject of wireless telephony has always been one of especial interest to the radio worker since wireless communication first became practicable. It is one of still greater interest at the present time when a comparatively easy solution is within the reach of all. The commercial development of the three-electrode valve, or triode, has rendered possible this success.

I do not wish in this Paper to give merely a résumé of the historical development, or to chronicle the multitudinous attempts at radio-telephone communication that have been made by various workers up to the present time, as such information can now be found by all who wish to make use of it in the text books of wireless communication,† together with accounts of the many and various methods and apparatus with which such attempts have been made. I wish rather to deal with one or two aspects of the subject that may possibly be of interest to the wireless amateur or experimenter, particularly from the point of view of the conditions imposed upon experimental work in this country.

1. Differences between Telephonic and Telegraphic Communication.

In many quarters there is a tendency to over-emphasise the difference between radio-telephonic and telegraphic communication. Some, I believe, would even regard wireless telephony as a different branch of science altogether. In reality the differences between the two are small, and with modern apparatus tend if anything to become less, as continuous wave working becomes more general. In the days when the spark transmitter was the only one for telegraphic communication, the differences were undoubtedly greater, but with such we have not to deal this evening.

At the present time, when reduced to its essentials, the differences between radio-telegraphic and radio-telephonic signalling resolve themselves merely into the different methods of controlling or modulating the high-frequency energy in the aerial of the transmitting station. In the one case this modulation takes the form of abrupt changes in either (or both) the frequency or intensity of the radiated waves so as to form the Morse Code signals, while in the other the corresponding changes are effected gradually, and in varying degree so as to reproduce the waveform of the speech it is desired to transmit. Certain other small differences must also be taken into consideration in designing a commercial station, for instance, but such need not concern us here.

It has often been stated that it is almost immaterial at what point of a wireless telephone transmitter the energy is modulated in accordance with the speech to be transmitted, and in most cases this is approximately true, provided of course that the modulation apparatus employed is suitable for the part of the circuit in which it is situated, and that it is designed for the type of current that it has to handle. With three-electrode valve transmitters there is less difference between the modulation apparatus requisite for effective control of the energy in different parts of the circuit, and this fact is evidently of importance from our point of view, as it means that less apparatus is required for experimental work.

I also wish particularly to draw attention to the fact that the modulation or control unit is, in effect, quite separate and distinct from the real transmitter or oscillation generator, and that therefore, particularly for low-power amateur work, an appropriate control unit can readily be applied to any given C.W. transmitter in a number of different ways. Hence it is comparatively easy for anyone possessing a good C.W. transmitting apparatus to fit the necessary additional modulating apparatus for the transmission of telephony. Bearing in mind what has already been mentioned with regard to the differences between telegraphic and

*Paper read before the Wireless Society of London on Monday, May 2nd, 1921.

†See in particular "Telephony without Wires," by Philip R. Coursey. (London: *The Wireless Press, Ltd.*).

telephonic signalling, it follows that a microphone can be applied in all places in a C.W. transmitter where can a key for telegraphic signalling, and also that the same general type of control unit can therefore be used for telegraphic, telephonic or tonic-train signalling, as well as for any other special type of radio signalling—such, for example, as the transmission of pictures from place to place.

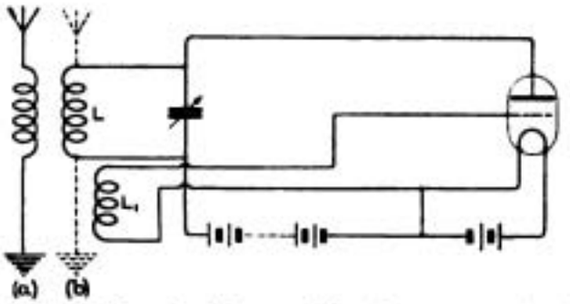


Fig. 1. Valve Oscillator with electromagnetic inductive reaction (separate coils). Coupling between LL_1 *provides reaction between anode and grid circuits. (a) shows inductive coupling to aerial circuit and (b) direct coupling.*

2. Methods of Modulation.

The most important methods of modulation by means of an ordinary pattern of microphone, and applicable especially to low-power C.W. transmitters of the valve type, may be summarised briefly as follows :—

(1) Aerial Modulation.
- (*a*) In series.
- (*b*) In shunt.
- (*c*) Coupled.

(2) Grid Circuit Modulation.

(3) Anode Circuit Modulation.

(4) Modulation of Power Supply to Valve.
- (*a*) In series, or coupled—*i.e.*, arrangements in which the modulator controls a separate power supply.
- (*b*) By the "Quiescent-Aerial" method—*i.e.*, arrangements in which the modulator unit furnishes the power supply to the oscillation generator.

(5) Valve Modulation.
- (*a*) Methods using the valve or valves as simple amplifiers in connection with any one of the preceding arrangements.
- (*b*) "Choke-Control" Modulation—also called (principally by the Americans) "Constant-current" control, and the "Heising Method" of modulation.
- (*c*) Shunt Control—usually applied to the aerial circuit.

These various methods of control will be discussed more in detail later in the Paper.

3. Arrangements of Transmitting Valve.

The leading arrangements of a triode valve for oscillation generation that are suitable for use under the conditions of low-power working imposed by the Post Office are indicated in Figs. 1, 2 and 3. These diagrams represent in particular the simplest arrangements involving electromagnetic and electrostatic retroaction between the anode and grid circuits, and some modifications of the simpler arrangements. In most cases it is possible to insert the high tension supply either directly into one or other of the valve

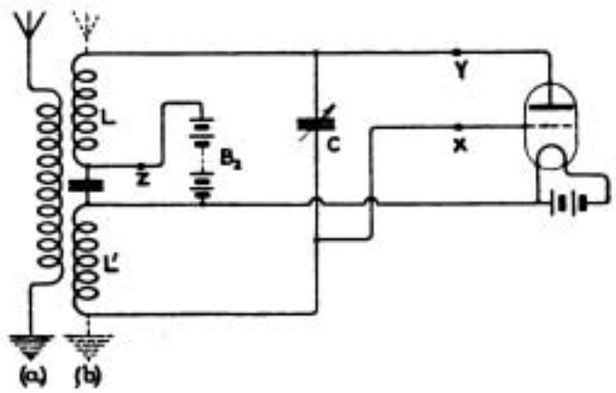


Fig. 2. Valve Oscillator with electromagnetic inductive reaction using single split coil LL'. (a) shows inductive coupling to aerial circuit and (b) direct coupling.

circuits (usually with a suitable condenser in parallel to bypass the high-frequency components of the anode current); or else to connect it in shunt to the valve as a whole. These differences are indicated in the diagrams of Figs. 2 and 4 for an otherwise similar arrangement of circuits. They will not require further explanation for the purposes of this Paper.

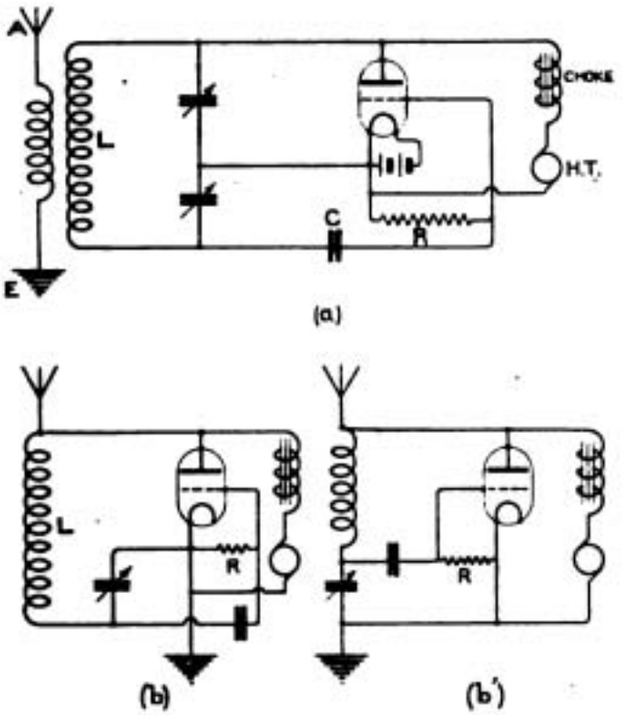


Fig. 3. Valve Oscillator with electrostatic reaction coupling. (a) *shows inductive coupling to aerial circuit,* (b) *shows direct coupling and* (b') *direct coupling to the aerial circuit rearranged in simpler form.* C = *blocking condenser in grid circuit and* R = *grid leak.*

It may also be noted that these diagrams show in each case alternative arrangements of the aerial circuit—*viz.*, with the aerial and earth connections either brought directly to the ends of the main oseillation circuit inductance (direct coupling of the aerial), or else inductively coupled to the oscillating valve circuits. These alternatives are marked (*b*) and (*a*) respectively in the diagrams.

For all low-power work, using aerials of limited size, the second arrangements are to be preferred in most cases. One of the chief reasons for this is that when the aerial is inductively coupled, the wavelength that is radiated is determined solely by the constants of the main oscillation circuits, which, being inside the operating room, are all under control, whereas when direct coupling is employed the radiated wavelength changes with all variations of the aerial capacity such as may be brought about by its swaying in the wind. This variation is most harmful at short wavelengths, as all will know who have listened in to short wave amateur C.W. transmissions when direct coupling is employed. It is often extremely difficult to maintain the received heterodyne note within the limits of audibility. With telephonic transmission such variations would bring about large charges in the intensity of the speech heard at the receiver.

4. The Control or Modulation Unit.

In many of the earlier wireless telephone experiments very special microphonic apparatus was employed, but at the present time such is not necessary. The modulation unit now consists of an ordinary pattern of microphone transmitter, either employed directly or in conjunction with a suitable

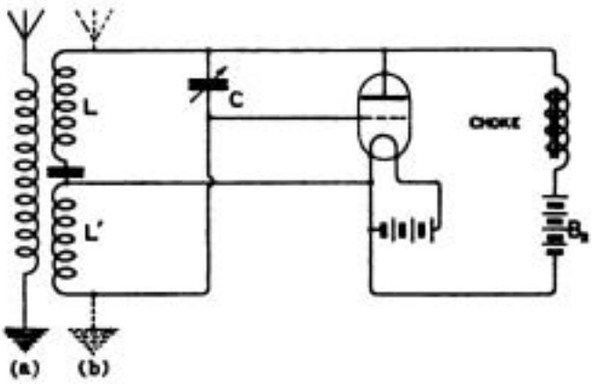


Fig. 4. Valve Oscillator with electromagnetic reaction arranged similarly to Fig. 2 with the H.T. supply B_2 *in shunt to the valve instead of in series with the anode circuit. The choke coil in series with* B_2 *is to prevent the flow of H.F. current through* B_2.

microphone transformer, the design of which must be related to the part of the transmitting circuit in which the unit is to be connected. In the valve modulation methods the control unit really comprises the modulating valve as well, but these arrangements will be dealt with more fully later.

It will be noted that I have indicated in these diagrams no special means for controlling the voltage of the grid of the oscillating valve. Usually, when using ordinary valves for transmission purposes, it is necessary to maintain the grid at a suitable negative potential. The higher the plate voltage, in general the greater must this negative grid voltage be made, both in order to maintain the working point as near as possible to the

centre of the characteristic, so as to secure good oscillations and as much freedom from harmonics as possible, and also to reduce the grid current and the consequent losses in the grid circuit. This negative voltage may be obtained by a potentiometer or battery in the grid circuit or by the use of a grid circuit condenser and leak of the proper value depending upon the valve in use. While the use of the grid condenser and leak is a very simple means of securing the desired negative voltage, and it also works well for C.W. telegraphy, its use for a telephone transmitter may, at times, introduce distortion of the speech. The reason for this is not hard to find. The negative voltage to which the grid is brought by the action of the condenser and leak depends upon the strength of the oscillatory currents flowing in the valve circuits. When these are modulated by the transmitting microphone the resultant negative grid voltage will therefore also vary, so that the oscillations set up by the valve will no longer be about a fixed value of grid potential—that is to say, variations in the strength and quality of the oscillations will be introduced in addition to the normal variation due to the microphone. This evidently may constitute a source of distortion.

5. Aerial Modulation.

Direct modulation of the energy in the aerial circuit may be effected with a 10-watt C.W. transmitter by connecting a carbon microphone, either directly in series with the aerial circuit, in shunt to a few turns of the aerial inductance, or by connecting it to a few turns of wire which are coupled to the aerial tuning coil, Fig. 5 (*a*), (*b*) and (*c*).

These arrangements in particular are best when an inductive coupling is used between the aerial and oscillation circuits, as when this is not the case the variations of the microphone resistance are liable to stop the valve oscillating. When this occurs distortion of the speech is always found, since the oscillations take an appreciable time to build up again. This liability to breaking of the speech can be lessened when the microphone is coupled to the aerial circuit, but the inductive coupling of the aerial

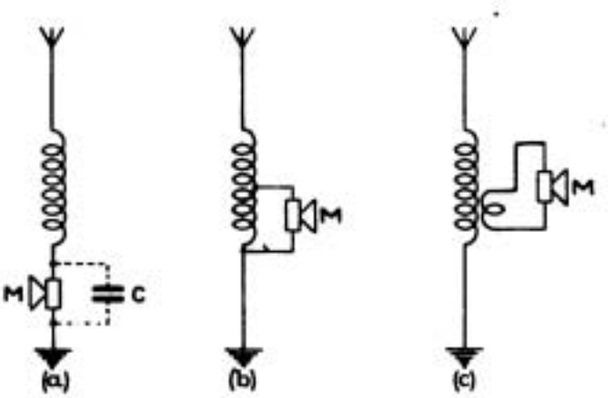


Fig. 5. Three alternative methods of direct modulation of the aerial circuit. (a) *in series,* (b) *in shunt to part of the aerial tuning inductance, and* (c) *coupled to the anode circuit.*

is best, as even if the aerial current is reduced completely to zero the valve should not then stop oscillating.

Moderately good speech transmission is possible with these arrangements, but it is usually not nearly so good as is possible with the other methods of control.

It should be borne in mind that with any of these methods of aerial modulation the microphone is traversed by high-frequency current, and that therefore the microphone must be carefully picked. It should not have too much metal work in its construction, and the granules should be large and moderately free so as to prevent "packing" of the instrument.

No microphone transformer is required with any of these methods, since only high frequency currents pass through the microphone. The leads connecting the microphone to the aerial circuit must be short to avoid stray capacities. The method is therefore quite unsuitable for distant control of the transmitter, an arrangement that is often useful if it is desired to transmit music, etc.

6. Modulation of the Grid, Anode or H.T. Circuits.

A similar type of control unit can be used for telephone modulation by any methods in which the modulating impulses are applied to the grid, anode, or H.T. supply circuits

of the valve. In these cases the microphone is not traversed by high frequency currents, but is connected up into a closed circuit fed with direct current from one or two cells. The general arrangement of the modulating unit for grid circuit modulation is indicated

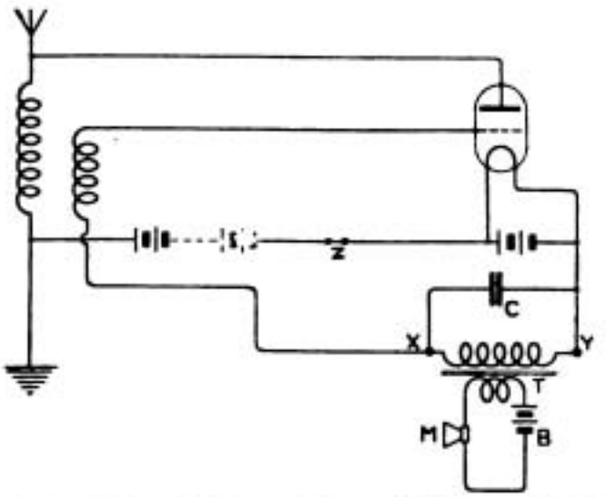


Fig. 6. Valve Oscillator with modulation unit X Y *applied to the grid circuit.*

in Fig. 6. It should be noted that the apparatus included between the points marked X and Y in this diagram constitutes the modulator unit. The condenser C is required shunted across this unit to bypass the high frequency components of the currents flowing in the circuits. It is not required when the modulator unit is joined in the H.T. supply circuit of the valve, such as indicated by the point marked Z in this figure, the unit X Y being inserted in the supply circuit at Z, and the grid circuit of the valve closed again by connecting together the points X Y after removing the modulator unit.

The condenser is required in all other cases not only to protect the windings of the microphone transformer from the effects of the high frequency p.d.'s, but also to enable the valve to set up the oscillations. Without the bypass condenser the impedance of the transformer windings would stop the oscillations.

The circuit shown in Fig. 6 is the one with inductive reaction coupling between the valve circuits, using two separate coils for this purpose, but the same principle of applying the modulator unit holds good for other arrangements of the oscillation circuit. For instance, the modulation unit comprised by the apparatus between the points X and Y in Fig. 6 might be connected in series with the oscillation valve circuits at any one of the points marked respectively X, Y and Z in Fig. 2, these three places corresponding to grid circuit, anode circuit and H.T. supply circuit modulation. The bypass condenser would be required for the first two of these, but not for the third, as has already been pointed out.

In all these and similar cases the microphone transformer must be designed to be suitable to the circuit in which it is connected. Given a suitable design for this transformer, and for the remainder of the circuit constants, grid circuit modulation may, in many cases, be practically as effective as the more favoured choke control method with a separate valve, while its advantages in the way of requiring less apparatus may, in many cases, be very important. The speech distortion with which it is often credited, is largely a matter of bad design. Evidently the transformer must deliver to the circuit a higher E.M.F. from its secondary winding when it is connected in the anode circuit than is required when it is joined in the grid circuit of the valve. This point will be further considered later in the paper.

7. Quiescent Aerial Transmission.

In the classification of the modulation methods given in Section 2 of the Paper the "Quiescent Aerial" method of modulation was classified under the methods of modulation by control of the H.T. supply circuit. It differs, however, from the methods discussed in the last section in that no separate source of H.T. supply is used, but the necessary high voltage for the oscillating valve is generated by the secondary winding of the microphone transformer by reason of the varying currents traversing its primary when the microphone is subjected to the action of sound waves. The method is quite a good one for tonic-train transmission.

The usual circuit arrangement is indicated

in Fig. 7. Although it is possible to transmit speech with this arrangement there is usually much distortion, due primarily to the lag in the building up of the oscillations after they have been stopped by a large negative voltage impressed upon the plate of the oscillating valve from the microphone transformer. There appears also to be a species of "threshold" value for the plate voltage below which no oscillations are established. The output of oscillatory energy is therefore no longer proportional to the modulating

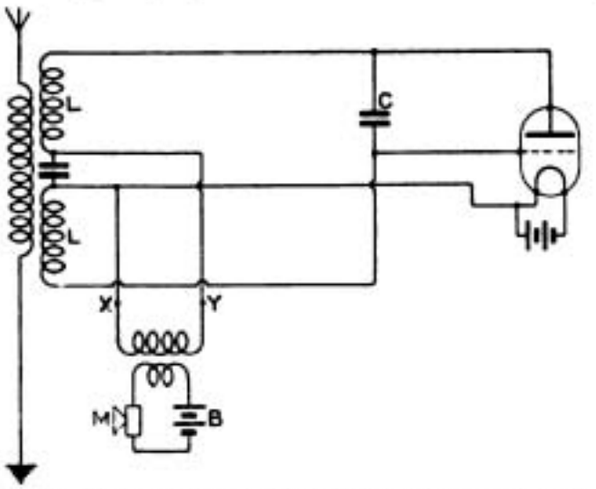


Fig. 7. Radiotelephone Transmitter using "quiescent aerial" modulation.

(NOTE.—The transformer between M and XY should be shown with an iron core as in the other diagrams).

currents traversing the microphone, so that distortion of the speech occurs. From the point of view both of economy of power, and of lessening the interference with other stations, the method should be good, but, unfortunately, it does not work well in practice. It should also have advantages from the point of view of obtaining duplex, or two-way, telephonic working, but it seems likely that even for this purpose it is not practically workable.

8. Microphone Transformers.

As has already been indicated the microphone transformer must be designed in a manner suitable to the circuit in which it is to be used. Thus, for instance, if the voltage factor of the oscillation valve is, say, 10, the microphone transformer will be required to yield approximately ten times the voltage on its secondary winding when it is required for anode circuit, or H.T. circuit modulation, as when it is used in the grid circuit. It is not advisable to go to the other extreme, and design it to yield as large a secondary voltage as possible, or else distortion of the speech will again arise due to the voltage variations impressed upon the valve being too great, with a consequent departure from the linear part of the valve characteristic.

It is possible in practice to employ a very wide variation in the type of transformer used, from a small spark or ignition coil to a properly designed transformer, but I should like to emphasise the utility of always aiming at the latter condition as likely to lead to more satisfactory results.

A transformer that will give fairly good results with many of the circuit arrangements that have been referred to above, may be built up in the manner described below. It should be understood, however, that the dimensions given should not be assumed to be the best for all conditions, but to be in many respects a compromise so as to be suitable for more than one method of use.

Iron core, laminated. Thickness of laminations, about $\frac{1}{32}$ in. or less. Number of laminations, about 16, or sufficient to build up a core thickness of $\frac{1}{2}$ in., if thinner sheets are used. Cross section of core, $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in., rectangular in shape, with a window of $1\frac{1}{4}$ in. $\times$ $\frac{3}{4}$ in. Outside dimensions of core, $1\frac{3}{4}$ in. $\times$ $2\frac{1}{4}$ in. Two sizes of core plates may be cut with the dimensions indicated in Fig. 8. One piece of each size should be used for each layer, and in the number of laminations given above it is to be understood as being the number of pairs of such plates. The relative positions of the laminations should be reversed in alternate layers, as indicated in Fig. 9, so that the junctions in successive layers do not come immediately over one another. Clamping screws should be inserted through the four corners when the core has been built up and the bobbin and windings inserted in place. A bobbin should be fitted on to one limb of the core, and may be built up of bakelite sheet, $\frac{1}{8}$ in.

thick, four pieces being cut $\frac{5}{8}$ in. wide by $1\frac{3}{4}$ in. long and fitted together into the square hole in the flanges, so as to form a square tube into which the core laminations may be slipped. The flanges should be $1\frac{7}{8}$ in. square, with a square hole of $\frac{3}{4}$ in. side in the centre. The sides and flanges may be secured in place with

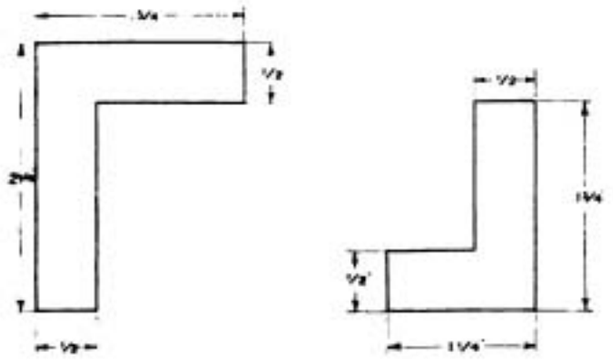


Fig. 8. Core plates for microphone transformer.

shellac, and may also be pinned lightly together as well if desired. The bobbin when completed should be wound with 300 turns of No. 22 S.W.G. cotton-covered wire for the primary, and then covered over with one or two layers of paper to separate the primary and secondary windings. The secondary consists of 6,000 turns of No. 44 S.W.G. silk-covered copper wire, and should nearly fill up the available space in the bobbin.

In the apparatus for the experimental demonstration referred to on page 137 below a "Wilson" 0·2 kW 100/2500 volt transformer was employed. This transformer has a voltage step-up of 25 : 1, instead of 20 : 1, as in the one described above, while it is also designed upon much more liberal lines. It is, however, quite a useful transformer for the purpose and it is possible to use it in many of the circuits shown.

In connection with the proper design of these transformers it should be noted in particular that the best windings to use depend very much upon the characteristics of the valves that are to be used with it. It is therefore only possible to indicate in a general way how these may be taken into account.

Considering the valve characteristic shown in Fig. 10, and assuming for the moment that the steady grid voltage is adjusted to the mid-point of the straight part of the characteristic, marked as X in the figure, then it will at once be evident that some at least of the effects of the speech will be lost if the representative point travels beyond Z and Y

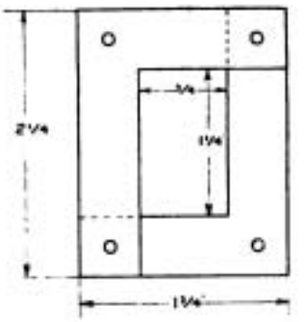


Fig. 9. Complete core for microphone transformer.

during the cycle of the speech current. The maximum voltage applied to the grid of the valve in grid control of the oscillator valve, or to the grid of the control valve in the "choke control" or similar methods (see below) should therefore not exceed the

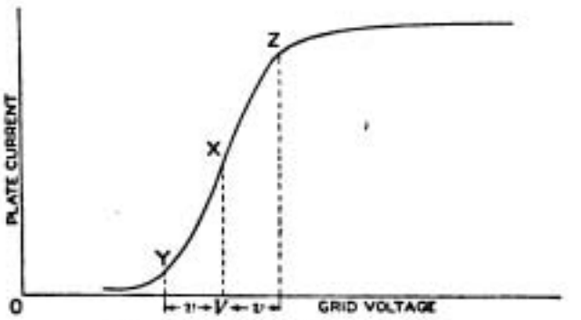


Fig. 10. Valve characteristic.

value v on either side of the normal voltage V. This value of v can hence be found at once if we plot out the characteristic of the valve to be used for the given conditions of anode voltage, filament current, etc. Assuming a sine curve of modulation, the effective or R.M.S. secondary voltage supplied from the secondary of the microphone transformer, in the case of modulation valve control, must not therefore exceed $0{\cdot}7v$. Hence, if T is the transformation ratio, or ratio of secondary turns to primary turns, the effective voltage applied to the primary must not exceed $0{\cdot}7v\ T = V_1$ say. This, how-

ever, neglects the effect of the grid current drawn from the secondary winding of the transformer when it is in use. This current although small, produces a by no means unimportant effect upon the operation of the transformer, as it means that a definite and no longer negligible power output from the transformer must be allowed for. The magnitude of this load current taken by the grid can be reduced by inserting a steady negative voltage in the grid circuit of the control valve. If k_3 is the slope of the grid current—grid voltage characteristic of the control valve, the effective load on the secondary winding may be represented by a resistance $R_g = 1/k_3$. If L is the inductance of the primary winding, and ω is 2π times the frequency, the equivalent impedance of the whole transformer reckoned on the primary side will be

$$Z = 1 \div \sqrt{[(T^2/R_g)^2 + (1/\omega L)^2]}$$

If I is the effective current flowing through the primary winding, the effective voltage across the transformer will be IZ, and this we have already seen must not exceed $0{\cdot}7v/T$. Equating these two we have an expression from which a value for T can be worked out, if we know the effective inductance of the primary winding and also the effective value of the alternating component I of the microphone current.

The problem of the design of these transformers is very similar to that encountered in designing intervalve transformers for low frequency amplifiers, or note magnifiers. Those interested may be referred to an interesting Paper by Mr. Catterson-Smith on this subject. (*Radio Review*, 1, pp. 473-480, July, 1920.) The frequency to be taken in such calculations should be the mean frequency of speech currents, *viz.*, 800 per second, giving a value of ω close to 5,000. The value of v used should, however, be on the small side, otherwise distortion may occur at the higher frequencies, as the transformer would then offer a higher effective impedance.

It may also be pointed out that it is possible to dispense entirely with the microphone transformer and to substitute for it either a choke or a resistance included in the grid circuit of the control valve. Neither of these arrangements, however, is as efficient as a properly designed transformer, but the former in particular may be of interest as involving the use of less additional apparatus.

The latter paragraphs in this section have been written primarily with the case of a separate control valve in view (see Section 9 of Paper), but with slight modification they may be applied to the other cases as well.

When the microphone modulation is applied in the anode or high tension circuits of the valve, the voltage step up that will be necessary will be greater by the amount of the voltage magnification factor of the valve. If this latter is about 10, then approximately ten times the number of turns will be required on the secondary winding than would be required for the case already considered. The exact ratio required in any given case can be determined from a knowledge of the magnification factor of the valve—a quantity that can be determined fairly easily by well-known experimental methods.

9. Valve Modulation.

The most usual arrangement of an extra valve for modulation purposes is that generally known as the "Choke Control" method. Briefly it consists in connecting the plate circuit of the extra valve in parallel with the plate circuit of the oscillating valve, and feeding both from a common H.T. supply, with a choke coil in series to maintain the approximate constancy of the total supply current, as indicated in Fig. 11. The grid circuit of the extra or modulating valve V_1 includes the secondary winding of the transformer T of the modulation unit. The chief points connected with the design of these transformers have been mentioned in the last section. The variations in the current drawn by the modulating valve, under the influence of the varying voltages impressed upon its grid by the modulating microphone, cause corresponding variations in the output from the oscillating valve, since the total

power supply is maintained approximately constant. A further effect arises from the back electromotive force of the choke coil which brings about a considerable increase in the voltage applied to the oscillator tube,

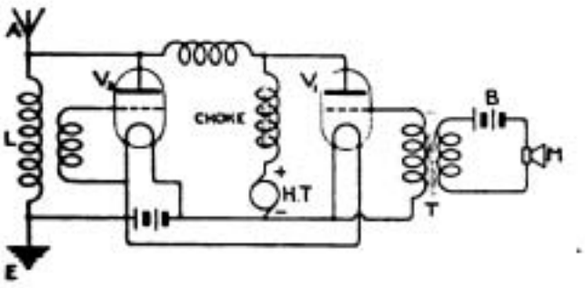


Fig. 11. Arrangement of transmitter for "choke control" or "constant current" modulation. Inductive coupling between the grid and anode circuits is shown and direct coupling to the aerial circuit, but the remainder of the circuit can be applied to any other arrangement of transmitting valve. V_1 = modulator valve, V_2 = oscillator valve.

when the grid of the control valve goes negative and the valve requires less current. This E.M.F. adding to the steady impressed voltage causes the maximum output of the set to increase at times to considerably more than the normal output of the one tube working at the normal voltage—in other words, the modulation in this case is not merely a modulation below the normal output line, but is on both sides of it, both above and below.

For this effect to be utilised to the fullest advantage the oscillator tube must be worked at such an anode voltage that it is not by any means saturated, but it must be capable of yielding an increased output when the voltage is raised.

The "choke-control" method has been employed in the R.A.F. telephone sets as well as in many American commercial instruments. The TWA Mark II telephone transmitter is a good example of a low power R.A.F. apparatus using this method of modulation. Such an instrument, using two R valves, forms a good amateur radio-telephone transmitter.*

As regards the best value of the choke to be used in this method of control, it is desirable that it have as large an inductance as practicable, consistent with its resistance being not unduly increased, as otherwise the necessary H.T. voltage will be higher on account of the voltage drop in the choke windings. It has, however, been shown that provided the impedance of the choke for the *lowest* speech frequency (say, 200 ~) is at least twice the combined internal resistances of the oscillator and modulator valves in parallel, little increase will be gained in the effectiveness of the modulation by further increase of the size of the choke coil. Some useful experimental work may be effected in investigating the properties of different arrangements of choke coil. As a guide for preliminary work, the following dimensions will usually prove useful: Iron core of the same dimensions as described for the microphone transformer, in Section 8. Bobbin wound with 2,000 turns of No. 33 S.W.G. S.C.C. copper wire, with a piece of thin paper to separate each layer from the next. The weight of wire required for the above winding will be slightly over a quarter of a pound. Fig. 12 shows the arrangement. The whole may be mounted on a suitable base with terminals, if desired.

It is possible to effect a further simplification of the apparatus by replacing this choke coil by a simple resistance, although there will be at the same time a loss in the efficiency of working. The arrangement may, however, be useful where light weight, cheapness and portability are important factors. An ordinary pattern of anode resistance rod of about 50,000 ohms may be employed. The voltage of the H.T. supply must, however, at the same time be increased by the voltage drop in the added resistance. This amount will, of course, be given by the resistance multiplied by the total anode current flowing through it and drawn by the two valves in parallel.

* One of these instruments, kindly lent by Messrs. Burnham & Co., was shown in operation at the meeting.

In the demonstration apparatus (see below) an aircore choke was used wound with No. 36 S.W.G. wire, which acts partly as a choke and partly as a resistance.

It may also be of interest to point out another arrangement that may be employed to replace the more usual choke control apparatus. This arrangement I will term the "saturated valve" control. It is based upon some observations contained in a recent

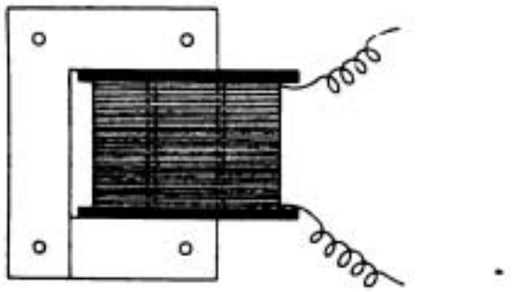


Fig. 12. Choke coil for choke-control modulation.

paper, read before the Wireless Section of the Institution of Electrical Engineers, by Dr. W. H. Eccles and Miss W. A. Leyshon, with reference to the use of valves IN SERIES.* It is well known that if the voltage applied between the plate and filament of a valve is steadily increased there comes a time when the anode current no longer rises with further increase of anode voltage. When this occurs the valve is said to be saturated. The voltage on the anode at which saturation sets in is determined by the temperature of the valve filament, and is lowered by a decrease of filament temperature. In other words, by suitably controlling the filament current we can bring about saturation of the valve for almost any value of the applied anode voltage.

When a valve is in this condition the current flowing through it is maintained constant, and is independent of changes in the resistance of the circuit in which it is included (within reasonable limits, of course). It therefore seems likely that it should be possible to use such a saturated valve to replace the choke coil in the "choke control" method, since the main function of the choke is to maintain approximate constancy of the total flow of anode current to the two valves. It would also seem likely that such an arrangement would be somewhat more efficient in this respect than the usual choke, and that it might therefore give somewhat better speech. Experiments which I have recently carried out confirm this surmise, and have shown that such an arrangement will speak very clearly. It has, of course, one disadvantage, viz., that the value of the total voltage applied to the combined anode circuits must be increased by the voltage drop in the extra series valve, when adjusted to its saturation condition, just as the total H.T. voltage has to be increased if the choke coil is replaced by a simple resistance, as has already been pointed out. In many cases, however, this is not such a serious disadvantage as might at first sight be supposed, since it is impracticable to use H.T. batteries for telephone transmitting circuits in most cases, on account of their initial cost and maintenance, whereas if a special high voltage dynamo is used it is no difficult matter to wind it for a somewhat higher initial voltage. In many cases, too, there would be a saving in the total weight of the apparatus, since a single valve with its filament resistance will often weigh less than the more usual choke coil. Of course, it must not be forgotten that the extra series valve requires to have its filament heated, which fact requires the employment either of another set of accumulators or, if alternating current is used for lighting the filaments, a special transformer is necessary with an extra and well insulated low voltage winding.

In experimenting with this arrangement it is found that the quality and intensity of the resultant speech transmitted by the apparatus depends very greatly upon the exact adjustment of the temperature of the filament of the series valve, showing that the setting for the correct saturation adjustment is fairly critical. When starting with the series valve at full brilliance the speech transmission is poor, since the valve is acting merely as a low resistance in series with the main oscillator and control valves. As the filament current is reduced the intensity of the speech increases up to a maximum, and then falls off again, and finally ceases altogether when the valve stops oscil-

* See *Radio Review*, 2, pp. 169-170, April, 1921.

lating due to the decrease of its anode voltage brought about by the increase in the internal resistance of the series valve.

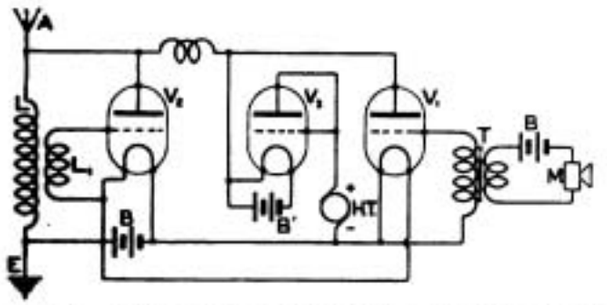


Fig. 13. Arrangement of transmitter for "saturated valve" control. V_1 = modulator valve, V_2 = oscillator valve, V_3 = special series valve (saturated).

It should, perhaps, be pointed out that it is evidently not necessary to employ an ordinary three-electrode valve for the series tube, but merely a two-electrode one, or diode, as it is also called. In many cases, however, it is convenient to use an ordinary three-electrode pattern, and to connect the grid and plate together to convert it into a two-electrode tube. It is often desirable to connect the grid and plate together in lieu of connecting the grid to the filament as is more usual when using a three-electrode tube as an ordinary two-electrode rectifier. The reason for this change is that by so doing the internal resistance of the tube is decreased owing to the proximity of the grid to the filament, so that a smaller increase of H.T. voltage is required. The arrangement is indicated in Fig. 13.

It may also be pointed out that it is possible to dispense with the third valve used as the control valve in this arrangement, and when the valve used in series with the H.T. supply to the main oscillation valve is a three-electrode one instead of a two-electrode one which is all that is necessary for the above described arrangement, the modulation impulses can be applied to the grid of the series valve. By a proper adjustment of the filament temperatures of the two valves in series it becomes possible to so arrange matters that a small applied modulating P.D. on the grid of the series valve brings about a large readjustment in the relative potential drops on the two valves. The application of a somewhat similar idea for amplification purposes is referred to in the above-mentioned paper by Dr. Eccles and Miss Leyshon, and it is there shown that a small change in the conditions of operation of one of the valves may bring about such a large change in their relative shares in the available H.T. voltage.

Other modifications of the idea are also possible, but will not be described here more in detail.

Another way in which the modulating valve may be applied to control the output of a C.W. transmitter is that known as the "Shunt" Control of the aerial circuit. This method is more especially useful for higher powered apparatus, but can, nevertheless, also be employed in connection with 10 watt sets. In reality the method is closely analogous to the one considered first of all, viz., direct modulation of the aerial circuit by means of a microphone of variable resistance connected in series with it. The valve being essentially a high resistance, and being a voltage rather than a current operated device, is connected in shunt to the aerial instead of in series. The connection scheme is indicated in Fig. 14, and should be self-explanatory. Fuller modulation can be obtained by the use of two valves instead of one, but it is not necessary to consider these

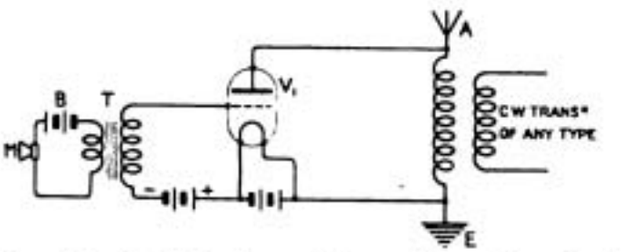


Fig. 14. Radiotelephone Transmitter with shunt control of aerial circuit. V_1 = modulator valve.

arrangements more in detail for the purposes of this Paper.

A demonstration was then given of the different methods of modulation that are described in the Paper, using a special control panel for this purpose. The panel is shown in Fig. 15, and has mounted on it the following apparatus:—

Divided inductance for main oscillation circuit (which is arranged on the lines of Fig. 2).

Fixed condenser of 0·0002 mfd. capacity connected across above inductance.
Blocking condenser between two halves of above coil.
Valve (V.24) for maintaining oscillations.
Microphone transformer ("Wilson" 0·2 kW transformer).
Shunt condenser with switch for connecting it across secondary of the microphone transformer.
Modulating valve (V.24).
Choke coil for connection in series with H.T. supply for "choke-control" modulation.
Valve (V.24) with filament regulator and switches to connect it in series with the H.T. supply in place of the choke, for showing the "saturated-valve" method of control.
Filament regulators, switches, change-over plugs, etc., for obtaining the circuit arrangements of the various controls.

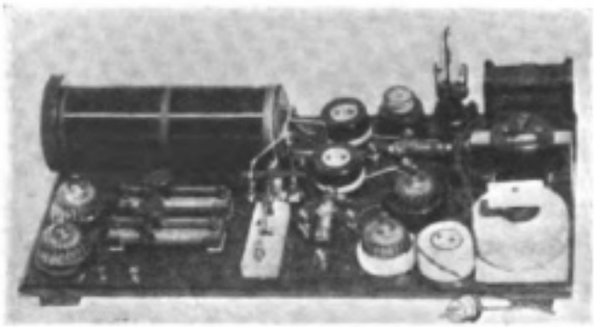


Fig. 15. Control Panel used to demonstrate the various methods of transmitter modulation.

The following methods of modulation were shown in operation by means of this control board, the signals radiated from the oscillation circuit being picked up by means of a valve detector and four-valve note magnifier provided with a loud-speaking telephone and arranged near the transmitting panel :—

Grid circuit modulation, Anode ,, ,, , H.T. supply ,, ,, } H.T. supply in series with anode circuit of valve.
Grid circuit modulation, Anode ,, ,, , H.T. supply ,, ,, } H.T. supply with series choke in shunt to the valve.
Quiescent aerial transmission.
Choke-control modulation.
Shunt control of the oscillation circuit.
Saturated-valve control.

The circuit diagram of the control panel is given in Fig. 16. L L′ is the divided inductance forming, with the condenser C_2, the main oscillation circuit excited by the oscillator valve V_2. C_1 is the blocking condenser between the two halves of the coil L L′ V_1 is the modulator valve, which is connected in parallel with the oscillator valve V_2 when the switch Sw_3 is closed. The switch Sw_6 serves to change the H.T. battery B_2 from the series connection to the shunt connection through the choke coil, shown on the right-hand side. The modulator unit comprises the microphone transformer T, the microphone M and battery B being external to the apparatus. The secondary of the microphone transformer is shunted by the condenser C when the switch Sw_5 is closed and it is also connected to the plug P, which may be inserted into any one of the sockets, S_1, S_2, S_3, S_4. R_1, R_2 are filament regulators for the oscillator and modulator valves respectively; while the valve V_3, having its grid and anode connected together and to the additional anode battery B_2', acts as the saturated valve in series with the H.T. circuit when the switch Sw_4 is closed and Sw_6 is opened.

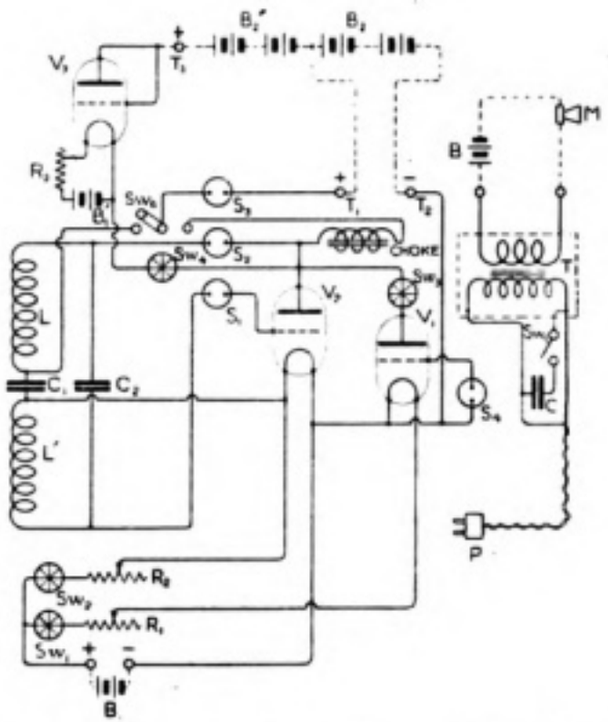


Fig. 16. Connection scheme for apparatus shown in Fig. 15.

Good modulation was obtained with all the arrangements shown, but some were noticeably better than others.

In particular the quiescent aerial method showed speech distortion, with undue emphasis of the loud sounds of the speech. The effect of the series saturated valve was shown by commencing with the valve at full brilliance when the speech picked up by the receiver was of feeble intensity. As the valve filament was gradually dimmed the intensity of the speech increased and became suddenly quite loud for a particular filament brilliancy. A further dimming of the filament caused a diminution in the intensity of the speech owing to the limitation of the emission of the dimmed filament of the saturated valve cutting off too much of the energy from the oscillator valve.

10. Sources of H.T. Supply for Telephony.

Undoubtedly the steadiest source of H.T. for telephonic transmission is a battery of small accumulator cells, but such a battery is rather a nuisance to equip and maintain. A battery of small dry cells is convenient, but their life is short unless fairly large cells are employed, which, however, would render their cost almost prohibitive.

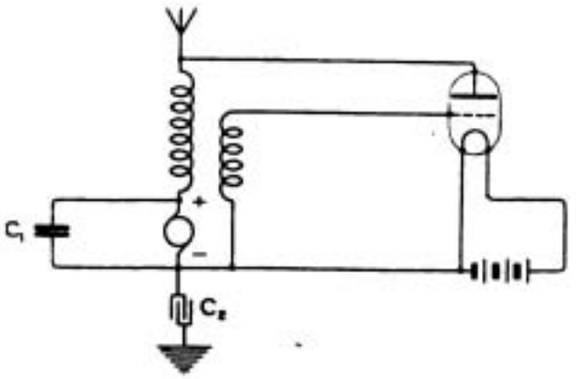


Fig. 17. Arrangement of valve transmitter using supply mains as H.T. when negative of supply mains is earthed.

The power supply mains, if of direct current, may be employed, but it is often useful to have a higher voltage than is frequently available from this source. It is, however, possible to obtain quite a good output from ordinary types of valves, using power circuits of about 220 volts D.C., while the life of the tubes is usually lengthened by the use of these voltages instead of the higher ones. The circuits shown in Figs. 17 and 18 may be noted as available for the two cases when the negative or the positive pole of the supply is earthed. Both of these cases may be met with in the usual three-wire distribution networks, and the writer has often been asked how it is possible to arrange matters when the positive is earthed—the earthed negative giving a more obvious arrangement of circuit.

When the positive pole of the mains is earthed the adaptation of the choke control method is not so obvious as when the negative is earthed. A suggested arrangement is indicated in Fig. 19, in which L is the series choke. This choke may, of course, be replaced by a saturated valve for that alternative control method. The blocking condenser shown in the earth lead in this figure, and in Figs. 17 and 18, is to prevent the circulation of currents between the earth connections at the power and radio stations.

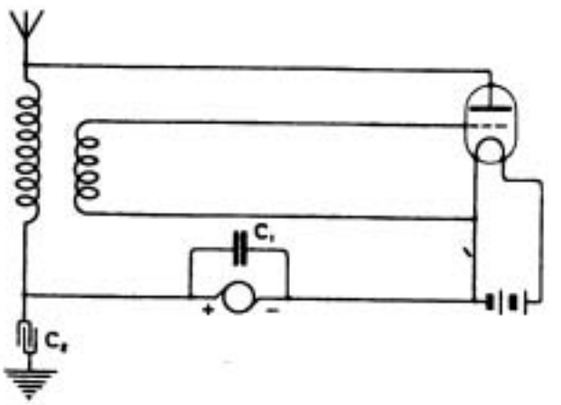


Fig. 18. Arrangement of valve transmitter using supply mains as H.T. when positive of supply mains is earthed.

Failing any of the above we must employ either a motor generator of the requisite output voltage, or else rectify a high voltage alternating current obtained by a step up transformer from a lower voltage A.C. supply. The latter alternative involves additional troubles in smoothing out the ripples of the rectified current, so as to avoid the undesirable hum that would otherwise be heard at the receiving station.

Such smoothing requires the use of a shunt condenser of the requisite capacity—say, of at least 2 mfd. in the case of the voltages customarily used for amateur work, *i.e.*, up to about 600. This condenser should be used in conjunction with two or more smoothing chokes connected in series with the circuit, and a second similar shunt smoothing condenser. The condensers must be built for the voltage on which they are to be used, and may conveniently be of the mica dielectric type.

Suitable smoothing choke coils for use in series with the supply circuit for experimental work may be built as follows :

Core of soft iron wire, built up to form a bundle $\frac{5}{8}$ in. diameter × $3\frac{1}{2}$ in. long. This

should be fitted with a bobbin having flanges about 5 in. diameter, and may be wound to fill the bobbin with No. 26 d.c.c. copper wire.

Alternatively, the secondary winding of an ignition coil or small induction coil may be employed.

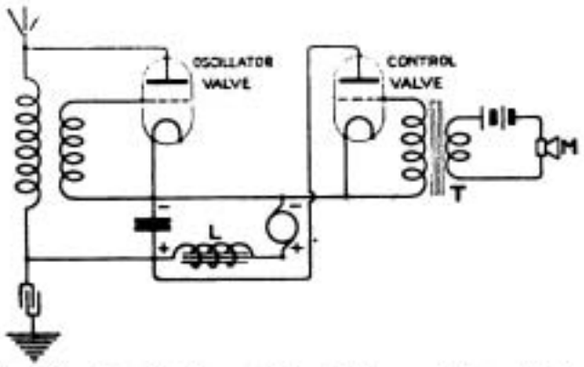


Fig. 19. Application of the choke control method of modulation to the circuit of Fig. 18 using supply mains with positive terminal earthed.

It may also be noted that it is possible here to make a further use of the properties of the saturated valve that were referred to in connection with the modulation of the transmitter output by the modification of the choke control method, there referred to as the "saturated valve" method of modulation. Since when the valve is saturated, the current flowing through it remains constant when the applied voltage in its anode circuit is varied over fairly wide limits, it follows that it will similarly remain constant with respect to smaller variations of voltage, such as comprise the ripples of a rectified current, or the commutator ripples normally existent in the voltage of D.C. supply mains.

To effect a smoothing in this way it suffices to connect a valve in series with the H.T. supply circuit and to arrange for it to be saturated just as was done in connection with the modified "choke control" method described above. When the proper adjustments are obtained it will be found that the voltage ripples have been smoothed out to a considerable extent.

A very similar effect may be obtained by using a three-electrode valve of the usual type for the series valve, and instead of connecting the grid to the anode, connecting it to a suitable battery to maintain an appropriate positive potential on the valve grid. The effect of this is to saturate the valve as regards changes of voltage applied in the anode circuit, just as if the filament has been dimmed, but with the advantage that the total emission is not at the same time reduced. The full advantages of the method are thus obtained without the need for an excessive voltage drop in the series valve, or a restriction of the total H.T. current that it is possible to draw through the valve.

It may also be mentioned in parentheses that the use of a positive voltage applied to the grid of the series valve could also be used for the saturated valve modulation method described above in lieu of the dimming of the filament that should otherwise be resorted to to secure the necessary saturation conditions in the series valve.

> A demonstration was given of this effect by means of such a valve connected in series with the plate circuit supply to a low frequency amplifier, on the output side of which a loud-speaking telephone was connected. By dimming the filament of the series valve, or increasing the positive voltage applied to its grid the ripple on the supply circuit was almost completely eliminated, while in the latter case retaining the full value of the emission current.

It is possible to derive the necessary H.T. for the valve transmitter from a step up transformer run off a low voltage battery with a suitable interrupter in the primary circuit, as employed in an ordinary induction coil. Such an apparatus has been manufactured commercially by the de Forest Co., and has been called by them a "Buzzer Radiophone." It is evidently suitable only for the sort of power outputs that are available for our use, and could not be employed for high power work in the same form. I, personally, have not tested such an apparatus, but given proper smoothing circuits, it should be quite feasible, and it would be interesting to have details of the results obtainable from anyone who has used such a set.

11. Duplex Working.

One of the greatest problems still outstanding in the realm of radiotelephony

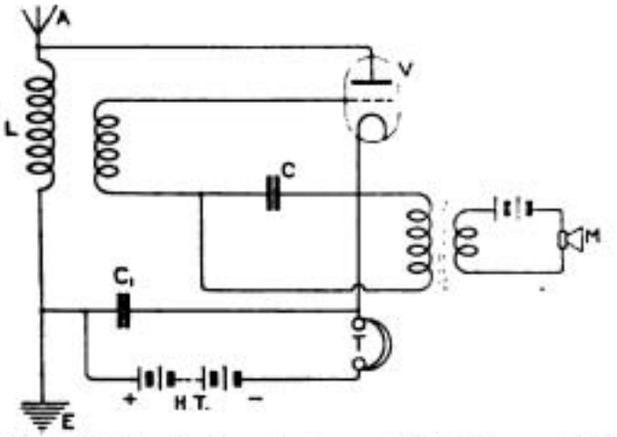


Fig. 20. A simple duplex radiotelephone. M *is the transmitting microphone;* T = *receiving telephones.*

both in the commercial and in the experimental field, is that of duplex working. A simple circuit that may be used for this purpose is shown in Fig 20, but it should be noted that the valve is oscillating for receiving—a bad arrangement to secure good speech. It is, however, possible to carry on a conversation in both directions over a short range by such a method, although the articulation leaves much to be desired. The use of an oscillating receiver also causes disturbance to others attempting to receive signals in the vicinity. A similar, but slightly better, arrangement is shown in Fig. 21.

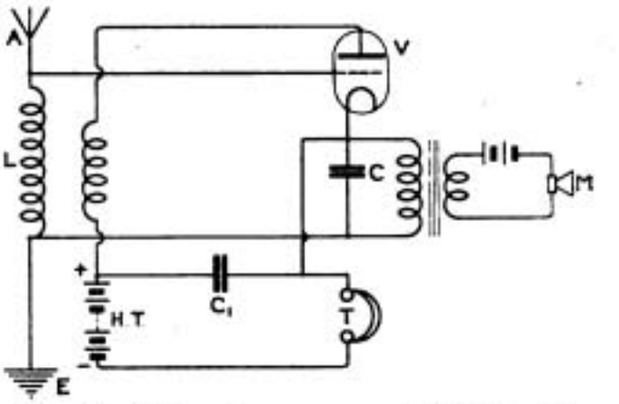


Fig. 21. Alternative arrangement of Fig. 20.

As regards more complicated methods, mention may be made of the use of a balancing aerial, a method which is about the most successful of any at present devised and available for use in a radio station of limited size. A circuit arrangement that has given good results with low power sets is shown in Fig. 22. This at first glance seems a little complicated, but closer inspection reveals it merely as a transmitter with modulator valve on the left, and a receiver on the right, coupled together by the balancing coil L_1 L_2, which is tapped at its mid point. Equal currents flow through the two halves of this coil, so that the transmitter produces no resultant direct effect on the local receiver.*

* Some further details of a set of this type may be found in the *Radio Review*, 1, pp. 751-753, December, 1920.

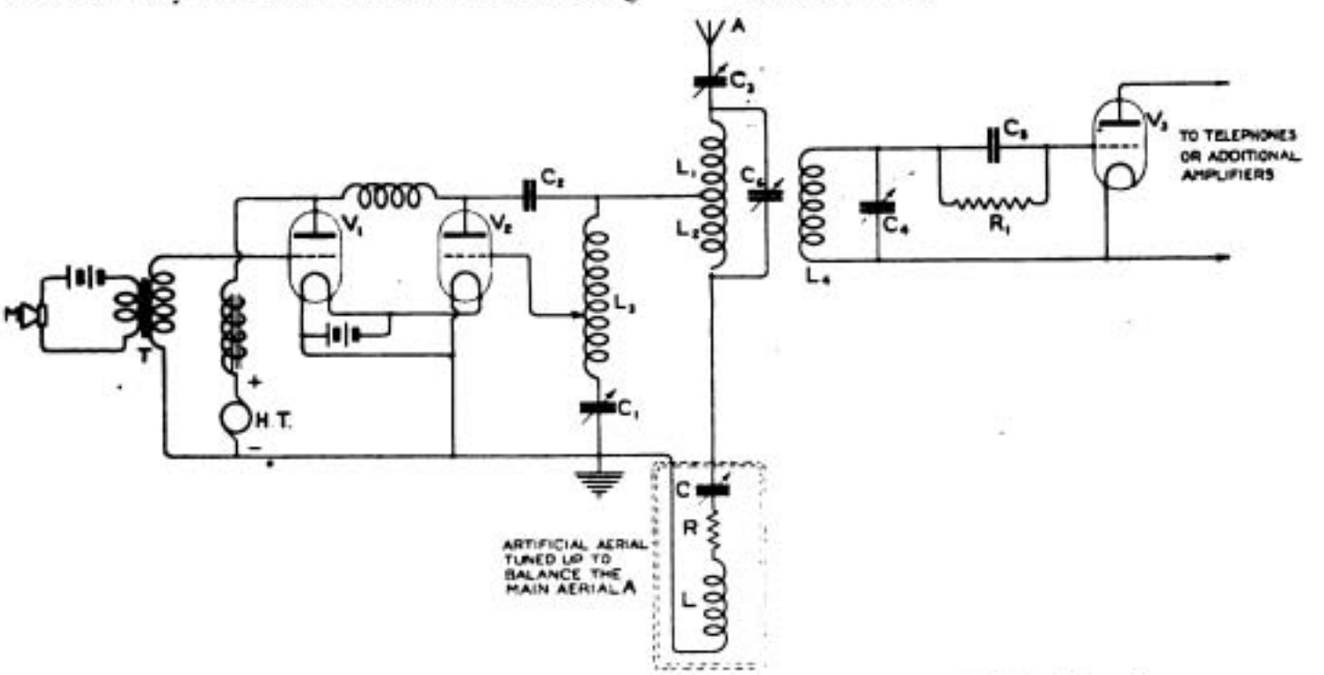


Fig. 22. A duplex radiotelephone for low power work with artificial aerial for balancing purposes.

An instrument made up on these lines is illustrated in Figs. 23 and 24.

The field of duplex working is, however, a very little explored one, particularly as regards the low-power conditions under which we work, and I hope that those of you who are in possession of transmitting licences for telephony will test out arrangements of this

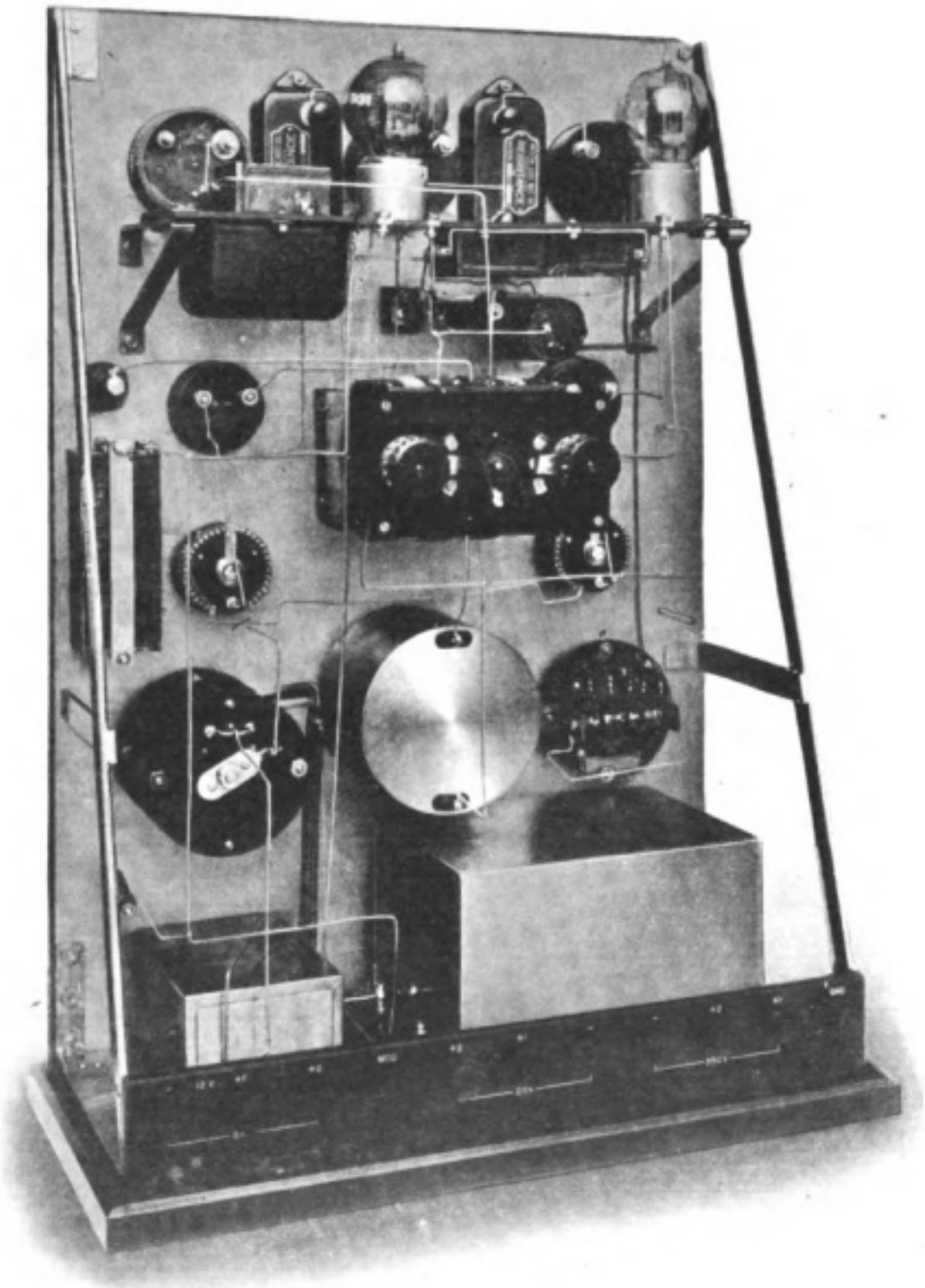


Fig. 23. Transmitting unit of apparatus shown in Fig. 22.

type, and so determine the best constants to be used for the various parts.

12. Receiving Apparatus.

So far I have hardly said a word with regard to receivers, as these do not involve any radical departure from those we are in the habit of using for other purposes, except in so far as duplex working is concerned. It is essential, however, if good articulation is desired, to avoid the use of too much low frequency amplification. High frequency amplification is always preferable when any amplification is necessary. The receiver also must be kept from oscillating, and no separate heterodyne is required. A small amount of reaction is not unduly harmful provided the set is kept from the oscillating condition. (One exception to this rule has been mentioned under Section 11, but it is not an arrangement to be encouraged.)

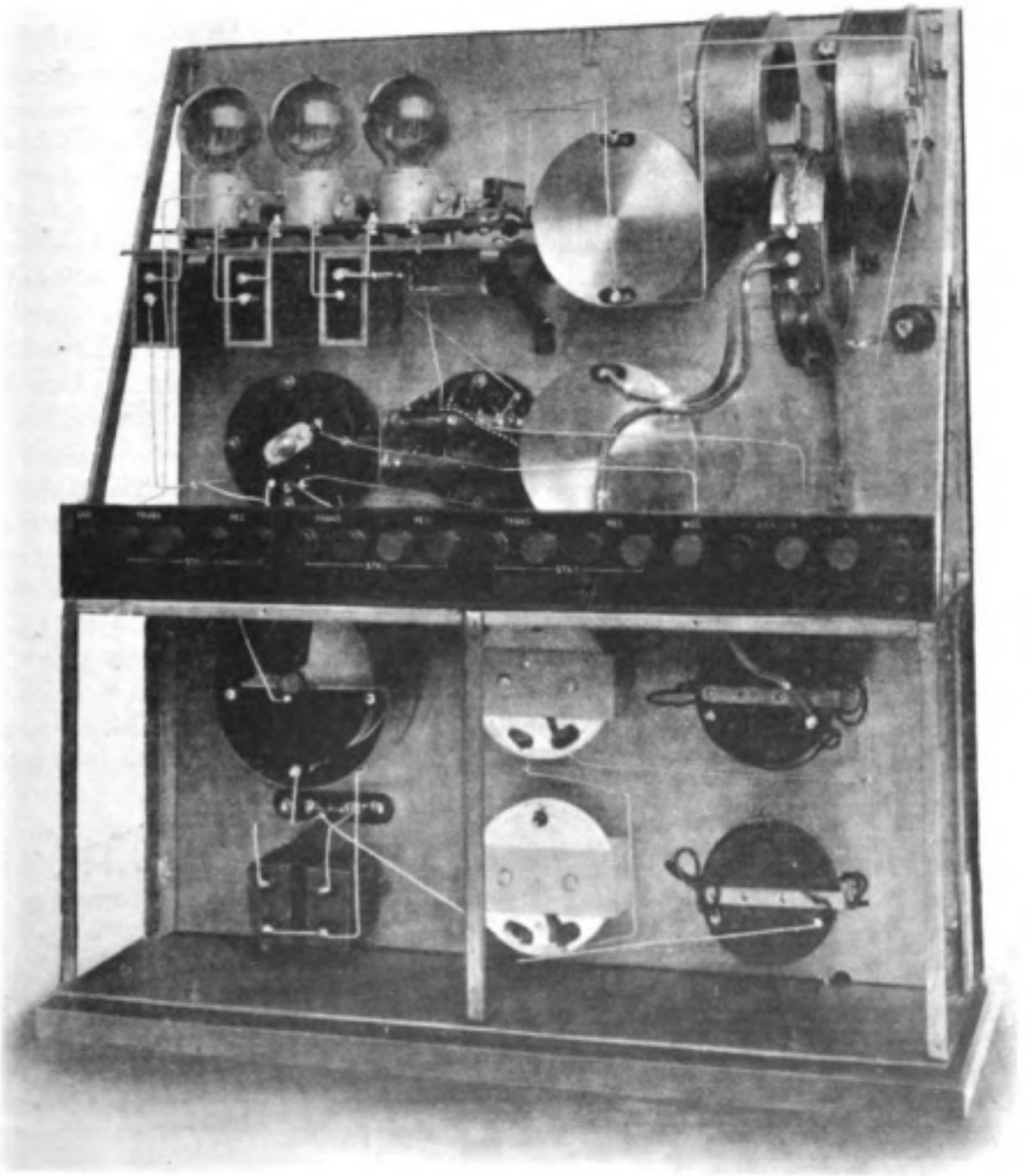


Fig. 24. Receiver unit of apparatus shown in Fig. 22. This unit also contains the artificial balancing aerial.

In conclusion, I would express a hope that I have been able to indicate a few useful points in connection with the experimental study of modulation methods for radio-telephone transmitters, and to point out a few directions in which useful work may be done in developing reliable low power sets for amateur use. I would also like to emphasise the necessity of not neglecting the efficiency of the whole set, and the desirability of striving to increase it as much as possible, as by this means not only will better communication be obtained, but less interference will be caused to other workers in the immediate neighbourhood. Accurate measurement of all quantities will help in this direction as compared with the cruder, but perhaps more prevalent, "trial and error" methods.

A SIMPLE GRID LEAK

A READER of *The Wireless World*, Mr. V. Auckers, of Sweden, has supplied us with a description of a very simply constructed grid leak, which gives good results. A specimen grid leak was forwarded with his letter and this gave satisfaction under test.

The method of construction is as follows. A piece of ordinary slate pencil, about four centimetres long and five millimetres thick, is obtained.

Two coatings of indian ink are then given to the ends as shown in A of the figure. Two strips of thin copper or brass, 5 millimetres wide are then bent round the slate pencil, over the indian ink, care being taken not to rub off the ink. The bands of metal should then be soldered up to fit tightly to the rod. Now measure off a distance of 1 centimetre in the middle of the rod and give two coatings of indian ink to the space on either side of this right up to the metal bands, as shown in B in the figure. The indian ink should be encouraged to run under the bands of metal to improve the contact. The next operation is to draw with a match a straight line of indian ink across the blank space in the middle of the rod, as shown in B in the figure. This line should be 2 millimetres thick. When all is dry two coatings of thin shellac should be given, avoiding the metal bands.

Now fit up the grid leak in position, and with a penknife remove a little of the "Line," bit by bit, till the resistance value is increased to exactly that which is required. The knife scratches should now be shellaced over again, and the grid leak is complete.

AUTOMATIC PRINTING OF SIGNALS RECEIVED BY WIRELESS

Above is a reproduction of some tape printed with the apparatus described in the article with the above title in the May 14th issue of *The Wireless World*.

A GOOD TWO-VALVE CIRCUIT FOR TELEPHONY

By G. P. KENDALL.

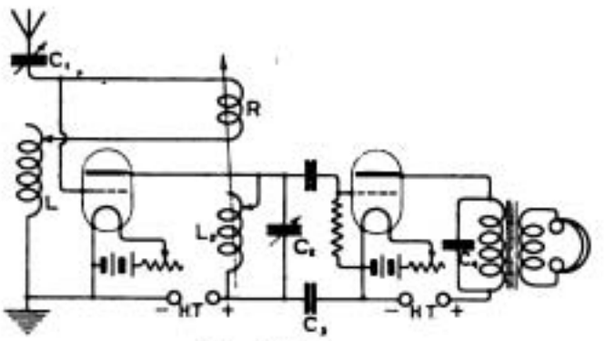
IN common with, I suppose, the majority of British amateurs it has long been my ambition to find a simple circuit giving good and reliable reception of the twice-weekly Hague concerts. With this end in view I have tried many circuits, always limiting myself to two valves. (Of course, it's easy enough to get them with four or five H.F. amplifiers, but I wanted a circuit suitable for the amateur of limited resources.) Until quite recently results were not such as to satisfy me. Always, it seemed, to get sufficiently loud signals (in Leeds) something had to be sacrificed, either clearness or selectivity (generally both !) if only two valves were to be used. Recently, however, I have devised a circuit that meets requirements very well. I propose to give a brief description of this circuit, for I think it will be new to many readers of *The Wireless World*.

The first valve (see diagram) functions as a high frequency amplifier, its anode circuit containing capacity and inductance, with reaction coupling into the aerial circuit. Across this tuned circuit is connected a leaky-condenser rectifier, the position of whose grid leak should be noted. The fixed condenser C_3 also is important ; it should be of fairly large capacity, though the actual value is not at all critical. (I find a telephone condenser quite O.K.) C_4, the telephone condenser is, I find, essential to good results.

Since I am addressing myself particularly to the newly-fledged amateur it may be helpful to give some suitable capacities for the various condensers :—

C_1 variable up to	0·001	mfd.
C_2 " "	0·0003	"
C_3 fixed	0·001 to 0·01	mfd.
C_4 "	0·001	"

To tune in PCGG proceed as follows :— First tune both circuits (*i.e.*, aerial and plate) to 600 metres, which wavelength is chosen because there are always plenty of spark signals to be heard, and it may consequently be readily found, especially if the aerial circuit adjustments have been previously ascertained with a simpler circuit. Tune carefully to one particular station, and then tighten the reaction coupling until the set just oscillates and spark signals come in hoarsely. Now proceed to add inductance to both circuits,



Circuit Diagram.

a little at a time, at each increase searching round with the condensers until the howl of PCGG's carrier wave is heard. While doing this it may be necessary to tighten the reaction a little, to maintain the circuit in oscillation. (To ascertain whether the set is oscillating, touch the aerial terminal with the finger—a sharp click should be heard.) The object of the preliminary tuning to 600 metres is to ensure that such an adjustment of reaction coupling is obtained as to make the set oscillate only when its two circuits are tuned to the same wavelength, thus providing an indication of correct tuning.

Having found the carrier wave, increase the amount of L_2 in circuit and correspondingly decrease C_2 as much as possible leaving only such an amount of capacity in circuit as will serve for final fine adjustments. Now tune to the silent point of the howl and weaken the reaction until oscillation just ceases. The concert will then be heard and will be much improved by final correction of the adjustments of C_1, C_2 and reaction coupling. These being somewhat critical it is a great advantage to have long handles to C_1 and the reaction coil. (C_2 is not so critical.) For the same reason, and others, it is desirable to have the coil R spherical and to rotate within a cylindrical L_2. This

arrangement is vastly superior to a cylindrical coil to slide within L_2.

As regards the possibility of causing interference by the preliminary adjustment of this circuit I do not think the risk is serious, because, unless the coupling is far too tight, the amount of energy radiated is much less than in the case of the much abused autodyne circuit. Besides, with a little practice, the adjustment is over in a few seconds and the circuit is then operated non-oscillating, when it is of course impossible to cause any trouble at all.

In conclusion, I may add that this circuit is, in my experience, almost ideal for spark and telephony, though not very good for C.W. Its great feature is its quietness and freedom from jamming. X's are noticeably reduced, and my great enemy—humming from A.C. mains—is cut out entirely. Indeed, when no signals are coming in and X's are moderate, the circuit sounds positively "dead."

If three valves can be used the addition of the third as a note magnifier gives the finest three-valve circuit I have ever tried for the types of signals mentioned above. With it on my 100 ft. single wire aerial Budapest (HB) spark set is readable all round a good-sized room.

[EDITOR'S NOTE: *The circuit described and shown in the diagram is of course merely a simple form of direct coupled autodyne receiver. It should therefore be used for as short a time as possible in the oscillating condition.*]

RADIOTELEINSCRIPTION

By AUSTIN RIU.

THE following is a description of apparatus designed and constructed by myself, which permits of the transmission of writing or drawings by wireless.

It is possible, with this apparatus, to transmit matter, written upon a surface measuring 9 by 12 cms, in about four minutes.

Referring to Fig. 1, it will be seen that the transmitter and receiver consist essentially of two cylinders revolving at a constant speed. In the apparatus here shown both the transmitting cylinder and the receiving cylinder are synchronised in speed, since they are rotated by the same electric motor, but for transmission over a distance it would be necessary to utilise some means of synchronising the two if driven by independent motors.

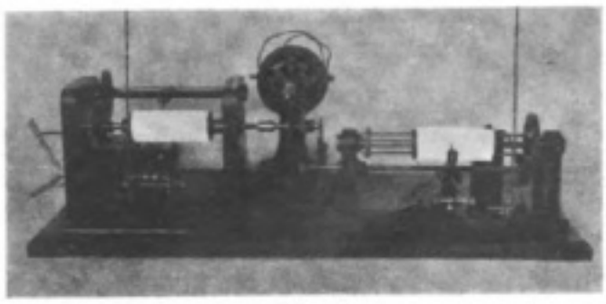


Fig 1.

The Complete Arrangement.

In preparing matter for transmission the procedure is as follows :—Referring to Fig. 2,

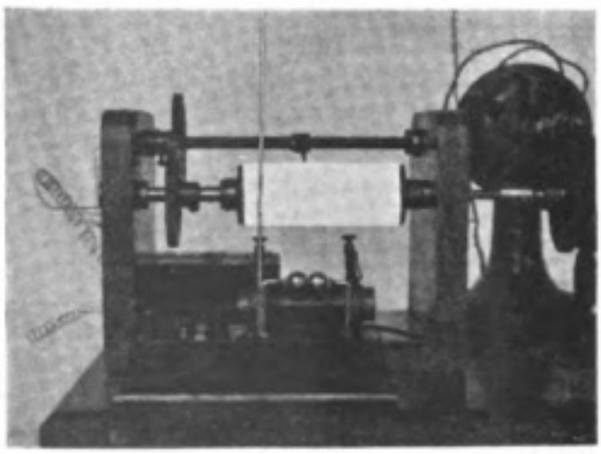


Fig. 2

A larger view of the Transmitter.

the cylinder is of copper and is written upon with insulating ink. Fig. 4 shows the diagram of the arrangement. The point P

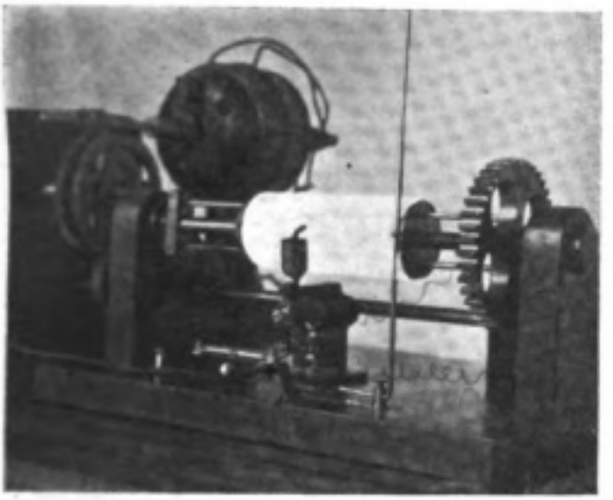


Fig. 3.
A larger view of the Recorder.

makes contact on the copper cylinder whilst the latter is rotated, but when the point P comes in contact with insulating ink on the

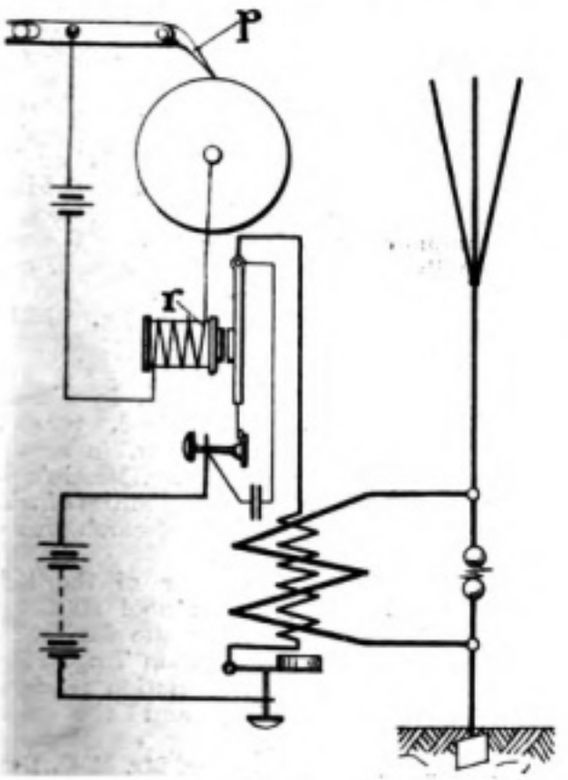


Fig. 4.
Circuit diagram of Transmitter.

cylinder the contact is broken and the electromagnet R releases the lever, which, in turn, closes the circuit, which operates the induction coil. By a suitable arrangement the point P is moved along as the cylinder revolves, and ultimately the whole surface of the cylinder is thus traversed by the point P, and wherever this point comes in contact with the inscription on the cylinder a signal is transmitted.

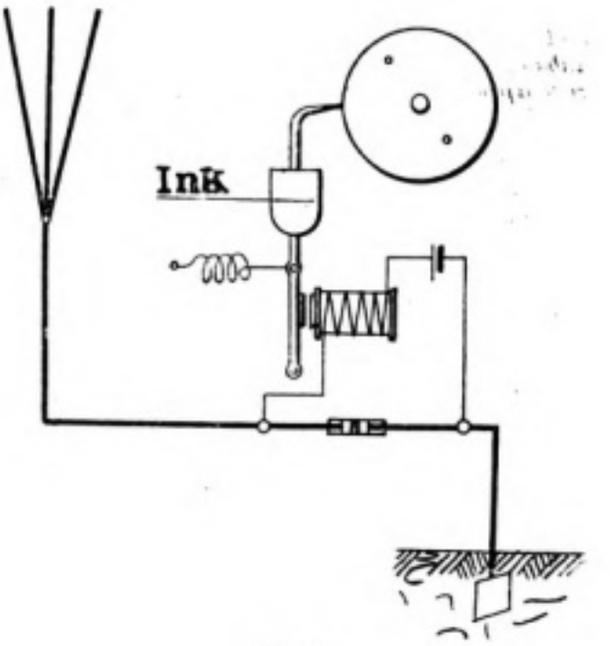


Fig. 5.
Circuit diagram of Recorder.

For reception, the receiver cylinder, shown in Fig. 3, is covered with white paper and the mode of operation is clearly indicated in the diagram given in Fig. 5.

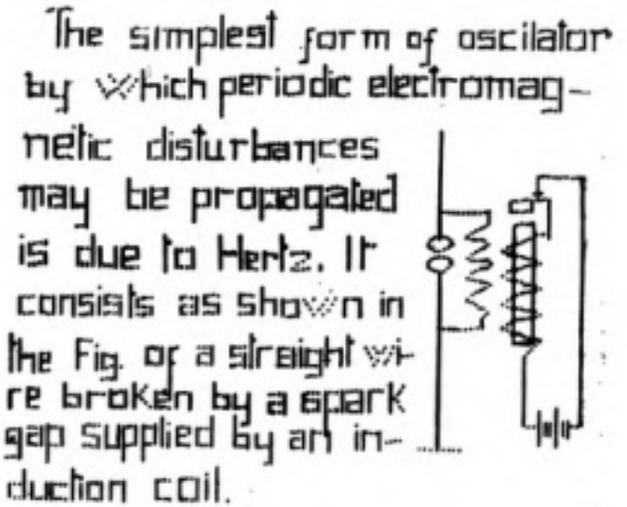


Fig. 6.
A specimen of Reception.

Fig. 6 shows a message and drawing exactly as it is reproduced by the receiver. This matter was transmitted in about five minutes.

EDITOR'S NOTE.—The arrangement described above is utilising a spark coil for transmission and a coherer for reception. It would be a comparatively simple matter to arrange other circuits, complying with the conditions of the P.M.G's. license, to produce the same or better results.

WIRELESS CLUB REPORTS

NOTE.—Under this heading the Editor will be pleased to give publication to reports of the meetings of Wireless Clubs and Societies. Such reports should be submitted without covering letter in the exact form in which they are to appear and as concise as possible, the Editor reserving the right to edit and curtail the reports if necessary. The Editor will be pleased to consider for publication papers of unusual or special interest read before Societies.

The Wireless Society of London.

A meeting of the Wireless Society of London was held on Monday, May 2nd, 1921, at the Royal Society of Arts, John Street, Adelphi, London. In the absence of the President, the chair was taken by Mr. A. A. Campbell Swinton (Past President) at 8 p.m.

After the minutes of the last meeting had been read by the Secretary, and confirmed by the meeting, the Chairman called upon Mr. Philip R. Coursey, B.Sc., to read his Paper entitled "Experimental Wireless Telephony." (For a full report see page 127 of this issue.) At the conclusion of the discussion (see next issue) which followed the reading of the paper, the Chairman announced that the following candidates whose names had been ballotted for by the meeting had been duly elected to membership of the Society:—MEMBERS: Albert Hart, Ronald L. Latcham, Owen F. Puckle, C. F. Elwell, James W. Ellam, Lieut. W. G. Fuge, William H. Griffith; and ASSOCIATE MEMBER: Maurice G. Puckle.

The meeting adjourned at 9.40 p.m.

North Middlesex Wireless Club.

(Affiliated with the Wireless Society of London.)

A meeting of the North Middlesex Wireless Club was held on April 20th at Shaftesbury Hall, Bowes Park, with Mr. C. W. Beckman in the chair. After the usual formal business, he called on Mr. A. J. Dixon to describe the Mark III long-wave tuner which he had brought for exhibition. Mr. Dixon had also provided himself with the internal works of another similar tuner, which he described as "junk," and this he took apart to show its construction. At the close of his lecture the instruments were connected to the Club's aerial, and signals were received.

At another meeting Mr. W. A. Saville gave an address on winding "Basket" and "Honeycomb" coils. Mr. Saville had provided himself with a supply of the formers he had made for his own use and some wire; also several coils in various stages of manufacture. Mr. Saville was listened to with great interest, and gave members a number of very useful tips on the construction of this class of inductance, which, he considers, is practically as efficient as the cylindrical type and much more convenient to handle. Certainly he gets very good results on his set, as several of the Club's members can testify.

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

Dartford and District Wireless Society.

(Affiliated with the Wireless Society of London.)

There was an excellent attendance of members and staff of Dartford Grammar School at the usual fortnightly meeting, held on Friday, May 6th, 1921, the occasion being a demonstration lecture by Captain W. R. H. Tingey, of Hatton Garden, London, on "Single Valve Reception."

Dr. Miskin presided, with Mr. J. R. Smith, A.M.I.E.E., Vice-President.

Captain Tingey dealt with all details in connection with the construction, erection and working of amateur receiving stations in a very excellent and instructive manner. The various questions put to him during the progress of his lecture proved that his remarks and detailed instructions were being very keenly followed by his audience. Some excellent signals were received on the instruments kindly brought by the lecturer, the 4-valve amplifier and loud speaker rendering the signals audible throughout the room, and adding further interest to the proceedings.

At the conclusion of the lecture Dr. Miskin, in proposing a vote of thanks to Captain Tingey, spoke of the educational value of the lecture and of the very excellent manner in which the various details had been explained. Mr. J. R. Smith, A.M.I.E.E., Vice President, in seconding the proposition, fully endorsed Dr. Miskin's statements, adding that the future possibilities of wireless were such that a vast field for research was open to the amateur experimenter.

Mr. Prichard, physics master of the School, tendered the thanks of the school staff to the Dartford Wireless Society for the invitation to attend the lecture, and to Captain Tingey for the valuable and instructive information rendered.

Captain Tingey replied, and the meeting terminated at 10.30 p.m.

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

Croydon Wireless and Physical Society.

(Affiliated with the Wireless Society of London.)

The May meeting of the above Society took place on Saturday, May 7th, at the Croydon Central Polytechnic. Owing to the sudden indisposition of Mr. Reynolds the lecture on "Polarised Light" was cancelled, and Mr. G. J. Hibbert, F.R.P.S., came forward at extremely short notice with a

most interesting lecture and demonstration on "Recording Natural Colours."

In view of his departure for France, Mr. C. Harrison resigns his position of Honorary Secretary, and the Society recorded their appreciation of his work and interest by placing his name among the list of vice-presidents.

Mr. E. M. Spink was elected as Honorary Secretary, and requests that all communications should now be addressed to him at 18, Piccadilly, W.

The Cardiff and South Wales Wireless Society.

(Affiliated with the Wireless Society of London.)

A general meeting of the Society was held at headquarters, the Technical College, Cardiff, on Thursday, April 18th, Mr. E. G. Farrow in the chair.

A lecture was given by Mr. A. W. M. Dyke on "Phantom Telegraphy," which was both instructive and interesting, though the lecturer explained that, owing to the scope of the subject, only a brief outline could be given in the time at his disposal. It was explained how telephone and telegraph circuits could be superimposed on other existing lines and conductors without interfering with the original working of the latter. Drawings were also issued to each member showing some of the various forms superimposed could take.

In conclusion a hearty vote of thanks was accorded the lecturer.

Owing to the possibility of the Wireless Department of the Technical College permanently closing down in July, members have been requested to make enquiries as to the possibility of obtaining other suitable headquarters before that date.

Wireless and Experimental Association.

(Affiliated with the Wireless Society of London.)

At a meeting of the above Society on April 27th, Mr. Kirkby exhibited and demonstrated a five-valve detector and amplifier, which he had designed and constructed. It was neat and workmanlike in appearance, and left nothing to be desired by way of operation when connected to the Club aerial. It is hoped that a photograph will be made so that others than those who were fortunate enough to be present may form an opinion of its appearance, at least.

At a meeting held on May 4th, Mr. Selden exhibited and demonstrated a Morse inker, which he had converted into an automatic buzzer, and the members sat round and wrote down the message punched on the paper tape, revelling in the perfect letter formation and spacing so different from the stuttering staccato of the ordinary wireless operator. Mr. Sharman, of the British School of Telegraphy, had helped Mr. Selden considerably with his work, and the result was quite successful.

Mr. Nicholson had been presented with a small piece of wireless apparatus by Mr. Claud Wilcox, of Warminster, as a memento of his receiving the latter gentleman's message of 12½ watts over a distance of 100 miles.

Derby Wireless Club.

(Affiliated with the Wireless Society of London.)

During May and June meetings will be held on the first and third Saturdays at 7.30 p.m., at Mr. Lee's, The Court, Alvaston, Derby.

Manchester Wireless Society.

A general meeting was held at the Headquarters, Albion Hotel, Piccadilly, on April 27th, at which the work of the past session was reviewed and future progress discussed. On April 30th the Society conducted a ramble in the neighbourhood of Hale. Three portable sets were erected at different points and splendid results obtained in reception from standard stations. A congratulatory message from Paris to the Luton Wireless Society was intercepted. The same evening a transmission took place from headquarters, using one valve and 200 volts H.T., and this was received at a point 20 miles distant. Telephony was also tried with fairly good results up to 7 miles. Further transmissions have been arranged, and the Hon. Secretary will be glad to hear from any amateur who receives the same. The Society's call sign is "2FZ." Commencing on Wednesday, May 11th, meetings will be held once a fortnight at headquarters, in addition to which a series of outings has been arranged for the summer session. The first of these is in the neighbourhood of Knutsford, on May 28th, when further experiments will be conducted with portable sets.

Hon. Secretary, Mr. E. Samuels, 1, Parkwood, Victoria Park, Manchester.

Plymouth Wireless Society.

A meeting of the Plymouth Wireless Society was held at the Plymouth Technical College, on Friday, April 22nd, 1921. Mr. W. S. Templeton M.A., B.Sc., A.M.I.E.E., occupied the chair.

Mr. L. E. Currah gave an interesting lecture on how to make a valve receiving set. He demonstrated the methods he had employed in making condenser, honeycomb inductance coils, grid leak, etc., in his own valve detector, which he had kindly brought with him. Many stations were easily received, showing the practical value of his own workmanship. It proved an excellent address, and at its conclusion Mr. Currah was unanimously elected a member of this Society.

A letter was read from Mr. A. C. Harwood, an ex-student of this College, requesting to become a member. He was duly elected: the secretary stating what great pleasure it gave him to receive letters from ex-students of this College.

A meeting was held on Friday, April 29th. Mr. W. J. Lewarn in the chair.

Mr. J. [illegible]. A. Nicholson, A.M.I.E.E., gave a most interesting lecture on "Wireless Receivers and Receiving Circuits."

A Marconi magnetic detector, a No. 31 crystal detector and three-valve amplifier being at the disposal of the Society and demonstrated on by the lecturer, the practical interest in the subject was greatly increased. This lecture was greatly appreciated by all members of the Society, and a vote of thanks was passed to Mr. Nicholson.

At this point Mr. H. P. Mitchell requested that his resignation from the post of Secretary be accepted. All present regretted this step, and Mr. Mitchell was asked if he would reconsider his decision, but he having declined, nominations were called and voted on, with the result that Mr. W. C. Bodle was elected as Secretary.

City and Guilds Wireless Society.

At a meeting on May 4th, Mr. H. Andrewes gave his experiences in the construction of wireless apparatus, from the first crystal set onwards.

He concluded a most interesting description with a demonstration, signals being made audible all over the room by means of his loud speaker and a German 4-valve amplifier, very kindly lent by Messrs. the R.M. Radio Co.

The meeting was adjourned after the usual discussion.

Luton Wireless Society.

On Saturday, April 30th, a most successful exhibition was held in the hall of the Hitchin Road Boys' School, the headquarters of the Society. The exhibition was opened at 3 p.m. by the President, Mr. W. H. Cooke, A.M.I.E.E., in the presence of a large company of members and visitors.

Photo A. P. Cook, Luton.

Receiving the Eiffel Tower Message.

The exhibition was divided into four sections, one being devoted to junior members, another to senior members, a third to exhibits by well-known makers, and the fourth to exhibits of general scientific interest.

The junior exhibits were simple in scope, but numerous, showing the educational value of wireless in the school curriculum, leading, as it does, to the encouragement of wider interest in science and world knowledge, and to greater power, ingenuity and initiative in mechanical and constructive work. Charts and lists were shown to illustrate the names and positions of several hundred stations, ship and land, picked up by the boys on the school receiving set.

The amateur section consisted mainly of short-wave tuners and receiving sets, exhibited by members. Among the professionally constructed exhibits were accessories by the Amateur Supplies Association; tuners, panels, etc., by Messrs. Butler & Co.; valve panel, by R. H. Tingey; B.T.H. set, by Messrs. Burnham & Co.; 3-valve set and loud speaker, by Messrs. Read & Co.; relay and loud speaker, by Messrs. Brown & Co.

Two demonstrations were given by the representative of H.P.R. Wireless Co., on amplifying long and short wave receiving sets to interested audiences.

Popular demonstrations with X-rays were given by Mr. Shoolbred, A.M.I.E.E., with apparatus kindly loaned by the local hospital.

At 5 p.m. all interest was centred on the expected message from Eiffel Tower, sent by courtesy of General Ferrié. Owing to the vagaries of an amplifier the numerous visitors were unable to hear the message through the loud-speakers, but it was successfully received on an amateur set by four operator-members (see photo.) The message was announced by the President, as follows:—

> "Eiffel Tower Radio-telegraphic Station sends to Luton Wireless Society an expression of the most cordial fraternal greetings with best wishes for success and prosperity."

A radio-telegram was immediately dispatched by the President, thanking General Ferrié for his kindness to the Society, and reciprocating his good wishes.

At intervals parties were conducted round the exhibition by the Hon. Secretary, and at 7 p.m. a short popular lecture was given by Mr. L. W. Pullman, of London. Telephony was received and

Photo A. P. Cook, Luton.

A Luton Wireless Society Group.

The tall figure in the centre is the Chairman, Mr. F. Mander, B.Sc., on his right is the President, Mr. W. H. Cooke, A.M.I.E.E., and on his left the Hon. Secretary, Mr. W. F. Neal.

the loud speakers made signals from high-powered stations audible to all.

Among the 600 visitors who attended in response to invitations were members of the Education Committee and the Mayor of Luton, who made an appropriate speech during the interval.

Many new members were attracted to the Society.

Cambridge and District Wireless Society.

At a meeting of the Cambridge and District Wireless Society, held at the reading room of the Photographic Society, Ram Yard, at 8 p.m., on May 4th, there was evidenced the growth of the Society by the number of new members that were present. The secretary was asked to apply to the Secretary of the G.P.O. for permission for the Society to use a portable set for demonstration purposes at future meetings. The Chairman, Mr. W. S. Farren, promised to give a lecture at the next meeting; subject, "First Principles of Wireless Telegraphy." Members promised to bring apparatus for demonstration purposes.

The formal business was then concluded, and the various pieces of apparatus brought by different members were demonstrated and commented upon. One piece drew attention which was made according to the constructional article in *The Wireless World*, "A Long-range Single Valve Receiver." The meeting was then concluded. Intending members please apply to the Secretary, Camden House, Park Terrace, Cambridge.

The Lowestoft and District Wireless Society.

On April 19th a paper was given on "Masts and Aerials," by Mr. C. Chipperfield, whose long experience with both fixed and portable masts enabled him to give a very pleasant and instructive evening.

On April 26th a paper was given on "Long and Short Wave Receiving Apparatus," and judging by the many questions asked the lecture was greatly appreciated by all present.

At a meeting of the Committee on the 26th ult. it was decided to alter the rule for membership as follows:—"Intending members to be proposed by two full members and passed by the Committee. Persons with a good knowledge of telephony and telegraphy, but are not holders of P.M.G.'s licence, to be admitted as associates.

"That all members' licence numbers to be registered with the Club. That a library be established and books to be loaned to members at the fee of 2d. per book per week."

The Club single-valve receiver is now nearing completion; in the meantime a list of interesting lectures and demonstrations has been prepared for future meetings.

All persons interested in the Society's doings are invited to apply for particulars to the Hon. Secretary, Mr. L. Burcham, "Gouzeacourt," Chestnut Avenue, Oulton Broad.

Tunbridge Wells and District Wireless Society.

This Society was formed on April 14th for the furtherance of all matters connected with wireless telegraphy and allied subjects, and to promote intercourse and exchange of ideas among experimenters in those sciences. The membership is increasing at a satisfactory rate, and a room is now being sought out for the exclusive use of members at all times: an aerial and apparatus is to be installed.

Our members' stations are dotted over an extensive area round (and, of course, including) Tunbridge Wells, and are variously equipped. Most of us are enthusiastic amateurs, but a few are highly skilled electrical engineers, and one or two are fully trained and experienced operators, and we are all ready to help and to learn.

Prospective members are invited to apply for further particulars to the Hon. Secretary and Treasurer, Mr. William H. Glaser, M.A., 4, Vale Avenue, Tunbridge Wells.

Ilford and District Radio Society.

On Friday, April 22nd, the inaugural meeting of the above Society was held at the home of Mr. Vizard, 12, Seymour Gardens, The Drive, Ilford, when about 20 wireless enthusiasts were present.

Owing to the great difficulty in securing a room for meetings, our Hon. Secretary, Mr. Vizard, kindly offered the use of his house until the Society was able to locate suitable premises.

Wireless men in the district wishing to join, and those interested, are invited to communicate with Mr. Vizard, or call at the above address any Tuesday evening.

Woolwich Radio Club.

A general meeting of the above Club was held at the Old Mill, Plumstead Common, on Wednesday, April 27th, at 7.30 p.m.

Both Mr. James—our able Secretary, who has looked after the interests of the Club for the last year—and Mr. Denny, our Treasurer, have been compelled to resign their respective offices owing to increasing pressure of business engagements.

New officers were elected as follows:—Hon. Secretary, Mr. H. J South; Assistant Secretary, Mr. A. C. Beeson; Treasurer, Mr. G. Dowling; Committee, Messrs. Exetet, Franklin, Frazer, Coverley and Nayler.

It was resolved to change the night of meeting. In future the Club will meet at their Headquarters, the Old Mill, Plumstead Common, at 7.30 p.m. A class in buzzer practice for those amateurs who wish to improve their code reading will occupy the first half-hour. Mr. Exeter and Mr. S. Hewetson have kindly offered to preside. After that the time will be devoted to reception of messages on the Club set, which comprises a 3-valve high frequency set, a 4-valve low frequency amplifier, and a separate crystal set.

An endeavour is going to be made to get the Dutch concerts; several members report having heard them on their own sets. On the last Thursday in each month the meeting will not be held, but members will attend at the Woolwich Polytechnic at 7.30 p.m. on the Friday instead, when lectures, papers and discussions will be arranged, as well as an exhibition of our own members' amateur apparatus.

As our aerial had suffered damage during the recent rough winds, several members attended on Saturday afternoon, April 30th, and re-erected it. Signals were quite O.K. immediately on connecting up.

Any interested in wireless in the Woolwich district are heartily invited to attend our meetings, or the Hon. Secretary, Mr. H. J. South, B.Sc., of 42, Greenvale Road, Eltham, would be pleased to meet them by appointment at his house any evening that is convenient.

The Radio Society of South Africa. (Cape Provincial Branch.)

The monthly meeting of this Society was held at the University, Cape Town, on the evening of March 24th, there being a fair attendance. After the usual business had been concluded, Mr. L. Buckley Bridge read a very interesting paper upon the construction of a receiving set having a range of 150-800 metres, and using crystal detection. The speaker dealt completely with each component, and furnished constructional details for the benefit of those members wishing to make the set. Various diagrams were given.

Telephony is being seriously taken up by the more advanced members, and the results are good. Fifty-watt transmitting valves with grid control, associated with the auto-transformer type of transmitter, seems to be the most favoured scheme at present, but choke control with loose coupling is likely to prove a serious competitor shortly.

Meetings of the Society are held on the last Friday of each month. Persons desiring information should communicate with the Provincial Hon. Secretary (Mr. A. T. Stacey), P.O. Box 2055, Cape Town.

A Wireless Club for Dundee.

We have been asked to announce that a Wireless Club is being formed for Dundee and district. Those interested are invited to communicate with Mr. A. MacLeod, 13, Magdalene Yard Road, Dundee.

Walsall Amateur Radio Club.

17, White Street,
Walsall.

To all Members. *April 20th.*

Gentlemen,

Your Committee have instructed me to inform you that in future meetings of the Club will take place at the Crescent Cabinet Works (Messrs. J. J. Adams), and will be at the following times:—

Monday, 7.30 p.m. to 9.30 p.m.
Wednesday, " " " (Juniors only).
Saturday, 7.0 p.m. to 9.30 p.m.

The new room is well equipped, containing 4-valve amplifier, loud speaker, experimental circuit for members' own instruments, charging board, rectifier, accumulators, work-bench, and buzzers, etc.

The Committee hope that all members will unite in increasing the membership of the Club, and in making known its new advantages, and, last but not least, in giving them their active support by being present on Club nights.

Faithfully yours,

E. W. BRIDGEWATER,
Hon. Secretary.

Leeds and District Wireless Society.

At a meeting of the Society on Friday, April 22nd, it was decided that an exhibition of apparatus should be held on Friday, May 6th, in the Society's rooms, and that the same evening a general meeting should be held to decide whether or not the Society should go into recess for the summer months

Particulars of the Club may be had from the Acting Secretary, Mr. S. Kniveton, "Brooklands," Altofts, Normanton.

THE MAKING OF WIRELESS APPARATUS

THE CONSTRUCTION OF LOW FREQUENCY MAGNIFIERS—PART I.

AS a preliminary to the design of a two-valve low frequency magnifier consider briefly the function of the intervalve transformer upon which the success of the magnifier depends. By means of this transformer the changes in the anode current of the first valve are reproduced, as voltage changes, on the grid of the next valve and control the anode current of this valve. The current changes are very small and are at low frequency, therefore, in order to obtain a fairly strong magnetic field, the winding through which this current flows must have a large number of turns. The voltage change across this, the primary winding, will only be of the order of one volt, and therefore in order that this voltage may be reproduced on the grid of the next valve the secondary must have at least the same number of turns as the primary winding. It is then a one to one ratio transformer. Sometimes transformers with ratios of two or three to one are used, in which case the secondary must have two or three times the number of turns of the primary. In many instances they are found to give no better results than one to one transformers. This is generally due to having insufficient primary turns. A one to one transformer with a good primary winding will give better results than a three to one

WIRE TABLE.

Gauge - -	42	43	44	45	46	47
Diameter Bare -	0·004 in.	0·0036 in.	0·0032 in.	0·0028 in.	0·0024 in.	0·0020 in.
Diameter Covered	0·00525 in.	0·00485 in.	0·00445 in.	0·00405 in.	0·00365 in.	0·00325 in.
Turns per inch Covered	191	206	225	247	274	308
Resistance per 1,000 yds.	1910 ohms	2360 ohms	2990 ohms	3904 ohms	5314 ohms	7652 ohms
Length of Bare Wire per 1 oz.*	428 yds.	530 yds.	670 yds.	875 yds.	1190 yds.	1650 yds.

* Note that the covered wire will only be half this length at No. 42 and one-third at No. 47, owing to the weight of the covering.

transformer with an indifferent primary winding.

There is no definite rule governing the best number of primary winding turns, but we have found in practice that for an open core transformer 10,000 turns is a good number to use. For a one to one transformer we shall require 10,000 turns on the primary and 10,000 on the secondary. To put this number into a small space, and as the current to be carried is very small, it is necessary to use very fine wire.

In practice it is usual to use any gauge from 44 to 47 single silk-covered or enamelled wire. For preference we recommend that No. 44 be used, as the saving in space and the efficiency with a No. 47 transformer does not balance the additional cost (No. 47 wire costs approximately two and a half times as much as No. 44 wire).

The information in the above table regarding small gauge wire will no doubt be useful to many. It should be borne in mind that the thickness of the insulation is almost the same with single silk-covered wire and enamelled wire. Also remember that all wire tables give the weight of wire *bare*, and that with very fine wires the weight of the covering is comparable with the weight of the copper, so that when calculating the quantity required, due allowance must be made for this. No. 44 is about half copper and half covering, while with No. 47 the proportion is about one third copper and two thirds covering. (*See* winding calculation below.)

We will now calculate the length of wire required for our one to one ratio transformer to be wound on a $\frac{1}{2}$-inch diameter soft iron core with 10,000 turns of No. 44 S.S.C. wire per winding. The length of the winding will be $1\frac{3}{4}$ in. The winding to be so many layers with a sheet of very thin waxed paper between each five layers.

Total turns required, 10,000—*Primary*.

Turns per layer $= 225 \times 1{\cdot}75 = 390$ say.

Number of layers $= \dfrac{10000}{390} = 26$ say.

Thickness of layers $= 26 \times 0{\cdot}00445$ in.
$= 0{\cdot}116$ in.

Plus five thicknesses of 0·004 in. paper
$= 5 \times 0{\cdot}004 = 0{\cdot}020$ in.

Total thickness 0·136 in.

Between the primary and secondary windings should be five thicknesses of waxed paper—thickness 0·020 in. The secondary winding, having the same number of turns, will have the same number of layers and thickness of winding.

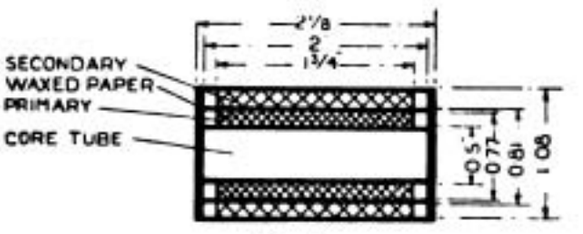


Fig. 1.

The approximate dimensions of the transformer are shown in the sketch (Fig. 1,) from these it is possible to calculate the resistance

of the windings and the weight of wire required.

Take first the *Primary* winding.

Its mean diameter is $0{\cdot}5 + \frac{0{\cdot}772 - 0{\cdot}5}{2}$

$= 0{\cdot}636$ in.

The length of one mean turn is

$\pi d = \pi \times 0{\cdot}636 = 2{\cdot}03$ in.

The total length of wire is the length per mean turn multiplied by the number of turns.

$\therefore$ Total length $= 10000 \times 2{\cdot}03$ in.

$= 550$ yds. approximate.

The resistance per yard of No. 44 is 2·99 ohms, therefore resistance of Primary winding is

$550 \times 2{\cdot}99 = 1640$ ohms.

The weight of copper is $\frac{550}{670}$ oz

$= 0{\cdot}82$ ounce.

Allowing for half copper and half covering, we shall require

$2 \times 0{\cdot}82 = 1{\cdot}64$ ounce

i.e., say 1½ ounces for the primary winding.

Now for the *Secondary*

Its mean diameter is $0{\cdot}81 + \frac{1{\cdot}08 - 0{\cdot}81 \text{ in.}}{2}$

$= 0{\cdot}954$ in.

Length of one mean turn $= \pi \times 0{\cdot}945$

$= 2{\cdot}97$ in.

Total length of wire $10{,}000 \times 2{\cdot}97$ in.

$= 825$ yards.

Resistance of winding $825 \times 2{\cdot}99$

$= 2470$ ohms.

The weight of copper is $\frac{825}{670}$ oz.

$= 1{\cdot}25$ ounce.

Again allowing for half copper and half covering we shall require $2 \times 1{\cdot}25$ ounce

$= 2{\cdot}5$ ounces.

Therefore for our transformer we shall require 4 ounces of No. 44 S.W.S or enamelled wire—1½ ounces for primary and 2½ ounces for the secondary.

For the paper specified to go in between each five layers—0·004 ins. thick—use cheap writing pad paper which is about the right thickness.

The constructional details of such a transformer are shown in Fig. 2.

The primary tube Fig. 3 should be made of thick cartridge or drawing paper rolled into a stout tube 2⅛ ins. long and ½ in. outside diameter. The end cheeks should be 1⅛ in. diameter, $\frac{1}{16}$ in. thick, with a ½ in. hole in the middle. They should be fastened to the primary tube by means of glue or gum.

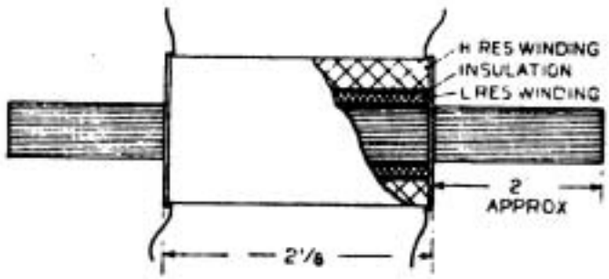


Fig. 2.

For winding the tube must be fitted on to a wood mandrel which can be fixed in a lathe or other winding device.

Make the wire fast to the tube by tying it with several turns of cotton, and wind layer by layer. From Fig. 1 it will be seen that the winding is not taken to the ends of the tube, but that an ⅛ in. space is left at each end. Between each five layers put one turn of thin waxed writing paper which will keep the winding level and also serve to insulate the layers. When the necessary number of turns has been wound on, finish off the winding by means of several turns of cotton.

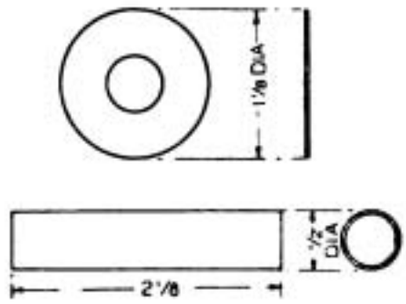


Fig. 3.

Cover this winding with five turns of thin waxed writing paper, taking care not to break off the ends of the first winding.

Then wind the secondary in the same manner and finish it off.

Try the continuity of the windings with a pair of telephones and a dry cell. Then immerse it in a bath of paraffin wax and allow it to drain and dry. The last thing is to fit the soft iron core. This should be of soft iron wire about No. 24 gauge, and cut into lengths of approximately 6 ins. The winding is put on to the middle of this core, and the ends of the iron wire are turned and bent over the transformer to make it almost a closed core transformer. This will be understood by reference to Fig. 4. In this manner a very satisfactory transformer can be made.

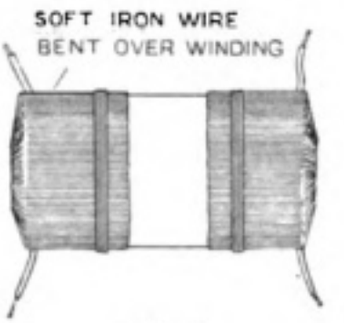


Fig. 4.

In the next issue we will describe the construction of a magnifier in which this type of transformer can be used.

REGULAR TRANSMISSIONS OF WIRELESS STATIONS.

WILL readers who have written letters of appreciation of the publication of "Regular Transmissions of Wireless Stations," in the April 30th issue of *The Wireless World*, please accept the Editor's thanks for their letters, and for the numerous additions and some corrections which have been received. The letters received on this subject have been too numerous to be replied to individually. It is proposed to make considerable additions to the original matter published, and issue the revised list of transmissions in pamphlet form at an early date.

BOOK REVIEW

ARITHMETIC OF TELEGRAPHY AND TELEPHONY.

By T. E. Herbert, A.M.I.E.E., and R. G. de Wardt.

London: Sir Isaac Pitman & Sons, Ltd. Price, 5*s*. net.

In the preparation of this book the authors have had in mind the requirements of those engaged in electrical work, and in particular telegraphy and telephony, who have not had the opportunity of undergoing a full technical training in their subject and are consequently handicapped when, in the course of their daily occupations, they become involved in the calculation of practical quantities involving electrical units. The ground covered by this book is that required for Junior Examinations in the subject, such as the Post Office Grade I Examination in Telegraphy and Telephony. In addition to clear explanations of the methods of arriving at solutions, detailed examples are given. Exercises are also provided, with solutions embodied at the end of the book. H.S.P.

THE HAGUE CONCERTS.

In connection with the article on the "Hague Concerts" published in the April 30th issue of *The Wireless World*, the Nederlandsche Radio Industrie have requested us to point out that the aerial and earth wire dimensions given on page 66, column one, should be 150 feet and 24 feet, respectively, and not metres as stated.

CONFERENCE OF WIRELESS SOCIETIES.

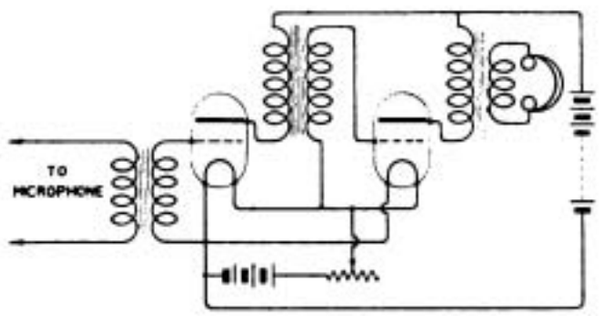
We have been requested by the Wireless Society of London to point out an error in the Report given of the Second Annual Conference of Wireless Societies, which appeared in the April 16th issue of *The Wireless World*. On page 46, column 2, the remarks attributed to Mr. Haye, should have appeared under the name of Mr. R. Heather (Wireless and Experimental Association). This correction will be made before the reprinting of the *Journal of the Wireless Society of London* containing the report.

QUESTIONS AND ANSWERS

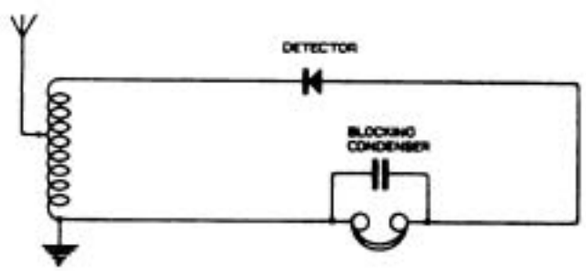
NOTE.—This section of the magazine is placed at the disposal of all readers who wish to receive advice and information on matters pertaining to both the technical and non-technical sides of wireless work. Readers should comply with the following rules.—(1) Questions should be numbered and written on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

F.H. (London, N.W.) *asks how to apply a thermionic valve to amplify very faint noises.*

It is difficult to advise you without knowing the kind of sound you wish to amplify. As far as we can judge we should recommend you to obtain currents from your sounds by means of any very sensitive microphone, and then amplify these audio frequency currents by means of a multivalve L.F. amplifier of ordinary type, of which the following is a specimen.



S.O.S. (Rugby).—(1) No. We presume you require a single circuit receiver. Connect up as per diagram.



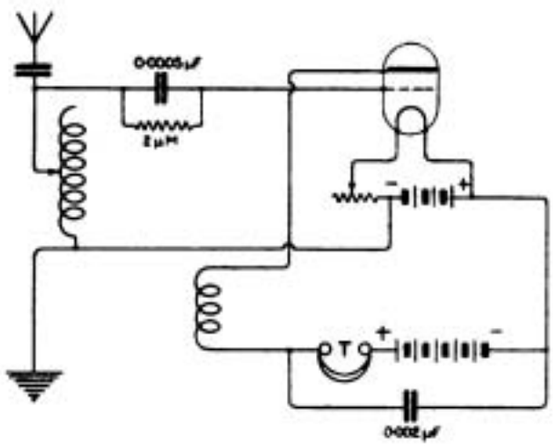
(2) Yes, without a telephone transformer.

(3) The earth lead as thick as possible, and No. 20 gauge for the other connections.

(4) If you make up a former 6" diameter by 11" long and wind it full of No. 24 D.W.S. or enamelled wire with a number of tappings, or a continuous sliding contact, your wavelength range will be up to 3,000 ms., and you should get ships and coast stations, also Eiffel Tower, Nantes, Nauen, Poldhu, Cleethorpes and other stations.

BEGINNER (Highgate) *asks (1) What are the necessary instruments for a simple valve receiving set, to tune to 5,000 ms. Is a telephone transformer necessary for telephones. (2) Diagram of connections for the above set. (3) Dimensions of primary and secondary of a loose coupler to tune to 5,000 ms. (4) What is the meaning of A.T.I. and A.T.C.*

(1) and (2) A simple valve receiving circuit is shown in the figure.



Necessary gear:—Aerial condenser, aerial inductance, reaction coil, filament resistance (2 ohms), grid condenser (0·0005 mfds.), grid leak (2 megohms), blocking condenser (0·002 mfds.), 6-volt accumulator, H.T. battery (30 to 50 volts, according to valve), telephones. A telephone transformer is not necessary for 4,000 ohm telephones, but we should advise you to use low resistance telephones and a transformer for a valve set. For telephone transformer see the issue for March, 1920.

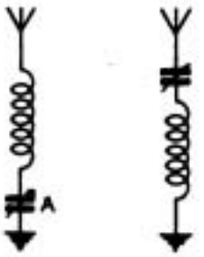
(3) For the aerial inductance and reaction coil make an 8" diameter former 12" long and wind full of No. 24 for the A T.I. For reaction coil make a former 6" in diameter. 8" long and wind full of No. 28 D.W.S.

(4) A.T.I. means aerial tuning inductance. A.T.C. means aerial tuning condenser.

F.J.J. (Southport).—We are afraid the sketch you send is not enough for us to identify the set in question, as a good many sets of this type were designed. In any case it would be out of the question to use the old calibration with a new instrument, with condensers and coils made afresh to the original specification, as it would be impossible to duplicate the old values of inductance and capacity sufficiently closely for the old calibration to hold.

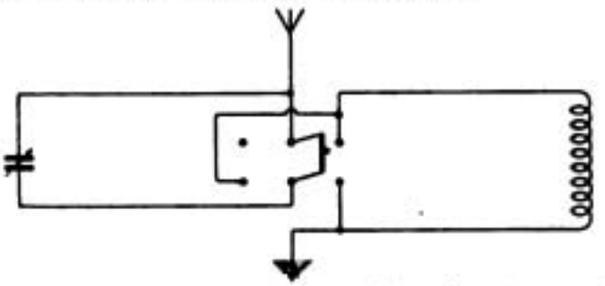
QUESTIONS AND ANSWERS

E.G.B. (Welling) *asks* (1) *What is the difference between the two circuits sketched.*



(2) *Why, with variable condenser in parallel between earth and aerial, he gets good signals, and with condenser in series he gets none at all.*

(1) For a crystal circuit neither arrangement possesses any advantage over the other.



(2) Your series—parallel switching is not correct. When the switch is down the condenser and inductance are connected in parallel with aerial and earth on. When the switch is up the condenser is cut out of the circuit and also the earth connection taken off. A correct arrangement with a two-pole-way switch is shown in the diagram.

GRID (Birmingham) *asks* (1) *If an earthing switch fitted to an aerial will make the apparatus and house safe from lightning.* (2) *Times of telephone transmission from Croydon, etc.* (3) *If a frame aerial can be used with advantage together with a P.M.G. aerial.* (4) *If he should get the Dutch concerts with a certain single-valve set.*

(1) Yes.

(2) No stated times. Transmission is governed by the traffic to be handled.

(3) For general reception there is no advantage to be gained by combining a frame and P.M.G. aerial.

(4) Possible, but unlikely; many people have difficulty in receiving this with considerably more elaborate sets.

C.C.H. (Clifton).—(1) Inductance of a single-layer coil in microhenries =

$$\frac{1}{1{,}000}\,\pi^2\,n^2\,d^2\,l\,K$$

where n = No. of turns per cm
d = diameter in cms
l = length in cms.

K is a factor depending on d/l, varying between 1 for very long coils and almost 0 for very short. The values are given in text books, and have also been given at various times in these columns.

(2) Capacity of tubular condensers in mfds. =

$$\frac{1}{900{,}000} \times \frac{K/2}{2{\cdot}30 \log \frac{r_2}{r_1}}$$

where K is the S.I.C. of the dielectric and r_1 and r_2 are the inner and outer radii of the dielectric.

(3) Wavelength of a closed circuit in metres.

$$= 1885 \sqrt{LC}.$$

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

(4) No very suitable book has been published.

J.D.H.C. (Dunlop) *asks* (1) *If he can put up an aerial over the flat lead roof of his house.* (2) *If the leading-in wire has to be taken from one end of the aerial, or whether it can be taken from the centre.* (3) *Whether the enclosed sample of large thickly insulated lead-in wire need be otherwise insulated.* (4) *How are signals affected by the nearness or distance apart of the wires in a twin wire aerial.*

(1) The aerial will not be efficient unless well above the lead.

(2) With a short aerial a lead from one end is much preferable to a lead from the middle, but the latter can be used if unavoidable.

(3) No; sample sent should be satisfactory.

(4) Two wires close together give results very little better than a single wire—increasing the spacing up to, say, 10′ improves the results.

CLIVE (Welshpool) *asks for details of* (1) *An audio-frequency intervalve transformer for a note magnifier.* (2) *A radio frequency intervalve transformer for an amplifier.*

(1) Windings should be about ½ oz. and 1½ ozs. of No. 44 wire, on a core of thin iron wires, the core being about ½″ in diameter and 3″ long. The exact sizes and quantities of wire used are not important, but they should not differ greatly from those given, and the ratio of the turns on each winding should be about two and a half to one.

(2) Suitable dimensions depend on the wavelength required, and we therefore cannot give particulars without more information. The transformer should be wound in sections on one former with the thinnest resistance wire obtainable.

W.P. (Liverpool) *asks* (1) *Which aerial has the greater efficiency, one wire 60′ long and 20′ high (inverted L type) or a twin wire 3′ apart and 20′ long.* (2) *Is 3′ sufficient spacing between the two wires of a twin aerial. If not will we state correct distance.* (3) *Would a receiver as described on page 781 of the issue for February 5th be responsive to Channel shipping at Doncaster.*

(1) and (2) A twin aerial is always better than a single wire of the same dimensions, but the improvement is not great unless the wires are spaced fairly well apart; 3′ spacing is of some use, but more would be desirable—the more the better up to a dozen feet, at least.

(3) You should get such stations, but weakly. We should recommend the addition of another valve; this would be simplest included as an L.F. amplifier—see various sketches given recently.

G.G.B. (Birmingham).—(1) You can make a very fair set with the apparatus you have with the addition of a valve filament resistance, and, of course, telephones.

(2) Increase the height of the aerial, if possible. It is difficult to advise improvements, as a simple

set such as this may be elaborated in scores of different ways, all good. The first additions we should recommend would be a potentiometer, and a reaction coil in the plate circuit, with blocking condenser across the telephones.

(3) Modified in this way the circuit would be similar to that in Fig. 2, on page 662, of the issue for December 11th last.

(4) The maximum wavelength should be about 7,000 ms., but the set will not be efficient on such a tune. The minimum is uncertain—probably about 250 ms.—this, too, will be inefficient.

E.H. (Amsterdam).—We do not know the characteristics of the valves you mention, which are somewhat uncommon in this country, but suitable values for hard receiving valves of average characteristics would be about as follows:—

$r_1 = r_2 = r_3 = 3\text{-}5$ megohms.
$R_1 = R_2 = R_3 = 50{,}000$—$80{,}000$ ohms.
$C_1 = 0{\cdot}00005$ mfds.
$C_2 = 0{\cdot}0001$ mfds.
$C_3 = 0{\cdot}00015$ mfds.

These values are not at all critical.

W.H.L. (Sheffield) *asks* (1) *Is the sample of wire enclosed suitable for a* 100 *ft. single wire aerial.* (2) *Can he use No.* 20 *bare copper wire in constructing an A.T.I., and how best can it be insulated.* (3) *An explanation of the method of tapping.* (4) *Can he purchase formers, wire and other parts for constructional purposes without a P.M.G. permit.*

(1) Yes, the wire appears to be 7/26 bronze, and should be quite suitable.

(2) You would find it very difficult to insulate this wire satisfactorily. We should advise you to get cotton or silk insulated wire, selling the No. 20 if you have much on hand. You might, however, use it if you have access to a lathe, and could turn a thread on your former, winding the wire in the groove, to prevent neighbouring turns touching.

(3) Bare the insulation from your coil at suitable points. Solder leads on to these points and carry to your switch. Details would take more space than we can spare.

(4) You are not allowed to purchase or make wireless gear without a permit. You may, of course, purchase articles of general electrical usefulness, such as wire, without a permit.

A.S.L. (Newhaven).—(1) The secondary condenser and inductance are both shown as fixed quantities, therefore the wavelength of the secondary will be fixed.

(2) The maximum wavelength of the aerial circuit is approximately 2,000 ms., and, if your value of the secondary condenser (0·004 mfds.) is correct, the secondary has a fixed wavelength of 10,000 ms.

(3) The length of the earth lead, which is probably a thin wire, is excessive. If you cannot bury the plate nearer the set, try earthing on to the gas or water pipe.

(4) The condenser 0·004 mfds. is far too big for a secondary circuit. It should be variable, the maximum capacity being 0·0005 to 0·0006 mfds. This will give you a secondary wavelength of 4,000 ms. Increase your A.T.I. to tune the aerial circuit up to the secondary.

C.A.J. (Bury St. Edmunds).—If the fault with your circuit still exists when you switch off the valves, it is obvious that one of the following things is happening. Either the condenser across the telephones and battery is defective or, which seems more likely, the insulation of the telephones is breaking down and a current flowing *via* your body. Try a telephone transformer, particulars of which are given in *The Wireless World* of March 1920.

W.D.C. (King's Lynn).—The item you mention as a potentiometer of resistance 1·2 ohms. is probably a series resistance for use with a valve. A potentiometer for a crystal set should have a resistance of at least 100 ohms. For connections of circuit see Fig. 4, page 756, of the issue for January 22nd.

(2) The size winding of the coil will depend on the wavelength required. For about 3,000 ms. make coil 6" diameter by 10" long, wound with No. 22.

T.U.S. (Walthamstow) *has on two occasions heard a C.W. note with a crystal set. Being quite reasonably surprised at this, he asks the probable reason.*

This result is probably due to the fact that your aerial was picking up two C.W. stations at once at the time; and one of these was heterodyning the other. For instance, the result would be obtained if there was a station near you using valves for reception with such a circuit that oscillations were being set up in the aerial (autodyne reception). If this is so the note changing effects you mention would be due to a change of wavelength of one station, and not to change of adjustment of your receiver, as you suppose.

SHARE MARKET REPORT.

Business in the Wireless Group has been of a steady nature, and the prices have changed very little during the last fortnight.

Prices as we go to press, May 19th, are:—

Marconi	Ordinary	£2 - 11 - 3
,,	Preference	£2 - 11 - 3
,,	Inter. Marine	£1 - 8 - 9
,,	Canadian	8 - 6
Radio Corporation of America:—		
	Ordinary	9 - 6
	Preference	11 - 6