The WIRELESS WORLD AND RADIO REVIEW

CENTRALISING RADIO DEVELOPMENT.

By THE EDITOR.

THE development of Radio Communication in all its branches is proceeding at a surprisingly rapid rate and achievements which a year or so ago were not dreamed of are now regarded as almost back numbers. It has been pointed out by more than one authority that this country is not taking the lead in wireless invention and development, and is even falling considerably behind other countries in this respect. Such a state of affairs is intolerable, and yet no steps are being taken to effect a remedy. In looking round in an endeavour to discover the cause of the lag in British enterprise in this direction, one is reminded that during the war radio communication in this country made enormous strides, but that the rate of progress achieved has not been maintained since, particularly when comparison is made with what has been done by other nations.

During the war, of course, the secret of the progress made lay largely in the fact that there was no lack of funds for research work and development, and every facility was given for pushing ahead. In those days a high output was demanded without the cost of production being taken into serious consideration. These two factors contributed largely to the progress in the development of radio communication made during those years, but perhaps there is another consideration which is sometimes overlooked. Co-operation between all Government Departments and Commercial Companies engaged in production of wireless apparatus existed during the war to an extent which is totally unknown in the present days of peace and in addition the work done in every branch was co-ordinated and utilised insofar as it had any bearing on development in specialised directions. At the present time it is true that we have the Radio Research Board conducting an important service in collating the results of research in various Government Departments, but it would seem that this work is not carried far enough.

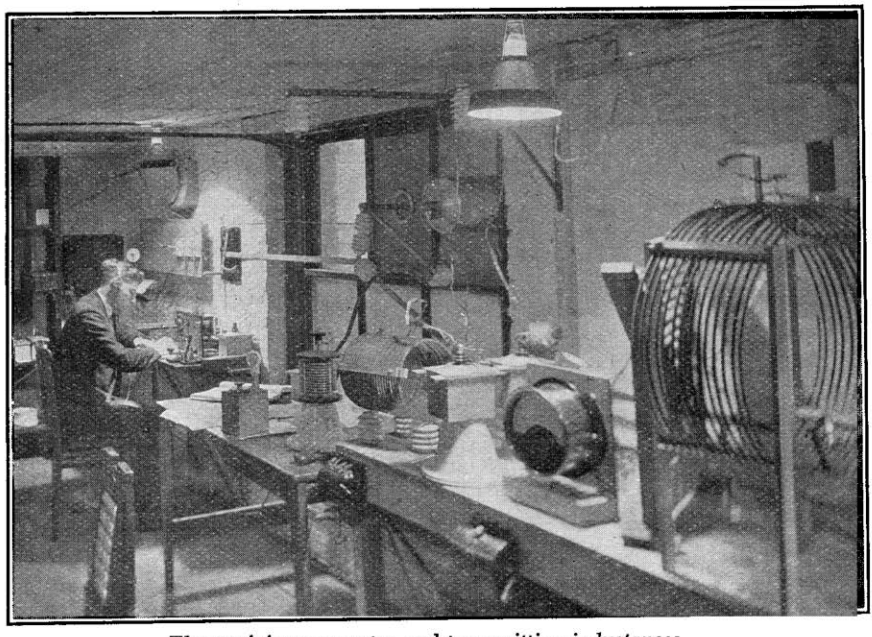
There is still a tendency to regard radio engineering as merely a section of electrical engineering, whereas it has now become so vast a subject that those who take up radio engineering as a career must turn their attention to specialising in this particular branch of electrical engineering at an early date, and indeed it is now necessary to specialise in some sub-branch of radio engineering itself.

Under these circumstances one would think that the time had come for the establishment of a centralised Government Radio Laboratory and Radio Engineering Department where preliminary work for any branch of the service could be conducted.

One does not like to look to other nations for example, but it has to be admitted that a lesson can be learnt from the co-ordination work of the Bureau of Standards of the United States of America, although one need not regard this system as in any way ideal.

With a centralised organisation, experts from the various services could still advise on their own special requirements in the way of apparatus, etc., without the necessity for distributing the work amongst the services and other Government Departments which must result in overlapping and duplication of preliminary research and development.

Some advantage would be gained in the direction of economy, for, whereas it is a common complaint of the several wireless departments at present engaged on Government work that they are limited in funds to such an extent that their work is seriously hampered, yet by combining these several departments as one and avoiding duplication of work, a bigger central fund would be available for useful research and development.



The receiving apparatus and transmitting inductances.

THE RADIO SOCIETY'S TRANSMITTING STATION 6XX.

The station was set up to take part in this season's transatlantic tests. Its signals are familiar to many experimenters, and particularly on account of the calibration signals which are periodically transmitted. During the test transmissions between December 22nd and January 10th signals from this station were heard in America on eighteen nights out of the twenty in spite of the somewhat screened locality in which the station is erected.

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

AS for last year's transatlantic tests the Radio Society of Great Britain again made a special attempt at transatlantic transmission this winter. It will doubtless be recollected that for last year's tests (Christmas 1922-January 1923) a special station was erected at Wandsworth by a few members of the Radio Society Committee.* Although a good aerial was possible there, the locality was rather inconvenient of access, so that for this year's tests another site was chosen.

The old call sign of the Society, **5 WS**, was not retained after the expiration of the permit in January, 1923, so that for this year's tests a new call, **6 XX**, was allocated—this call being of course prefixed with the nationality prefix of **G** in accordance with the scheme agreed upon by the Post Office.†

On this occasion the station was installed at Shepherd's Bush, London, W.12, in a room which was kindly placed at the disposal of the Society in the Works of the Dubilier Condenser Co., Ltd. The aerial for the station was slung between the works chimney stack and a 60-ft. mast erected in some ground adjacent to the works.

* For description see *Wireless World*, Vol. XI., pp. 785–789, pp. 826–830, March 17th and 24th, 1923.

† See *Wireless World*, Vol. XIII, pp. 767-770, March 19th, 1924.

The aerial consists of a six-wire cage, the wires being spaced apart by 7-ft. spreaders lashed together at an angle of 120 degrees to each other. The length of the upper horizontal portion is approximately 80 ft. between insulators. The same wires are

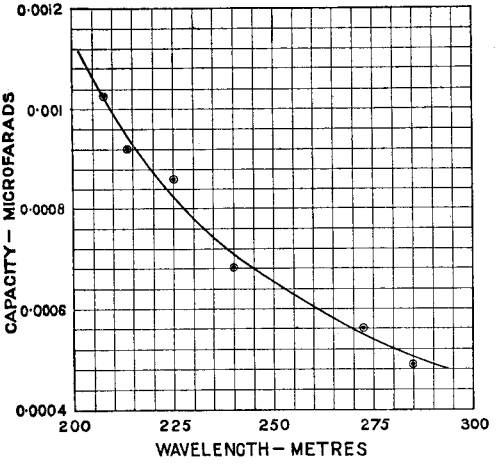


Fig. 1. Curve showing effective capacity of the aerial at different frequencies.

continued through to form the down leads, which are also arranged in the form of a six-wire cage, but of much smaller size than the top of the aerial. The six wires forming the down leads are spaced apart by light wooden hoops approximately 1 ft. diameter, and are all soldered together at the lead-in insulator mounted in the frame of a window. The lead-in insulator is of a special porcelain type of similar pattern to that used for high power C.W. transmitting condensers. It is suitable for continuous operation at any C.W. voltage below 25,000, so that under the normal working conditions of the station there should be very little loss at this point.

A general view of the situation of the aerial is shown on the next page, it was photographed from the roof of some adjacent buildings, and so does not give an indication of the full height of the aerial. It, however, also serves to show that the surroundings are somewhat congested, so that doubtless there is considerable screening. The Metropolitan and Great Western Railway track can also be seen in the background. At this point the railway track is considerably above the ground level, and this again probably considerably reduces the radiation from the aerial, particularly in a westerly direction.

In spite of these disadvantages, good ranges have been obtained from the station and its signals have been reported by numerous American stations.

A counterpoise consisting of six wires in two groups of three is erected under the aerial, with the object of acting more as an earth screen than as a counterpoise in the ordinary sense. The reason for this is that underneath the aerial are a number of small wooden buildings and other materials which are of poor dielectric quality and might cause considerable absorption of the signal energy. The presence of the counterpoise wires largely screens these poor dielectrics from the field of the aerial.

That this screening is reasonably effective is shown by two things: firstly, that in practice practically the whole of the aerial current returns *via* the counterpoise leads, and very little from earth; and secondly, from capacity measurements on the aerial system, which indicate that almost the whole of the electrical capacity of the aerial itself is accounted for by the capacity

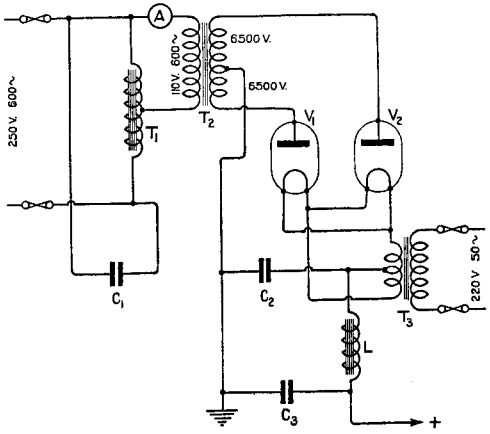


Fig. 2. The rectifying circuit.

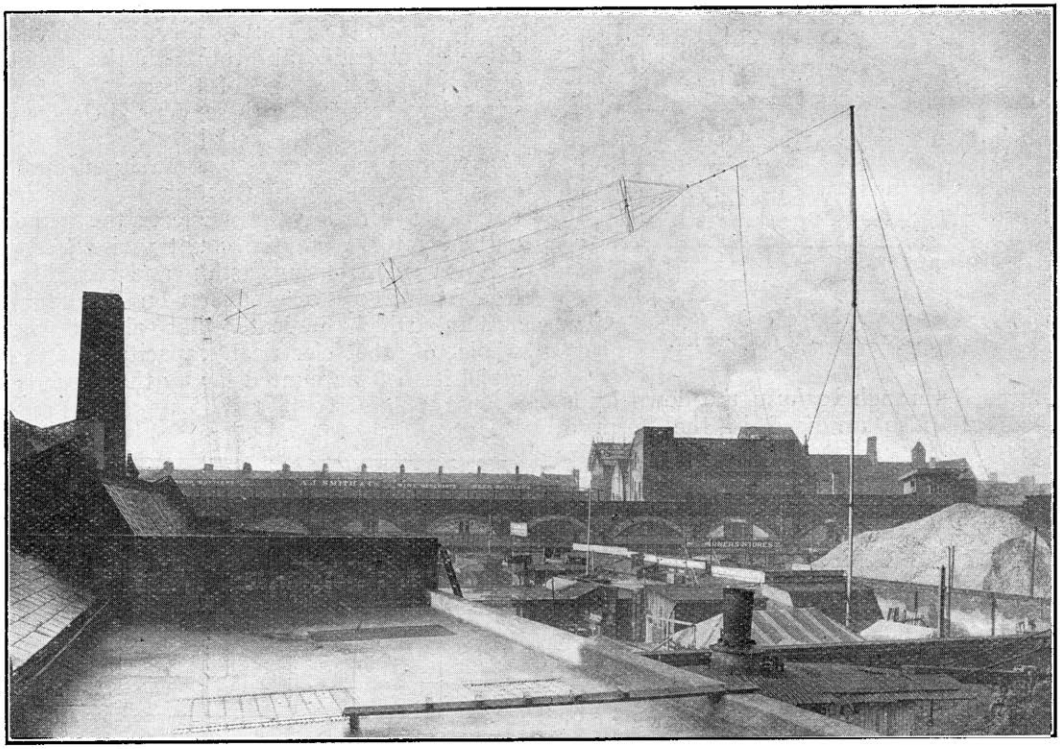
between it and the counterpoise wires, showing that very few of the field lines from the aerial have their ends on earthed objects.

The counterpoise connections are led into the operating room through two separate

insulated lead-in terminals in the window frame. At the station end the counterpoise is approximately 16 ft. above the ground, the aerial lead-in passing down through it in the space between the two groups of three wires, to the lead-in insulator. The counterpoise at this end is secured to the roof of the operating room immediately over the window through which the aerial is led into the room. It slopes down to the further end where it is only about 8-9 ft. above the ground. The counterpoise wires extend for some 6 to 10 ft. beyond the further end of the aerial, each wire being insulated from and supported by a transverse wire strung between two short posts secured to a wall. At two or three places the counterpoise wires pass very close to the guy wires of the 60-ft. mast, but are insulated therefrom by insulators as necessary.

On account of the above distribution of the counterpoise wires and their proximity to the earthed stay wires, the capacity of the counterpoise to earth is considerable, which fact may account in some measure for some of the phenomena found in tuning this station. For instance, under normal conditions the position of the earth clip on the aerial circuit coil for maximum radiation current is usually very close to the point where the counterpoise is connected.

A series of measurements has been made of the effective capacity of the aerial at different radio frequencies in the neighbourhood of the normal working wavelengths.



The aerial at **6 XX.**

These were made by a substitution method, replacing the aerial by a variable condenser which could be adjusted until the same wavelength was obtained as when the aerial alone was connected up. The result of these measurements are set out in the curve in Fig. 1.

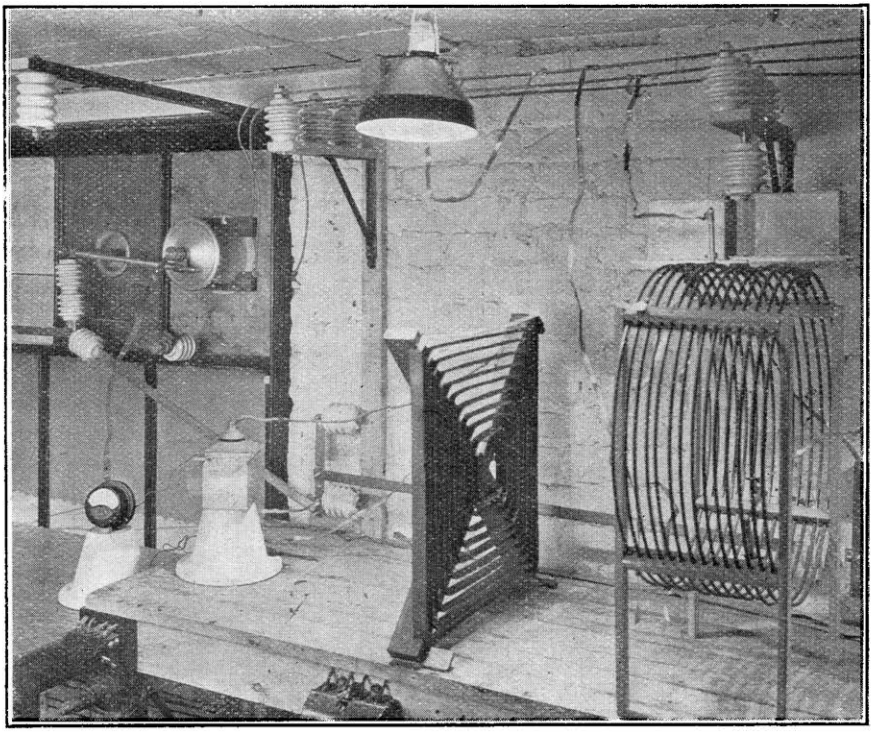
Similar valves are employed as were used at **5 WS** last year, but they have been erected in a more workable manner, using porcelain pillar insulators to support all parts having a high voltage to earth.

A general view of the valve panel is reproduced on page 7. The four valves may be seen in a row, the right-hand pair being the rectifying valves, and the left-hand pair the oscillator valves. The oscillators are of the M.O. Valve Co.'s "T450A" type (previously known as "T2B"), and the rectifiers "U2" type. Both types are capable of an anode dissipation of about 450 watts.

The rectifying circuit is the usual one for two-wave rectification, employing a step-up transformer with a centre tapping on the secondary winding—T_2 in Fig. 2. This transformer has a 13,000 volt secondary winding, *i.e.*, 6,500 volts each side of the centre tap. Its primary is fed at 110 volts from the step-down auto-transformer T_1, since the supply voltage is at 250 volts. This is derived from a 2 kW, 250 volt, 600~ motor generator, the input side of which is a 5 H.P. squirrel-cage induction motor running on the 220 volt 50~ supply mains.

The outside ends of the secondary windings of the H.T. transformer lead directly to the anodes of the rectifying valves V_1 V_2, the rectifying circuit being completed by the mica dielectric smoothing condenser C_2 of 0·6 μF capacity, which is built up of a number of standard Dubilier condenser units connected in series so as to make it suitable for a normal working voltage of about 7,000 to 7,500 volts D.C.

Across this condenser the smoothing circuit consisting of the iron-cored choke L, and the second condenser C_3 of 1 μF capacity is connected. During the actual transatlantic test transmissions this additional smoothing circuit was not always used, the first bank of smoothing condensers C_2 only being employed, its capacity then being 0·4 μF instead of 0·6 μF. Sometimes during the tests, the smoothing choke was connected in the centre of this first smoothing condenser, so that there was a capacity of 0·2 μF only on each side of the choke. This arrange-



The loose-coupled transmitting transformer. The primary circuit inductance on the right is wound with ¼-in. tubing. The primary circuit condenser is suspended behind the inductance.

ment was used to facilitate the keying of the set, as will be seen below.

Further, with reference to Fig. 2, another point of interest may be noted, viz., the condenser C_1, which was given a capacity of 6 to 8 microfarads. Its function is to raise the power factor of the load on the generator. The voltage of the generator can be raised considerably by this means, since a "lagging" load current tends to partially demagnetise the machine (which is of the inductor type), whereas when the current is "leading" this effect is removed.

The filaments of the rectifying valves, as indicated in Fig. 2, are lit from the 220 volt 50~ supply mains through the step-down transformer T_3, which provides a secondary voltage of 18-20 volts, with a centre tap to which the rectifying circuit is connected. Since the filaments of these valves are subjected to the full D.C. voltage to earth, plentiful insulation is provided between the primary and secondary windings. The transformers used for these valves, and for the oscillator valves, are in fact the same as those employed a year ago at the station **5 WS**.

Turning now to the oscillator valves, and the transmitting circuit, the general arrangement is shown in the diagram Fig. 3. It will be noted that once again the valve filaments are supplied from the 50~ A.C. mains through a step-down transformer T_4, of similar construction to the one used for the rectifying valves except that less insulation is provided between the windings, since the electrical mid-point of the filaments of these valves is connected to earth. This electrical mid-point is provided by the potentiometer resistance P, which is connected across the filaments of these valves. Both the grid leak and the H.T. feed circuits are connected to the slider of this potentiometer resistance. P has a total resistance of about 120 ohms, and each half of it is shunted by a condenser C of 0·01 microfarad capacity, which serves to by-pass the high frequency components of the anode current and the grid current, from the resistance P and from the windings of T_4.

The anodes and grids of the two oscillator valves V_3 and V_4 are connected in parallel as shown, the former being connected to the common grid condenser C_4 of 0·0025 μF capacity. The grid leak R_1 is a "Zenite" resistance of approximately 10,000 ohms.

As may be seen from the photograph of the valve panel reproduced on page 7, the oscillator valves, and their connections are mounted upon porcelain insulators. The filament transformers can be seen in the photograph mounted on a shelf behind the valves, while adjustable filament resistances are mounted up between the valves. The H.T. feed transformer can be seen at the bottom, towards the right, with immediately to the right of it the small auto-transformer to which reference has already been made. To the left of the same shelf two other step-up transformers can be seen—these provide an alternative H.T. supply at

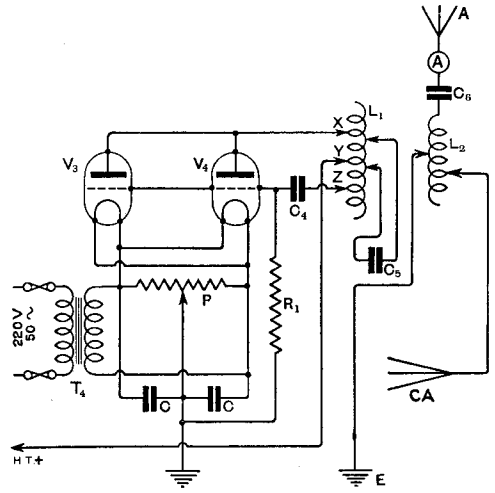


Fig. 3. The general arrangement of the transmitter circuit.

350~ from a rotary converter which delivers 100 volts at that frequency. The bank of smoothing condensers is on the bench at the left-hand side immediately below the oscillator valves.

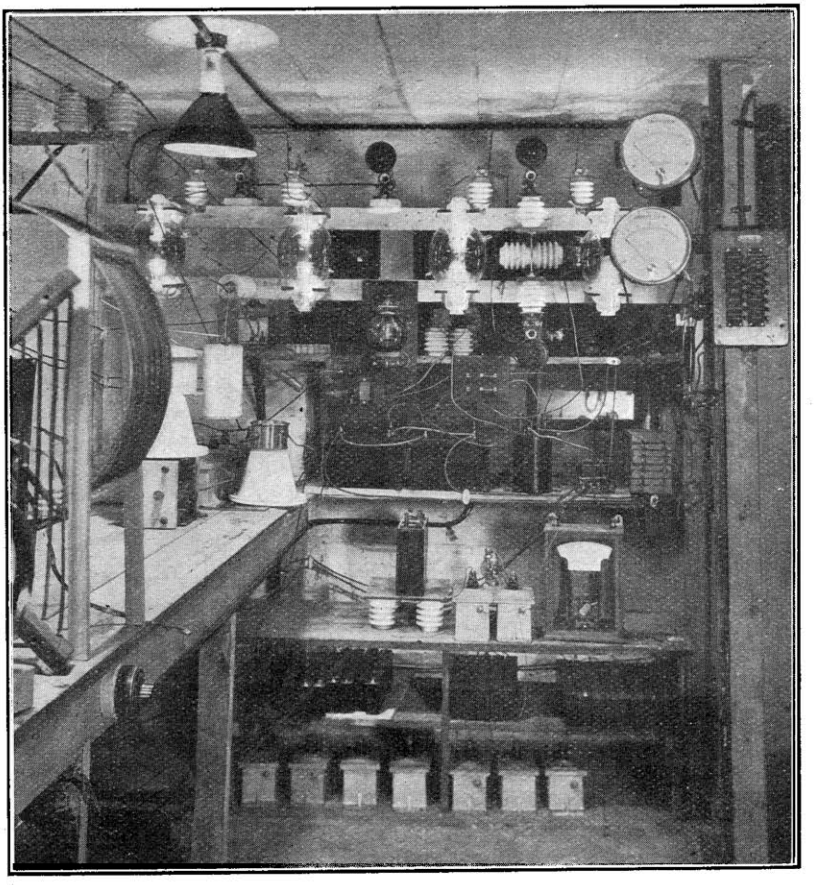
The valves are mounted up at one end of the room, while the actual transmitting circuits are near the centre, so as to place them nearer to the aerial lead-in. Between the two it is necessary to run the three leads marked X, Y, and Z in Fig. 3, in addition to the earth wire for the valve filaments and H.T. transformer. These three leads are carried overhead on porcelain pillar insulators supported by brackets from the side wall. These leads are run in $\frac{1}{4}$ in. diameter tubing so as to provide a stiff conductor on to which the connections to

the oscillation circuit can readily be clipped. This arrangement is in fact particularly convenient since it enables experimental circuits to be clipped on to the valve supply leads at any convenient point along the bench. Changing over from one test circuit to another is thus easily effected. One end of these three leads can be seen near the top left-hand corner of the photograph on this page, as well as in the photograph on page 5.

This latter photograph illustrates the general arrangement of the apparatus used for the transmissions made during the Transatlantic Tests. The primary circuit inductance L_1 (Fig. 3) is the coil of $\frac{1}{4}$ in. tubing to be seen on the right-hand side of the photo. The primary circuit condenser of 0·0005 μF capacity (C_5 in Fig. 3) is suspended from a porcelain insulator behind this coil, so that the leads between it and the coil are reasonably short. These connections are made to the coil by screw clamps, so that the wavelength of the transmission can be varied between certain limits by moving the clips.

The usual transmission wavelength was approximately 197 metres, but this could be varied down to 180 metres without disturbing the remainder of the circuit.

To the left of this coil is the aerial tuning inductance (L_2 in Fig. 3), which is wound in the form of a flat coil of copper strip. In series with it is the aerial shortening condenser (C_6 in Fig. 3) of 0·0005 microfarad. This condenser, in an aluminium case, can be seen standing on a porcelain



The rectifying and oscillating valves and valve equipment.

insulator to the left of the aerial coil. From the H.T. terminal of this condenser a copper strip runs to the Weston Thermo-Ammeter, which enables the aerial current to be read. This instrument is graduated from 0 to 10 amperes.

The coupling between the aerial coil and the closed circuit is adjusted by moving the aerial coil along the bench, nearer to or further from the primary coil.

One of the main advantages of the use of the loose-coupled transmitter of the type described above, is that the wavelength of the transmission is determined mainly by the primary circuit, so that swinging of the aerial and other similar changes have little effect upon the wavelength of the transmission. This feature is obviously of considerable importance as affecting the ease of reading of the signal at a considerable distance.

The adjustment of the coupling between the two coils is fairly critical for maximum current in the aerial, as also are the positions of the anode and grid taps on the primary coil.

An aerial change-over switch is fitted for changing over from sending to receiving. This is operated from a control handle in front of the operating bench which is to the left of the window where the aerial is led in, whereas the remainder of the apparatus is to the right of the window as may be seen from the general view of the station reproduced on page 2. On the operating bench is placed the key controlling the set, the receiving apparatus, and the field regulator of the alternator of the motor-generator which supplies the valves. The power used for transmission can be controlled over a certain range by this means.

It may be noted from the photographs that an extension arm is provided from the aerial switch leading down to the bench on which the transmitting coils are supported. This operates two auxiliary switches for the purpose of opening the grid or oscillatory circuit of the transmitting valves when the aerial is being used for reception. It has been found that if this is not done oscillations are still generated by the valves even when the H.T. supply is switched off, which, although relatively feeble are still powerful enough to interfere very considerably with reception. By opening the grid circuit these undesirable oscillations can be stopped. They apparently originate from a small residual A.C. voltage set up in the grid and anode circuits of the oscillator valves from the filament supply transformers, since they are not pure C.W., but tonic train of the frequency of the A.C. filament supply viz., 50 ~.

Keying of the set for morse transmission is accomplished by a heavy key connected in the main transformer supply circuit from the motor generator, the comparatively high supply frequency of 600 ~ enabling the currents in the circuit to be interrupted very readily, even although the break at the key is fairly small. It is because this method of keying is in use that it is not practicable for morse transmission to use too large a smoothing condenser, since this condenser has to be charged up at the beginning of and discharged again at the end of each signal. If it has a large capacity, this will result in a signal that builds up slowly and runs on after the key has been released. Too large a condenser tends to make the dots of the morse disappear, and at the same time to make one character run into the next, making reading of the signals very difficult. Hence, as has been mentioned above, a smoothing condenser of only 0·4μF total was used during the test transmissions so that the signals should be as clear as possible. The absence of complete smoothing only affects listeners in the immediate neighbourhood of the station, since at ranges of 200 miles and upwards the 1,200 ~ ripple due to the double wave rectification of the 600 ~ supply is inappreciable, and the signal, while still exceedingly strong, sounds like a pure C.W. signal under normal conditions.

Only a simple type of receiving apparatus incorporating a detector valve with L.F. amplifier has up to the present been installed at **6 XX**, since reception conditions there are none too favourable, due to considerable interference from electric railway, flicker signs, and charging generators in the neighbourhood, which disturbances last far into the night as a general rule. For this reason during the bulk of the testing work with this station listening has been accomplished at other stations more favourably situated, the receptions being relayed to **6 XX** by telephone land line or by radio.

AN EXPERIMENTAL DIRECTION FINDING STATION*

The purpose of this article is to extend the scope of amateur experimental work. Already the experimenter takes a keen interest in both transmission and reception, and it can be said that a good deal of specialised progress has been made in these branches as the result of amateur activity. Direction finding, which made considerable progress during the late war, has not found its way to any great extent into the realms of amateur work. It is a field as yet almost unexplored by the amateur and the information given here may induce him to set up apparatus which will give added interest to his work.

This article will be completed in three instalments and includes detailed practical advice on the setting up of a reliable direction finding station.

By R. KEEN, B.Eng., A.M.I.E.E.

THE amateur wireless experimenter who takes his hobby seriously, and reads technical books and journals, can hardly complain that the subject of direction finding has been neglected during the past year or two, for two or three books and a number of articles and papers have appeared dealing exclusively with the subject. There may be, however, other readers of *The Wireless World and Radio Review* who, whilst interested in the possibilities of directional reception, do not study technical literature, but approach the whole subject in a more amiable and easy-going manner, and who may welcome information on the elementary theory and construction of a radio compass station which might form a stepping stone to more serious work at a later date.

It is well known that the frame aerial receiver has pronounced directional properties and that when the frame is pointed towards the transmitting station the received signals are of maximum strength, whilst, when the frame is placed broadside on to the direction of travel of the wave, the signals vanish entirely. There must be many who have put these matters to the test by rigging up a rotating frame aerial indoors and attempting to take bearings on the broadcasting stations. Possibly, in some cases, the experiment was a complete success, but it is also quite likely that the effect of rotating the frame, so far as the signal strength was concerned, was almost negligible, and the final deductions, after an evening's concentrated effort, were that firstly all signals were undoubtedly weaker than those obtained with a good elevated aerial, and secondly that they were more or less the same strength irrespective of the position of the frame, but perhaps a little better in the direction of the fireplace! This does not mean that there is any fallacy in the theory of directional aerials; it simply means that the frame was being expected to work under impossible conditions, and the object of these articles is to explain, in a simple manner, how a frame receives, the precautions that must be taken before it can be used for accurate direction finding work, and finally to supply some data for the construction and calibration of a radio compass installation, together with suggestions on possible uses to which the station may be put.

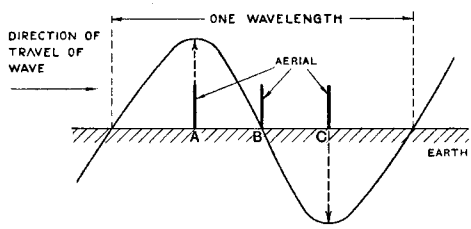


Fig. 1. *Conventional way of showing instantaneous flux intensity in a wave, relative to the three aerials spaced in the direction of travel of the wave.*

The first idea is to get a clear idea of the difference between frame aerial reception and open, or vertical, aerial reception. When the alternating magnetic flux of the electro-magnetic wave cuts an open aerial there is induced in it an electro-motive force (E.M.F.) which keeps exactly in step or in phase with

* Manuscript received Jan. 24th, 1924.

the intensity of flux in the wave. That is to say, when the maximum amount of flux in the wave is cutting the aerial the aerial E.M.F. is a maximum in one direction—say tending to force a current up the aerial, charging it positively—and after a time corresponding to the passage of half a wavelength, when the flux is cutting the aerial at the maximum rate in the opposite direction, then there is a maximum E.M.F. in the aerial tending to force the current down to earth and leaving the aerial negatively charged. This state of affairs is more easily described by means of the diagram in Fig. 1, where the height of the curve represents the instantaneous flux intensity in the wave, and may also be taken as a measure of the E.M.F.s induced in the open aerials A, B and C, situated at various points in the path of the wave. Just what is happening to the current in an aerial all this time depends entirely on whether the aerial is properly tuned, and does not matter at the moment. The important point to observe is that *the E.M.F. in an open aerial is in phase with the flux in the wave producing it.*

Now consider a modification of the above case. Suppose that instead of using the two aerials at A and C, which are just half a wavelength apart in the path of the wave, for separate receivers, we combine them together as in Fig. 2. A lead is taken from the top of one aerial to the top of the other and another lead joining the bottoms has a coil in it for coupling to a receiver. The open aerials have now become a frame, and notice particularly that the two E.M.F.s in

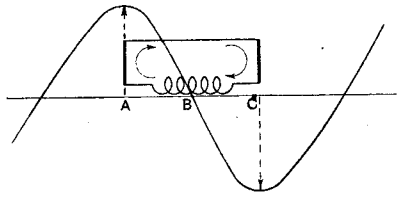


Fig. 2. Two open aerials combined to form a frame.

the vertical limbs of the frame at A and C, although in opposite directions relative to the earth, are *in the same direction round the frame* as indicated by the arrows, and since the E.M.F.s in A and C were at their maximum values, there is a maximum E.M.F. round the frame. Clearly the arrangement in Fig. 2 is not a practical one, or, assuming the wavelength illustrated to be 600 metres, then the distance between the side members of the frame would be 300 metres. Also, although use is made of the fact that there is maximum E.M.F. in the vertical limbs, there is the resistance of twice 300 metres of connecting leads to be taken into account,

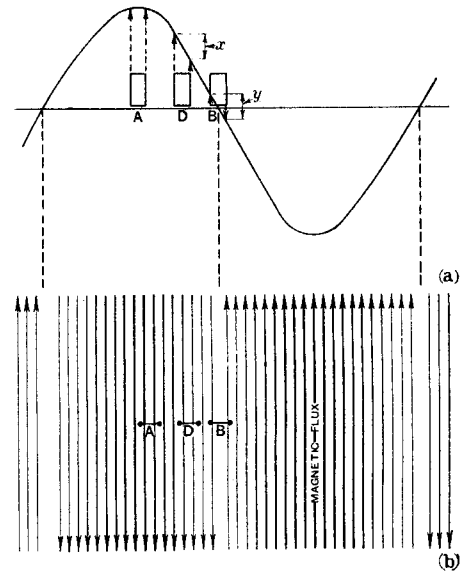


Fig. 3. Elevation and plan views of three frames, showing that the E.M.F. induced round a frame is 90° out of phase with the flux in the wave.

and anyhow, the whole thing is impossibly unwieldy. Observe now what happens when the sides of the frame are brought closer together. In Fig. 3a the frame has been reduced in size, and three positions of it are shown, namely, at the instant when the flux at the centre of the frame is a maximum, when it is decreasing, and when it is zero. When the centre of the frame is at A, then although the two E.M.F.s in the side limbs are almost at their maximum values (assuming the E.M.F. in the vertical limbs to be proportional to the height of the curve at the place), yet they are acting *in opposite directions round the frame,* so that their net effect is zero. At the position D when the flux in the wave is decreasing, the E.M.F.s are also less than before, but they are different in value by an amount proportional to the length x in Fig. 3a, and this is the effective E.M.F. round the frame. Lastly, when the flux at the centre of the frame is zero, we see

that although the E.M.F.s in the side limbs are almost at their minimum values, yet, owing to the fact that they are *in the same direction round the frame*, the frame E.M.F. proportional to y is a maximum. The result

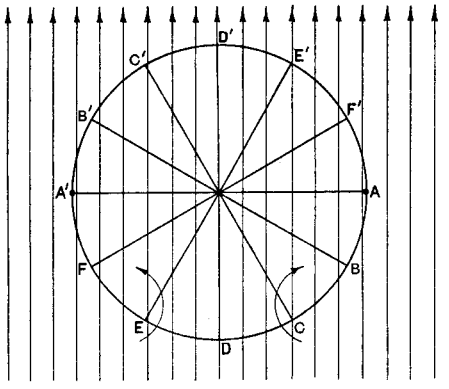


Fig. 4. Variation in flux linkage as a frame is rotated about a vertical axis.

is that the frame E.M.F. is seen to decrease as the width of the frame is made smaller, and also that *the frame E.M.F. is not in phase with the flux in the wave, but lags a quarter of a period behind it.* These are extremely important characteristics of the frame.

Leaving the question of relation between the E.M.F. and the size of the frame, let us see how rotating the frame affects the E.M.F. and hence the received signals. Fig. 3b is a view looking down on top of the arrangement in Fig. 3a, the varying intensities and direction of the magnetic flux in the wave being shown by a variation in the thickness and direction of the arrows. The three frames are all shown in the direction of travel of the wave. Fig. 4 is an enlarged view of one of the frames and it has been assumed that the frame is so small in comparison with the wavelength that it is permissible to consider the flux in the neighbourhood of the frame to be uniform. Now, the E.M.F.s in the vertical limbs of the frame depend on their height and the frame E.M.F. also depends on their distance apart so that the frame E.M.F. depends on the height and width, that is, on the area of the frame and hence on the amount of flux linked with it. If the frame be rotated about a vertical axis and the number of lines threading it are counted for the various angular positions of the frame in Fig. 4, then a diagram may be made as in Fig. 5, in which the radial lines represent the angular positions of the frame and the lengths of the lines are proportional to the numbers of flux lines linked with it in the respective directions. The "Polar Curve" drawn through the extremities of the lines is a figure eight as shown in Fig. 5, and there are seen to be two positions of maximum signals strength corresponding to the two positions when the frame is in the direction of the path of the wave. Intermediate between the maxima are two positions of zero signals when the frame is broadside on to the wave, and there is no flux linkage, or, when the E.M.F.s in the vertical limbs are exactly equal and in phase with one another so that the net E.M.F. round the frame is zero. Note that in Fig. 4, when the frame moves from the position CC^1 to EE^1 the flux arrows change their direction *through the frame* as a result of which *the E.M.F. reverses in phase as it passes through the minimum value.* One part of the diagram is therefore arbitrarily marked +ve and the other −ve, and this distinction becomes very necessary later when devising means of determining "Sense" or absolute direction. The method of taking a bearing of a transmitting station, using the figure eight diagram of reception, is to observe the direction of the frame when signals are a minimum, this being easier to detect accurately than the position of maximum signals which is not sharply defined. The

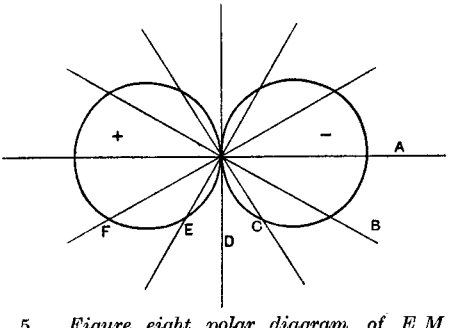


Fig. 5. Figure eight polar diagram of E.M.F. induced in rotating frame.

position of the pointer is of course arranged accordingly with reference to the scale. It must be noted that the simple frame will only indicate the plane of travel of the wave, and will give no information as to the "To and From" directions.

At this point, suppose that a frame aerial composed of half a dozen turns of wire on a three feet square frame is prepared and suitably erected so as to rotate about

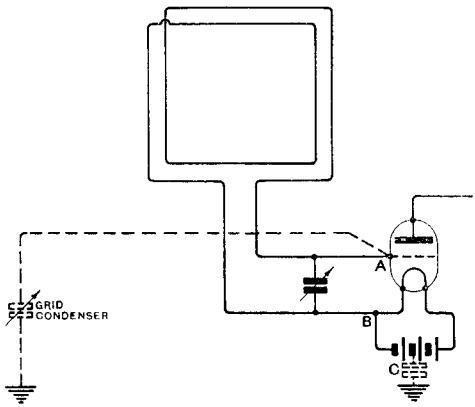


Fig. 6. The cause of "Vertical" or "Antenna Effect" in a simple frame D.F.

a vertical axis, with pointer and scale. The frame may be tuned to say 600 metres by a suitable condenser across the terminals of which is also connected a valve amplifier, and the arrangement will be approximately as in Fig. 6, and will constitute, according to first principles, a direction finder. Although the circuit may have been rigged up in some

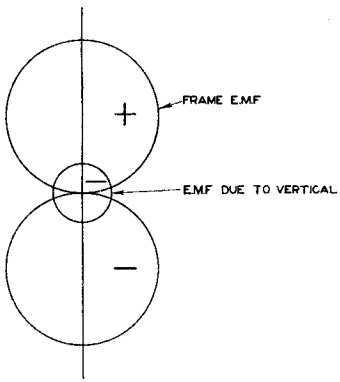


Fig. 7. Circle diagram due to vertical superposed on figure eight diagram due to frame.

clear space (that is, not indoors nor very near to large metal or stone structures), it will, in general, be found that instead of the diagram of reception being a figure eight with two crisp minima exactly opposite each other, it is more likely that the minima will be very indefinite, and even if sharp enough to get fairly accurate readings on a distant station, it will be found that the two minima are not opposite one another. Figs. 8 and 9 show fairly typical polar diagrams which might be obtained, and in a room, the results would probably be far worse than this.

To find a reason for all this, it is necessary to go back for a moment to Fig. 3a, in which it was seen that the maximum E.M.F. round a frame aerial was at the instant at which the flux in the wave was zero and the two individual E.M.F.s in the side limbs of the frame very small. When these E.M.F.s in the side limbs are at a maximum,

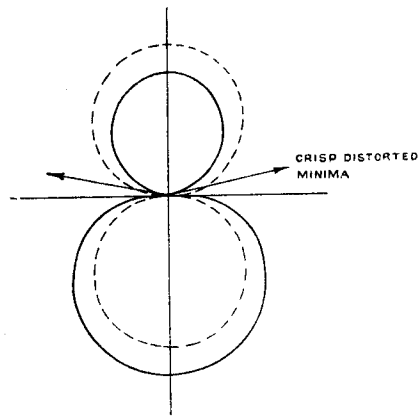


Fig. 8. Figure eight diagram of reception distorted by "in-phase" vertical.

they are opposing one another round the frame so that there should be no received signal. Notice that at this instant, these two E.M.F.s are very many times greater than the little frame E.M.F. even at its maximum, and it is these very large E.M.F.s acting together up and down the sides of the frame which force their way through to the receiver and cause the minima to be either indefinite or not diametrically opposite. Any signal which is heard is caused by a potential difference across the frame tuning condenser and it has been seen how this potential difference can be reduced to zero when the frame is turned broadside on to the wave so that there is no linkage of flux with the frame or, in other words, so that

the two E.M.F.s in the side limbs are exactly equal and in phase with one another. Even when the frame is in this position, however, the large E.M.F.s in the side limbs are still there, and are tending to force currents to earth *via* the points A and B in Fig. 6. Now, the point B is presumably joined to the filament batteries which may be standing on the floor and will have an appreciable capacity to earth as shown in the diagram by the dotted condenser C, or they may be actually metallically connected to earth. On the other hand the A terminal is only attached to the grid of the first valve which has a very small capacity so that the B path to earth is of much lower impedance than the A path and more current will flow on the B side than on the A. There will, therefore, be a greater drop in potential down the B path than the A path, and *there will be a difference of potential between A and B regardless of the position of the frame.* The polar diagram for the frame was seen to be a figure eight, but this new effect, being independent of the orientation of the frame, will have a diagram which is a circle as shown in Fig. 7, and is known as " Antenna Effect," " Vertical Component" or simply " Vertical."

Provided that the vertical and the frame currents are in phase with one another, the ordinates of the two may be added together, and when this is done, taking into account the fact that one half of the figure eight diagram is of different sign from the other, the composite diagram of Fig. 8 is seen to have two minima which are not exactly opposite, and neither of which is in the correct direction. When the vertical and frame currents are not in phase, then, although the two individual polar diagrams will look just the same as before, we cannot add the ordinates algebraically as before (except in the special case when the effects are exactly in phase opposition). The resultant E.M.F. across A and B can now never be zero, for when one effect is at its minimum the other is not, and a resultant diagram, as in Fig. 9, is not at all uncommon.

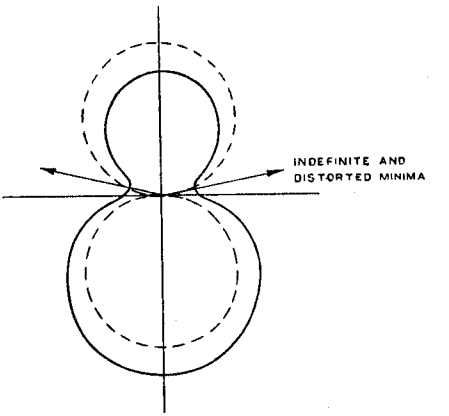


Fig. 9. As Fig. 8, but vertical E.M.F. out of phase with frame E.M.F.

Fortunately, there is a simple method of overcoming this trouble, namely by making the impedance of the A path equal to that of the B path to earth by putting a small variable condenser between A and earth. If this condenser be adjusted whilst listening to signals and rotating the frame, a value can generally be found for which two crisp and diametrically opposed minima are obtained so long, of course, as the point B is not actually connected to earth.

(To be continued.)

THE SCHOOLS RADIO SOCIETY.

In the autumn of this year the Schools Radio Society is to carry out Transatlantic telephony tests and it is hoped actually to converse with American schools.

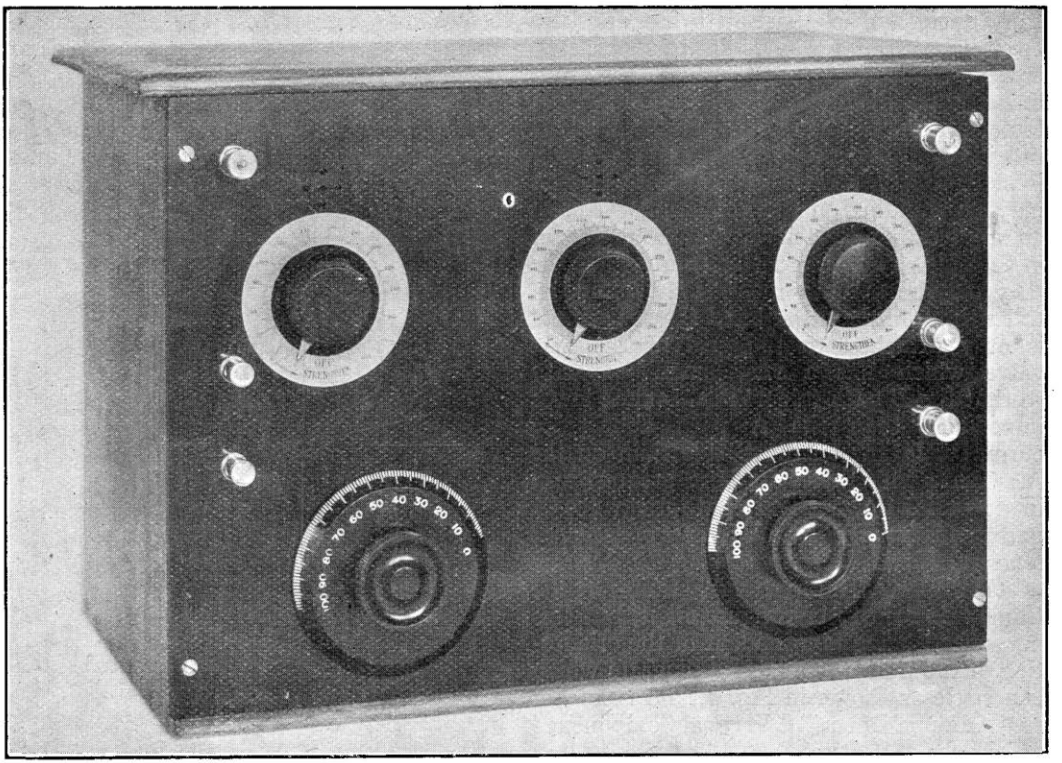
This announcement was made by Mr. R. J. Hibberd, Hon. Secretary of the Schools Radio Society, in the course of his talk from **2 LO** on Thursday, March 21st.

Speaking of the exceptional interest which boys and girls take in radio, Mr. Hibberd said that at the present time there is a great danger that wireless may become simply an amusement instead of a help to education. The Schools Radio Society was formed with the object of extracting a true instructional value from wireless and to assist the development of radio in schools on sound educational, scientific and interesting lines.

The Society undertakes to answer technical questions, to organise inter-school competitions and to arrange school lectures and visits to radio manufactories.

Mr. Hibberd urged parents and schoolmasters to see that, by increasing membership, radio can be established in schools on sound and permanent lines.

Full particulars concerning the movement can be obtained from Mr. R. J. Hibberd, Grayswood Mount, Haslemere, Surrey.



A finished receiver built to the design given in this article.

SELF CONTAINED

THREE-VALVE RECEIVER.

The three-valve receiver, consisting of one stage of H.F. amplification, detector and one note magnifier, is probably the most favoured and also the most useful of a varied selection. In spite of this, there is a vast scope in the selection of component parts and their arrangement. This receiver is easy to construct and makes use of a minimum number of component instruments, thus limiting cost and constructional work and simplifying wiring. Easy manipulation is a feature, there being only two tuning adjustments which give smooth oscillation control. Variometer tuned receivers of this type are almost universally used in America for broadcast reception.

By W. F. GILDERSLEVE.

THE receiver is designed to mount all component instruments directly or indirectly on a vertical panel which forms one side of a cabinet. The valves, L.F. transformer and fixed condensers are mounted on an ebonite platform which is supported on two variometers (aerial tuning inductance and tuned anode) which in turn are securely fastened to the vertical panel. The three resistances, grid leak and six terminals are mounted on the large panel, while the L.F. transformer is suspended from the platform and hangs between the two variometers.

Another feature of this receiver is that it is so designed that if dull emitter valves are used and the low voltage batteries obtained for them, the complete set with batteries will not occupy any more space than the average three-valve receiver. Alternatively, external batteries can be used, and an additional pair of terminals are mounted and connected to the filament for the purpose. Readers will no doubt appreciate this

method of construction as external connections to batteries are always a source of inconvenience

A view is given on an accompanying page of the back of the set and although most of the components can be readily identified, it may be helpful to refer to the portions of the circuit in which they are connected. A, B and C are the filament resistances of the H.F., detector, and L.F. valves respectively, and D, E and F the valve holders. G is the variometer in the H.F. amplifying circuit and H the aerial tuning variometer. The H.T. bridging condenser is shown at J; K is the grid leak, L the transformer bridging condenser, M the H.F. variometer condenser, while the grid condenser is hidden away behind the centre valve holder.

A complete list of components is detailed below and it should be pointed out that the types stated should be procured to avoid modifications in the design, as the same types are essential.

Front vertical panel, 14 ins. × 9½ ins. of best grade ebonite with a minimum thickness of 5/16 in.

Valve mounting panel of ebonite, 13¼ ins. × 2⅝ ins. × 5/16 in.

Two Edison Bell variometers.

1 Igranic L.F. transformer.

3 Burndept valve holders with external side connections.

3 Burndept filament resistances.

1 0·0003 fixed condenser for grid.

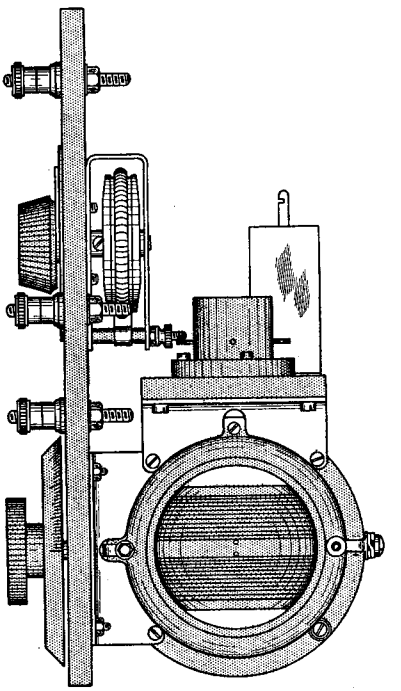
1 0·002 μF fixed condenser for telephones.

1 0·0002 μF fixed condenser across the H.F. variometer.

1 2μF fixed condenser across the H.T. battery.

1 Dubilier grid leak, 2 megohms.

6 4 B.A. terminals with nuts and washers.



Side view, showing the method of supporting the valve platform. The variometer makers will supply the additional brackets.

6 yards of No. 16 S.W.G. tinned copper wire.

4 supporting brackets.

6 4 B.A. countersunk brass screws, ⅜ in. in length for securing filament resistances.

4 4 B.A. cheeseheaded brass screws, 1¼ ins. in length for securing brackets to variometers.

13 6 B.A. cheeseheaded screws, ⅜ in. in length, 9 of which secure to valve holders, 4 to fixed condensers.

16 4 B.A. countersunk brass screws, ⅜ in. in length, 8 for bolting the variometers to the vertical panel, and 8 to secure the platform to the variometers.

2 4 B.A. washers for use in spacing the variometer brackets.

4 6 B.A. ¾ in. screws for bolting the L.F. transformer and the 4 fixed condensers together through the panel.

6 6 B.A. washers, 4 of which are used for the above screws, taking care that the heads and washers are downwards underneath the panel and the other two are used when fixing the grid leak.

2 6 B.A. cheeseheaded brass screws, ¼ in. in length for mounting grid leak.

16 6 B.A. hexagon brass nuts.

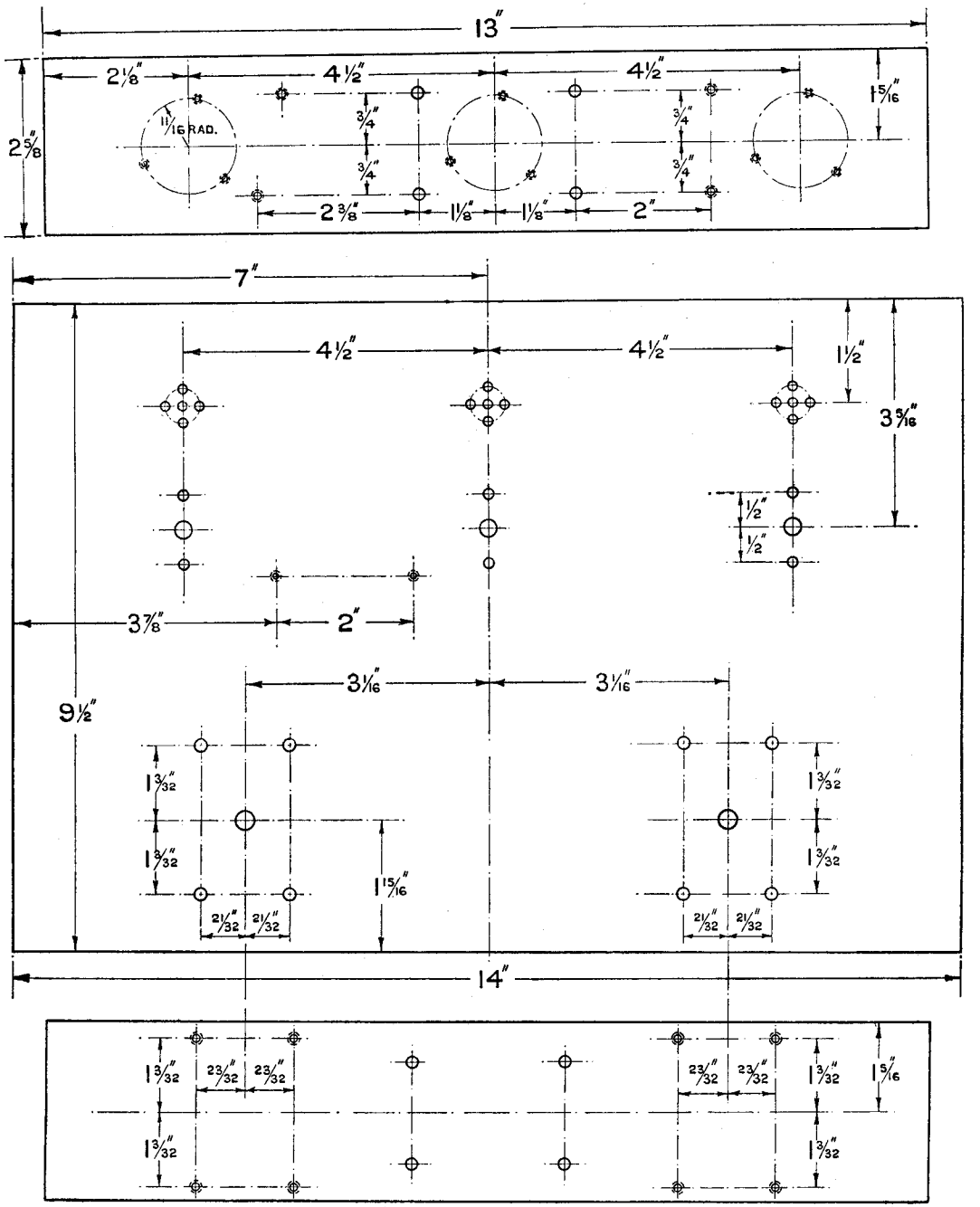
2 spring supports for grid leak.

8 4 B.A. hexagon brass nuts.

The wavelength range is approximately 300 to 600 metres and tuning by means of the two variometers is inclined to be sharp.

When all components are obtained, the marking off should be carried out on the back to correspond with the drilling diagram. Care must be exercised when the drill is nearly through, to avoid chipping the face of the panel. When drilling the two holes for securing the grid leak, care is also required, as these are blind holes and the maximum depth should be ¼ in.

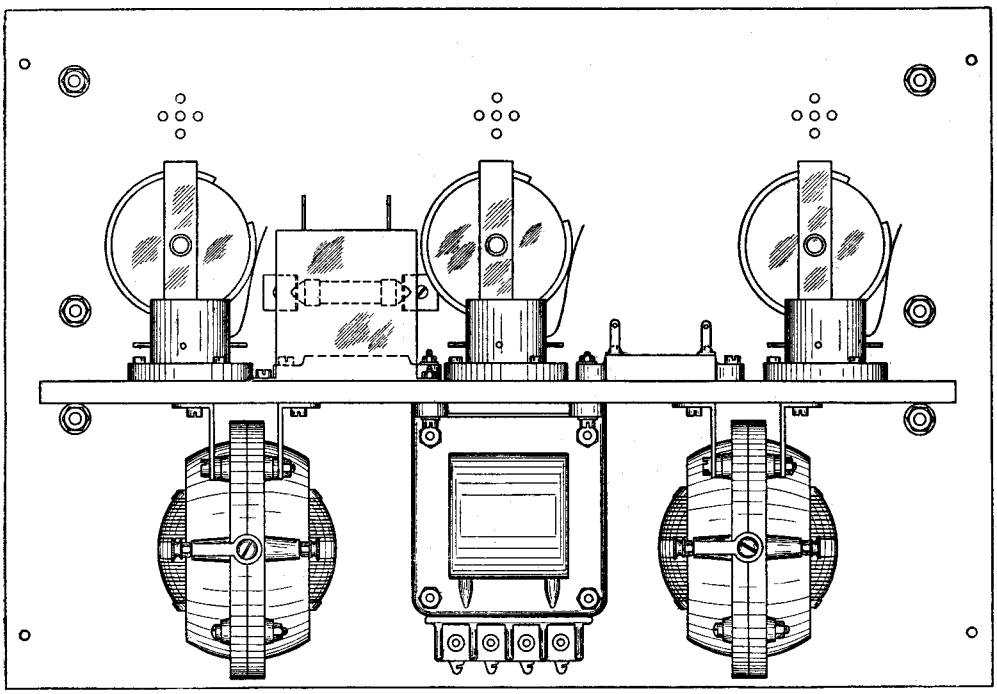
The eight holes for securing the two variometers and the six for securing the filament resistances may be countersunk on the face or front surface to take the heads of 4 B.A. countersunk screws. Engraving adds to the appearance of a panel and can be obtained at a comparatively low cost. This should be done,



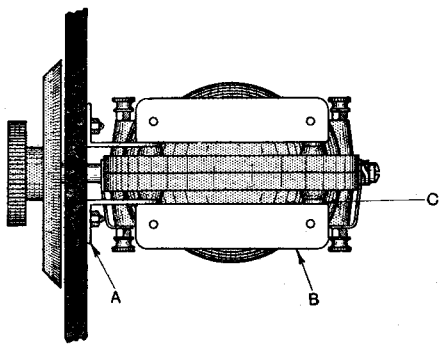
Dimensional drawings of front panel and valve platform. The drilling of the valve platform is shown on the top and underside as apparatus is attached to both faces.

of course, before the assembling is commenced.

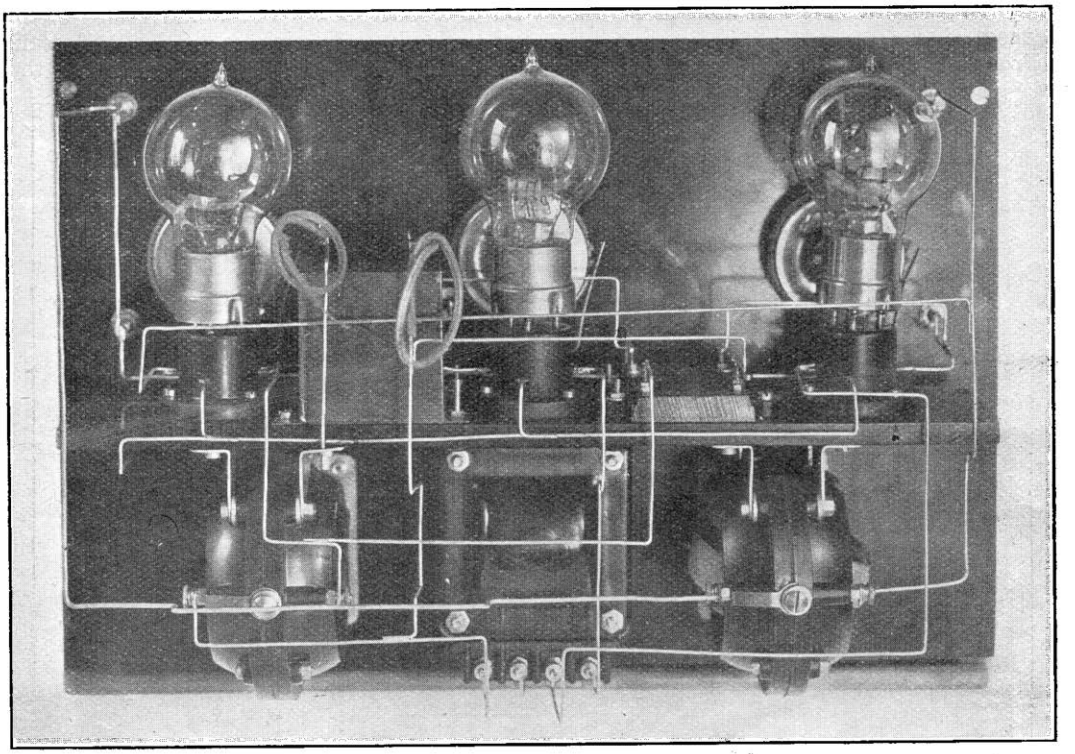
Proceeding, the platform which is supported by the variometers and carries the transformer may next be cut and drilled. As components are mounted on both sides of this panel it is necessary to give two drilling diagrams and the panel should be drilled on both sides accordingly. It will be noticed that only four holes are given for the four fixed condensers, these being nearest to the ends of the panel, the reason being that the holes for securing the transformer on to the other side of the panel answer the purpose by using the 4 6 B.A. cheeseheaded screws, $\frac{3}{4}$ in. in length. When erecting the transformer and fixed condensers, the heads of the screws should be underneath the panel with the washers close up to the heads and the nuts uppermost against the fixed condensers. Care must be taken when finally tightening up, as the condensers are liable to break. Before mounting the two variometers, the two metal brackets should be secured to them. This is done by removing the screws on one side which hold the brackets already on, placing the two extra brackets outside and using one of the 4 B.A. × $1\frac{1}{4}$ in. screws with nut in place of those removed. This is repeated with the other variometer and is shown diagrammatically in the accompanying figure. It will be found necessary to put the 4 B.A. clearance drill through the hole in the variometer as the screw used previously is an odd size. When the valve holders are being mounted they will be found to come in close contact with the corresponding terminals of each filament resistance, and in the writer's case, no wiring was necessary

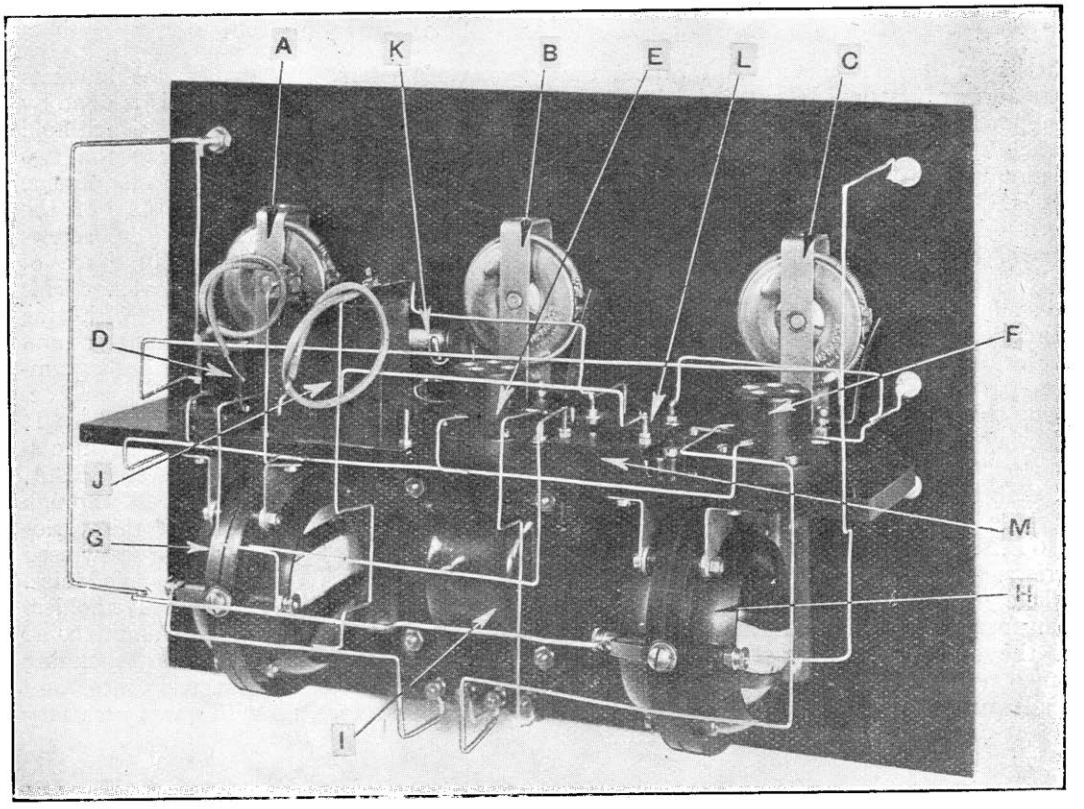


Scale drawing (about one-third full size) of back of panel.



Fixing the variometers and valve platform. A, the usual fixing brackets; B, additional brackets; C, spacing washers.

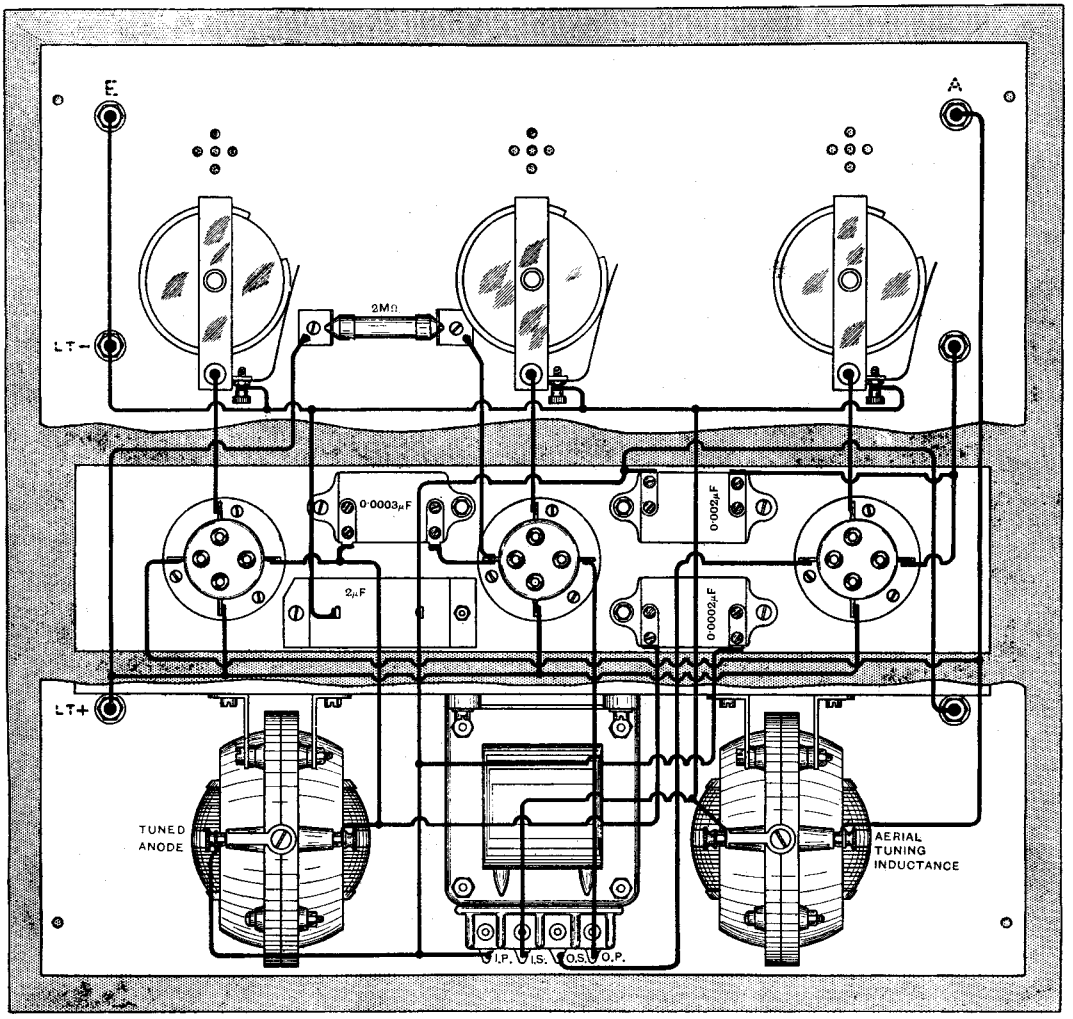



A
K
B
E
L
C
D
F
J
G
M
H
I

to make connections. To obtain this the filament resistances must be mounted with the connections downwards.

When all components are mounted and securely fastened, all contacts must be cleaned and carefully tinned. This precaution

positions with all grid connections to the left-hand of the panel and the plates to the right looking from the rear of the panel. The components and wiring extend to a maximum depth of 4 ins., while the cabinet is 7 ins. deep, with the result that the space



Practical wiring of the set, reproduced from the actual instrument and points between which connections are made and the positions of linking the leads across.

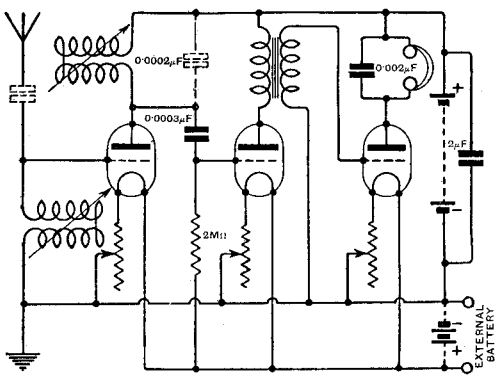
saves time and greatly facilitates soldering when wiring up.

General layout and wiring diagrams are given, and for the sake of clearness, the platform is shown as two panels having components mounted on both sides. The valve holders are shown in their correct

of 13¼ ins. × 9½ ins. × 3 ins., is allotted to batteries. This will take a 100-volt "Ever-eady" H.T. battery and a battery for dull emitter valves.

The cabinet is made with the top hinged to form a lid, but it is essential that after valves and batteries are in place, and the

correct plate voltage ascertained, that the lid should not be raised more than necessary, to avoid dust which, apart from being harmful,



Circuit of variometer tuned three-valve receiver.

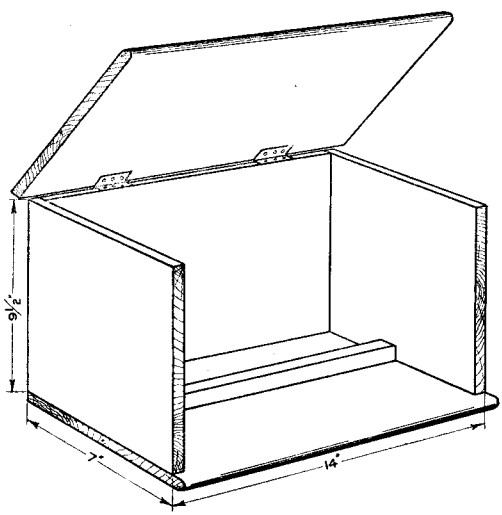
is difficult to remove owing to the compact arrangement and wiring. The manner of securing batteries used by the writer is one of several, and other methods can be employed to suit various types of batteries. Four holes only are necessary for securing the panel to the cabinet. The wood screws should not be less than $\frac{3}{4}$ in. in length and the holes should be about 1 in. from top and bottom.

Reference might be made to the wiring up, and a practical wiring diagram is shown on the previous page. The wire used is No. 16 tinned copper which should be straightened by stretching prior to clipping it up into lengths of suitable size.

Each lead should be carefully shaped with a pair of small square-nosed pliers and where it is necessary to twist the tinned wire round the terminals it will be found that a small pair of round-nosed pliers will be quite helpful. The solder should be of the soft variety which is usually procured in thin strips as distinct from the hard solder used on bigger jobs and which runs at a higher temperature.

Each lead could be exactly copied from the wiring diagram and the beginner might mark out the leads as they are fitted into the set. It has been necessary to turn the valve platform into the same plane as the front panel in order to show its connections.

Using this set as a broadcast receiver it will be found easy to manipulate and to produce very smooth reaction effects. It



Sketch showing the design and general dimensions of the cabinet.

does not burst into oscillation or howl, though it will receive continuous wave signals and is very successful for telephone reception generally.

A NEW FRAME CIRCUIT.

This article describes a novel form of reflex circuit in which a frame aerial is employed.

By J. H. REYNER, B.Sc.

SOME time ago the writer turned his attention to the production of a completely self-contained portable set. It was desired to mount the whole of the apparatus in a case about 15 ins. by 9 ins., and from motives of economy both as far as first and running costs were concerned, it was decided to employ one valve only. Further, since the set was intended as a present to a novice with no experience, it was essential that the adjustments of the apparatus should be as simple as possible.

Somewhat naturally, "super" circuits were tried in the first place, the autoplex arrangement being given special consideration on account of its simplicity, but it was ultimately decided that this type of circuit would not be satisfactory in the hands of a novice.

Attention was then turned to simple dual amplification circuits, using plain reaction, and here a certain success was at once obtained. Any of the usual types of circuit may be employed, one used by the author being shown in Fig. 1. L_1 is the frame tuned with a 0·0003 μF condenser, the frame consisting of 24 turns of No. 22 S.W.G. wire spaced $\frac{1}{4}$ in. apart on a former 15 ins. by 9 ins. L_2 is a variometer having an inductance range of 800-4,000 microhenries which tunes with the self capacity of the valve. The rest of the circuit is straightforward. Reaction is obtained by the anode-grid capacity of the valve, and under normal circumstances the set oscillates freely. Oscillation has to be controlled by (*a*) Dimming the filament, (*b*) mistuning L_2, (*c*) finding a low resistance spot on the crystal which introduces damping into the variometer circuit. This, of course, renders the tuning flat.

It will be seen that there are several possible adjustments, and careful tuning is necessary to find the best. The circuit, however, is stable when adjusted, and worked satisfactorily for some weeks. The time taken in adjustment was a disadvantage and this, coupled with the fact that the set would sometimes "sulk" for as long as fifteen minutes, caused the author to investigate the possibility of a more easily controllable reaction.

Plain reaction circuits were, therefore, experimented with for a time, and of the several arrangements possible, the Reinartz connection proved most satisfactory. With

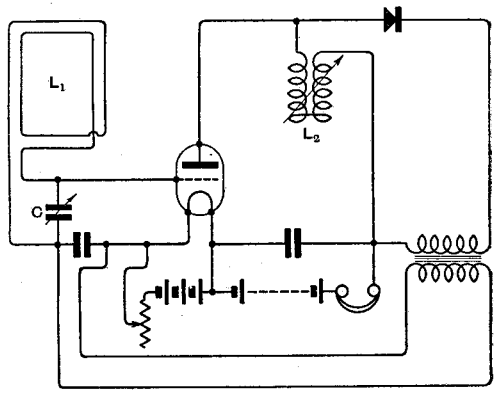


Fig. 1.

the circuit shown in Fig. 2, results could be obtained as good as those given by the original circuit, although no dual amplification is employed with this arrangement. Here L_4 is a high frequency choke of about 5,000 microhenries, and L_3 is the reaction coil, coupled to L_2. The reaction is controlled by the condenser C_2 in the usual way.

It may perhaps be observed that when using this circuit, L_3 should be comparatively small, as this enables a better reaction control to be obtained with the condenser C_2.

The next step in the development was the arranging of dual amplification on this circuit. This presented a problem because the anode circuit contained no tuned circuit

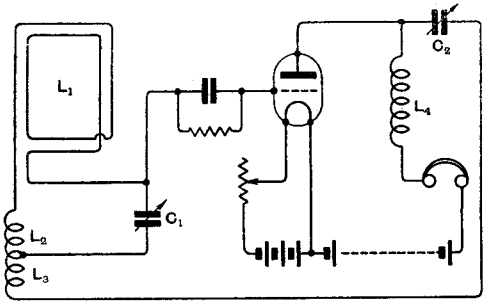


Fig. 2.

across which to tap the crystal and transformer. Several attempts were made to eliminate the crystal and insert the transformer directly in the anode circuit, but no satisfactory method could be devised for keeping the low frequency under control, and persistent whistling resulted.

Finally, however, it was decided to try the frame on the anode circuit. This arrangement was immediately successful,

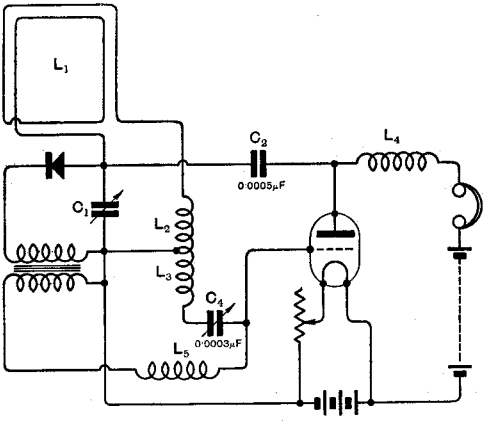


Fig. 3.

the circuit being shown in Fig. 3. In this case the arrangement develops into a simple crystal and note magnifier circuit, the valve being utilised at the same time to provide high frequency reaction on the frame.

The circuit has several advantages. There is only one tuning operation, and the reaction, if C_2 and L_3 are suitably proportioned, is under smooth and definite control without change of tune. The crystal setting is not critical and comfortably loud signals can be obtained in a very short time. Birmingham and Bournemouth can be tuned in at London, although the operation is naturally more delicate. The smooth reaction is a great help here.

The condenser C_3 may be found undesirable in some cases, and the connection shown

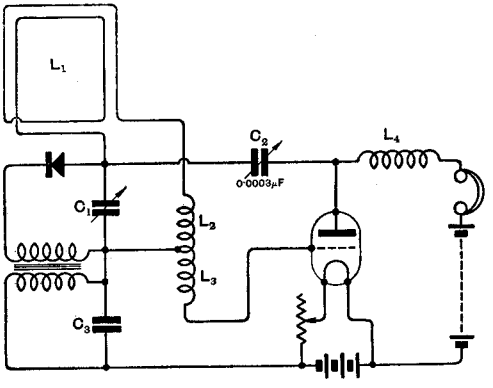


Fig. 4.

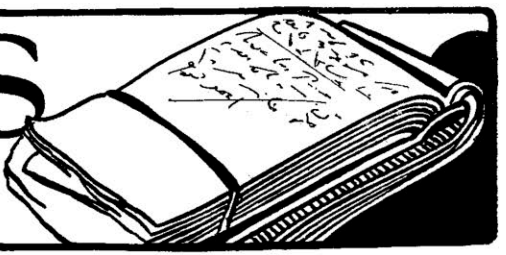
in Fig. 4 may give better results. In this case, C_3 may be made fixed and C_4 variable, reaction being controlled by C_4. In either case, no capacity should be placed across the telephones as this defeats the object of the circuit.

L_5 is a high frequency choke to keep the high frequency from short circuiting through the transformer. It should be of the same value as L_4, that is about 5,000 microhenries.

The circuit will operate with an aerial and earth connection, but does not seem to be as satisfactory as the usual circuits under such conditions. It would be interesting to hear what results other readers obtain with this type of circuit.

(Constructional details of a portable receiver embodying the circuit will appear in an early issue.)

NOTES & CLUB NEWS



A new studio has been opened at the Eiffel Tower and transmissions are reported to have improved.

* * * *

The Radio Club of Luxembourg transmits telephony daily between 10 and 11 p.m. on 200 to 230 metres.

* * * *

A wireless demonstration has been given before convicts in Parkhurst Prison, programmes from Bournemouth and other stations being received on a loud speaker.

* * * *

Lessons in English are being broadcast throughout Germany. "A thousand English words you must know," is the slogan adopted by "The Ullstein Service," which is responsible for the talks.

* * * *

The broadcast speech of His Majesty the King, at the opening of the British Empire Exhibition, is tentatively fixed for 11.30 a.m. on St. George's Day, April 23rd. It is understood that on the same evening an Esperanto translation of the speech will be broadcast from **2LO.**

5 PY Opens.

The official opening of the Plymouth Relay Broadcasting Station (**5 PY**) took place on Friday, March 28th, when the inaugural speech of the Mayor of Plymouth was simultaneously broadcast to all stations.

The Sheffield Relay Station has been allotted the call sign **6 FL.** Sheffield showed its independence on Friday, March 28th, by broadcasting a Grand Opera programme on its own account, admirably carried out by the Sheffield Grand Opera Company.

New French Broadcasting Station.

Another broadcasting station has commenced operations in the Paris area, and has already been widely reported in this country. Announcing itself as "Le Petit Parisien," the new station transmits on about 340 metres on Tuesdays, Thursdays, and Saturdays, between 10 and 12 p.m. The quality of transmission is good and the tuning is exceptionally sharp.

Good Work by American Transmitters.

Mr. George Rogers, of Ashford, Middlesex, has received a letter from **6 AWT**, of San Francisco, California, stating that Mr. Rogers' report of his signals tallies almost exactly with his log. A similar letter has been received from **1 ARL** of Boston, Mass. Both transmissions are exceptional, the latter particularly, for **1 ARL** states that at the time of Mr. Rogers' reception of his signals he was transmitting on 200 metres, using only 10 watts input with 0·5 amperes in the antenna.

Spanish Broadcasting.

Hitherto broadcasting in Spain has been of a rather perfunctory kind, confined principally to tests on varying wavelengths. It has now been decided, however, to install a regular broadcasting station in Madrid, according to our French contemporary, "Radio Electrique." The new station, operating on 2·5 kilowatts, will transmit concerts and also plays performed in the Theatre Royal, Madrid. We have no information at present as to the wavelength to be used.

The Eternal Feminine.

Many radio societies include ladies in their membership; but we believe that the first to have an honorary secretary of the fair sex is the South Norwood Radio Association, the onerous post being filled by Miss D. M. B. Cullis.

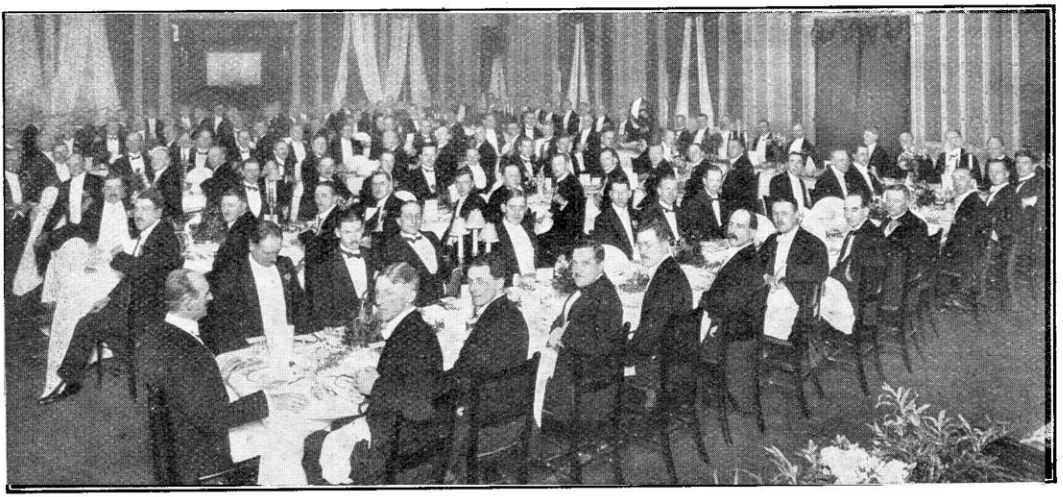
Another Transmitter's Society.

We welcome the announcement of the formation of "The Wolverhampton and District Radio Transmitters' Society," which is open to experimenters with transmitting licences. The objects of the new Society are to further the progress of amateur radio transmission, to help and advise in all matters relating thereto, and to maintain member's rights in accordance with the terms of licence and the Postmaster-General's Regulations. The members at present include **2 KQ, 2 OQ, 2 SY, 2 AAD, 2 NV, 5 AF, 5 LK, 5 UW, 6 PB, 6 HT, 6 UR, 6 XJ** and **6 MO.**

The Hon. Secretary is Mr. J. A. H. Devey, 232, Gt. Brickkiln Street, Wolverhampton.

Short Wave Transmitssions from FL.

We are indebted to a correspondent for further particulars of the short wave test transmissions now being conducted from Eiffel Tower. Tests have taken place during March on Mondays, Wednesdays



Our photograph shows the assembled company at the 3rd Annual Meeting of the British Wireless Dinner Club, which took place at the Trocadero Restaurant on Saturday, March 15th. Senatore Marconi was unanimously elected president for the ensuing year.

and Fridays on wavelengths of 115, 210 and 380 metres, and it is understood that the transmissions will continue.

The probable times of transmission, which we hope to confirm in our next issue, are as follows :—

a.m.			p.m.		
5-5.10	..	F's	3.0 -3.15	..	F's
5.15-5.25	..	L's	3.20-3.35	..	L's
5.30-5.40	..	F's	9.0 -9.15	..	F's
5.45-6.0	..	L's	9.20-9.35	..	L's

Broadcast Talk on Time Signals.

Mr. Frank Hope-Jones, M.I.E.E., Vice-President of the Radio Society of Great Britain, has been invited to broadcast on the subject of "Time and Time Signals" from **2 LO** on Saturday, April 12th.

Mr. Hope-Jones will lecture on "The Free Pendulum" at the Royal Society of Arts on Wednesday, April 9th at 8 p.m., when the chair will be taken by Professor C. Vernon Boys, F.R.S.

A Tenth Anniversary.

Although the number of wireless societies in this country now exceeds two hundred, not many can boast of an existence of ten years. Among the select few who have weathered a decade must now be included the North Middlesex Wireless Club, which held its Tenth Annual Meeting on March 19th.

Mr. A. G. Arthur, who has been President of the Club since its foundation, was unanimously re-elected.

Mr. K. B. Warner's Station.

The calls **1 MO** and **1 XW** are assigned to the transmitting station of Mr. Kenneth B. Warner, Secretary of the American Radio Relay League. A photograph of the equipment appeared on page 656 of our issue of February 20th, the call sign **1 XM** being erroneously ascribed to this station. **1 XM** is the call sign of the Massachusetts Institute of Technology.

A Musician on Broadcasting.

An interesting review of broadcasting from the musician's point of view appears in the March issue of "The Choir," over the name of Mr. George Dodds.

After relating his trying experiences when broadcasting for the first time, the writer gives some practical advice to singers unaccustomed to the silent and unresponsive microphone. "Be natural," he says, "sing as you always sing; the purest and best produced voices are those which give the best results. All shouters, forcers, hooters, squeezers and others of that ilk are horrid to listeners-in, and if you will only sing naturally, with easy and forward production, you can trust the B.B.C. to send out good tone for you to your unlimited audience."

The writer's concluding hint to listeners-in would comfort Captain Eckersley. "If you do not get good results," says he, "blame your own set 99 per cent. and the B.B.C. 1 per cent. for what is wrong."

Earliest Reception of WJZ.

Mr. J. Ridley (**5 NN**), of South Norwood, points out that the claim made in our issue of March 19th to the effect that Mr. R. E. Williams, of Holyhead, was the first British amateur to report reception from **WJZ** is incorrect. Mr. Williams was unable to identify his first Transatlantic reception, whereas Mr. Ridley distinctly picked up **WJZ**, and was the first amateur in this country to accomplish the feat.

R.S.G.B. to Transmit to Australia.

An attempt to communicate with Australia on a wavelength of 200 metres is to be made shortly by the Radio Society of Great Britain.

A schedule of special times for tests is being arranged so as not to clash with broadcasting, and these will be cabled to Australia and published in order that the amateurs there may be ready.

Transmissions will be made from **6 XX**, the Society's station, described in this issue.

2 JU.

This station owned by Mr. E. J. Pearcey, of Birmingham, has been temporarily removed to 610, Fulham Road, London, S.W.6.

An Error.

A typographical error occurred in the advertisement of Messrs. Cunningham and Morrison appearing on p. xxix, in the March 26th issue of this Journal. The reduced prices of Myers Valves should have read as follows :—Universal Bright Emitter, 12s. 6d.; Dry Batteries Dull Emitter, 21s.

Wireless for London Schools.

The example of Glasgow, in providing broadcast talks to schools, is being followed by London, and four lectures are to be transmitted to pupils during April and May during school hours.

The following is a provisional programme :—

April 4th: Dr. Sir Henry Walford Davies, "Music."

April 11th: Mr. E. Kay Robinson, "Natural History."

May 2nd: Sir J. Forbes-Robertson, "Shakespeare."

May 9th: Col. Sir F. Younghusband, "Climbing Mount Everest."

In order to ensure good demonstrations without distortion the B.B.C. advises those in charge of school sets to test reproduction on the midday transmissions from **2 LO.**

Radio Society of Great Britain.

An informal meeting of the Radio Society of Great Britain will be held on Wednesday, April 9th, at the Institution of Electrical Engineers at 6 p.m., when Mr. L. F. Fogarty, A.M.I.E.E., F.R.S.A., will open a discussion upon "The Use of Rectified Alternating Current as a Substitute for Accumulators and Dry Batteries in Receiving Circuits."

R.S.G.B.—Informal Meeting of Transmitter and Relay Section.

An interesting account of obstacles surmounted in the erection of a transmitting station was given by Captain Hartridge, opening a discussion at a meeting of the Transmitter and Relay Section of the Radio Society of Great Britain at the Institution of Electrical Engineers on Friday, March 14th. The chair was occupied by Mr. Philip R. Coursey, B.Sc.

Captain Hartridge opened his remarks by cataloguing the obstacles that confronted him when first setting out to design his transmitter. The only source of power supply was alternating current from the borough mains, by no means best suited to transmitting requirements, and the only earth connection was a water pipe situated 60 ft. below in the basement. Moreover, he was limited to a flat on the fourth floor of a rather shaky house, and it was impossible to run a generator without disturbing other occupants. Many arrangements were tried for the supply of high tension current, including dry batteries and the series valve method of feeding H.T., all with indifferent success. Finally, Captain Hartridge experimented with a master oscillator circuit, and by this means was able to overcome the disadvantages of the high earth resistance.

The circuit employed, embodying choke control for the supply of H.T. from the A.C. mains, was illustrated on the blackboard and evoked a favourable discussion.

PERIODICALS RECEIVED.

Radio. April, 1924, Vol. I, No. 1. A monthly magazine dealing with general aspects of wireless. Contributors to the first number include Sir R. Glazebrook, J. C. Squire, A. P. Herbert and George Morrow. (London: Radio Intelligence, Ltd., 34-35, Norfolk Street, W.C.2. Price 1s.)

Radiofunk. Volume I, No. 1. An illustrated weekly journal devoted to the interests of German amateurs and experimenters. Price 30 Pf.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 2nd.

Institution of Electrical Engineers (Wireless Section). At 6 p.m. At Savoy Place, W.C.2. Lecture: "Thermionic Valves with Dull-Emitting Filaments" (work conducted by Messrs. M. Thompson and A. C. Bartlett, of Research Staff, General Electric Co., Ltd.).

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Annual General Meeting.

Golders Green Radio Society. At 8.30 p.m. At the Club House, Willifield Way, N.W.11. Lecture: "Crystals and Their Characteristics." By Mr. A. Hinderlich.

THURSDAY, APRIL 3rd.

St. Pancras Radio Society. At 8 p.m. At 71, Park Street, Camden Town, N.W.11. Auction of Members' Surplus Apparatus.

Kensington Radio Society. At 8.30 p.m. At 2, Penywern Road, Earl's Court. Lecture: "Detectors for Electric Wave Reception." By Mr. M. Child.

Sale and District Radio Society. At 37, School Road. Open Club night.

Blackpool and Fylde Wireless Society. Lecture-Demonstration: "Practical Hints." By Mr. J. V. Potter.

FRIDAY, APRIL 4th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture: "Valves." By Mr. Wade.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture: "The Low-Temperature Valve." By Mr. C. Wainwright.

MONDAY, APRIL 7th.

Barnet and District Radio Society. At 8 p.m. Lecture by Mr. Philip R. Coursey.

Ipswich and District Radio Society. At 55, Fonnereau Road. Open Night.

Sale and District Radio Society. At 37, School Road. Fault Testing Competition.

Hornsey and District Wireless Society. Lantern Lecture: "The Theory and Practical Uses of Honeycomb Coils." By the Igranic Electric Co., Ltd.

WEDNESDAY, APRIL 9th.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers. Informal Meeting. Mr. L. F. Fogarty, A.M.I.E.E., will open discussion on "The Use of Rectified A.C. as a Substitute for Accumulators and Dry Batteries in Receiving Circuits."

Stoke-on-Trent Wireless and Experimental Society.*

The first annual dinner of the Society was held at Swinnerton's Café, Hanley, on Thursday, March 6th. Mr. F. Jenkinson presided, and was supported by the Mayor (Alderman F. Collis), Col. W. J. Kent, Mr. L. F. Fogarty (Hon. Vice-President of the Radio Society of Great Britain), Mr. T. R. Clarke, Mr. F J. Goodson (Hon. Sec.) and Mr. E. A. Haliburton.

Proposing the toast of the Society, Mr. L. F. Fogarty said the Society was first formed in 1919. Rapid advances were made, and in 1922 the Society took a prominent part in demonstrations at an exhibition held in Burslem. Thereupon interest in the Society increased and reconstitution under its present form took place. The speaker concluded with an appeal for new members.

Other speakers included the Chairman, Col. W. J. Kent, Alderman Collis and Mr. F. J. Goodson.

It was greatly regretted that owing to a bereavement, Col. F. F. Wenger, President of the Society, was unable to be present. A photograph of the assembled company appeared in *The Wireless World and Radio Review* of March 12th, in the description of which Col. W. J. Kent was erroneously termed President instead of Vice-President.

Hon. Sec., F. J. Goodson, B.Sc., Y.M.C.A., Marsh Street, Hanley.

Tottenham Wireless Society.*

Cabinet making was the subject of a lecture given by Mr. Kilbey on March 12th. As an expert on his subject Mr. Kilbey ably supplied much useful information and answered many questions. Mr. Holness then spoke on the Theory of Design. He explained why carefully designed coils and condensers gave better results than articles on which less care had been expended.

The lecture on "Marvels of the Microphone," arranged for March 19th, was not given owing to the illness of the lecturer. Mr. Tucker, at short notice, filled the gap with a talk on his experiences with wireless in the forces during hostilities. Particulars were given of trench spark sets, the Intelligence telephone, and power buzzer, and other items of interest in connection with doings on the French front. After a period in this country he was sent over to Ireland, where he had some further experiences with an ½ kw. single valve set. Mr. Neale followed with a talk on his experiences with aeroplane sets.

Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Bruce Grove, Tottenham, N.17.

The Kensington Radio Society.*

On Thursday, March 6th, a paper was read by Major A. C. Fuller, R.C.S., on "Novelties in the Design of Loud Speakers. In it he described his investigations in the causes of distortion and his experiments in methods of overcoming the defects. An experimental model was shown embracing the improvements he had found of practical value. Speech and music were received on it and the audience were of the opinion that the rendering of music in particular was much more perfect than by another loud speaker used for comparison.

Persons desirous of joining the above Society please communicate with Hon. Sec., J. Murchie, 33, Elm Bank Gardens, Barnes, S.W.13.

Battersea and District Radio Society.*

On Thursday, March 13th, Mr. Philip R. Coursey gave a very interesting lecture on the products of Messrs. The Dubilier Condenser Co., with the aid of lantern and slides.

The lecturer began by showing the Leyden Jar and Spark Gap. The materials used in the construction of condensers and their passage through the various departments, including inspection and testing rooms, the machine and assembling shops, were fully dealt with.

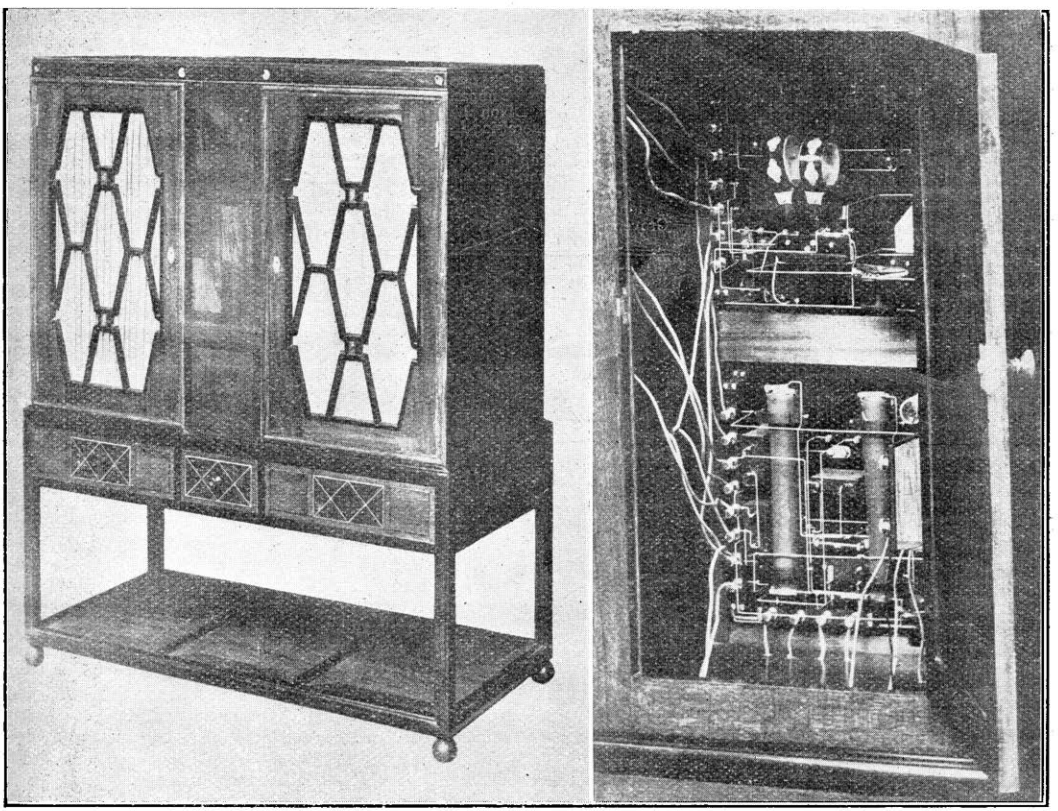


Photo: Barratt's.

The cabinet receiver recently presented to H.M. the King by the British Broadcasting Company and installed at Buckingham Palace. Resistance coupled high and low frequency amplification is employed.

The uses to which condensers are put were interestingly described, and the lecturer demonstrated graphically their power to resist lightning.

Local readers wishing to avail themselves of the Society's lectures will do well to communicate with the Hon. Secretary, T. M. Norris, 39, Warriner Gardens, Battersea, S.W.11.

The West London Wireless and Experimental Association.*

On Tuesday, March 11th, Mr. A. P. Dobson explained a circuit that he had constructed with great success for the reception of short wave telephony direct from **KDKA**. Mr. W. T. Fair also explained how he had overcome difficulties in the reception of short wave telephony. Mr. F. E. Studt (Vice-President) exhibited a very interesting plotting chart that he had made by using logarithm-ruled paper to get straight line curves showing the wavelengths of various coils that he had in use, amongst which were Burndept, Igranic Honeycomb and Gambrell makes. The demonstration given by Mr. Studt was very greatly appreciated, as it indicated a very simple and reliable method of ascertaining the capabilities of any coil in use in any circuit. The plotting chart, which showed a considerable amount of very careful work, was then passed round for individual inspection. The Secretary will be pleased to answer all enquiries as to membership of this Association.

Headquarters: Acton and Chiswick Polytechnic, Bath Road, Chiswick, W.4

Hon. Sec., Horace W. Cotton, 19, Bushey Road, Hayes, Middlesex.

Wimbledon Radio Society.*

An instructive evening was spent by this Society on Friday, March 14th, when Mr. Wright, of the Igranic Electric Company, lectured on "Low Frequency Amplification Circuits." The lecturer most ably explained the principles underlying the action of resistance, choke and transformer amplification at audio-frequency, and proved most conclusively that transformer amplification is, in the long run, the cheapest and most efficient. It was shown how stray capacities are minimised in the construction of commercial L.F. transformers, and stress was laid on the importance of correct grid bias adjustment. An interesting point mentioned was with regard to changing the reaction coil on a receiving set whilst the valve filaments are switched on and the steady anode current is passing. The sudden removal of the reaction coil, perhaps whilst the valves are oscillating, owing to the additional capacity caused by the approach of the operator's hand, places a severe strain on the primary winding of the first L.F. transformer, and is a prolific cause of breakdown in badly made transformers.

A party of members visited **2 LO** on Wednesday, March 12th, and the Society is very much indebted to the B.B.C. and the Marconi Company for their courtesy in allowing this to take place, more especially as permission has been granted for a second party to pay a visit.

The Society meets every Friday evening at the Red Cross Hall, 59, Church Road, Wimbledon, S.W.19. The subscription for 1924 is 7s. 6d., entrance fee 5s., and all enthusiasts in the Wimbledon district should join. Further particulars will gladly be forwarded an application to the Assist. Hon. Sec., P. G. West, of 4, Ryfold Road. Wimbledon Park, S.W.19.

North Middlesex Wireless Club.

As the meeting on March 5th was the occasion of the half-yearly sale of instruments the Chairman became temporarily an auctioneer. Although the number of "lots" was not so great as usual, some very useful pieces of apparatus changed hands, and Mr. Dixon had plenty of opportunity of exercising his well-known descriptive talent.

The membership of the Club is still growing satisfactorily, five new members being elected during the evening.

Hon. Sec., H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

Liverpool Radio Co-Operative Association.

An interesting talk on "American Broadcasting" was delivered by Mr. A. G. Penlington, President of the Association, on Friday, March 14th.

Mr. Penlington contrasted the American and British systems, to the advantage of the latter. Having sketched the history of radio in America from the early days of the Marconi coherer to the present super-regenerative circuits, he paid special tribute to the inventive genius of such pioneers as Edison, Dr. Fleming, De Forrest and Tesla.

The President then introduced Mr. G. R. Rowe, an American citizen, who gave some interesting particulars of the progress of the service in America.

Hon. Sec., James Kearns, 107, Walton Breck Road, Liverpool.

Honor Oak Park Radio Society.

On March 7th, Mr. C. D. Richardson (Chairman of the South London League of Radio Societies), delivered an interesting lecture on the potentiometer, its theory and construction.

A clear idea was given of what "potential" actually is, the lecturer illustrating his remarks with analogy and demonstration. The action of the primary cell was also explained and the practical construction of a 40 ohm potentiometer dealt with.

The lecture concluded with the testing of cells by means of the potentiometer and a reflecting galvanometer, using a Daniell cell as the standard, readings being taken from time to time and loss of voltage noted.

Hon. Asst. Sec., H. Norris, 54, Bovill Road, Forest Hill, S.E.23.

Brockley and District Radio Association.

"Dual Amplification" formed the title of an instructive lecture delivered by Mr. E. Gilbert on Friday, March 7th. Having outlined the principles of dual reception Mr. Gilbert gave an effective demonstration with a three-valve receiver of his own construction.

Hon. Sec., Harrie King, 2, Menslowe Road, E. Dulwich.

CORRESPONDENCE.

Homodyne.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I was interested in F.G.G.D.'s letter mentioning Dr. Appleton's paper on the "locking" of oscillating valve circuits, and was reminded of a paper read before the (then) Wireless Society of London on "A Portable Set and Some Properties of C.W. Circuits," on January 29th, 1920, when I demonstrated this locking or synchronising effect by means of two portable receivers and a loud speaker. An account of this was given in *The Wireless World* for March, 1920, page 712. Undoubtedly, as F.G.G.D. says, many listeners must unconsciously use "Homodyne" reception. Unfortunately, however, the unconsciousness does not always extend to their fellow listeners.

Rugby. R. C. CLINKER.

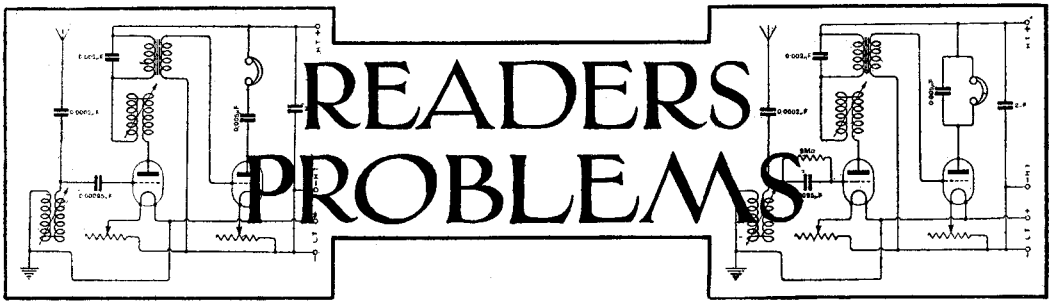
To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I am indebted to your correspondent F.G.G.D. for his interesting comments on my article on "Homodyne" reception.

I was, as a matter of fact, aware of the existence of the paper he mentions and had intended to refer to it, but unfortunately omitted to do so.

His criticism in the matter of rectification involved in homodyne reception I accept without reserve. Inasmuch as a modulated high frequency E.M.F. in one part of the circuit appears as a modulation frequency current in another part, it is of course obvious that rectification has taken place somewhere. The idea I intended to convey but which, apparently, I did not express very clearly, is that the rectification which takes place in homodyne reception is something quite different from the usual rectification process in a triode valve. The latter depends upon a lowering of the mean grid potential due to variations of grid filament conductivity, producing in consequence a lowering of mean anode current. In the case of the homodyne circuits considered in my article, the mean grid potential cannot change appreciably as the grid is connected through a low resistance to the filament. Moreover, the high frequency E.M.F.s operating in the grid circuit cause, in this case, not a lowering of mean anode current, but a very considerable increase of mean anode current. The precise mechanism of the rectification is not clear, but it obviously depends on the anode characteristic and not on the grid current characteristic. This is the distinction which I wished to emphasise.

Teddington. F. M. COLEBROOK.



READERS' PROBLEMS

1. *All questions are answered through the post. A selection of those of general interest is published.* **2.** *Not more than four questions may be sent in at any one time.* **3.** *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* **4.** *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

"*R.D.*" (*Richmond*) **wishes to construct a two-valve receiver having a detector and note magnifier, and asks for the connections.**

The diagram of connections is given in Fig. 1. The aerial circuit is tuned with a 0·0005 variable condenser, and may be connected in series or parallel with the coil by using the switch. It will be noticed the grid leak is connected between the grid and the positive terminal of the filament heating

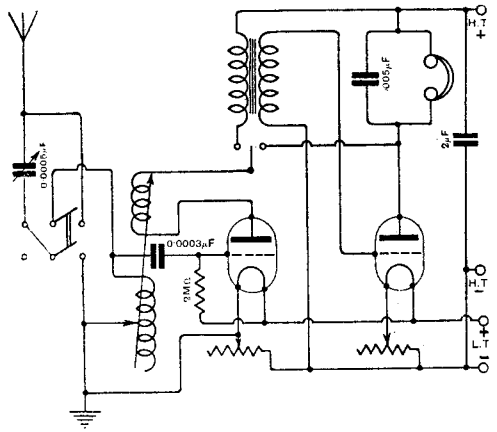


Fig. 1. "*R.D.*" (*Richmond*). *Diagram of connections for a two-valve receiver* (*detector and L.F.*) *with switch for disconnecting the L.F. valve.*

battery. The reaction coil is connected between the anode of the detector valve and one side of a single pole two-position switch. With the switch in the left-hand position, the intervalve transformer is connected in the anode circuit of the detector valve, and the secondary is joined to the note magnifier. With the switch in the right-hand position, the intervalve transformer is disconnected from the anode circuit, and the telephones are joined up instead, so that the note magnifier is not used. For short wavelength work the aerial coil may have 60 turns of No. 22 D.C.C. on a 3" former with five or six tappings. The reaction coil may have 50 turns of No. 30 D.S.C. on a former 2½" in diameter. You may prefer to put the reaction coil winding on a ball, which can be mounted to rotate in one end of the aerial coil. To obtain smooth reaction, adjust the high tension voltage and the filament temperature of the detector valve. If the anode voltage is 90 to 100 volts, it may be advisable to connect a cell in the grid circuit of the note magnifier, so that the grid is made negative with respect to the negative terminal of the filament battery. A correct grid bias should always be given, and depends upon the anode voltage and the particular valves which are employed.

"*J.C.*" (*Hendon*) **asks questions concerning a low frequency step-up transformer.**

For the type of transformer you require, it is satisfactory to allow three turns per volt when the core has a cross section of 3 square ins. The primary voltage is 200, therefore the number of turns required in the primary winding is 600. The primary winding may be wound with No. 18 D.C.C. The number of secondary turns to give 500, 700 and 1,000 volts are 1,500, 2,100 and 3,000. No. 38 D.S.C. will safely carry the current of 50 milliamperes.

"*H.H.*" (*Hebden*) **asks for the dimensions of a 1:1 ratio intervalve transformer for the last stage of a low frequency amplifier.**

The bobbin may consist of a tube of insulating material 2¼" long by ½" in diameter. The cheeks may be circular, with a diameter of 1½". Wind 10,000 turns of No. 44 S.S.C. for the primary, and 10,000 turns of the same gauge wire for the secondary. The resistance of the primary will be roughly 1,700 ohms, and for the secondary

2,600 ohms. The core should consist of a bundle of soft iron wires, about No. 22 gauge, built up to a diameter of ⅜", and 7½" long.

"C.L." (*Yorks*) asks for a diagram of a one-valve and crystal dual receiver.

The diagram is given in Fig. 2. It is convenient to mount all three coils in a three-coil holder. The aerial circuit is tuned with the 0·0005 variable condenser, and for broadcast reception a No. 75 coil is used. This should be the lower coil in the holder. The centre socket of the holder should contain the closed circuit coil, which is tuned with a 0·0002 variable condenser. The anode coil is the upper one, and this is also tuned with a 0·0002 condenser, so that the settings of the anode and the closed circuit condensers are approximately the same. Both coils may be a No. 75. The high frequency oscillations which appear in the tuned anode circuit are rectified by the crystal detector, and the low frequency component passes through the primary winding of the L.F. transformer. The secondary winding is connected between the filament and the secondary circuit, so that the 0·0002 fixed condenser is across the secondary winding. Sometimes better results are obtained if a larger fixed condenser, such as 0·002 mfds., is employed in place of the 0·0002. Try the effect of connecting the earth with the negative terminal of the filament battery. The telephones which are shunted by a suitable condenser, generally 0·002 mfds., are connected in the anode circuit in series with the high tension battery. With a receiver of this sort very good results are obtained, especially when proper use is made of the regeneration

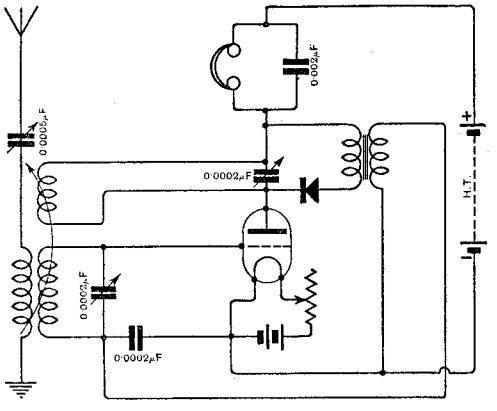


Fig. 2. "C.L." (Yorks). Circuit diagram one-valve and crystal dual receiver, employing a three-coil holder.

obtained by coupling the anode and the closed circuit coils in the way suggested above. It is a good plan to try several types of crystal detector. The adjustment should be carefully made. With the wire of the detector making a very light contact on the face of the crystal, the circuit is very often unstable. It is sometimes an advantage to connect a 0·2 megohm resistance across the secondary winding of the intervalve transformer.

"L.M." (*Birmingham*) asks for a diagram of a two-valve amplifier.

The diagram is given in Fig. 3. The primary winding of the first intervalve transformer labelled "input" is connected with the telephone terminals of your receiver. The secondary winding is connected between the grid of the first valve and

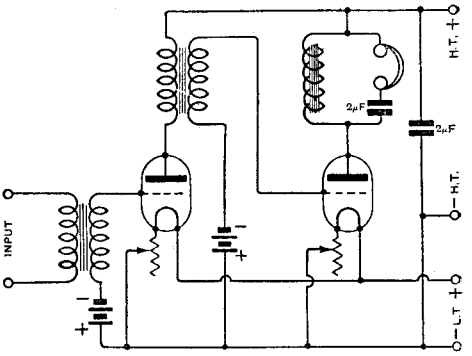


Fig. 3. "L.M." (Birmingham). Connections for a two-valve amplifier.

the negative terminal of the filament heating battery through a grid bias battery, which should be adjustable. The grid of the second valve is also given a negative bias, which may be the same as that of the first valve if the same high ten ion voltage is used for each. The filter circuit connected between the positive H.T. and the anode of the last valve is to prevent the steady valve current passing through the loud speaker. The choke may consist of the two windings of an intervalve transformer joined in series, or a choke could be made as follows:—On a bobbin 2½" long and ½" in diameter, wind 15,000 turns of No. 42 D.S.C. Through the centre of the bobbin fit lengths of No. 22 soft iron wire, and bend the ends over the surface of the choke.

"F.J." (*Seven Kings*) asks for the inductance of various single layer coils which he has wound.

A coil of No. 22 D.S.C., 2" in diameter and 4" long has an inductance of 325 microhenries. A coil of No. 22 D.S.C. 4" in diameter, with a winding length of 4", has an inductance of 1,140 microhenries. A coil of No. 30 D.S.C., 2" in diameter and 4" long has an inductance of 1,300 microhenries. A coil 4" in diameter and 4" long, wound with No. 30 D.S.C. has an inductance of 4,750 microhenries.

"W.W." (*Twickenham*) asks how many turns to put on a step-down telephone transformer.

The primary winding may consist of 8,000 turns of No. 42 S.S.C., and the secondary winding 800 turns of No. 34 S.S.C. Wind the wire on a bobbin 2½" long. The core may consist of a bundle of soft iron wires built up to a diameter of half an inch.

Calls Heard

Contributors to this section are requested to limit the number of calls sent in o those heard in the previous three weeks, these being of greater interest and value to transmitt rs than earlier records. The repetition of the same call sign in consecut ve lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

Copenhagen Denmark.
English: **2 WF, 2 RB, 2 NO, 2 NA, 2 SM, 2 DF, 2 OD, 2 LZ, 2 FZ, 2 NM, 2 SZ, 2 KF, 2 KW, 2 SQ, 2 WJ, 2 AW, 2 XY, 2 AP, 5 KO, 5 DN, 5 UO, 5 US, 5 BV, 5 AT, 5 SZ, 5 FS, 5 MO, 5 MQ, 6 NI, 6 RY.** French: **8 AG, 8 AQ, 8 BF, 8 BM, 8 GF, 8 LB, 8 AB, 8 EM, 8 OH, 8 CS, 8 AZ, 8 SSU, 8 DU.** Dutch: **0 XP, 0 BS, 0 DV, 0 NY, 0 YS, PA 9, PAOY, PCII, 0 AA, PCTT, 0 KX.** Danish: **7 QF, 7 ZM, 7 EC.** Italian: **1 MT, ACD.** Miscellaneous: **1 JW, 4 ZG, YDL, 4 UA.**
Borge Forgensen.

Gloucester.
2 AOJ, 2 AS, 2 CW, 2 FL, 2 GG, 2 KO, 2 LG, 2 MP, 2 MT, 2 OP, 2 RH, 5 KO, 6 CW, 6 QP, 6 UG, 8 AB, 8 AU, 1 MT.
(A. R. Jennings, **6 HH.**)

Howden, Yorks (during January).
1 JW, 2 AC, 2 AO, 2 DX, 2 FD, 2 FN, 2 GJ, 2 GK, 2 GP, 2 GX, 2 HQ, 2 LT, 2 LX, 2 OG, 2 OK, 2 QH, 2 YO, 2 XK, 2 ZA, 2 ZT. 5 AW, 5 BS, 5 CH, 5 FB, 5 FL, 5 FU, 5 ID, 5 NP, 5 OW, 5 PB, 5 SI, 5 UM, 6 LK, 6 NI, 6 NO, 6 VB, 8 AB, 8 AE, 8 BA, 8 BP, 8 BV, 8 CJ, 8 CS, 8 CT, 8 CW, 8 CY, 8 CZ, 8 DY, 8 EB, 8 EI, 8 FB 8 JL 8 OH 8 QJ 0 AB 0 KX 0 NY 0 PB. (o—v—o.)
(D. E. Scarr.)

Milan, Italy.
2 DR 2 FQ 2 GG 2 LE 2 ON 2 OR 2 PC 2 PG, 2 JF, 5 AT, 5 BV, 5 PA, 5 PU, 6 NH, 6 XX, 7 EC, 8 AA, 8 AD, 8 AE, 8 AL, 8 AP, 8 AQ, 8 AS, 8 BE, 8 BP, 8 CW, 8 CS, 8 CZ, 8 DA, 8 EB, 8 EB, 8 EM, 8 ZA, 0 AB, 0 BS, 0 KX. (1—v—1.)
(Franco Pugliese and Eugenio Gnesutta.)

Grisons, Switzerland (since November).
2 DR, 2 FN, 2 FQ, 2 GU(?), 2 HF, 2 IN, 2 KW, 2 LZ, 2 NM, 2 OD, 2 ON 2 OZ, 2 SZ, 2 WJ, 2 ZG, 2 ZT, 5 AT, 5 DN, 5 GJ, 5 NN, 5 PU, 5 QV, 5 RZ, 5 SZ, 5 WR, 6 XX, 8 AA, 8 AE, 8 AS, 8 AU, 8 BE, 8 BF, 8 BM, 8 BU, 8 CD, 8 CF, 8 CQ, 8 CK, 8 CM, 8 CS, 8 CT, 8 CY, 8 CZ, 8 DA, 8 DX, 8 EB, 8 EM, 8 JL, 8 LS, 8 LY, 0 AA, 0 AR, 0 KX, 0 MG, 0 NY, 0 XP, 0 YS, 9 PA, PAR 14, 1 MT. (1—v—1.)
(Hugh R. Macdonell.)

Edgbaston, Birmingham.
2 DU, 2 HA, 2 HF, 2 HW, 2 KO, 2 LX, 2 NP, 2 NV, 2 OX, 2 PH, 2 QR, 2 WG(?), 2 XC, 2 YI, 2 YV, 2 YX, 5 CW, 5 FI, 5 FV, 5 FX, 5 KD, 5 MB, 5 MV, 5 NU, 5 WO, 5 YF, 5 YS, 5 ZY, 6 HU, 6 UU, 6 VK, 6 XQ.
(K. R. Brecknell, **2 AAH.**)

Hove, Sussex.
2 AC, 2 AO, 2 BS, 2 CW, 2 FA, 2 FL, 2 IL, 2 IM, 2 IO, 2 JU, 2 KA, 2 KF, 2 LM, 2 MC, 2 NM, 2 OJ, 2 OM, 2 OY, 2 OZ, 2 PL, 2 PQ, 2 PU, 2 RB, 2 SL, 2 SO, 2 ST, 2 WZ, 2 XW, 2 XZ, 2 ZV, 5 CC, 5 GJ, 5 MC, 5 OZ, 5 PU, 5 QM, 5 QJ, 5 SL, 5 SV, 5 TS, 5 TZ, 5 VA, 5 WU, 5 UV, 6 AH, 6 AW, 6 BS, 6 CO, 6 GZ, 6 HD, 6 LH, 6 LS, 6 MS, 6 NH. 6 OM, 6 PS, 6 SH, 6 VS, 8 AB, 7 BJ, 8 BV, 8 CJ, 8 CZ, 8 FG, 0 BS, 0 BQ, 0 FN, 0 KB, 0 MX, 0 NY, 0 XO. (2—v—1.)
(F. C. Clarke.)

Handsworth, Birmingham.
American Calls: **1 ABJ, 1 AG, 1 AJA, 1 AUR, 1 AZL, 1 BCF, 1 BDI, 1 BUQ, 1 BU, 1 CMP, 1 DN, 1 XAR, 1 XJ, 1 XU, 1 XW, 2 AGB, 2 BG, 2 BL, 2 BQ, 2 BQH, 2 BYW, 2 YW, 2 CPD, 2 CXU, 2 CXW, 3 OI, 3 OX, 3 QI, 3 QR, 3 VU, 3 YO, 4 ZZ, 8 FM, 9 BL,** (Indoor Aerial.) (o—v—1.)
(D. A. Broun.)

Books Received.

Wireless Telegraphy and Telephony: And How to Make the Apparatus. By E. Redpath. A revised edition of the book, first published in 1922. (London: Cassell & Co., Ltd., La Belle Sauvage, E.C.4. 152 pages. 87 illustrations. Price 1s. 6d. net.)

Fitting and Adjusting Bearings. Marking Out for Machinists. Practical Hand Forging. Three useful little books forming Nos. 1, 2 and 3 of Marshall's "Practical Workshop Series." By Captain Richard Twelvetrees, A.M.I.Mech.E. (London: Percival Marshall & Co., 66, Farringdon Street, E.C.4. With numerous illustrations. Price 9d. net each.)

Radio Time Table: A time-table of Radio Transmissions throughout the twenty-four hours. (London: Percival Marshall & Co., 66, Farringdon Street. 48 pages. Price 6d. net.)

The Radio Year Book, 1924. A book of reference for all interested in broadcast receiving. With contributions by eminent radio engineers and scientists. (London: Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, W.C.2. 184 pages. Price 1s. 6d. net.)

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres; **BRIMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **P YMOUTH 5PY** (Relay), 330 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. Daily, 6.40 to 7 a.m. Weather Forecasts; 10.50 a.m. (Thursday and Friday), 11.15 to 11.30 a.m., Time Signal and Weather Forecast; 12.0 noon, Live-stock prices; 3.40 p.m. (Saturday excepted); Financial report, 5.30 p.m. (Saturday excepted) Bourse Closing Prices; 6.10 p.m. Concert or Address; 7 p.m., Weather Forecast; 7.20 p.m. (Sunday), Concert and Address; 10.10 p.m., General Weather Forecast.

PARIS (Compagnie Francaise de Radiophone Emissions "Radiola"), SFR, 1,780 metres. Daily, 12.30 p.m., Cotton Oil and Café Prices, News, Concert; 1.45 p.m., First Bourse Report; 4.30 p.m., Bourse Closing Prices; 4.45 p.m., Concert; 5.45 p.m., News and Racing Results; 8.30 to 9 p.m., News; 9 p.m., Concert; 10 p.m. to 10.45 p.m., Radio Dance Music.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres. 9 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 8.15 p.m. to 9.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert.

LYONS, YN, 3,100 metres. Daily, 9.45 a.m. to 10.15 a.m., Gramophone Records; 450 metres. At 11 a.m., Concert and News. 3.45 p.m., Market Reports. 5 p.m. and 9 p.m. Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 1 p.m. and 5.30 p.m., Meteorological Forecast; 9 p.m. (Tuesday), Concert.

BRUSSELS ("Radio Electrique"), 410 metres. Daily, 5 to 6 p.m., 8.30 p.m. to 9.30 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 3 to 5 p.m. (Sunday), 8.40 to 10.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 9.40 to 10.40 a.m. (Sunday), Concert; 8.40 to 9.40 p.m., Concert; 7.45 to 10 p.m. (Thursday), Concert.

THE HAGUE (Velthuis n), PCKK, 1,050 metres, 8.40 to 9.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 8.10 to 10.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 8.10 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular). 7.40 to 9.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres. 8 a.m. and 4 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 7.30 to 8.45 p.m., Concert (Sunday excepted).

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,800 metres (Sunday), 10.50 a.m. to 11.50 a.m., Orchestral Concert; 650 metres, 4.30 p.m. to 6 p.m. (Weekdays), 4,000 metres, 6 to 7 a.m., Music and Speech; 11.30 to 12.30 p.m., Music and Speech; 4.0 to 4.30 p.m., News; 650 metre , 8.30 to 9. 0 p.m., Concert.

EBERSWALDE, 2,930 metres. Daily, 12 to 1 p.m., Address and Concert; 7 to 8 p.m., Address and Concert; Thursday and Saturday, 7 to 8 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 8 to 9 p.m. Concert.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 7 a.m., 11 a.m. and 3 p.m,. Meteorological Bulletin and News; 4,500 metres, 9 a.m., 2 p.m., and 9 p.m., Concert.

KBEL (near Prague), 1,000 metres. Daily, 6.20 p.m., Concert, Meteorological Report and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 2.15 p.m. Concert or lecture.

LAUSANNE, HB 2, 780 metres. Daily, 8.15 p.m. Concert and Address.

SPAIN.

MADRID, 1,650, 2,200 metres (Irregular). 12 to 1 p.m., Tests.
MADRID, PTT, 400 to 700 metres. 4 to 5 p.m., Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 11 a.m., Gramophone Records.

Radio Society of Great Britain.

ANNUAL CONFERENCE OF AFFILIATED SOCIETIES.

THE Annual Conference of Affiliated Societies of the Radio Society of Great Britain was held at the Institution of Electrical Engineers on Saturday, March 1st, at 2 p.m. Dr. W. H. Eccles, President of the Radio Society of Great Britain, was in the chair, and there were delegates from all parts of the country.

The Chairman, in opening the Conference, said that the main object was to discuss the alterations proposed by the Radio Society in its constitution, with special reference to the new rules relating to the affiliated societies. After explaining the general object in making these alterations, the Chairman continued:—That work took the greater part of ten months, and the result has been a change that will inaugurate a new era. We have not been so unwise, I may venture to say, as to make a terrible revolution. Revolutions are very often accompanied by various dangers. We have made an intermediate step in order to obtain safely that which we all desire. We must take this new constitution, therefore, as a compromise and one which it will be safe to inaugurate immediately. Anything more violent we think, might be dangerous to us and to the whole of the amateur movement, but you will find if you read the whole thing carefully—I hope that most of you have—that the guiding aim throughout has been to promote unity among the ranks of the experimenters in this country. That unity is desirable is shown by the old motto that "Unity is Strength," and that strength is desirable in the experimenters' ranks and the amateur movement is surely indicated by the fact that the amateur is, as we all know, being unjustly attacked in many ways. Whenever anything happens to spoil the evening's programme in any part of the country it is the experimenter who gets the whole of the blame, and therefore those of us who have at heart the freedom of experiment in this country will have to stand together and show that we have a thoroughly good case for the preservation of that freedom. That is what is running all through these draft Articles and Memorandum of Association. The troubles that we have in front of us are very numerous. There is the question of the difficulties in obtaining amateur transmitting licences, and other problems of similar magnitude will demand the whole-hearted support of affiliated societies so that the Radio Society can say that it represents not only themselves but also everybody else in the country who is an experimenter or a lover of the subject.

The first thing I have to do is to ask you to discuss the series of principles, A-F on the Agenda paper. The first principle is:—

A. A General Committee should be formed for the discussion of national wireless affairs affecting amateurs.

In order that we may proceed quickly, I will ask for a proposer and seconder at once.

Mr. Stanley (Highgate).

I have much pleasure in proposing principle A.

Mr. Crowther (Sheffield).

I have much pleasure in seconding the motion.

Mr. Stanley.

This General Committee, I take it, will be representative of the affiliated societies, and it will bring about a much closer co-operation between them and the parent Society—the Radio Society of Great Britain. My Society some time ago felt that some such Committee was very desirable, and we think that the present scheme will bring about the aims we had in view. Whilst it does not go perhaps quite so far as the idea my Society had in mind, I think it is the best compromise we can get at the present moment. We shall have an advisory body to advise the Radio Society of Great Britain on all matters of national interest affecting amateurs, and it will also work in conjunction with the parent Society on all other matters. Therefore, I think this General Committee will bring about that closer association between the affiliated societies and the Radio Society of Great Britain which we all desire.

The motion was then carried without further discussion.

The Chairman.

The second principle is:—

B. This General Committee should be elected mainly by the Affiliated Societies.

The stress is on the word "mainly" and there may be some discussion about that, but I think the word was used in order that the Radio Society, which is the largest of the societies, should have the privilege of sending some members to the General Committee. In the Articles of Association I think the proportion is six out of 30 or 40. I will ask the same gentlemen to propose and second this motion as before.

Mr. Stanley proposed and Mr Crowther seconded the adoption of B.

There was a short discussion, and eventually principle B was carried with three dissentients.

The Chairman then put principle C as below, and it was moved and seconded as before:—

C. Communications with public bodies on national affairs should be made by the Council on the advice of the General Committee, provided that—
(i) The Affiliated Societies have representation on the Council.
(ii) All administrative expenses of the General Committee be defrayed by the Radio Society.

The Chairman.

I think I might explain that the idea was that we ought not to have big national affairs discussed say with the Government Departments by two bodies representing the Radio Society and the wireless amateur. It would be as perplexing as the dog who used to growl with his mouth and wag his tail at the same time, so that the stranger never knew which end to believe.

Principle C was carried *nem. con.*

The Chairman then read principle D as follows:—

D. For the purpose of electing the General Committee the Affiliated Societies should be divided into groups which shall each elect one member.

The Chairman.

The principle does not say how many groups, but it does say that each group shall elect one member. It may be that some members will say that it will be better to have large groups electing two or three members rather than small groups electing one member, and it is to elicit opinions that I ask for discussion. It may also be conceived that there are other ways than dividing into groups.

Capt. Plugge (T.O.T.).

It is mentioned at the end of the Agenda that groups should be neighbouring societies, geographically speaking. I represent a society that is not limited exactly geographically. It is the Radio Society of the Underground Railways of London. We have members all over the town, and it will be difficult for us to link up with any definite area. I suggest that, therefore, in such cases, affiliated societies of similar detachment might join together.

Mr. Betts (Leyton).

I would like to suggest that in congested areas a large number of societies might be grouped to elect more than one member. It would be easier to obtain suitable members from a number of societies thickly grouped together, than one member from a small number of societies. I suggest that we should say "one or more members" instead of "one member."

This proposal was agreed to.

Mr. Bird (Cambridge University Wireless Society).

The Universities have a larger floating and continually changing population than the ordinary society. On the principle laid down by the representative of the Underground Railways I am wondering whether wireless societies connected with universities or colleges could be grouped together.

The Chairman.

It seems to me that the two cases mentioned are exceptional, and another which occurs to me is that of the Ladies' Lyceum Club of which we have a representative here to-day. Perhaps the difficulty would be met by having a Miscellaneous Group into which this class of society could be put.

Mr. Crichton (Edinburgh).

This particular question is one which affects the Scottish group. The Edinburgh Society has discussed the matter on many occasions, and there is the difficulty of a representative of the Society attending meetings in London. Hitherto our Secretary has managed to be present about twice a year, but it is unsatisfactory, because we are a long way from London, and very much out of touch. The farther north you go the more complicated it comes. Obviously the best method for Scotland would be for the Scottish group to become affiliated direct with the

headquarters group of London, because that is the only way, I think, we can solve the problem. Speaking as a Scotsman for the Scotsmen I should be very much disappointed if we were classed in the Miscellaneous Group, with all due respect to the other members of it. (Laughter.)

The Chairman.
I am just reminded that we have foreign and colonial societies associated with us, and the colonial societies especially would have to be considered. So far as the Scottish Society is concerned, if they like to form one group, as the principle has been amended it will be possible for them to send several members to the General Committee, and I think that will be sufficient to cover their case. If the Scottish Societies made up one large group they might be able to elect four or five members.

Mr. Crichton (Edinburgh Society).
The difficulty is to find someone with the leisure and means to attend the meetings because it is an expensive business for us.

The Chairman.
You could appoint someone who lived in London.

Mr. Betts (Leyton).
It occurs to me that if principle D is passed, societies like those of the Universities and the Underground Railways will be left out in the cold, and I would therefore like to propose the addition of the following words to D :—

That the General Committee have power to co-opt nominees, members or representatives of societies not adequately represented.

The proposal was seconded.

Mr. Epton (Hackney).
We have heard of the Universities and Underground Railways, and there is also a society representing a well-known caterers and another representing a town where boots are manufactured. Probably there are others, but when it comes down to brass tacks, all these societies have their headquarters in some particular spot. For instance the Underground Railways Society probably meets somewhere near the headquarters of the Underground Railways Company, at Westminster, and in their case I do not see why it should be necessary to go into a separate category. They could link up with the other societies in the area in which they hold their meetings. Similarly I do not see why the Cambridge University should be taken out of the Cambridge area, and altogether it seems to me that there need be no necessity to have any miscellaneous group.

Mr. Hope-Jones.
I should like to support the suggestion that there is no reason why these societies should not come under the geographical scheme. The Ladies' Lyceum Club has a definite location in Piccadilly, and the fact of sex is nothing whatever to do with it. As a matter of fact the ladies at the Lyceum Club have shown more enterprise and co-operation than others, and had a representative present at the meeting held to elect a temporary representative of the western suburban societies.

Capt. Plugge (T.O.T.).
The Underground Wireless Society is called the T.O.T. Society, and includes people engaged on trams, omnibuses and tubes. It includes the South Metropolitan Electric Tramways and the North Metropolitan Tramways Company, as well as the Underground Railways of London, and we do not meet at a central point. We have divided our Society into small groups distributed round London, and the meetings take place in different parts; therefore, I think that the remarks I made earlier still hold good.

The Chairman.
The T.O.T. are really big enough to have a member of their own. As regards the Universities the people who work there have no strict home at the University, and have probably less apparatus at the University than they have at their home. In the same way the Ladies' Lyceum Club may not have, for all I know, any headquarters, but if they are willing to go into the geographical scheme this fact would not prevent them doing so.

Miss Dicks (Ladies' Lyceum Club).
The Ladies' Lyceum Club has groups in almost every city in Europe, Canada and America.

Mr. Betts (Leyton).
If the rider which I have proposed is accepted it would leave it to the General Committee to deal with any hardships of the kind referred to, which are always found in dealing with rules of this nature.

The Chairman then put the rider to the meeting, and principle D was eventually passed with the two alterations indicated above and now reads as follows :—

For the purpose of electing the General Committee the affiliated societies should be divided into groups which shall each elect one or more members. The General Committee shall have power to co-opt nominees, members or representatives of societies not adequately represented.

The Chairman.
The next principle is E.

E. The division of the Affiliated Societies into groups should be left to the General Committee and revised frequently.

Principle E was carried without discussion.

The Chairman.
Principle F is as follows :—

F. The General Committee should from time to time fix the fees of affiliation, but not lower than those existing at present.

The idea is that the General Committee must be allowed to control its own contributions. As the Radio Society of Great Britain will do all the clerical work it will probably be found that the expenditure for the first few years is likely to go up and the tendency will be for the affiliation fee to be raised gradually during the next five years.

The principle was proposed and seconded.

Mr. Matthews (Birmingham).
I object to the words "lower than those existing at present," my point being that circumstances may arise which will enable the fees to be reduced below what they are at present. I think it should be left to the General Committee to fix fees according to circumstances.

Mr. Dixon (North Middlesex).
I should like to recall a suggestion I made last year, that if the Committee find it necessary to raise fees they should not be raised from say a guinea to one and a half guineas or two guineas per group, but should be raised on the basis of membership. That is because groups with a membership of say 40 or 50 cannot afford to pay such a large fee as a group like the T.O.T., which has a membership of over a hundred. Such groups of course can afford to pay a higher affiliation fee than the small group with only a few members.

Captain Plugge (T.O.T.)
I think the suggestion just made destroys the principle of the affiliated societies. If one bases the affiliation fee on the number of members the whole idea of an affiliated society disappears. I would like to support what the gentleman from Birmingham just said in favour of giving the General Committee full freedom to raise or lower the fees according to circumstances.

The Chairman.
We must not raise the whole question of how to fix the fees for affiliated societies because it is a very difficult question and has never been settled, although it has been discussed at previous conferences. The only point we have to consider now is whether the General Committee should have the power to fix fees, but not to reduce them below those existing at present. It would be within their power to fix it at a per capita figure and take into account the payments made by each individual member of an affiliated society. The only limitation in F is that they shall not be lower than those existing at present.

Mr. Stanley.
May I suggest that we get over the difficulty by adding the words "without the consent of the Council" at the end of F.

This was agreed to.

Mr. Epton (Hackney).
Is there any question of discontinuing this Annual Conference?

The Chairman.
This one may be the last, unless the General Committee chooses to call annual conferences in the future.

Mr. Epton (Hackney).
If I thought the General Committee were going to interfere in any way with the Annual Conference I should vote against its formation, because I think it is most important that the affiliated societies should have annual conferences or perhaps conferences even more frequently. You get much better co-operation from holding meetings as we are to-day than in any other way.

The Chairman.
The conferences are not being done away with, but will be in the hands of the General Committee. Hitherto it has been left to the Council whether an annual conference was called or not, but in future it is left to the affiliated Societies. There is no obligation on the General Committee to continue or discontinue the annual conferences.

Would it please the majority of the members to say "annual" instead of "from time to time?" I think it might be taken that "from time to time" means every year or something like that.

Mr. Dixon (North Middlesex).
I propose that the General Committee should be empowered to revise the fees for affiliation annually.

This motion was seconded.

Eventually principle F was agreed to in the following terms :—

The General Committee should be empowered to revise annually the amount due for affiliation but shall not fix these fees lower than those existing at the present time without the consent of the Council.

The Chairman.
We now come to the new Articles dealing with the affiliated societies. The first one is No. 87 :—

87. The Council may admit societies interested in the science of radio communication to the privileges of affiliation at any meeting of the Council upon the recommendation of the General Committee.

This means that the General Committee will have the main voice in choosing

ts own company, so to speak. At the same time any recommendations for affiliation sent up by the General Committee will have to be passed by the Council. The Council wants to have some say, as well as the General Committee, simply because both bodies are concerned and are anxious to keep up the standing of the Society.

Mr. Betts (Leyton).
We have a rival Society on our doorstep, and there is nothing to stop them being affiliated, whereas we as the senior Society, feel that the affiliation of a new society should come through us. Under Article 87 they can become affiliated independently of us, and I suggest there should be some alteration or addition to prevent that.

The Chairman.
I take it that the General Committee would publish in some form the names of the societies it proposes to affiliate from time to time, and if anyone had any objection to any society being affiliated then they could write to the General Committee, or if the matter had passed them, to the Council of the Radio Society, which would have to pay attention to your objection. Unless the last speaker wishes to press his point strongly I hope he will appreciate that he has a means of objecting in the manner I have described.
Article 87 was then put to the meeting and carried *nem con.*

The Chairman.
Article 88 is as follows :—
88. The General Committee, which shall be advisory to the Council, shall discuss matters affecting the common interests of the Society and the Affiliated Societies, but shall not communicate with bodies or persons outside or other than the Society and its Affiliated Societies and their officers, without the special sanction of the Council.
This has nothing to do with matters that are of purely local interest, but is only intended to prevent the Society speaking with two voices. It is, perhaps, a little badly worded, and will have to be amended. The aim is that there shall not be given to an outside body the impression that there is a divergence of view within the amateur movement, and that is why it is sought to provide that such national matters shall not be dealt with by the General Committee without the consent of the Council of the Society.

Mr. Sutton.
I have had occasion recently to write to the Postmaster-General regarding the granting of experimental licences. Shall I in future be forbidden to do this?

The Chairman.
Oh, no. This merely means that the General Committee in the name of the whole Society shall not carry on communications with, say, the Postmaster-General concerning matters of general interest and shall not commit the whole Society. Perhaps we ought to say "shall not communicate in the name of the Radio Society on such matters . . . ."

Mr. Sutton.
Shall we still have freedom to send a paragraph about our local meetings to the local papers?

The Chairman.
Yes, certainly.

Mr. Epton (Hackney).
There is one word in the Article which I object to, and that is the word "advisory." It seems to me that if the General Committee is to be regarded merely as advisory to the Council, then they are being treated like a lot of irresponsible children who cannot do anything without the consent of their parents. It will cause a great deal of trouble, I am certain, and it will be intolerable if a body like the General Committee, after having given serious consideration to a certain subject and come to a decision, must then come and ask the permission of the Council to carry out their decision. There are many matters upon which it should not be necessary for the General Committee to obtain the consent of the Council, and therefore I think the words "which shall be advisory to the Council" should be omitted, otherwise the General Committee will never be able to lift its finger without the consent of the Council.

Mr. Dixon (North Middlesex Wireless Society).
It all comes down to what it always has been, surely. The General Committee will represent what we have always called the parent society, the Radio Society of Great Britain now and the Wireless Society of London formerly. At the same time, if the General Committee comes to a certain decision and the Council of the Radio Society says they must not do it, what is going to happen? Some contingency like that is bound to arise, and we ought to make provision for it.

Capt. Plugge (T.O.T.).
I do not agree with the last two speakers. I think to call the General Committee "advisory to the Council" is a very correct way to put it. If the General Committee can do as it pleases, then we are not entitled to the backing of the Radio Society of Great Britain which we are getting.

Mr. A. A. Campbell Swinton.
The affiliated societies will be represented directly on the Council.

Mr. C. T. Atkinson (Leicester).
I do not think it should be necessary for the General Committee to have to ask the Council, when they have decided a point, as the Radio Society will be represented on the General Committee, and the views of its representatives will have just as much weight as those of the affiliated societies. Therefore, any decision of the General Committee ought to be acted upon without going to the Council again.

Mr. J. H. Reeves (Kensington).
It seems to me that the representative from Hackney and the other speakers are overlooking a very important point. The General Committee will not be a local body, and would be dealing with matters of interest all over the country. I cannot conceive of any decision unanimously come to by the General Committee being turned down by the Council. I consider that a possibility which is an impossibility, but on the other hand, suppose the General Committee want something done and get the consent of the Council, they then have behind them a body which, being duly registered, is in a position legally to enforce the decision. All those who want to have the General Committee acting for itself without the Council must bear that in mind.
After further discussion the **Chairman** asked for a vote as to whether the words "which shall be advisory to the Council" should remain in the Rule, and there was a substantial majority in favour.
It was then agreed to pass Article 88 as it originally stood, with the addition of the words "in the name of the Radio Society on such matters"—meaning national matters—after the words "but shall not communicate . . . ."

The Chairman.
Article 89 is as follows :—
Article 89. The General Committee shall consist of the President of the Radio Society ex officio, a Vice-Chairman, and Hon. Secretary, together with elected and nominated persons who are members of the Radio Society or of one or more affiliated societies. All the members of the General Committee retire annually in January at a date fixed by the Council.
There is very little to discuss there. The aim is to keep close touch between the two arms of the Society and that is why we suggest the Presidents of the Radio Society should be ex officio members of the General Committee. We feel that the Presidents of the Radio Society—following such men as Mr. Campbell Swinton and Admiral Jackson—would have great weight in the wireless world, and that it would be an advantage to have them as Chairmen of the General Committee. The Vice-Chairman would be selected from an affiliated society, and so would the Hon. Secretary.
Article 89 was carried without discussion.

The Chairman.
Article 90 is as follows :—
Article 90. The elected members of the General Committee shall be elected annually in January. For this purpose the affiliated societies shall be divided by the General Committee into Groups comprising as a rule not less than six affiliated societies. Each group shall have the right to elect to the General Committee one person who shall be a member of one or more societies belonging to a group or, alternatively, a corporate member of the Radio Society. The nominated members of the General Committee shall be nominated by the Council from their own membership in January of each year and shall be (in addition to the President) the Hon. Secretary, the Hon. Treasurer and three other persons.
This is what will happen when these arrangements are in running order. It cannot happen this year, and we shall have to take special measures to start with. In addition we shall have to say "one or more persons" instead of "one person," and then we shall have to add "member or members" instead of "member of one or more Societies . ." It may be a debatable point, whether a member actually representing a society should belong to that society or group or whether he could belong to another group. That is the alternative offered by the drafters of this Rule.

Mr. Matthews (Birmingham).
We object to the limit of six societies to form a group. The Birmingham Club is at present classified in the same group as Manchester, but the possibility of inter-communication between the two groups is very small. We think that we should have considerably more than six clubs, because there are 20 local Birmingham clubs alone.

Mr. Dixon (North Middlesex).
I take it that the large provincial towns which have a large number of clubs would be classified as one, such as Birmingham, Manchester, and so on.

Mr. Fogarty.
I think the reason for the suggestion to have not less than six clubs in a group was that this would make the representation on the General Committee not unwieldy, and so enable us to get a workable committee. If each Society sent a delegate the General Committee would

be so unwieldy that it would not be able to transact its business.

Mr. Jakeman (Sheffield).
Might I suggest that the Groups be based upon the number of members rather than upon the number of clubs?

Mr. Epton (Hackney).
I certainly think it would be a great danger if we limited the number forming Groups. I think the figure of six Societies to a Group as a minimum is a good one as a basis and it might be possible to arrange things so that there can be one member for every six clubs in a Group. Thus Birmingham with 20 clubs might be entitled to three members.

The Chairman.
Gen. Holden has suggested to me the words "comprising as a rule not less than six . . ." leaving it to the discretion of the General Committee to make even one club constitute a Group. We could say that the Group should comprise not less than 150 members, and then it would not matter if there was one society or 20 societies. There are these two ways of doing it, and there is the third way of putting no limitation on the size at all, and leave it to develop as it grows. Those of us representing the Radio Society are trying to find the best way and the wisest. I do not think the Radio Society will mind which one of the three methods is adopted.

Mr. Child (Golders Green).
I should like to support the idea of a limitation on the basis of the number of members. I do not know whether 150 would be the best figure, but it would be a fair one to start with.

Mr. Stanley.
I do not think I could agree with that suggestion for the reason that it is difficult for secretaries to know exactly what their membership is. Some societies —the Universities, for example—would, I imagine find it difficult to know exactly what their membership is. There might be say 80 members on the books, but the actual number that turn up at meetings is much less and very often those who have paid their subscriptions is less still. (Laughter.) If the membership basis is adopted it would have to be in respect of those members who had paid their subscription up to a certain date. On the whole, however, I do not think the membership basis is a very good one.

Mr. Crowther (Sheffield).
I should like to support the membership basis. Ours is an exceptional case. It is a big Society with 120 or 130 members, and we are in an almost isolated position geographically, being just on the edge of Derbyshire and Yorkshire. Under the geographical scheme we should probably have to come in with Birmingham or Manchester, and have a representative from one of these other districts who really has no interest in the Sheffield Society. I speak selfishly, but on these grounds I support the membership suggestion of say 150.

The Chairman.
Would Sheffield come in then alone?

Mr. Crowther.
As a matter of fact we should not, but we might get another Society to come in and make up the number.

The Chairman.
In the case of isolated societies, say such as in the Shetlands, it might be necessary for them to come in and be regarded as a group, even if they only had 50 members, and that could be done by the co-option method which we have already adopted. We could, of course, say that no Group should have less than 150 members and leave it to the General Committee to modify it afterwards.

Mr. Carpenter (Croydon Wireless Society).
I should like to support the membership suggestion. The difficulty of getting at the exact number could be got over by saying that the membership shall consist of those who have paid their subscriptions at a certain date.

After a little further discussion, **The Chairman** took a vote on the question of adopting the figure of six as the minimum number of societies to form a Group.

There was a large majority in favour of this.

Article 90, with the slight modifications set out above, was then agreed to.

After a short interval for tea the Conference resumed at 4.20 p.m.

The Chairman, referring back to Article 90 just passed, said t had been pointed out to him that as it stands it would not be possible for a member of one Group to be elected as representative of another Group, and he asked for the feeling of the Conference as to whether this limitation was desired. Should the representative of a Group necessarily be a member of that Group?

Mr. Stanley said he would like to see it left so that it did not matter which Group a representative belonged to as long as he was a member of "one or more Societies" in the words of the Rule. It might be an advantage for some of the far northerly Societies to elect someone in London to represent them.

Eventually it was agreed to leave it to the Chairman to widen Article 90 in this respect, always remembering that they could not have as a member of the General Committee anyone who was not a member of an affiliated Society or the Radio Society.

The Chairman.
Article 91 is as follows:—

Article 91. In December of each year the Hon. Secretary of the General Committee, or failing him the Hon. Secretary of the Council or other officer, shall send to the secretary of each affiliated society as grouped by the General Committee, a copy of Articles 87 to 100 inclusive and a notice calling upon the affiliated society to join with the other societies of its Group in nominating an agreed representative on the General Committee. The name of the agreed Group representative should reach the Hon. Secretary of the General Committee before the 20th January. Failing the submission of an agreed name, the General Committee shall take such special steps as they think fit to obtain representation of the Group.

Article 91 was adopted without discussion.

The Chairman.
Article 92 is:—

Article 92. For the first election of the General Committee the affiliated societies may be divided into groups at a conference of the affiliated societies to be held in January, 1924. Subsequent General Committees shall be elected by Groups created by or approved by the preceding General Committee.

These Articles are not yet registered and the word January will have to be changed for March.

Article 92 was agreed.

The Chairman.
Article 93 is as follows:—

Article 93. No member of the General Committee shall be eligible to serve in the same capacity more than three years in succession.

Mr. Epton (Hackney).
I take it that members of the General Committee are compelled to retire at the end of three years.

The Chairman.
Yes.

Mr. Epton (Hackney).
Supposing a group has nobody else, that means that their particular representative cannot serve although they want him to.

The Chairman.
Yes.

Mr. Epton (Hackney).
That does not seem fair. Cannot some proviso be put in to cover that?

Mr. Dixon (North Middlesex).
He could be made vice-president because the Rule says that a member shall not serve "in the same capacity for more than three years in succession."

Mr. Hope-Jones.
This enforced retirement is only for one year and the same representative can come on again in the fourth year.

The Chairman.
This Rule is to be found in the rules of practically every society, for the simple reason that it has been found necessary in order to bring fresh blood in. There is just as much argument for bringing in fresh blood as there is for keeping somebody on the Committee who has done good service. We will put it to the vote as to whether there should be the possibility of perpetual membership.

This proposal was put to the meeting and the majority of those present voted in favour of the three years limit.

A short discussion took place as to whether a member of the General Committee should be allowed to serve three years representing one group and then be immediately elected for a further period as representative of another group.

The point was eventually put to the meeting and it was decided that the Article should be amended so that no member of the General Committee should be entitled to serve for more than three consecutive years as representing any group.

Article 93 was then agreed to.

The Chairman.
Article 94 is as follows:—

Article 94. Any casual vacancy occurring in the elected members may be filled by the General Committee, and in the nominated members by the Council.

A Delegate (Western Metropolitan Group).
I propose that Article 94 be deleted so that casual vacancies be not filled in this way. It was felt by the majority of the associations in the Western Group that the General Committee should not have the power to do this, but that the societies should have the opportunity of doing so. I therefore propose we substitute the following:—

In the event of a vacancy occurring in the elected members of any group such vacancy shall be filled by the group concerned within a period of two months, following which the General Committee shall fill the vacancy.

The Chairman.
There is no objection to that.

A Delegate.
As representative of one of the societies in the Western area, we thrashed this out very carefully and we thought that as the Article stands, a group will not have a chance of electing a member to fill a casual vacancy. Under this amendment we shall have two months chance and if the societies do not come up to the scratch then, the General Committee can do it.

The Chairman.
I think there is absolutely no objection to that.
Article 94 as amended was then agreed to.

The Chairman.
Article 95 is as follows :—
Article 95. The General Committee shall after the annual election forthwith appoint a Vice-Chairman and Hon. Secretary from among their own number, and shall elect three of their members who are not already members of the Council to serve on the Council.
That means that the General Committee sends five men on to the Council out of 22 or 23.
Article 95 was agreed to.

The Chairman.
Article 96 is as follows :—
Article 96. The President shall act as Chairman at all meetings of the General Committee at which he is present, and in his absence the Vice-Chairman shall act. In the absence of both, any member of the Committee may be elected by those present to act as Chairman.
Article 96 was carried without discussion.

The Chairman.
Article 97 is as follows :—
Article 97. The General Committee shall meet at least twice in each year and at a time and place fixed at the preceding meeting or by the officers. Special meetings shall be held by direction of the Council, the President or Vice-Chairman, and the President shall call a special meeting on being requested in writing by ten members of the General Committee.
This is got straight from the Articles of other societies. The only new thing in it is that the general Committee shall meet at least twice a year.

A Delegate (Western Metropolitan Group).
I should like to propose an addition to safeguard the position that no motion shall be voted upon at a general meeting which is not on the Agenda.

The Chairman.
That is the meaning of "special meeting." If you look up the Companies Acts under which we shall be registered, you will find that you cannot, at a special meeting, take any other business than the business on the Agenda; it is usually a single item.

A Delegate (Western Metropolitan Group).
If that is so I withdraw my motion.

Mr. Child (Golders Green).
May I suggest the words "extraordinary meeting" instead of special meeting.

The Chairman.
The explanation is that the expression "special meeting" is a technical term used in the Companies Acts and also that as the Rules have still to be gone through by the lawyers matters of that description will be put in order.
On the motion of the representative of the Western Group words were added to Article 97 to the effect that "a special meeting" shall be called "within fourteen days of the receipt of a request."
Article 97 was then left to be expanded by the Chairman in such a way as to leave no doubt regarding business at special meetings.

The Chairman.
Article 98 is as follows :—
Article 98. The Secretary of the General Committee shall keep the minutes of the meetings and conduct the correspondence of the Committee. He shall by means of a monthly letter, or otherwise, keep all the societies in touch with the work of the Council and General Committee. He shall keep the Hon. Secretary informed of additions to or removals from the list of affiliated societies.
This does not mean that everything that goes on in the Council can be reported at once but it does mean that all things that can be, will be reported.
Article 98 was agreed to.

The Chairman.
Article 99 will now read as follows in view of the amendments previously made on principle F.
Article 99. The General Committee shall be empowered to revise annually the amount due for affiliation, but shall not fix the fees lower than those existing at present, without the previous consent of the Council.
Article 99 was agreed to.

The Chairman.
Article 100 is as follows :—
Article 100. The General Committee has no authority to expend or pledge any part of the income or property of the Society, but the Society shall defray all necessary administrative expenses incurred by the Hon. Secretary of the General Committee in the conduct of the correspondence of the General Committee.
It is necessary to put that in to warn prospective creditors that the General Committee cannot buy even a typewriter on the credit of the Radio Society, otherwise we could be sued by some tradesman for goods supplied. All this does is to protect the Radio Society against unknown expenses.
Article 100 was adopted.

The Chairman.
I have got to make certain amendments to these Articles and then they will be printed and circulated again. After that they will go to the Board of Trade.

Mr. Epton (Hackney).
So far as I can see there is no provision in these Articles with regard to delegates or representatives of each society having membership powers that they have had in the past. At present an affiliated society has power to elect one of its members as a delegate to the Radio Society of Great Britain, he has full membership powers and can vote for the election of officers and on other general matters concerning the Radio Society. There is no such provision in these Articles.

The Chairman.
That is an oversight.

Mr. Epton (Hackney).
I propose the following :—
Every affiliated society having paid its subscription for the current year shall be entitled to appoint one of its members as a representative member of the Radio Society of Great Britain, having the full rights, privileges and responsibility of a member of the Radio Society of Great Britain during his tenure of this position.
This was agreed to.

Mr. Stanley.
At the end of Clause 89, it says that all members of the General Committee shall retire annually in January, at a date fixed by the Council. It does not say that they are eligible for re-election; reading that alone it seems that they are not eligible for re-election.
It was agreed to add the words "and shall be eligible for re-election subject to Article 93."

ELECTION OF FIRST GENERAL COMMITTEE AND OFFICERS.

The Chairman.
Some of the societies have already formed groups—I do not know how many—and we have got to try and get the thing working in spite of the fact that some of the groups have not yet been formed.
The next hour was spent in ascertaining what representatives of groups that have been formed were present and in electing members provisionally to represent these groups on the General Committee.
The following elections were made, the remaining ones to be arranged by correspondence between the respective groups and the Hon. Secretary of the General Committee, Mr. Stanley being elected to this latter position.

T.O.T.	Captain Plugge.
Western Metropolitan Group.	Messrs. Bland-Flagg and Coote.
East Metropolitan Group.	Messrs. Stanley, Haynes and Dixon.
Birmingham ..	Messrs. Matthews and Clarke.
Sheffield	Mr. Jakeman.
Halifax	Mr. Wood.
Bradford	Mr. Wright.
Southern Group ..	Messrs. Nilbrett and Folkstone.
Southern Metropolitan Group.	Mr. Sutton.
Leicestershire ..	Mr. Schofield.
Edinburgh ..	Mr. Winkler.
Hampshire ..	Capt. Young.
Cambridge University.	Mr. McConnell.
Eastern Group ..	Mr. Richardson.

Other nominations were left open to be settled later.
Mr. Hesketh was the only nomination for the office of Vice-Chairman and he was duly elected.
The question of separate representation of the Ladies' Lyceum Club was agreed to be left over for the consideration of the General Committee.

(To be concluded.)

An Ordinary General Meeting of the Radio Society of Great Britain was held at 6 p.m. on Wednesday, March 26th, at the Institution of Electrical Engineers. The President, Dr. W. H. Eccles, F.R.S., was in the chair. After the reading and confirmation of the minutes of the previous meeting, Mr. A. A. Campbell Swinton, F.R.S., M.Inst.C.E., M.I.E.E., (First Past-President) gave a lecture on "The Possibilities of Electrical Television both with and without Wires." The meeting terminated after a discussion which followed the lecture.

The WIRELESS WORLD AND RADIO REVIEW

THE NEW LOCATION OF 2LO.

By THE EDITOR.

OF course it is no business of ours editorially to criticise or advise as to where the new **2 LO** should be housed, but at the same time we are free to express an opinion which need not savour of interference on our part, if it is taken in the spirit in which it is meant.

A recent editorial in the official organ of the B.B.C., *The Radio Times*, gave one to understand that the policy of the B.B.C. is to act rather than discuss, and that new projects must go forward in the interest of the development of broadcasting without being delayed for the purpose of hearing the views of would-be criticisers.

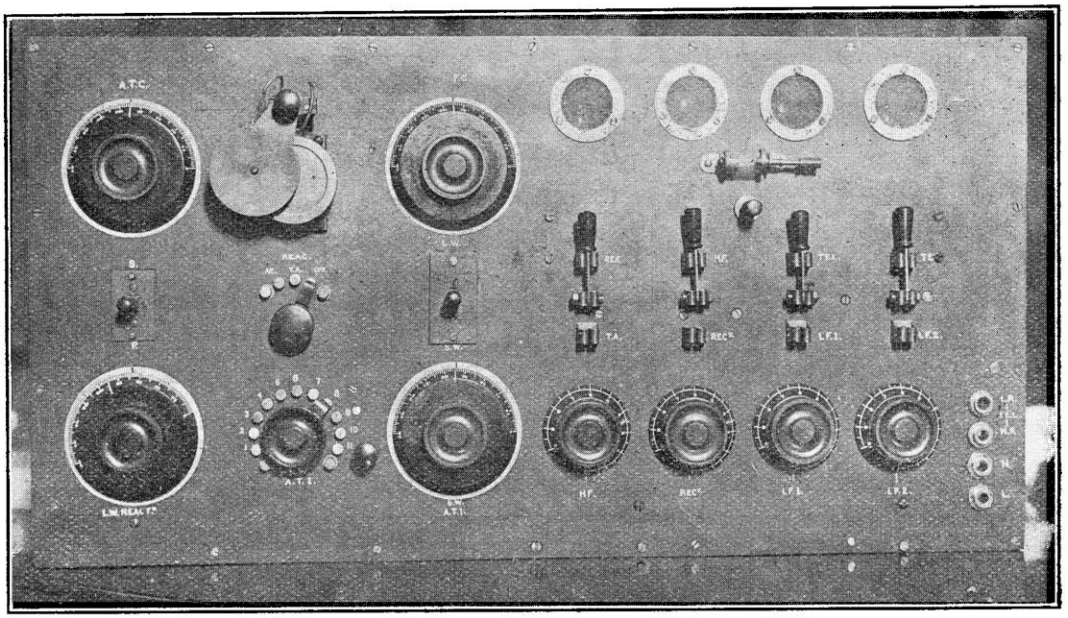
Certainly this policy was adopted in the case of the proposals for the long wavelength auxiliary station, and in keeping with the same policy we must not be surprised to wake up any morning and find that the new site for **2 LO** has been chosen and that the work of installation is well in hand, even though we may not have received any previous warning through the channels from which information is passed by the B.B.C.

A big organisation, such as this Company has now become, cannot, however, conduct its work entirely in secret. Rumours have been in circulation for some time past that it was intended to install the new **2 LO** transmitter on some existing building in the West End of London, and the actual site has even been named in some instances.

Later information leads us to believe that the proposal to erect the station on any particular building owned by a commercial concern, which would benefit by the publicity thereby afforded, has met with strong opposition, and we should not be surprised if the B.B.C. find it necessary to reconsider their original proposal.

Again, without wishing to interfere in what may be regarded as the private affairs of the B.B.C., we would like to ask what is the objection, in view of the increasing wealth of the Company, to the B.B.C. being the owners of the site on which the new station is to be erected. It would seem that such an arrangement would be more satisfactory from all points of view, more especially, we should imagine, from the point of view of the Company itself, as it would short-circuit any criticism that it was favouring the interests of any particular commercial concern.

The **2 LO** Transmitting Station, as everyone knows, is at present located at Marconi House, and one of the reasons which prompted the decision to move the station was, no doubt, the fact that such a location associated **2 LO** with one particular member Company of the B.B.C. To remove the station from that location and establish it on a site controlled by another interest where rivalry in commercial enterprise is even stronger than in the wireless industry would seem to be merely a case of "*out of the frying pan into the fire.*"



The finished set.

FOUR-VALVE EXPERIMENTAL RECEIVER

FOR WAVELENGTHS FROM 200 TO 20,000 METRES.

This set has been constructed by an experimenter to meet his needs and forms a good basis of design for other amateurs desirous of building a universal receiver for general requirements.

By J. G. MACVIE.

THE PANEL AND BASEBOARD.

AS will be seen from the photographs, the whole of the components of the set are mounted on a vertical ebonite panel and wooden baseboard. Their exact positions will be seen on reference to the dimensional drawing (Fig. 1).

The panel, of best quality ebonite, measures 24 ins. by 12 ins., and as economy demanded that its weight be kept at a minimum, a thickness of only 3/16 in. was decided upon. Lack of rigidity was overcome by securing the panel to a frame made from strips of hard wood $\frac{1}{2}$ in. square in section, the corners of which were "jointed," glued, and strengthened with brass corner plates. The result is a panel that is fully as rigid and flat as a piece of $\frac{5}{8}$ in. ebonite, but less than one third the cost and weight.

The baseboard is a piece of $\frac{3}{4}$ in. hard white wood, 24 ins. long and 7 ins. wide. This was planed up true, and the panel secured to its long edge by a 3-in. angle iron at each end. Ordinary cast-iron shelf brackets, obtainable at any ironmongers, are very suitable for this purpose, and were also used to carry the valve and transformer shelves to be described later.

Before the final assembly of the set, the panel was rubbed down with very fine carborundum cloth and turpentine, thus procuring a fine smooth "matt" surface on both front *and* back, whilst the wooden

frame and baseboard were given a coat of optical-instrument makers' "dull black" enamel.

inductance for waves up to about 6,000 metres. Either of these tuners may be brought into circuit by means of another

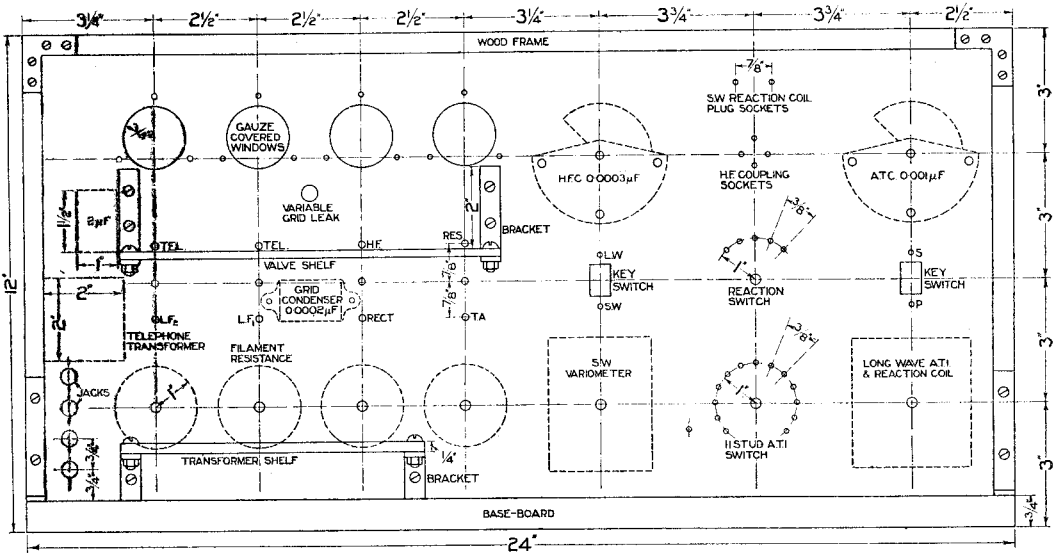


Fig. 1. Dimensional drawing of the panel showing drilling and layout of components.

AERIAL TUNING.

The aerial tuning circuit is adaptable to all wavelengths, and, briefly, consists of a 0·001 μF variable condenser with a

Dubilier double-pole two-position switch, whilst for longer waves still, *i.e.*, up to about 20,000 metres, a slab-type loading coil is plugged in series with the long wave in-

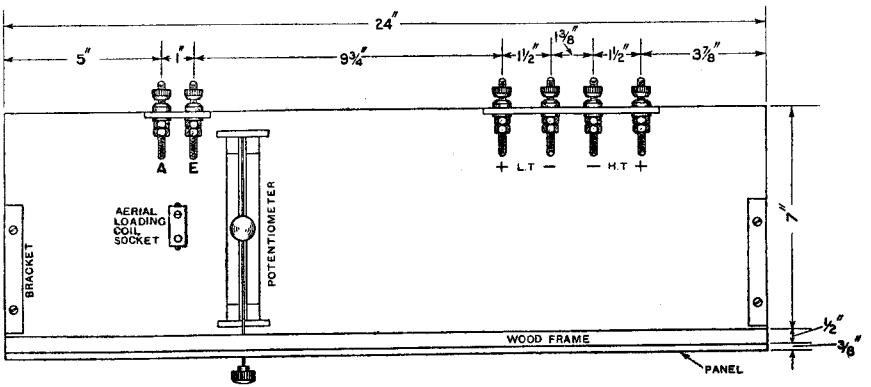


Fig. 2. The baseboard and the components which are secured to it.

Dubilier type "series-parallel" switch, a variometer for waves of from 300 to 600 metres, and a special "pile wound" tapped

ductance, the plug-socket, of course, being short-circuited when the loading coil is not in use.

VARIOMETER.

Almost any of the "broadcast" variometers at present on the market would serve for the short wave tuner. The one constructed by the writer, however, is wound on ebonite formers with Nio. 26 S.C.C. wire. The outer former is $3\frac{1}{4}$ ns. in diameter, $2\frac{1}{2}$ ins. long, wound in two sections,

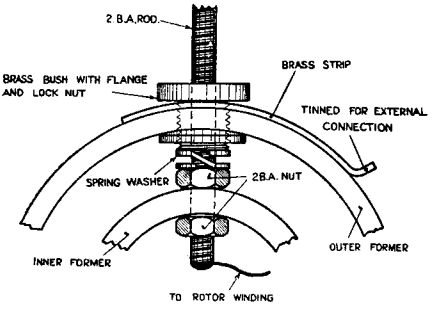


Fig. 3. Constructional details of the variometer spindle.

each having 18 turns. The inner former (the rotor) is $2\frac{1}{2}$ ins. in diameter, 2 ins. long, wound in two sections, each having 20 turns of wire. The inner and outer windings are connected in series, of course, and the space left in the middle of each former between the winding sections kept large enough to allow the 2B.A. spindle to pass through.

The arrangement of the variometer bearings may be of interest, as the same method is employed for the reaction coil bearings in the long wave tuner. The diagram (Fig. 3) is practically self-explanatory, and it may be mentioned that these screwed brass bushes have been used not only for coil bearings, but also for condenser and tapping-switch bearings throughout the set.

THE LONG WAVE TUNER, AND REACTION COIL.

These are constructed upon similar lines to those described in *The Wireless World* of February 5th, 1921, but with one or two modifications in the windings. Although there has been an epidemic of honeycomb coils of various kinds since then, the writer has come across nothing to equal this pile-wound form of inductance for efficiency and simplicity in long-wave reception.

The outer former which carries the A.T.I. is rectangular in shape, the two sides measuring each 5 ins. by $2\frac{7}{8}$ ins., and the two end pieces $3\frac{1}{8}$ ins. by $2\frac{7}{8}$ ins. Thin but strong cigar-box wood was used in the construction of this, and the ends and sides held together by glue only. After a final smoothing with No. oo glass-paper the whole former was stained black with a "carbon-free stain" (presumably aniline dye) and given two coats of shellac.

The winding, of No. 26 S.C.C. wire, consists of two five-pile sections, each occupying a space of one inch on the former and leaving $\frac{5}{8}$ in. clear between them to accommodate the reaction coil spindles and bearings. It is not necessary to describe the details of pile-winding here, as several excellent articles on the subject have already appeared in this paper.* It should be noted, however, that the "cross-overs" produced on commencing each successive pile should be kept at one end of the former, preferably the one which is to be mounted close to the panel, as it is from this end that eleven tappings are taken (at approximately equidistant points along the outermost layer) to the eleven-stud switch seen on the face of the panel.

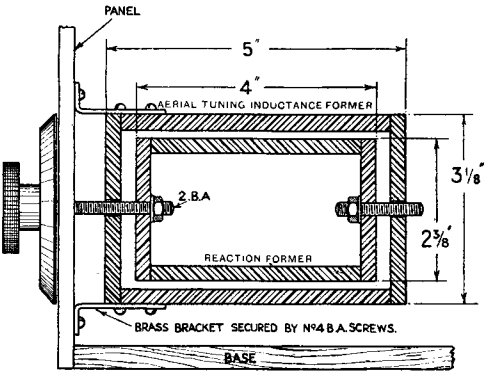


Fig. 4. Wooden inductance formers pile wound for long wave tuner and reaction coupling.

The exact positions of these tappings on the inductance were not calculated very accurately, but, in conjunction with the aerial tuning condenser, give a fairly regular increase in wavelength for each stud advance.

The whole former is supported on two brackets of $\frac{1}{2}$ in. by 1/16 in. brass strip on the back of the panel. (Fig. 4.)

* Page 52, October 14th, 1922.

The long wave aerial reaction coil is wound on a smaller rectangular former, and rotates through 180° within the A.T.I. This former is constructed in exactly the same way as that of the A.T.I., and has similar bearings to those of the variometer. Its two sides measure 4 ins. by 1¾ ins., and its ends 2⅜ ins. by 1¾ ins; the winding, of No. 32 D.S.C. wire, is also five-pile, and consists of two sections each occupying 7/16 in. winding space.

It will be seen that in order to reverse reaction when switching in a stage of H.F. amplification it is only necessary to rotate this coil to the required position on the opposite side of its zero setting (the zero setting being, of course, when its plane is at right angles to that of the A.T.I.).

THE AERIAL LOADING COIL.

A "slab" type of plug-in coil has been found to serve this purpose very well, and the one employed for raising the wavelength of the long wave tuner to 20,000 metres was made as follows.

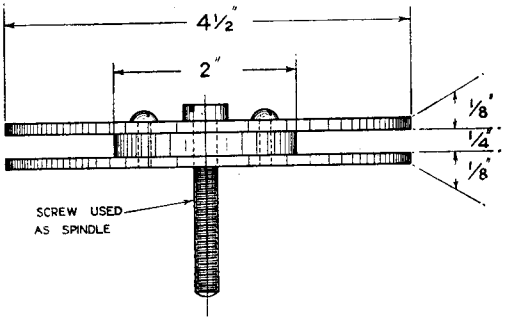


Fig. 5. Details of former for building loading coils.

A former was first made from three discs of cigar-box wood, the dimensions and assembly of which are shown in the accompanying diagram (Fig. 5.). The side and centre discs are held together by small wood screws, whilst a long 3/16 in. screw passing through the centre serves as a spindle to be held in the chuck of a hand drill for the process of winding. The winding consists of 950 turns of No. 36 S.C.C. wire, and whilst a somewhat heavier gauge would doubtless be more efficient, this was the only wire available at the time and has proved quite satisfactory. When the winding is completed the former is carefully taken apart, the coil tied at three or four points with thread, and immersed in molten paraffin wax. When drained and set, it is secured to a standard two-pin plug by means of a strip of thin fibre passing around its circumference, and then carefully and evenly wrapped with narrow empire tape.

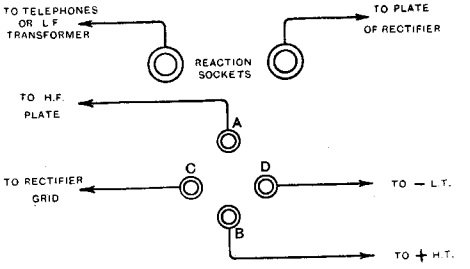


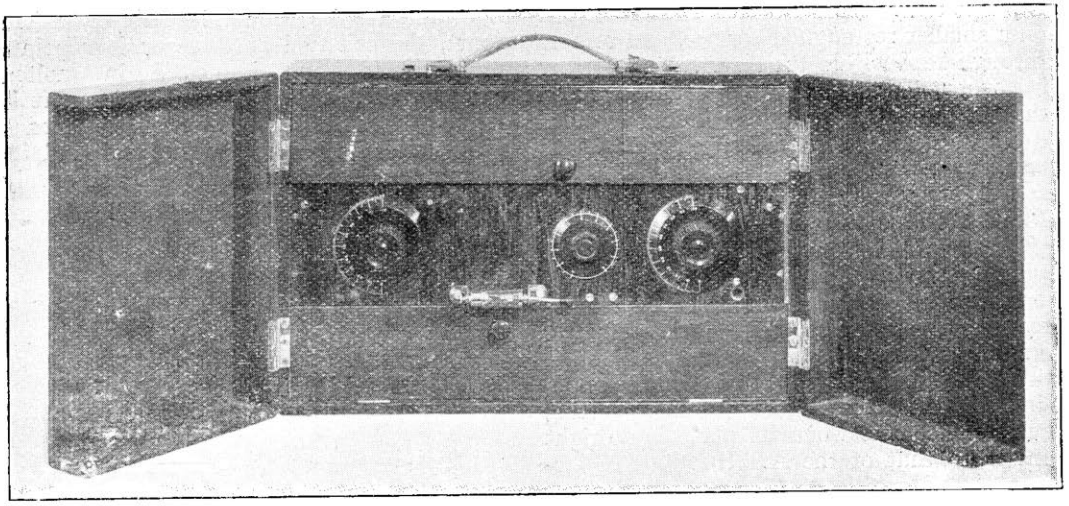
Fig. 6. Reaction coil and H.F. transformer connections.

HIGH FREQUENCY AMPLIFICATION.

High frequency amplification is arranged on a plug-in system which facilitates a rapid change from one method of coupling to another. As seen in the illustration, four standard valve sockets are let in flush with the face of the panel (a composition valve-holder involves unwanted capacity effects, and if utmost efficiency is desired, should not be used), and the usual connections are made to the plate of the H.F. valve, positive H.T., grid of rectifying valve, and negative L.T. *via* the potentiometer slider (Fig. 6). A 0·0003 μF variable condenser connected across the two sockets A and B (*i.e.*, plate and +H.T.) serves for tuning either the plug-in type transformer or anode coil used, whilst the first of the four knife-switches cuts out this condenser when resistance-capacity coupling is employed.

Above the H.F. coupling sockets are two more valve sockets *standing out* from the face of the panel. These are for the variable coupling short wave reaction coil, to be described later, whilst the three-stud switch below gives the choice of (*a*) Long wave aerial reaction, (*b*) Short wave reaction on to the H.F. coupling in use, and (*c*) No reaction, but a "through" lead to 'phones (or primary of the first L.F. transformer).

(*To be concluded.*)



The set contains both frame aerial and batteries. The circuit is distinctly unique.

A SELF-CONTAINED PORTABLE SET.

This article describes a self-contained portable single valve receiver in which a frame aerial is employed incorporated in the case. A dry cell valve is used so that the set is really self-contained in every respect.

By J. H. REYNER, B.Sc.

The Circuit.

THE circuit utilised has already been described by the author,* and its development shown step by step.

When making the set up in final form several slight modifications were found to be practicable. The low frequency transformer gave excellent results but it was found that a certain tendency to low frequency oscillation was present. This was finally eliminated by replacing the transformer by a choke coil. Although with such a circuit there is no step-up, the low frequency whistle is kept in check and the resultant signal strength is not impaired.

Fig. 3 shows the circuit adopted in the set to be described. It will be seen that in addition to the use of a choke instead of a transformer, the two coupling coils have been eliminated and the necessary reaction is obtained by two additional turns on the frame itself.

* Page 21, April 2nd, 1924.

It was observed, also, that more stable operation was obtained by connecting the telephones on the negative side of the H.T. battery. A jack is used for the telephone connection and this is made to switch on the filament of the valve when the telephones are inserted.

The electrical dimensions of the various components in the circuit are given in an accompanying diagram. It was found that in order to obtain satisfactory reaction control and also to eliminate the low frequency whistle the reaction condenser had to be made very much smaller than the original value of 0.0003 mfds. quoted in the previous article. In practice a 5-plate vernier condenser is employed and complete oscillation control can then be obtained.

Essentials of the Set.

Having decided on the circuit, the next thing was to design the layout of the components. For the container an attaché case seemed the most desirable, but was ultimately abandoned for several reasons. Such a case

would require reinforcing, and moreover the frame would have to be on the lid with flexible connection. The attaché case also did not permit of a neat panel layout. A wooden case as shown in the photograph and in detail in Figs. 1 and 2 was designed accordingly. The front is made in two halves which open on hinges at the sides.

The ebonite panel containing the apparatus

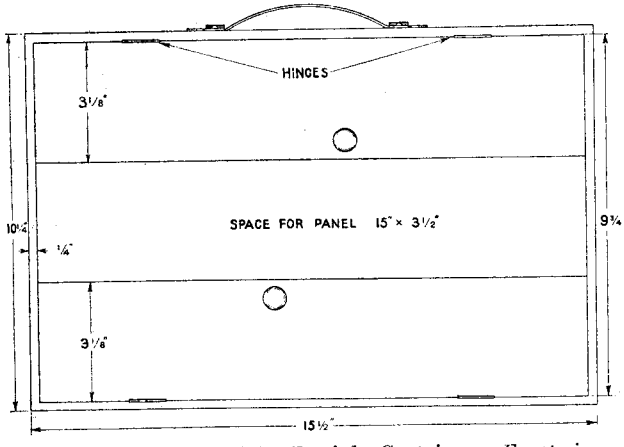


Fig. 1. Constructional details of the Container. Front view.

is in the form of a long strip running across the middle. A flap is provided at the bottom, behind which is a space for the filament and H.T. batteries. Another flap at the top conceals the pocket for the telephones, and by lifting the flap access is obtained to the back of the set for inserting the valve which is carried on a bracket behind the panel.

The frame is wound on a 3-ply former, fitting inside the main body of the case itself, while to complete the arrangement a leather carrying strap is provided on the top of the case, and four rubber feet are fitted on the bottom.

Such an arrangement has many advantages. The set is always standing and is carried about in the position in which it is used. Hence the valve is jarred as little as possible and also there is less necessity for rigid packing of the various batteries. The arrangement is stable, the heaviest portion, *i.e.*, the batteries, being at the bottom. It will be seen that, when in use, only the panel is visible, all other apparatus being concealed, and consequently the whole presents a very neat appearance.

The dimensions of the case are given in diagrams. Mahogany, $\frac{1}{4}$ in. thick, was employed throughout.

Frame.

The frame, as previously mentioned, is made of 3-ply wood, and is wound with 20 turns of ordinary bell wire. These turns are spaced by making small saw cuts, $\frac{1}{8}$ in. apart, at each corner of the frame. Dimensions of the frame and details of the winding are given in Fig. 4. A tapping is taken at the 18th turn, the 18 turns being used for the main frame, the remaining two turns being for reaction purposes. The frame is fixed in position by screws to the bottom of the case. It is further held by two battens placed on the sides of the case about half-way up. These battens, which are $4\frac{1}{4}$ ins. by $\frac{1}{2}$ in. by $\frac{3}{8}$ in., serve not only

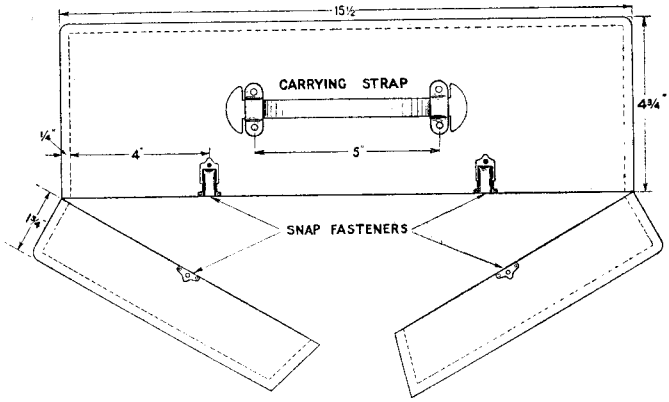


Fig. 2. Top view.

to hold the frame steady, but also act as mountings for the panel itself, which is screwed into the battens as detailed in right-hand diagram, Fig. 4.

The projecting portions of the battens serve as stops for the two flaps.

The pocket for the telephones is also shown in Fig. 4, and is attached to the frame before the winding is commenced.

Apparatus Panel.

The apparatus is mounted on a panel of ebonite 15 ins. by $3\frac{1}{4}$ ins. by $\frac{1}{4}$ in. In the particular set being described, "Mahoganite" is used, as this, with a dark red stain on the wood, gives a very pleasing finish. Fig. 5 gives a front view of the panel, showing the dispositions of the components and the main dimensions.

Detailed dimensions are not given as these depend to a large extent on the type of components employed in making up the set.

A back view of the panel is given indicating the disposition of the components somewhat more clearly, while Fig. 6 shows a plan and side elevation of the valve bracket which also serves to carry the high frequency choke.

The details of the several items are as follows :—

Main Tuning Condenser.—A condenser of 0.0005 mfds. capacity. Any reliable make will serve.

Fine adjustment.—This is detailed in Fig. 10. It consists of a strip of copper foil covered with a thin piece of mica.

These two are stuck to the panel and each other with a very thin layer of Chatterton's compound, applied with a warmed knife blade. This method of fixing is quite secure. Fixed over these is a strip of springy brass, held firm at one end and having a 2 B.A. nut sweated on the other. Through this nut a 2 B.A. screw operates, and motion of the screw thus brings the two plates nearer or farther apart.

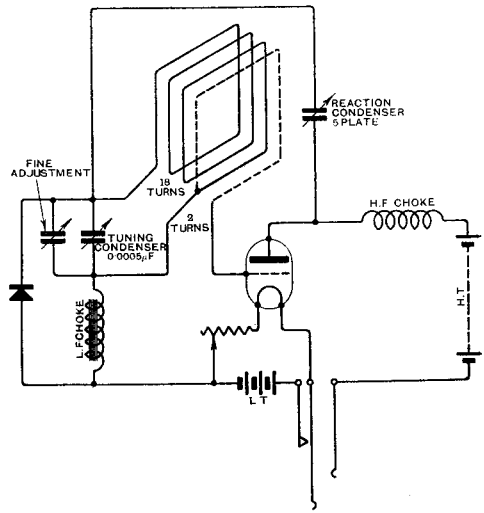


Fig. 3. The Circuit. The valve amplifies at high and low frequency and a crystal is used for detection.

Reaction Condenser.—A condenser of vernier capacity with 5 plates is suitable. This condenser, however, is at a high-frequency potential, and there is therefore some hand effect. To avoid this the condenser is mounted on an ebonite base and a screen of copper interposed

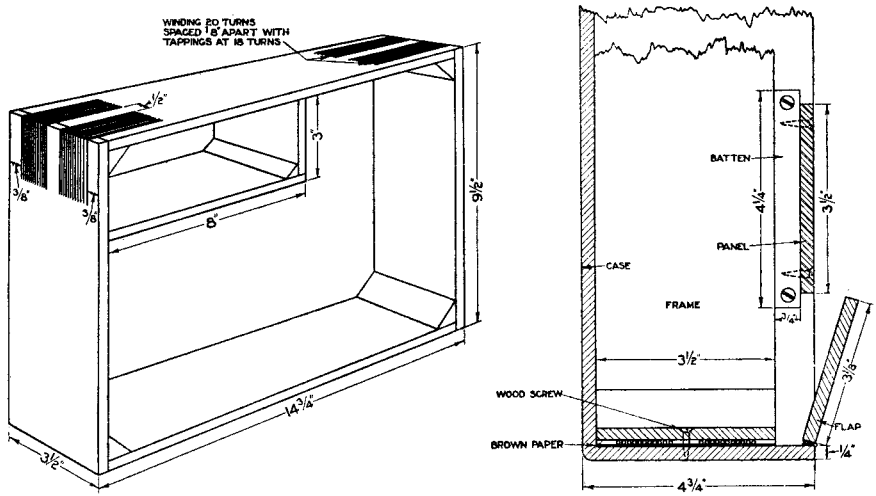


Fig. 4. The frame aerial and details for mounting it in the case.

between the panel and the condenser. This screen, which of course is entirely insulated from the condenser, is connected to the S.W.G. wire on a former 1¼ ins. diameter, ¼ in. thick.

The low frequency choke should have a

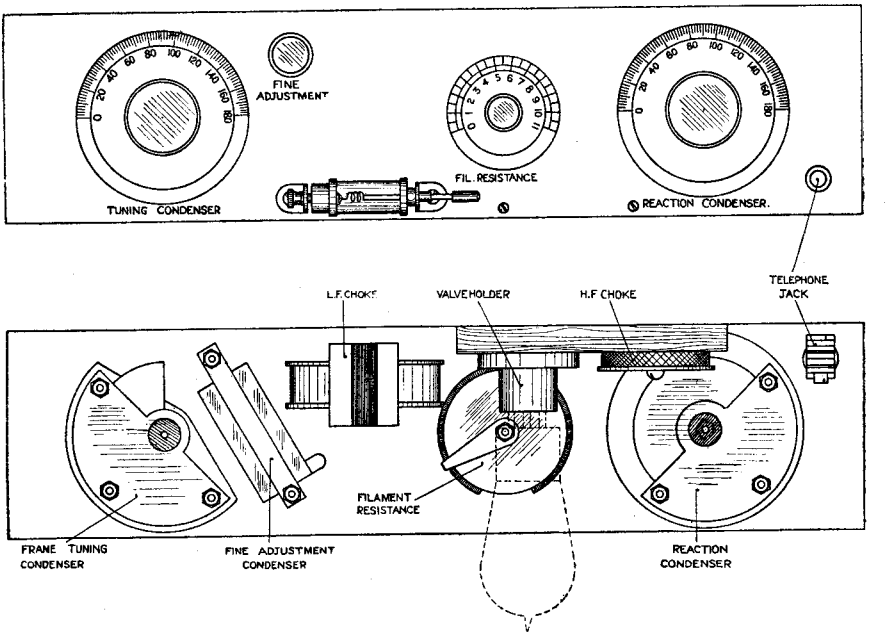


Fig. 5. Front and rear views of the panel showing the dispositions of the components.

telephone jack. Such a device effectively eliminates the hand effect.

Crystal.—After some experiment a cat whisker type of crystal was decided on as being suitable in this particular circuit.

value somewhat higher than the usual choke coils on the market. In the particular set an intervalve transformer was used with the primary and secondary windings connected in series.

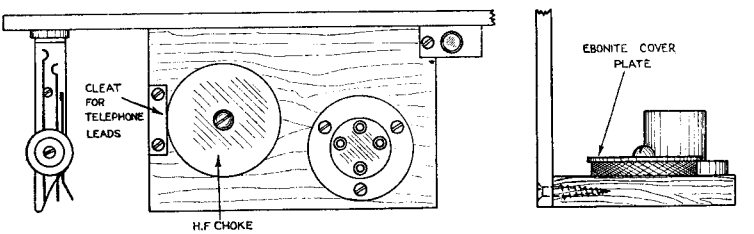


Fig. 6. Details of the valve platform and H.F. choke.

Choke Coils.—The high frequency choke coil has an inductance of about 5,000 microhenries. A convenient choke can be made up by winding 250 turns of No. 30

If this method is adopted one of the cheaper makes should be employed as with a good instrument the combined inductance of the windings in series is too high, and

low frequency whistling may set in. On the other hand loss of efficiency results if the choke is too small—*e.g.*, if the primary only is employed.

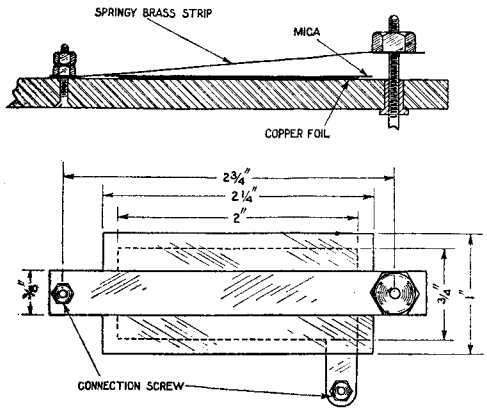


Fig. 7. The Vernier condenser.

Resistance.—A type B5 valve is employed, but any similar valve will serve. The filament resistance, however, must have a value of 30 ohms. Such a resistance can now be bought as a standard item, or alternatively an ordinary 2 ohm resistance may be rewound.

Wiring.

The set is assembled as already indicated, and wired up as shown in Fig. 8.

The leads to the batteries are of flex of ample length and suitable size, terminating in plugs for the H.T. and tags for the L.T.

Batteries.

A 36-volt plug-in H.T. is employed, which is contained at the bottom of the case on the right-hand side. The valve bracket serves as a top partition and a little cotton wool or other packing prevents the battery from rattling or sliding about.

The L.T. battery consists of 3 dry cells in series, the Ever-Ready R size, 1½ ins. by 1½ ins. by 3½ ins., or a similar article being suitable for the purpose.

These are contained in the left-hand bottom corner of the case, and a separate partition is provided, screwed to the back of the case to hold the cells steady.

The set is found to give comfortable headphone strength at distances up to 50 miles. In London, **6 BM, 5 IT** and **5 NO** have been picked up, and the set is remarkably selective, no interference from **2 LO** being experienced.

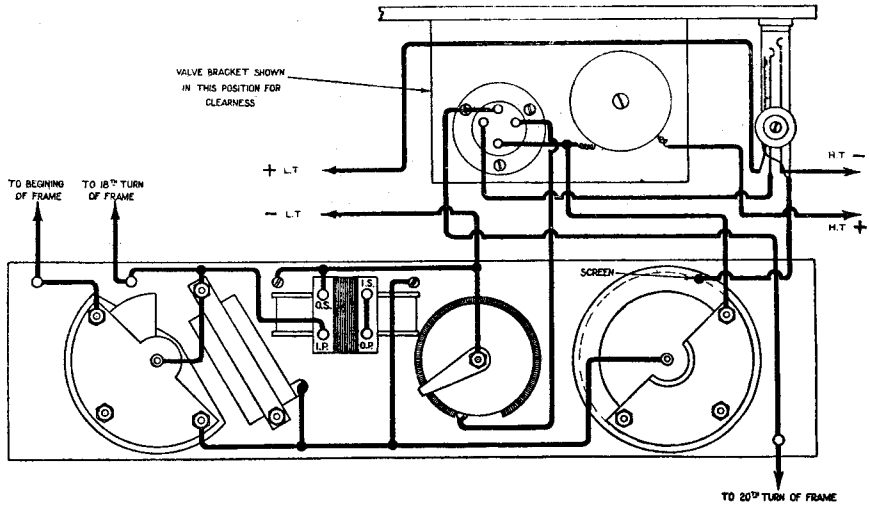
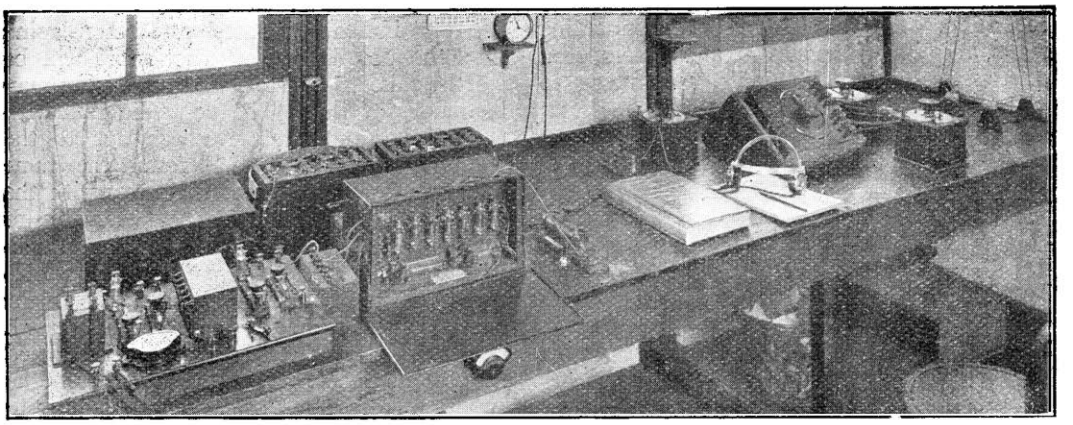


Fig. 8. Practical wiring diagram.

The arrangement is, of course, directional, and must be turned into the appropriate position for maximum results.



A Typical Commercial Direction Finding Apparatus.

AN EXPERIMENTAL
DIRECTION FINDING STATION.

Further details are given here concerning the operation of directional receiving apparatus. Causes of error in the taking of bearings are described, and also the methods by which true direction is determined.

By R. KEEN, B.Eng., A.M.I.E.E.

(*Continued from page* 13 *of previous issue.*)

Fig. 10 shows the addition of a coupled circuit and vertical will again be present, but to a much smaller extent. The E.M.F.s in the side members of the frame will now tend to force currents to earth through the capacity of the coupling coils L_1 and L_1, and these currents on reaching L_2 will divide and flow to earth *via* the A and B paths as before, in the inverse ratio of their impedances, and may be corrected by a grid condenser. If, however, the tuning condenser be put in the middle of the frame winding farthest from the coupling coil L_1, then the mid-point of this coupling can be joined direct to earth as in Fig. 11, and this forms a short circuit path for the vertical. These vertical currents flow inwards through the coupling L_1, as shown by the arrows,

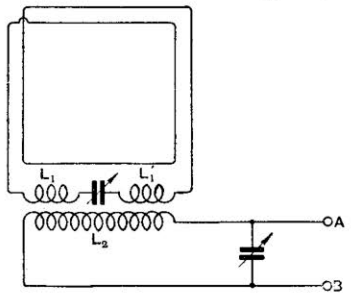


Fig. 10. *Rotating frame with coupled circuit.*

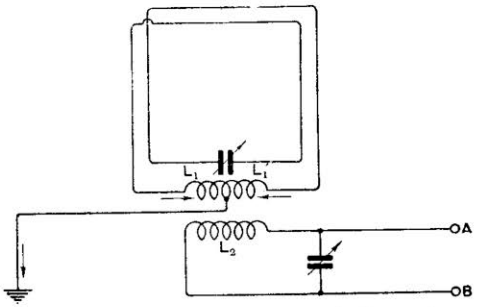


Fig. 11. *Centre point of frame coupling coil connected to earth to reduce effect of vertical.*

and so far as any effect in L_2 is concerned, the one half of the vertical current will neutralise the effect of the other. A grid condenser will now probably not be necessary.

There are one or two more inherent defects in certain types of frame aerial which may cause slightly indefinite minima, but they are not very important in a small frame, and only one more precaution remains before we have a reasonably accurate direction

finder, namely, the prevention of direct reception. The coupling coils, connecting leads, amplifier, intervalve transformers, etc., are themselves small aerials, and owing to

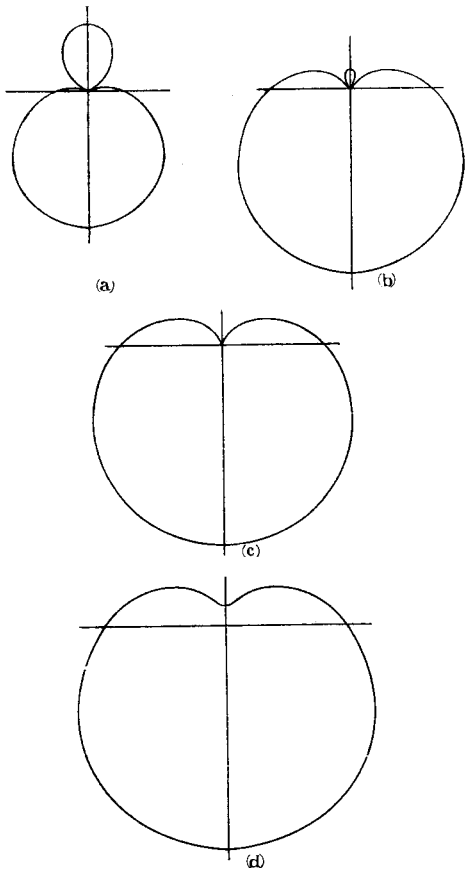


Fig. 12. *Evolution of heart-shaped polar diagram by combination of the circle and figure eight diagrams of reception.*

the comparatively high amplification which is used with frame aerials, it may be found that even with the frame disconnected altogether, quite readable signals are heard, and being non-directional (as a rule) they will affect the minima. The screening of the receiver is a simple matter, and will entirely remove the trouble. The whole of the coils and amplifier and batteries should be placed either in a large metal box, such as a metal-lined packing case or one or two large size biscuit tins, and it may also be found an advantage if the negative pole of the batteries be soldered to the shield and also to a good earth connection; but these points should be tried out experimentally.

The direction finder, up to the present, does not indicate "sense," and before going into the details of construction it will be worth while to consider how provision may be made for this. The polar diagram with the minima not opposite was due to the combination of the E.M.F. round the frame which had a figure eight diagram, with the circular diagram due to vertical. In Fig. 12 (*a*) to (*d*) are shown a series of diagrams in which the figure eight remains the same size and the ratio of circle diagram to figure eight maximum has been gradually increased, whilst the two currents are maintained exactly in phase. The two minima of the resultant diagram are seen steadily to approach one another, until in Fig. 12 (*c*) they merge into one, and form the cardioid or heart-shaped diagram. Now, clearly, if we can arrange for a diagram of reception of this form there will be an end to all ambiguity in connection with the two figure eight minima. What is apparently required is more vertical, and this may be produced by

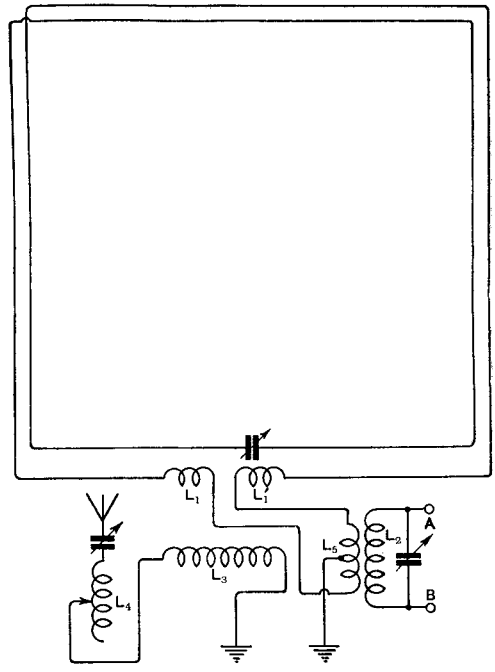


Fig. 13. *Circuit for heart-shaped diagram of reception, using tuned open aerial.*

setting up a special open aerial as in Fig. 13 and coupling it to the frame, adjusting the coupling between L_3 and the split coil L_1 to give the correct relation between the two

E.M.F.s, but at the same time it will be necessary to look into the phase relations between the E.M.F.s and currents in such a circuit to ensure that the arrangement is a workable one.

In the open aerial in Fig. 13 the E.M.F. is in phase with the flux in the wave. The frame E.M.F. lags a quarter of a period on the flux in the wave, and hence the open aerial E.M.F. leads by this amount on the frame E.M.F. If the open aerial is very accurately tuned to the incoming wave the current will be exactly in phase with its E.M.F., and hence will also lead a quarter of a period on the frame E.M.F., but between the open aerial and frame is a coupling, and, by a fundamental law, the E.M.F. induced in the frame by the open aerial current will lag a quarter of a period on the current producing it. The two E.M.F.s in the frame will therefore be in phase and will add and subtract correctly to give the diagrams shown in Fig. 12. The balance will only be maintained as long as the open aerial tuning is exactly correct, for the smallest change in the value of the tuning condenser will result in the current swinging out of phase, and either lagging behind its E.M.F. or leading on it according to whether the condenser be above or below the tune point, and will spoil the diagram.

The phase relation between the E.M.F. and current in a circuit can, however, be anchored in a simple but rather ingenious manner. Slight alterations in the "tune" of the circuit only affect the phase of the current to any great extent when the resistance of the circuit is small. If series resistance be added up to a value of say 2,000 to 3,000 ohms, then the inductive capacity impedance will be swamped by pure resistance, and it will be found that comparatively large changes in the tuning condenser can be made without putting the current appreciably out of phase. How about the amplitude of the current in such a case? The chief defect of the frame has been that the net E.M.F. round the frame is so small compared to the individual E.M.F.s in the two aerials forming its side limbs, and it is actually found that we can insert a resistance of thousands of ohms in a small open aerial, and by coupling moderately tightly to a frame can still obtain an induced E.M.F. which will balance the maximum frame E.M.F. A convenient method of arranging for the open aerial to be symmetrical with respect to the frame is to suspend a piece of copper gauze (or any sheet of conducting material) in the centre of the frame, suitably insulated, as shown in Fig. 14, and to use this as an aerial.

There are a number of reasons why it is inadvisable to take bearings using the heart-shaped diagram when accuracy is required, although it is quite satisfactory for rough bearings. It is usual to provide suitable switching arrangements so that the bearings may be taken on the figure eight diagram, and then, having decided upon the two

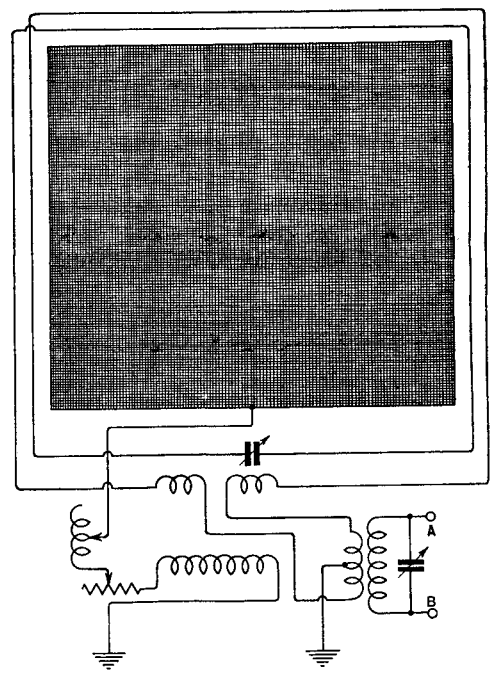


Fig. 14. *Heart-shape circuit, using "Resistance-phased" open aerial.*

minima, the set is switched over to the heart-shape and a rapid check is made to see which of the minima is the correct one. On reference to Fig. 12 it will be noticed that *it is one of the maxima of the figure eight which becomes the minimum of the heart-shape,* and as we have been taking bearings on the figure eight minimum it will also be necessary to have a separate sense pointer at right angles to the D.F. pointer, or else a second scale. Fig. 15 shows a double-pole two-way switch arranged so that for D.F. on the figure eight diagram,

the switch is left in the open position, which disconnects both ends of the open aerial coupling coil. This is advisable since if either end be left connected to earth when direction finding, there may be stray capacity effects between primary and secondary which will bring in vertical. Similar effects may also be introduced if a Kellog switch be used, owing to the capacity between the springs. With the switch in the top position, the open aerial is in series with the

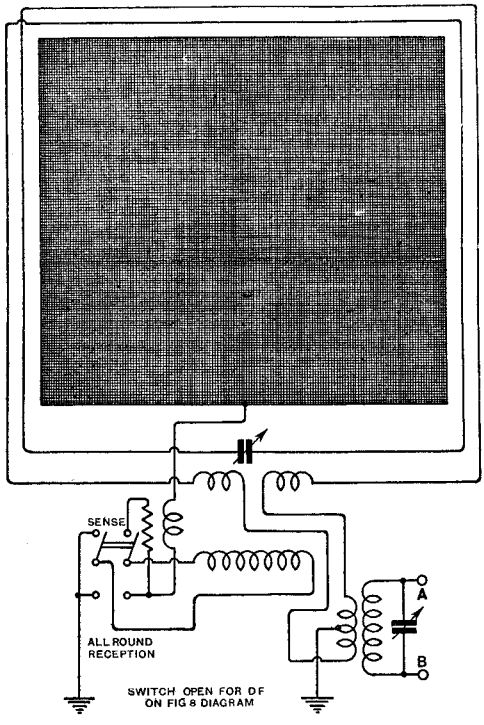


Fig. 15. *Switching device for obtaining either "All-Round" reception on the open aerial, D.F. on the figure eight diagram or Sense Determination on the heart-shaped diagram.*

tuning inductance, resistance, coupling coil, and thence to earth connection, giving the heart-shape circuit, whilst with the switch thrown to the bottom, the coupling coil and tuning inductance are left in circuit, but the resistance is cut out, allowing the open aerial to swamp the frame effect and give "all round" reception for use when standing by. The centre point of the jigger coupling coil remains connected to earth throughout—or it may be found better to connect this to the screening box only, but this point is referred to later.

Great care is always exercised, where possible, in choosing the site for a commercial radio compass station, as errors amounting to 10 or 15 degrees can easily be introduced by metal structures and buildings or transmitting aerials near the D.F. site. Telegraph wires, railway or tram lines, trees, iron railings, wire netting and many similar objects will also have an effect if too near to the frame. Apart from the actual shielding of the aerial and distortion of the electromagnetic wave front, there is also re-radiation from conductors to be taken into account. When the magnetic flux in the incoming wave cuts an iron water pipe, gas pipe or other conductor which is earthed at one end and projecting more or less vertically, an E.M.F. will be induced just as surely as in the frame aerial and, depending upon the accidental "tune" or natural period of the object, the resulting current may be either infinitesimal or large enough to cause a wave to be radiated which is comparable at the D.F. with the strength of the wave from the distant station. In the latter case the frame, when in a position that signals from the distant station are zero, may still be able to collect enough energy from the spurious oscillations near at hand, to convert an otherwise crisp figure eight minimum into a fuzzy indeterminate result. It is a combination of factors of this kind, which sometimes crops up when using an indoor frame, and cause, as already mentioned, all the received signals to appear to come from one direction or else to be non-directional. An ideal site would be in an open field, but as this is not always available to the amateur, some compromise must be made, and it will be assumed that unless the initial tests are made out of doors, they will be made either in a wooden building or with the frame projecting above the roof of a stone or brick building and situated as far as possible from any of the detrimental objects mentioned above. Later it may be found feasible to get good results under adverse conditions, or to make allowances for the errors introduced, but it is almost impossible, for anyone without previous experience of D.F. work, to calibrate a set accurately except in a fairly open space.

(*To be concluded.*)

The concluding instalment describes in detail the setting up of a direction finding station suitable for amateur use.

PATENTS AND ABSTRACTS

Mounting Apparatus.

It is the usual practice to construct a receiver by mounting and wiring the components in a single containing case, or alternatively, to construct a number of boxed units which may easily be placed side by side and joined together by short

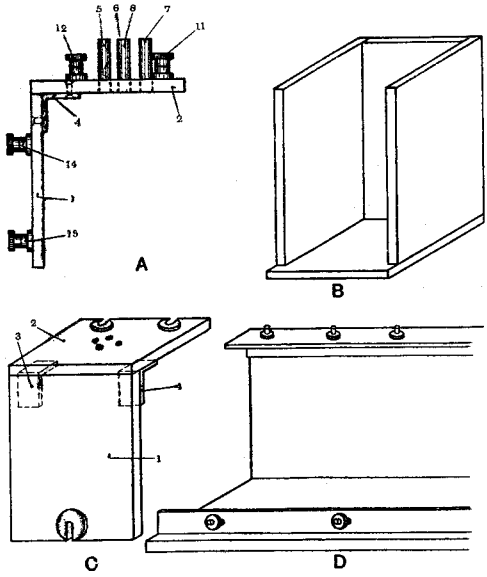


Fig. 1.

connecting wires. The units generally consist of a base with an ebonite panel, and the appropriately connected components. It is considered advantageous* from the point of view of portability and quick connection to construct the units along the lines indicated in Fig. 1. Nos. 1 and 2 are ebonite panels held together by brackets 3 and 4. The valve sockets are 5, 6, 7 and 8, and 9 to 16 are terminals connected to the input and output circuits of the unit and the batteries. With units of this sort, a multi-stage amplifier may be made up in two ways; by mounting each unit in a box, or by mounting a number of separate units side by side in a single containing frame. In the latter case, slots may be provided in the panels which fit corresponding projections on the frame, as indicated in the figure.

Valve Holders.

It is usual to connect a variable resistance in series with the valve filament to enable easy adjustment of the filament temperature to be made. The resistance generally takes the form of a unit which is located in an easily accessible position near the valve with which it is associated.

An improved construction* in which the resistance forms part of the valve

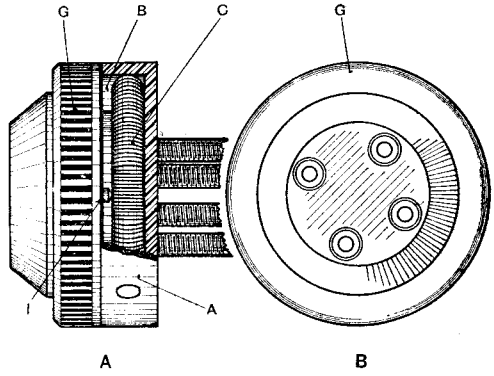


Fig. 2.

*British Patent No. 202,988; by Lucien Levy.

*British Patent No. 210,944; by J. H. Dickson.

holder is sketched in Fig. 2. Fig. 2A is an elevation partly in section, and Fig. 2B a plan view. It will be seen the variable filament resistance is situated in an annular recess formed in a ring concentric with the valve socket. The arrangement is such that by rotating the ring, more or less resistance is brought into or cut out of the valve filament circuit. Referring to the figures, A is the base of insulating material, B the annular channel, C the resistance, and G the rotatably mounted ring of insulating material. This ring carries a spring contact I, which is in electrical contact with the resistance. Connection between the contact and one of the filament sockets is made through a contact strip.

In operation the unit is fitted to a panel in the usual way and adjustment of the resistance made by turning the rotatable ring.

Fixed Condensers.

Parallel plate type fixed condensers consist of metal strips or armatures separated from each other by strips of dielectric material such as mica, paraffin paper or glass. Alternate armatures are connected together to form one terminal of the condenser, and the remaining armatures are interconnected to form the other terminal. A condenser of this type may be considered as a combination of a number of two-plate condensers connected in parallel, the capacity being proportional to the number of these two-plate condensers.

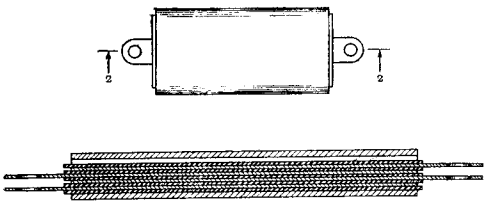


Fig. 3.

In designing condensers of this type it is necessary to select the proper combination of elements to give the capacity desired. The capacity depends upon the kind of dielectric employed, the size of the armatures, the distance between consecutive armatures, and the number of armatures used. In practice it is necessary to so proportion the various parts that the overall dimensions of condensers of different capacity are substantially different. Accordingly it is necessary to use different size casings for condensers of different capacity, and this, of course, increases the manufacturing cost.

Another practical difficulty encountered in the manufacture of parallel plate condensers consists in pressing the armatures and dielectric together in such a manner that all air will be excluded from the contact surfaces. Small air pockets greatly reduce the dielectric strength, and any moisture which the air contains augments this detrimental effect.

It is common practice to remove the air and then seal the exposed surfaces with paraffin wax.

According to an invention,* condensers of different capacity of the type above may be constructed from standard parts, the same size casing being used for condensers of different capacity.

The casing used consists of a piece of flat tubing of a length substantially equal to that of the armatures above described. The width of the tubing is slightly greater than the width of the dielectric strip. The tubing, which is preferably of metal, may be drawn in the desired shape, or it may be made from ordinary round tubing by pressing it the proper amount.

To assemble the several parts of the condenser, the armatures separated by the strips of dielectric material are inserted in the casing. When the correct number of armatures have been inserted the sides of the casing are pressed together in such a way that the several parts are tightly clamped in position.

The construction will be made clear by referring to the drawings of Fig. 3. The upper figure represents a complete condenser, and the lower drawing is a sectional view taken on line 2—2. W.J.

* British Patent 198,355, by C. E. Vawter.

A Self-Contained Three-Valve Receiver.

Through an unfortunate slip, the filament resistances employed in the Self-Contained Three-Valve Receiver dealt with in our last issue were described as being of the Burndept type. Whilst resistances of any reliable make may be used, those shown in the illustrations are manufactured by the Igranic Electric Co., Ltd.

THE POSSIBILITIES OF TELEVISION

WITH WIRE AND WIRELESS.*

The present position of the development of television is reviewed in the paper. The author describes in particular, a new device for analysing the image under transmission, and makes use essentially of a controlled cathode beam which is influenced by magnetic fields. The stage of development as considered along the lines described, indicates the almost insurmountable difficulties which have yet to be overcome though there is little doubt that television will some day be accomplished.

By A. A. Campbell Swinton, F.R.S.

WE have heard a great deal recently about the possibility of distant electric vision, or seeing by wire or wireless, as it has been called, but so far as I am aware no practical method of real electrical television has as yet actually materialised.

It is necessary to differentiate between what is meant by television and the telegraphic transmission of pictures and photographs. The transmission of pictures by telegraph is very old; the arrangements devised and actually put into use by Casseli, Bain and others, fifty or sixty years ago, are to be found described in most of the older books on telegraphy. More recently the transmission of photographs by wire or wireless telegraph with very considerable fidelity according to the methods devised by Korn, Belin, Thorne Baker and others, have arrived at a considerable degree of perfection. These methods, however, are not rapid, it usually taking several minutes to transmit a photograph that contains any considerable amount of detail, and in any case this is not television in the sense of what I wish to speak to you this evening.

If you point a photographic camera and lens at any view or object, whatever is in front of the lens is depicted on the ground glass screen, and what I mean by television is some method whereby what is depicted on such a screeen, with any motions or other changes that there may be taking place, is electrically transmitted to a distance and made to reappear instantaneously on a similar screen at the distant station.

Ideas for effecting this are by no means new. The earliest description of apparatus for this purpose that I know of is Carley's instrument for seeing by electricity, described in the now long extinct scientific periodical called "Design and Work," for June 26th, 1880—44 years ago—the arrangement suggested being one with multiple wires such as I will refer to later on.

The problem of distant electric vision is, in fact, an exceedingly difficult one, much more so than that of the telephone; for while, as we know from both the telephone and phonograph, the most diverse sounds that go to make up every description of music and articulate speech are capable of being resolved into a single more or less complicated curve, the principle involved being, in fact, the converse of the well-known mathematical conception known as Fourier's Theorem, we have, in the case of television, the additional factor of form or position; indeed, we can consider the transmission of diverse sounds by the telephone as analogous merely to the transmission of diverse colours by our television apparatus. But while, in the case of the telephone, when we have transmitted the sounds we have finished what we have to do, in the case of television not only have the colours to be transmitted, or, in the case of monochrome television, the lights and shades, but these must, in addition, be distributed on a surface in their proper positions, so that the form of what we are looking at may be apparent to our eyes.

* A paper read before the Radio Society of Great Britain at an Ordinary General Meeting held on Wednesday, March 26th, at the Institution of Electrical Engineers.

Now, in considering in what way the problem can be solved, we naturally look around to find out whether we can learn anything in the matter from nature, and just as Reis and Graham Bell, in considering how to make a telephone, received much help by taking as a model the human ear, from which in fact, they adopted the expedient of the diaphragm, so we naturally turn our attention to the structure of the human eye.

This organ, as everybody knows, consists of a camera obscura containing a lens whereby the image of what is looked at is thrown upon the retina, just as in a photographic camera the image is thrown on the ground-glass screen or on the sensitive plate. The surface of the retina is connected with the brain through the optic nerve by means of a very large number of threads or fibres, each of which connects with a certain definite point on the retina, and thus, under the stimulus occasioned by light falling upon it, communicates to the brain, in mosaic form, a conception of the different portions of the image.

Here at once is suggested a method of transmitting the image by means of a very large number of electric wires.

As is well known to everyone who has had to do with the so-called process or half-tone blocks employed for the modern printing of illustrations, it is possible to represent pictures of every kind by a sufficiently large number of sufficiently small black dots on a white surface. When looked at from a distance at which the eye cannot distinguish the dots, the picture presents itself in a satisfactory manner to the observer. Furthermore, white dots on a black surface will do just as well if properly disposed. Imagine, then, that for our television receiver we have a black surface entirely covered by very minute electric lamps, each connected by a separate wire to the distant transmitter. The latter may consist of another surface entirely covered with small selenium cells, the electrical resistance of which is reduced if light falls upon them. Now, imagine that upon the surface composed of all these cells the image that is wished to be transmitted is thrown by a lens, just as the image is thrown by the lens of the eye upon the retina. Certain of the selenium cells on which a bright light falls will have their resistance lessened to a great extent. Others on which the incumbent light is less strong will have their resistance reduced in a less degree, while those in the dark portions of the image will not be affected at all. Let us suppose, then, that these cells are connected by means of the numerous wires we have imagined each individually to one of the lamps forming the surface of the receiver, care being taken that each cell of the transmitter is connected to the correspondingly placed lamp of the receiver. Let us suppose, further, that the whole of these very numerous electric circuits are completed by a wire or by connection at both ends to earth, with a battery of suitable size interpolated. Then, with proper adjustment, we can arrive at the condition whereby the lamps which are connected with the selenium cells on which the bright portions of the image are thrown will light brightly; those lamps that are connected with the cells on which the less brightly illuminated portions of the image fall will only reach semi-incandescence, while the remainder, connected with the cells in the dark portions of the image, will not light at all. Thus, we will obtain on the surface of the receiver a fairly exact reproduction of the image thrown on the transmitter, a very granular mosaic it is true, but just as fine grained as we like to make it by multiplying the number of the lamps and wires and looking at it from a sufficiently great distance.

The idea is old, being the same as that of Carley's instrument of 1880, and seems very simple, and it is only when we come to consider the fearful number of selenium cells at the one end and lamps at the other, and wires in between, to get any practically useful result, that we realise that the mere complication and cost of such an arrangement, if nothing else, renders it altogether impracticable.

For instance, even if we go as far as only employing 10,000 each of cells, lamps, and transmitting wires, it is obvious that our image would only be made up of that number of bright or dark spaces, and that there would only be one hundred of them in a row to each side of the square of the luminous surface of our receiver. This would give an image of such very coarse grain in the case of an image of any useful dimensions as to be of very little value.

The late Mr. Shelford Bidwell, who gave a great deal of attention to this subject,

calculated that to give good close grain results on a surface of 2 ins. square would require 150,000 wires with their corresponding sets of transmitting and receiving apparatus at each end, while for very coarse results, about equal to the effect that one gets in the very coarsest process-block reproductions in the newspapers, about one-tenth of this number would suffice. Taking a medium number of 90,000 wires, he calculated that the whole apparatus and cables for a one-hundred mile transmission would roughly cost £1,250,000; or if the apparatus were to be triplicated in order to give coloured results by the three-colour process, the cost could be three times that amount.

Obviously, figures such as these show that any method such as is described above is commercially out of the question, and it has therefore been the aim of a number of inventors during the past many years to devise some arrangement whereby the number of wires and the complexity of the whole apparatus could be reduced. One apparent method whereby the large number of wires could be done away with is by employing two synchronised revolving distributors, such as are used in some forms of multiplex telegraphs, one at each end of the transmission line, which would simultaneously connect together each one of the transmitting cells and receiving lamps in turn through a single wire, the whole number being connected one after the other within the space of the one-tenth of a second which is the duration of human visual persistence. Here, again, when the matter is looked into, the impracticability of the method becomes apparent, as no mechanical apparatus, whether with revolving or with oscillating material parts that we can imagine, could be expected to execute with sufficient accuracy even 150,000 synchronised operations per second, which, on the basis of the above figures, is the very minimum that we could do with to obtain satisfactory results.

Then, Mr. Fournier d'Albe, the well-known inventor of the Optophone, has suggested an entirely new method of television, which was described in *The Graphic* for January 26th last.

This, however, though exceedingly ingenious and interesting, does not depend for its operation on the principles of synchronism, which is what I wish to pursue, so I will not say anything further about it.

Another method which was, I think, first suggested about twenty years ago, but has cropped up several times since then, and has quite recently, indeed during the last few days, been described in an improved form by Mr. Nicholas Langer in *The Wireless World and Radio Review* for March 19th and 26th, makes use of exceedingly minute synchronously oscillating mirrors at the transmitting and receiving stations, which, in connection with a single selenium cell at the transmitting end, and with a very high periodicity oscillograph, operated by the electric currents through the selenium cell at the receiving station, is designed to transmit images in the manner that is required. Here, too, however, in order to obtain satisfactory results, it would be necessary that material objects in the shape of the small mirrors should be kept oscillating in perfect synchronism at a rate of many thousands of oscillations per second, while, if I understand the apparatus correctly, the single selenium cell which is employed would have to change its resistance a hundred thousand or more times per second, and the receiving oscillograph would also have to operate accurately at frequencies of the order of this enormous magnitude, which, to judge from previous experience of apparatus of this character, are frequencies beyond what can be described as practicable for instruments in which the oscillating parts are of a material character.

About sixteen years ago it occurred to me whether one could not arrive at some better solution of the problem by the employment, of cathode rays. As we know from the ingenious oscillograph, invented 18 years ago by Braun, in which the curve of an alternating or oscillating electric current can be delineated on a phosphorescent screen in a vacuum tube, by the effect on the screen of the impact of a thin pencil of cathode rays which is deflected by the magnetic or electrostatic field, produced by the current or oscillation in question, cathode rays, owing to their almost imperceptible momentum, can be made to move with a rapidity and accuracy that could not be expected from more material objects.

In connection with a paper published in *Nature*, for June 4th, 1908, by the late Mr. Shelford Bidwell, from which some of the

figures I have given above are taken, I wrote a letter in that journal for June 18th, 1908, suggesting that this difficulty of obtaining enormous numbers of synchronised operations per second could possibly be solved by the employment of two beams of cathode rays, one at the transmitting and one at the receiving station, synchronously deflected by the varying fields of two electro-magnets placed at right angles to one another, and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams would be caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence, and that so far as the receiving apparatus was concerned, the moving cathode beam would only have to be arranged to impinge on a sufficiently sensitive fluorescent screen and given suitable variations in its intensity, to obtain the desired result. Since that date, in a Presidential address to the Röntgen Society on November 7th, 1911, I have explained this idea more in detail, pointing out, however, that it was to be understood that my plan was an idea only, and that the apparatus had never been constructed. Furthermore, I explained that I did not for a moment suppose that it could be got to work without a great deal of experiment and probably much modification. It was, indeed, only an effort of my imagination, and could be useful merely as a suggestion of a direction in which experiment might possibly secure what is wanted. What, however, was claimed was, that so far as I was aware, it was the first suggested solution of the problem of distant electric vision in which the difficulty of securing the required extreme rapidity and accuracy of motion of the parts was got over by employing for these parts things of the extreme tenuity and weightlessness of cathode rays. Indeed, apart from the revolving armatures of the alternators employed for synchronisation, which present no difficulty, there was no

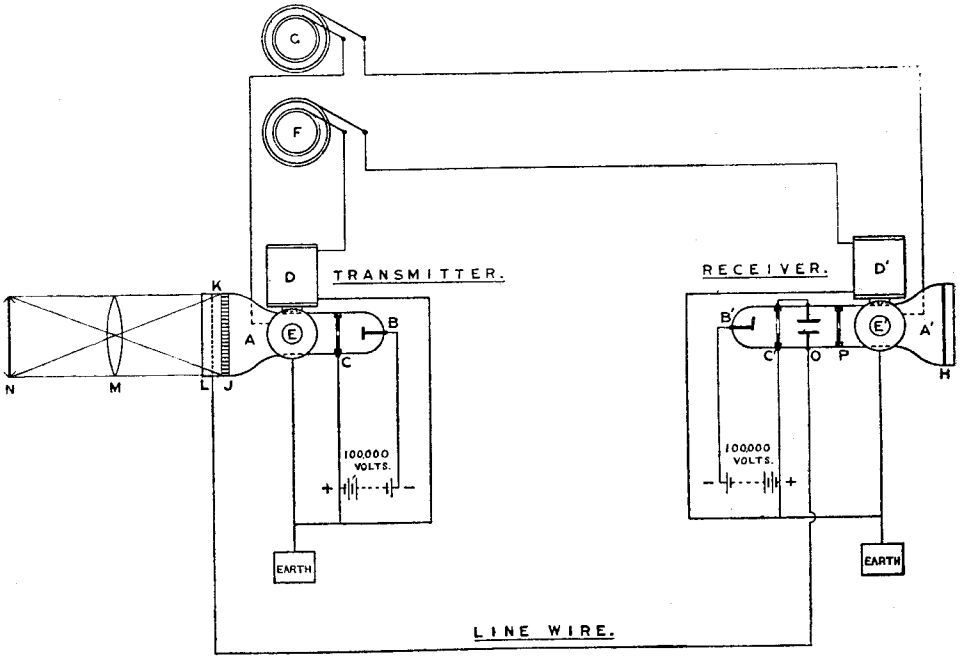


Fig. 1. *The alternating current generators G and F oscillate the cathode beams emitted from B and B' vertically and transversely. Cells in the screen J which are illuminated by the image, transmit potentials to the line wire which control the passage of the beam through the aperature O at the receiver.* (*The illustration is from the author's address to the Röntgen Society in* 1911.)

more material moving part in the suggested apparatus than these immaterial streams of negative electrons. Furthermore, as will be seen, only four wires, or three wires and earth connections at each end, were required.

In the diagrammatic illustration Fig. 1, which is from my 1911 Röntgen Society address, the transmitter is shown on the left-hand side and the receiver on the right-hand side. The transmitter consists of a Crookes tube A, fitted with a cathode B, which sends a cathode ray discharge through a small aperture in the anode C, the cathode rays being produced by a battery or other source of continuous electric current, giving some 100,000 volts. D and E are two electromagnets placed at right angles to one another, which, when energised by alternating current, will deflect the cathode rays in a vertical and in a horizontal direction respectively.

The receiving apparatus consists similarly of a Crookes tube A′ fitted with a cathode B′, which, under circumstances to be further described, transmits cathode rays through an aperture in the anode C′. D′ and E′ are two electro-magnets placed at right angles, similar to those in the transmitter, the two magnets D and D′, which control the vertical motions of the cathode ray beam being energised from the same alternating dynamo F, which has a frequency say of 10 complete alternations per second, while the other two magnets E and E′, which control the horizontal movements of the cathode ray beam, are energised by a second alternating dynamo G, having a frequency of say 1,000 complete alternations per second.

In the receiver, H is a fluorescent screen upon which, under conditions to be further described, the cathode rays impinge, and the whole surface of which they search out every tenth of a second under the combined deflecting influence of the two magnets D′ and E′, with the result that under these conditions the screen fluoresces with what appears to the eye as a uniform brilliancy.

Similarly, in the transmitting apparatus, the cathode rays fall on a screeen J, the whole surface of which they search out every tenth of a second under the influence of the magnets D and E. Further, it is to be remarked that as the two magnets D and D′, and the two magnets E and E′ are energised by the same currents, the movements of the two beams of cathode rays will be exactly synchronous and the cathode rays will always fall on the two screens H and J, on each corresponding spot simultaneously.

In the transmitter, the screen J, which is gas-tight, is formed of a number of small metallic cubes insulated from one another, but presenting a clean metallic surface to the cathode rays on the one side, and to a suitable gas or vapour, say sodium vapour, on the other. The metallic cubes which compose J are made of some metal, such as rubidium, which is strongly active photo-electrically, in readily discharging negative electricity under the influence of light, while the receptacle K is filled with a gas or vapour, such as sodium vapour, which conducts negative electricity more readily under the influence of light than in the dark.

Parallel to the screen J is another screen of metallic gauze L, and the image to be transmitted of the object N is projected by the lens M through the gauze screeen L on to the screen J, through the vapour contained in K. The gauze screen L of the transmitter is connected through the line wire to a metallic plate O in the receiver, past which the cathode rays have to pass. There is, further, a diaphragm P fitted with an aperture in such a position as, having regard to the inclined position of B′, to cut off the cathode rays coming from the latter, and prevent them from reaching the screen H, unless they are slightly repelled from the plate O, when they are able to pass through the aperture.

The whole apparatus is designed to function as follows :—

Assume a uniform beam of cathode rays to be passing in the Crookes tubes A and A′, and the magnets D and E and D′ and E′ to be energised with alternating current, as mentioned. Assume, further, that the image that is desired to be transmitted is strongly projected by the lens M through the gauze screen L on to the screen J. Then, as the cathode rays in A oscillate and search out the surface of J they will impart a negative charge in turn to all of the metallic cubes of which J is composed. In the case of cubes on which no light is projected, nothing further will happen, the charge dissipating itself in the tube ; but in the case of such of those cubes as are brightly illuminated by the projected image, the negative charge imparted to them by the cathode rays will

pass away through the ionised gas along the line of the illuminating beam of light until it reaches the screen L, whence the charge will travel by means of the line wire to the plate O of the receiver. This plate will thereby be charged; will slightly repel the cathode rays in the receiver; will enable these rays to pass through the diaphragm P, and, impinging on the fluorescent screen H, will make a spot of light. This will occur in the case of each metallic cube of the screen J, which is illuminated, while each bright spot on the screen H will have relatively exactly the same position as that of the illuminated cube of J. Consequently, as the cathode ray beam in the transmitter passes over in turn each of the metallic cubes of the screen J, it will indicate by a corresponding bright spot on H whether the cube in J is or is not illuminated, with the result that H, within one tenth of a second, will be covered with a number of luminous spots exactly corresponding to the luminous image thrown on J by the lens M, to the extent that this image can be reconstructed in a mosaic fashion. By making the beams of cathode rays very thin, by employing a very large number of very small metallic cubes in the screen J, and by employing a very high rate of alternation in the dynamo G, it is obvious that the luminous spots on H, of which the image is constituted, can be made very small and numerous, with the result that the more these conditions are observed the more distinct and accurate will be the received image.

Furthermore, it is obvious that, by employing for the fluorescent material on the screen H something that has some degree of persistency in its fluorescence, it will be possible to reduce the rate at which the synchronised motions and impulses need take place, though this will only be attained at the expense of being able to follow rapid movements in the image that is being transmitted.

It is further to be noted that as each of the metallic cubes in the screen J acts as an independent photo-electric cell, and is only called upon to act once in a tenth of a second, the arrangement has obvious advantages over other arrangements that have been suggested, in which a single photo-electric cell is called upon to produce the many thousands of separate impulses that are required to be transmitted through the line wire per second, a condition which no known form of photo-electric cell will admit of.

Again, it may be pointed out that sluggishness on the part of the metallic cubes in J or of the vapour in K in acting photo-electrically, in no wise interferes with the correct transmission and reproduction of the image, provided all portions of the image are at rest. It is only to the extent that portions of the image may be in motion that such sluggishness can have any prejudicial effect. In fact, sluggishness will only cause changes in the image to appear gradually instead of instantaneously.

Many modifications are, of course, possible in detail. For instance, the plate O of the receiver might perhaps be better replaced by an electro-magnet or solenoid so arranged as to repel the cathode beam when energised, or conversely the electro-magnets D and E, and D′ and E′ might be replaced by plates which would deflect the cathode ray beam by electrostatic attraction and repulsion as is the usual arrangement in modern cathode ray oscillographs. Again, the somewhat crude form of photo-electric cell described, composed merely of insulated cubes of rubidium in contact with sodium vapour, might be improved upon. Indeed, it is highly probable that research will reveal much more sensitive materials, the use of which would vastly improve this part of the apparatus.

Then instead of the alternating dynamos G and F giving sine form wave currents, it might be preferable to use revolving potentiometers working on sources of continuous current, and so arranged as to make the two cathode ray beams move in parallel lines.

(To be concluded.)

NOTES & CLUB NEWS

A complete service will be broadcast from St. Martin's Church, London, W., on the second Sunday in each month, at 8.15 p.m.

* * * *

The Exeter Chamber of Commerce is petitioning the Post Office to arrange for the broadcasting of the daily prices on the commodity markets.

* * * *

Captain P. P. Eckersley, Chief Engineer of the B.B.C., has been elected a Vice-President of the Radio Society of Great Britain.

* * * *

The new Belfast Broadcasting Station (**2 BE**), will transmit on 435 metres, with a power of 1½ k.W.

* * * *

Le Petit Parisien.

The new French broadcasting station, *Le Petit Parisien*, now commences transmissions at 9.30 p.m. (G.M.T.), on Tuesdays, Thursdays and Saturdays, on 340 metres.

Theatre Managers Adamant.

The rumours recently current that the Theatrical Managers' Association was relaxing its ban in respect of broadcasting are strongly contradicted by Mr. Tom B. Davis, President of the Association. It is stated that the Association is as uncompromising as ever in its opposition to broadcasting.

Good Amateur Telephony.

Mr. A. J. Dixon (**6 PD**), of Enfield Wash, Middlesex, has received a post-card from Mr. J. S. Dykes, of Skelmorlie, Ayrshire, reporting excellent reception of his telephony.

It would appear that Skelmorlie is a good centre for radio reception, for Mr. Dykes states that since September he has logged 215 amateurs.

Broadcasting Applause Cards.

Although printed applause cards have been in vogue in America for a considerable time, they have not at present "caught on" in this country. A writer in the *Daily Chronicle* suggests their adoption by the B.B.C. and reproduces a specimen card, which permits the sender to register his opinion of a programme in terms of "Very Good," "Fair," or "Rotten." Will the B.B.C. risk such frankness?

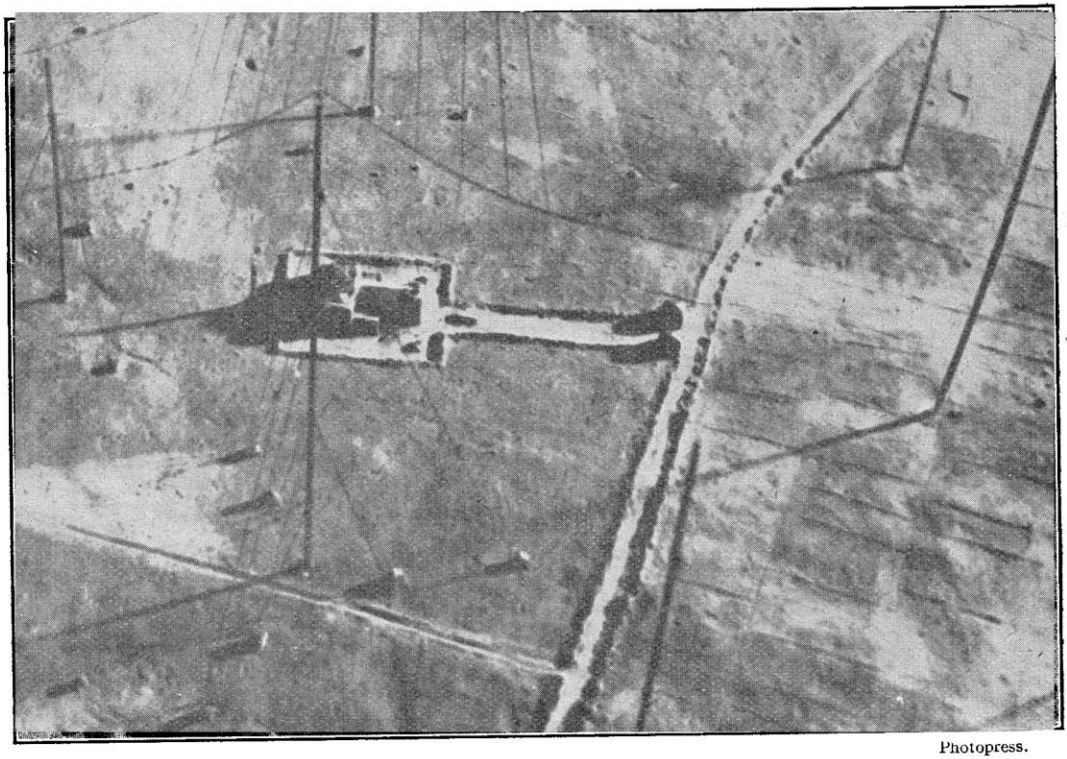
Honour for Well-known Radio Engineer.

Mr. E. F. W. Alexanderson, of alternator fame, has been awarded the Order of the Polonia Restituta, by the Polish Government, in recognition of his services in connection with the erection of the new radio station near Warsaw.

A Radio University.

America has long been recognised as a home of ambitious schemes and the latest plan to be discussed in connection with educational broadcasting is sufficiently characteristic.

The idea is to form a Radio University, with 60,000 students as a humble be-



Photopress.

This is not a bird's-eye view. The photograph portrays a realistic model of the Nauen wireless station, showing the inner ring of masts.

ginning, though it is expected that the number will ultimately approach 160,000. Thirteen colleges and universities in the Eastern States have organised themselves into a division of the American Radio Relay League, with the object of providing a radio chain of colleges to extend finally across the Atlantic and the Pacific. It is believed that the densely populated cities of the Eastern States will welcome this new avenue to higher education.

U.S. Transmitter asks for Reports.

3 XAQ is the call sign allocated to Mr. Harold Harvey, 2935, St. Paul Street, Baltimore, M.D. Any reports of **3 XAQ's** signals will be welcomed at the above address. Transmissions are on a wavelength of 110 metres, with a power of 100 watts and plate voltage of 1,500 volts.

Broadcasting Grant of £300,000.

Broadcasting is included in the Revenue Estimates for the year ending March 31st, 1925.

Provision is made for a grant to the British Broadcasting Company of £300,000 (as compared with £30,000 for the current financial year), equivalent to the following proportion of the fees collected by the Post Office in respect of receiving licences: Broadcast and experimental licences, 7s. 6d. for each licence; constructors' and constructors' interim licences, 12s. 6d. for each licence.

Schoolboys' Visit to 2 LO.

A refreshing account of a trip to the London Broadcasting Station has reached us from a scholar of the Ponders End Technical School, who formed one of a party recently initiated into the mysteries of broadcasting.

In the transmitting room the Engineer-in-charge explained how the current was amplified by means of four valves, their plate current being 10,000 volts, obtained by transforming 500 volts A.C. supplied by two generators in the basement. In the London Station, when a valve burns out, it is necessary to undo five connections, catch hold of a red hot valve, carefully fit another and reconnect. In the Company's other stations, it was explained, the valves are situated in cages so that in the event of a burn-out, the valve is slid out and replaced by another, the connections being automatically made by clips at the back.

Most fascinating was the control board in the simultaneous broadcasting department. It was stated that the engineer whoundertook the wiring of this apparatus, after completing his task, had taken a holiday for recuperation.

4 KK.

Hearing **4 KK** calling **CQ** on March 10th Mr. Alfred Cooper (**2 OG**), of Acomb, York, called up **F 8SSU**, at Bonn sur-Rhine, regarding the identity of the station, and was informed that **4 KK** is situated in Berlin.

"Chartered Electrical Engineer."

The Lords of His Majesty's Most Honourable Privy Council have allowed the adoption of the following Bye-law by the Institution of Electrical Engineers:

"Every Member and Associate Member is, and is entitled to describe himself as a Chartered Electrical Engineer, and in using that description after his name shall place it after the designation of the class in the Institution to which he belongs, stated in accordance with the following abbreviated forms, namely, M.I.E.E. or A.M.I.E.E. as the case may be."

A Mistake.

An error occurred in the advertisement of Messrs. The Bowyer-Lowe Co., Ltd., appearing on p. xxii of our issue of March 26th. In the second paragraph of the advertisement the first sentence should read: "Bowyer-Lowe Variable Condensers are characterised by exceptionally low *minimum* capacity."

"Igranic" Variometers.

In the Chancery Division on Friday, March 28th, Mr. Justice Russell granted to the Igranic Electric Co., Ltd., an injunction against the London Variometer Company restraining them from selling or offering for sale electrical apparatus under or in connection with any circular, notice or advertisement containing the word "Ivanic," or any other colourable imitation of the word "Igranic."

The Manchester Wireless Society.

With the idea of bringing membership within the reach of all interested in amateur wireless, the Manchester Wireless Society has reduced its subscription rate to 10s. 6d., and it is hoped that thereby its popularity will considerably increase. In an interview with a representative of the *Manchester Guardian*, Mr. Y. W. P. Evans, the honorary secretary, pointed out that one of the main advantages enjoyed by members was the opportunity for experimental transmission. The Society owns the call signs **2 FZ** and **5 MT** and periodical calibration tests are being arranged on wavelengths varying from 150 and 400 metres.

The Society intends to appoint "consuls" in different districts, who could keep in constant touch with the members.

Correction.

In the article describing the electrostatic microphone, by E. K. Sandeman, which appeared in our issue of March 26th last, an error occurred on page 787. The formula should read $Q = CV = 500 \times 10\text{-}12 \times 220$ coulombs.

Illicit Use of Call Signs.

The call sign of Mr. Thomas Geeson (**2 SO**), of Macclesfield, is apparently being misused by a transmitter in the Hove district.

Mr. John Mayall (**2 SD**), of Gloucester, states that he has received several reports of the recent reception of his call sign. His station, **2 SD**, has not been in operation for six months and the call sign has evidently been appropriated by another transmitter.

Information which may lead to the detection of the offenders is welcomed.

Dissatisfaction in Sheffield.

In a recent issue of the *Yorkshire Telegraph and Star*, a letter appeared over the name of Mr. F. Lloyd, purporting to voice the feelings of dissatisfied listeners in the Sheffield area. The chief ground for complaint appears to be in the low power used by the Relay Station, and it is stated that the 100 watts used is quite inadequate for the needs of crystal users. Comparisons are made with the Plymouth relay station, and the projected station at Leeds, the B.B.C. having arranged a power of 500 watts in the case of each.

"A 500-watt station," concludes the writer, "is for Sheffield a technical advisability, a good business proposition and an overdue realisation of the responsibilities of the B.B.C. to this important industrial area. The present station is to crystal users little better than an incitement to piracy."

Change of Address.

2 JP, the experimental station of Mr. M. C. Ellison, is now situated at Brockfield Hall, Dunnington, York, having been removed from Huttons Ambo Hall, York.

THE RADIO SOCIETY OF GREAT BRITAIN.

Transmitter and Relay Section.

Mr. F. L. Hogg (**2 SH**), the Highgate transmitter who has recently achieved remarkable success in communicating with American amateurs, opened an interesting discussion on Friday, March 28th, before an informal gathering of members of the Transmitter and Relay Section of the Radio Society of Great Britain. Captain Ian Fraser presided.

Mr. Hogg dealt with the question of H.T. supply for valve transmitters, paying special attention to the less widely used but more economical methods of deriving power. The speaker referred to a useful method of balancing the earth afforded by the mains and the balanced earth by means of a tuning inductance and series condenser placed in the leads between the valve filament and the earth. When D.C. mains are used a step up may easily be obtained by coupling up two small motors to operate a motor generator, and by connecting the output in series with the main supply.

The D.C. Raiser, the T.V.T. unit and the Synchronous Rectifier were all dealt with by Mr. Hogg. His condemnation of chemical rectifiers was warmly opposed by Mr. Hugh N. Ryan, and provoked a lively discussion.

A mild sensation was provided when, several speakers having given their experiences in earthing on the borough mains, a member of the audience announced that he was a borough supply engineer. He appealed to transmitters to avoid as far as possible the risk of causing leaks by this method, which gave infinite trouble to the engineers concerned, and advocated the use of a large condenser in the earth lead in order to obtain perfect insulation.

A Meeting of the Transmitter and Relay Section of the Radio Society of Great Britain, will be held at the Institution of Electrical Engineers at 6.30 p.m., on Wednesday, April 16th, at which a discussion will be opened upon "Power Transformer design."

Who is ZRBV?

A Melbourne reader reports that on January 7th he picked up a C.W. station calling **CQ** de **ZRBV**. He believes that the station is not Australian. Information regarding **ZRBV** would be welcomed.

French 8 AP.

Mr. J. J. Peugot, **8 AP**, of Sous Roches, Audincourt, Doubs, welcomes reports on the reception of his signals (C.W. and telephony). Transmissions take place on 100 metres, with a power of 100 watts, almost daily, at 8 p.m. (G.M.T.), not 9 p.m., as stated in a previous issue, owing to the change in French time.

Projected Australian Station.

Tenders are invited by Sir Joseph Cook, High Commissioner for Australia, for the erection of a new radio station at Wave Hill, in the Northern Territory of Australia. The station will provide communication with Darwin, 350 miles distant, and Wyndham, a distance of 300 miles.

The station must be capable of sending telegraphy and telephony.

Canadian Broadcasting.

The Canadian National Railways have completed arrangements for the establishment of a chain of seven wireless broadcasting stations across Canada, namely, at Montreal, Ottawa, Winnipeg, Saskatoon, Regina, Edmonton, and Calgary.

R.S.G.B. Talk on Interference.

The following remarks occurred in a broadcast talk given by Mr. Maurice Child, from the London Station, on Thursday, April 3rd, 1924:—

"*Atmospherics.*—These are due to what we may call Nature's little games with the ether, and are easily distinguished by intermittent clicks of varying intensity, sometimes resolving themselves into sounds like coals being emptied from a bag on to the telephone diaphragms or into the loud speaker.

"*Mush.*—This produces a hissing sound and is generally broken up into Morse characters, and can be tuned in or out. It is due to high power commercial radio stations, but is only heard generally within a ten-mile radius of the station.

"A good thing to do f t affects your desired reception, is to place the crystal or valve in a separate circuit, which must be loosely coupled magnetically with the aerial inductance. This is fairly effective. If the station you wish to receive happens to be approximately at right angles to the direction of the interfering station it will pay you to discard the outdoor for a frame aerial, fixing it in such a position that the 'mush' is inaudible.

"I would suggest to those transmitters who occasionally carry out telephony transmissions that they state the wavelength on which they are working in order that those who are inadvertently receiving them may know that it is due to the non-selective properties of their receiving apparatus, and not the fault of the experimenter transmitting."

Sheffield and District Wireless Society.*

A novel evening's entertainment was recently provided by a competition for short wave receivers. The task set was to make a two-valve receiver having a range of from 95 to 220 metres.

There were six entrants, of whom five produced their sets for judging. Of these, two could not be got to work, owing possibly to the fact that from lack of time their makers had not been able properly to experiment with them. The others obtained results, covering the desired range well, with some margin at both ends of the scale.

The winner, Mr. W. Skipworth, The Assistant Secretary of the Society, produced a Reinartz Tuner, which with the two valves allowed, obtained the first harmonic of the Sheffield Relay station on 150 metres, at such strength that the whole roomful of people were able to hear the music from the telephones held in the operator's hands. These results were obtained on a temporary aerial about 18 ft. long, stretched across the room.

Hon. Sec., R. Jakeman, "Woodville," Hope, Sheffield.

Golders Green Radio Society.*

A somewhat advanced lecture on "Note Magnification" was given on Wednesday, March 19th, by Mr. C. W. Ives, followed by a most interesting and practical demonstration. The argument of choke and resistance *v.* transformer coupling was hotly debated, and a good attendance of members and visitors loudly applauded him at its conclusion.

A range of crystals, kindly loaned by Mr Hinderlich, was exhibited, and members were invited to bring along any specimens which materially differed from them for examination at the lecture on "Crystals and their Characteristics," to be given on April 2nd

Great interest was displayed in the forthcoming visits of parties of the members to **2 LO**

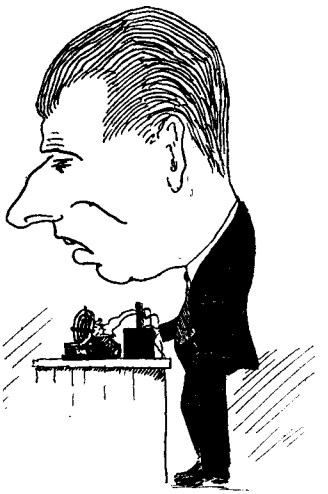
Particulars of membership gladly furnished by the Hon. Sec., W. J. T. Crewe, "The Dawn," 111, Prince's Park Avenue, Golders Green, N.W. 11. ('Phone Hampstead 3792).

Leicestershire Radio and Scientific Society.*

A fair number attended the first meeting of the Society in the new rooms on March 18th.

Unfortunately it was impossible to deal with the subject of "The Creed System," as had been previously arranged, but the breach was ably filled by Messrs. Walker and Palmer, who carried out some interesting experiments. Some novel aerials were tried out with Mr. Walker's multi-valve set.

Special attention is drawn to the Society's new address: Bank Building, 3, Granby Street. All communications should be addressed to the Hon. Sec., Jos. W. Pallett, 111, Ruby Street, Leicester.



Who is it? A well-known personality in radio circles as seen by a member of his audience.

Manchester Wireless Society.*

The following resolutions were passed at an extraordinary general meeting of the Society, held in the Council Chamber, Houldsworth Hall, Deansgate, Manchester, on Friday, March 7th:—

1. That consuls be appointed in each district to assist members and also to popularise the Society generally.
2. That owing to the enormous increase in membership it is now possible to reduce the subscriptions forthwith. Members over the age of 17, 10s. 6d. per annum; Juniors under that age, 5s. The entrance fee in both cases to be abolished. This will bring the membership of the Society within reach of all those interested in amateur wireless.
3. That members be given the opportunity of studying transmission and be allowed to work the Society's apparatus under the supervision of a competent operator.

Tests will be arranged periodically, commencing on a wavelength of 200 metres and gradually reducing until the 100 metre mark is reached. Throughout these tests calibration waves will be sent out, allowing members to follow the tests and check adjustments. Speech will also be transmitted at regular intervals.

The Society is being assisted by Mr. S. R. Mullard, Vice-President (Mullard Radio Valve Co.), The Chloride Electrical Storage Co., and Mr. John Roberts, of Manchester. Reports will be welcomed from those who are interested in these tests, and full particulars can be obtained from the Hon. Secretary.

The call letters of the Society are **2 FZ** and **5 MT**, which may be easily distinguished during the tests by the slow and deliberate morse which it is intended shall be used on these occasions. Particulars of a suitable receiving set with blue print are being distributed to members desiring them, and already results are proving the popularity of these experiments.

Hon. Sec., Y. W. P. Evans, 2, Parkside Road, Princess Road, Manchester.

Liverpool Wireless Society.*

On March 13th, Mr. Dan Godfrey, Junr., A.R.A.M., Station Director of the Manchester Broadcasting Station, gave an interesting address on "Broadcasting from Within." A short history of the station was given, together with details of its general layout and the positions of the orchestra and chorus to meet the special requirements of broadcast transmissions. The Secretary was also informed of some of the treats in store for listeners-in to the Manchester programmes.

Mr. Wood, the Station Engineer, also favoured the members with details of the transmitting apparatus.

Hon. Sec., G. H. Miller, 138, Belmont Road, Liverpool.

The Radio Society of Highgate.*

Mr. P. R. Coursey, B.Sc., F.Inst.P., A.M.I.E.E., President of the Society, gave a lantern lecture on Friday, March 21st, his subject being "Modern Condensers and their Manufacture." After dealing briefly with the theory of the action of a condenser, Mr. Coursey indicated the difficulties met with in designing condensers with a high power factor to withstand high pressures. Some interesting slides were shown, indicating the working of a mica mine and the transport of the raw material to the Dubilier Condenser Co.'s works in Shepherd's Bush, where the mica is split, guaged, sorted and tested for dielectric strength. The assembly of the small condensers used in wireless receivers, and the manufacture of grid leaks and anode resistances were followed step by step, special mention being made of the very thorough tests to which every condenser and resistance is subjected before leaving the works. The manufacture of various types of large condensers was then dealt with, and it was stated that the efficiency of these condensers exceeds 99.99 per cent. Mr. Coursey concluded his most interesting and instructive lecture by showing a few slides of the experimental transmitting station **6 XX**, the station of the Radio Society of Great Britain.

Hon. Sec., J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

Clapham Wireless Society.

Plans for a lecture and demonstration were discussed at a meeting of the Society held on March 12th.

Several new members were enrolled, but there is still plenty of room for new comers. Full particulars of membership may be obtained from the Hon. Sec., M. F. Cooke, 13, Fitzwilliam Road, Clapham, S.W.4.

Pudsey and District Radio Society.

On Tuesday, March 18th, an interesting evening was spent in designing a receiving set for the Society's use.

A number of valuable components have been generously presented. The Hon. Secretary would be glad to receive lists and catalogues from manufacturers and dealers.

Hon. Sec., W. G. A. Daniels, 21, The Wharrels, Lowtown, Pudsey, Leeds.

Honor Oak Park Radio Society.

On March 14th, at the headquarters of the Society, Mr. Lucie, of Messrs. Brown & Co., gave an informal but highly interesting lecture on Telephones and Loud Speakers. Mr. Lucie opened his remarks by refering to public opinion regarding these pieces of apparatus. In dealing with loud speakers the lecturer spoke about distortion due to horns, their size and shape, and explained the prineipal of the "Frenophone" and "Crystavox." The mechanism of the latter instrument was passed round for inspection. The lecturer also explained that a large number of the breakdowns in telephones was due to corrosion and not "burnout."

Hon. Sec., J. McVey, 10, Hengrave Road, S.E.23.

Yeovil and District Radio Society.

The above Society has been recently formed and several meetings have already been held. Plans for organisation have been carried out and officers have been elected. Meetings have been arranged for every alternate Wednesday evening at 7.30. It has been proposed to start a technical library and to install a receiving set at an early date, several members in the meantime having kindly offered to loan instruments. A series of lectures has been arranged for the future and the Committee will endeavour to cater for the beginner as well as for the more advanced amateur. Membership is rapidly increasing, and prospective members should communicate with the Hon. Secretaries.

Hon. Secs.: R. J. W. Marr, "Kismet," Sherborne Road, Yeovil: W. J. Hall, B.Sc.Tech., Greenhill, Sherborne.

Merthyr Radio and Scientific Society.

At a meeting of the above Society held on March 11th, Mr. E. L. Jones, B.Sc., presiding, it was decided upon the proposition of Mr. Lewis W. Dixon (Manager of the Merthyr Tydfil Electric Traction Co., Ltd.), to hold an Exhibition of Wireless, X-ray and other electrical apparatus of the latest designs in order to encourage the study amongst the members. It was proposed by the Secretary that the Society should write to the B.B.C. putting forward a recommendation that the Merthyr District ought to have a relay station.

Information regarding the Exhibition may be obtained of the Hon. Sec., W. T. Rees, 84, Brecon Road, Merthyr Tydfil.

Smethwich Wireless Society.

One of the most interesting events of the Borough was the 3rd Annual Whist Drive held on Saturday, March 15th, at the Smethwick Technical School in connection with the Smethwick Wireless Society. A large number were in attendance, amongst those present being Alderman G. F. Betts, J.P., and Councillor Beardmore. The drive proved a great success due to the initiative of the M.C., Councillor T. W. Evans, J.P. Wireless demonstrations were conducted on the Society's apparatus and operated by Messrs. Grew, Wiggins and Lea. The Society is also indebted to the Cable Accessories Co., Ltd., and Harrisons, High Street, Smethwick, for the loan of apparatus. Towards the conclusion of the evening the Mayor gave a very interesting discourse on the utility of the Society, incorporating the appeal for new members.

Hon. Sec., R. H. Parker, F.C.S., Radio House, Wilson Road, Smethwick, Staffs.

Northampton and District Amateur Radio Society.

"Sound, as Applied to Wireless," formed the title of an excellent lecture, given on Monday, March 17th. Having dealt with the general principles governing the production of sound waves, by means of practical experiments, the lecturer proceeded to demonstrate the laws of resonance. The limitations of loud speakers were next discussed, and the lecturer referred to the difficulties encountered in constructing the ideal diaphragm. He was of the opinion that the modern loud speaker should still satisfy all but the most critical as regards purity of reproduction.

Hon. Sec., S. H. Barber, M.B.E., 51, College Street, Northampton.

Western Metropolitan Association of Affiliated Societies.

A meeting of the Societies comprising the Association was held at 2, Penywern Road, Earl's Court, on March 10th.

The Association received the report of Mr. Coote, the delegate to the Annual Conference, in which he intimated that the Association had received recognition and would henceforth be the Western Group.

The meeting approved a set of rules for the working of the Association, after which the Executive were elected as follows:—

Chairman, J. H. Reeves, Esq. (Kensington Radio Society); Secretary, L. Bland Flagg (Paddington W. and S.S.); Committee, Miss Dicks (Ladies' Lyceum), F. W. Coote (Willesden R.S.), A. J. Calcott (Harrow R.S.).

Messrs. F. W. Coote and L. Bland Flagg were elected representatives to the General Committee of the R.S.G.B.

The Association now has 14 Societies as Members, and new Societies are requested to get into touch with the Secretary at the above address.

Hon. Sec., L. Bland Flagg.

Hampton and District Radio Society.

Lecturing before the Society on March 19th, Mr. Dye, B.Sc., described with the aid of diagrams, and also by the use of the actual apparatus, a most accurate means of wavelength measurement.

Mr. Dye concluded by measuring the wavelength of **2 LO**, and found it to be the same as usual, viz., 359.7.

Hon. Sec., G. W. Thompson, 8, Percy Road, Hampton.

West Bromwich Engineering Society (Radio Section).

On Friday, March 21st, Mr. G. B. Broughton, of the Hart Accumulator Co., Ltd., gave a highly interesting paper entitled, "The Selection and Care of Electrical Storage Batteries for Wireless Work," Councillor T. Wilson taking the chair. The paper was accompanied by a large display of cells and batteries, Mr. Broughton carrying out several instructive experiments. An interesting discussion followed, the lecturer answering many questions.

Assist. Hon. Sec., H. C. Richardson, 57, Birmingham Road, West Bromwich.

Radio Association of South Norwood and District.

Mr J. R. Jeffree (**5 FR**), described his one-valve set on March 20th, demonstrating its reception of **2 LO, 6 BM, 2 ZY, 5 SC, 5 NO, 2 BD,** and **5 WA**. On the addition of note magnifiers, five broadcasting stations were heard on a loud speaker.

Hon. Sec., Miss D. M. B. Cullis, 51, Quadrant Road, Thornton Heath.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 9th.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers. Informal Meeting. Mr. L. F. Fogarty, A.M.I.E.E., will open a discussion on "The Use of Rectified A.C. as a Substitute for Accumulators and Dry Batteries in Receiving Circuits."

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. "Elementary Notes." By Mr. J. G. W. Thompson.

Clapham Park Wireless and Scientific Society. At 8 p.m. At 67, Balham High Road. Lecture: "Long Distance Transmission." By Mr. F. L. Hogg.

Clapham Wireless Society. General Meeting.

THURSDAY, APRIL 10th.

Hendon Radio Society. At 8 p.m. At the Town Hall, The Burroughs, Hendon. Lecture: "The Measurement of Inductance and Capacity."

Sale and District Radio Society. At 37, School Road. Lecture by Mr. B. Ingleby.

Blackpool and Fylde Wireless Society. Open Meeting.

FRIDAY, APRIL 11th.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Practical Work.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture: "The Electron Theory of Matter."

SATURDAY, APRIL 12th.

Southend and District Radio Society. At 2 p.m. At the Boy's High School, Exhibition and Demonstration of Wireless Apparatus.

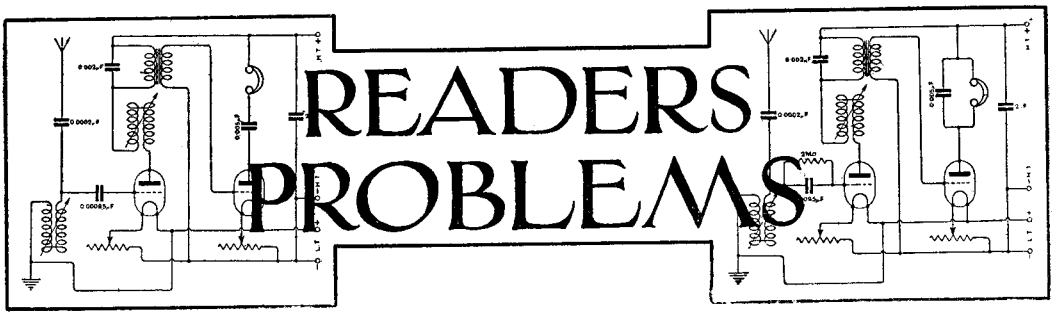
Sale and District Radio Society. Second Exhibition of Amateur and Trade Apparatus.

MONDAY, APRIL 14th.

Ipswich and District Radio Society. At 55, Fonnereau Road. Lecture: "Accumulators and Their Care." By Mr. F. Boddy.

Sale and District Radio Society. At 37, School Road. Open Discussion and Experimental Work.

Hornsey and District Wireless Society. At Queen's Hotel, Broadway, Crouch End, N.8. Lecture: "Wireless Valves and Their Uses." By Mr. L. S. Harley, B.Sc. (By arrangement with the Mullard Radio Valve Co., Ltd.)



READERS' PROBLEMS

1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for 1/-, or 3/6 for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.

"*L.H.*" (*Sudbury*) **sends in a diagram, with particulars of his reflex receiver, and asks how the selectivity and signal strength may be increased.**

The receiver has an untuned aerial circuit of 30 turns, 4" in diameter. It would be better if the number of turns were reduced to 10 or 12. This alteration will give much better selectivity, and probably only a slight reduction in the signal strength. A reaction coil could be connected by breaking the wire which joins the anode terminal of the first valve with the primary winding of the transformer, and connecting a coil which could be coupled with the closed circuit coil. The high frequency transformer is tuned with a 0·001 variable condenser on the primary side, and a 0·0005 on the secondary side. Results will probably be better if the number of turns in the transformer are increased, so that the winding may be tuned with 0·0002 μF variable condensers. Hard valves should be used in the note magnifier and the reflex amplifier. Try using an anode voltage of 100 to 120, with a suitable battery connected in the grid circuit. In the case of ordinary "R" type valves, a bias of two dry cells is satisfactory.

"*T.M.H.*" (*St. Margarets*) **asks for diagram of a 3-valve receiver with which he will be able to receive several of the broadcast transmissions. He has a detector and note magnifier receiver.**

We suggest you build a three-valve receiver having one stage of high frequency amplification, detector and note magnifier. The diagram is given in Fig. 1. It will be noticed that the aerial coil is tuned with a 0.00075 variable condenser which may be connected in series or parallel. The coil is connected between grid and the positive side of the filament. This damps the aerial circuit a little and is beneficial. The anode circuit consists of a coil tuned with a 0.0002 variable condenser. The grid condenser and leak are joined in the usual way, the grid leak between the grid and positive L.T. The reaction coil is coupled with the tuned anode coil.

Under ordinary circumstances oscillations will not be set up in the aerial circuit through wrong adjustments owing to the slight aerial damping introduced.

A cell is shown connected in the grid circuit of the note magnifier. An anode voltage of 70 will be satisfactory when dull emitter valves are used. With a receiver of this sort couple the reaction coil fairly closely with the anode coil and then tune the anode

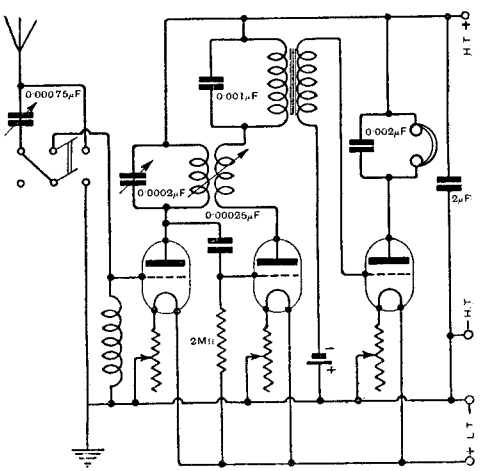


Fig. 1. T.M.H. (St. Margarets). A three-valve circuit for broadcast reception.

and aerial circuits together until a carrier wave is heard. Tune to the silent point and then reduce the reaction coupling until the speech is clearly heard.

"*D.V.O.*" (*London, N.W.2*) **asks if it is still necessary to connect the positive terminal of**

the telephones to + H.T. when the telephones are connected in series with a crystal across the tuned anode circuit of an H.F. valve.

Although the need for this precaution is not so great as when the telephones are connected directly in the plate circuit of a valve, yet we think that it would be advisable to take the trouble of connecting the telephones in the correct way, since a small steady current will flow through the windings if the crystal has a low resistance. There is no necessity to take precautions to neutralise the drop of voltage across the anode coil due to the steady plate current, as with the usual types of tuning coil this will only amount to a very small fraction of a volt.

"*W.H.S.*" (*London, E.C.*1) **asks what weight of No. 47 S.W.G. enamelled wire would be required to wind a pair of telephones to a resistance of 4,000 ohms.**

The weight required would be 0.3 oz. It is not necessary to wind the telephones accurately to a given resistance, and satisfactory results will be obtained if you merely fill each bobbin full of No.47 S.W.G. wire. In connecting up the coils, care should be taken that the magnetic sense corresponds with the polarity of the permanent magnets in the earpiece.

"*T.L.*" (*Swansea*) **asks if it would be possible to control the voltage applied to the grid of a valve by inserting a variable resistance in series with the grid cells.**

This method of varying the grid voltage would not be practicable, since in order to obtain an appreciable change in the voltage between grid and filament, it would be necessary to use a variable resistance comparable to the grid filament resistance of the valve. The only method of obtaining a continuously variable voltage would be to connect a potentiometer across the grid battery, and to connect the sliding contact to the grid circuit and the positive side of the grid battery to — L.T. In practice, however, such an adjustment is hardly necessary, and it will be found sufficient to adjust the grid voltage by varying the number of grid cells in the circuit.

"*B.C.*" (*Ealing*) **wishes to make a unit receiver and proposes to commence with a tuner and detector unit.**

The diagram of the two units is given in Fig. 2. The third unit shows the connections of a note magnifier in case you wish to add one at a later date. A 0.001 μF aerial condenser is connected in series with the aerial coil which is the top one in the 3-coil holder. The centre coil is tuned with a 0.0005 μF variable condenser and connected to terminals G, F. The detector valve is joined in the usual way with the reaction coil coupled to the closed circuit coil. The L.F. unit consists of an inter-valve transformer with the valve, filament resistance, and terminals. It is connected up to the detector unit as indicated in the diagram.

"*W.A.*" (*Edinburgh*) **asks why the use of a series aerial tuning condenser of high value does not reduce the efficiency of the receiver to the same extent as it would if it were connected in parallel with the A.T.I.**

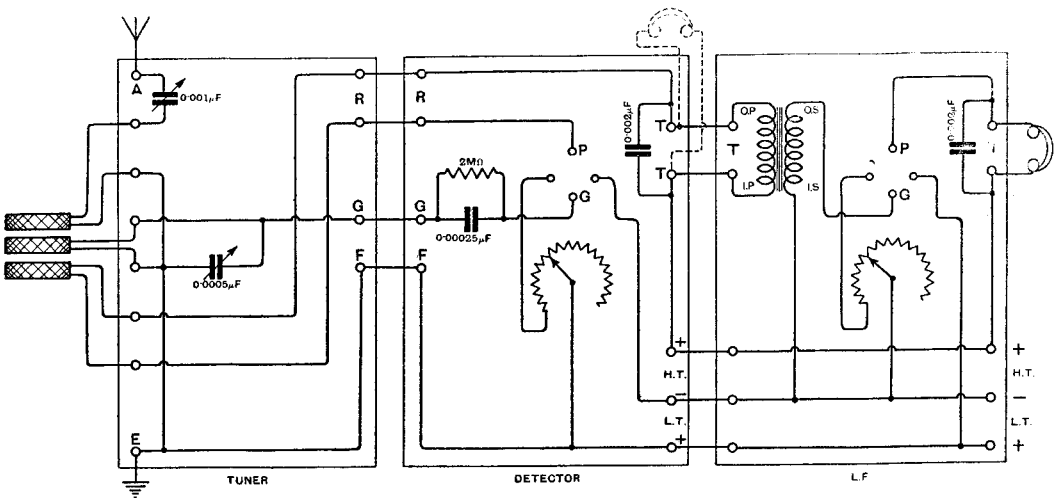


Fig. 2. B.C. (Ealing). A two-valve receiver built on the unit system to permit future extension.

The voltage across the ends of the A.T.I., and consequently the signal strength obtained, depends upon the total capacity in parallel with this coil. When the aerial tuning condenser is connected in series, the effective capacity across the A.T.I. is considerably less than the capacity of the tuning condenser, since the effective capacity is made up of the combined capacities of the aerial itself and the tuning condenser; thus, if the capacity of the aerial is, for the sake of example, 0.0005 μF, and if the tuning condenser has the same value, the effective capacity in parallel with the A.T.I. will be only 0.00025 μF.

Radio Society of Great Britain.

ANNUAL CONFERENCE OF AFFILIATED SOCIETIES.

(*Concluded from page 34 of previous issue.*)

AN AMATEUR RESEARCH FUND.

A Delegate (Derby Wireless Club).

At our last annual meeting we discussed the question of forming an amateur research fund. There are now something like 600,000 holders of licences and you can look upon a colossal number like that as a high potential source of L.S.D. With 1s. from each of them we could start with a fund of £15,000, but even if we did not get subscriptions from the individual members, but dealt with the matter through the affiliated societies there are 300 societies and if we took an average of 100 members per club we could start with a sum of £10,000 or £15,000 if each member undertook to collect 10s. Our idea is that we should establish a fund of £50,000 for the advancement of radio research, but we say that if such a fund is raised it is not for us amateurs to spend it. We should ask eminent radio scientists to see that the money is spent most wisely. If we got such a fund it would enormously enhance the prestige and status of the experimental wireless amateur. The Derby Club thinks it is desirable and I shall be pleased to hear what others have to say about the matter and we hope that you will co-operate with us.

Mr. Matthews (Birmingham).

This matter has been discussed by the Birmingham Club Committee and they are in favour of the idea. I have no instructions, however, to pledge Birmingham in any way. I am here for information on the matter.

Mr. Betts (Leyton).

The Leyton Radio Association has also discussed the matter fully and is in favour of it.

Mr. Stanley (Eastern Metropolitan Group).

The Eastern Metropolitan Group support the idea in theory but as we have very little detail with regard to it we feel we cannot do much until we know what the money is going to be for. At present there is the Radio Research Board and a great deal of experimental work is being carried out by the National Physical Laboratory. It may be that the raising of such a fund as that now proposed may provide someone with a "cushy" job for a little while, and not much work would be done. At the same time, if some scientific scheme was got out we think we could support it. Failing that, perhaps the General Committee might draw up some scheme which would usefully employ this fund. Then some of the Groups would no doubt be able to support it.

A Delegate (Hampton).

Can the Chairman tell us if there are any Government funds available for this purpose to-day, because the sum of £15,000 mentioned by the delegate from Derby seems to me hopelessly inadequate to carry out any experiments whatever. Another Society with which I am connected obtained £40,000 or £50,000 out of the Government on condition that we raised £6,000 ourselves, and that money is being used for research work to-day. If we could get £30,000 or £40,000 from the Treasury and use a portion of it to endow research laboratories then some thing might be done.

Mr. Dixon (North Middlesex).

I hope to see such a fund established, but the thing would be to keep it for the amateur. With all due respect to our friend from Derby I would not agree to having the fund administered by eminent radio experts because the amateurs approach this subject from a totally different point of view to the high authorities referred to. With the greatest respect to the eminent authorities who are here this evening I must say that it appears to me that their minds are trained in a certain groove, whereas the amateur comes to the matter with a totally different outlook. It is true that he staggers through it sometimes, but very often he hits upon the right way of doing things, and therefore I think we should keep this Fund for research work by the amateur exclusively because it would probably help to elucidate many problems which are not yet solved.

After further discussion **The Chairman** said: I am sure that very few people here would object to such a Fund being raised and used provided machinery could be found for doing the work efficiently. It must not be spent mainly in office expenses and stationery. It must be spent on objects worthy of the scheme. These are points which will have to be threshed out by those in charge of the Fund. I believe the Derby Society regards itself as the centre of the movement and would probably wish to run the thing as its own, with the support of this Society. I do not think the Derby Society is proposing to hand over the running of the business in any sense to the Radio Society.

A Delegate (Derby).

If I might explain. I believe there are some 200 affiliated societies out of the 300 which are in existence and we have been in communication with the remainder who for the most part have agreed to support the Fund provided it is got up by the Societies and is not associated with any particular association such as the Radio Society of Great Britain. Our opinion at the moment is that the Fund would have to be on a county basis and not run by the R.S.G.B. I do not approve the suggestion that the Fund should be used solely for amateurs. We put it on a higher plane and would prefer that the money was spent for the advancement of radio science generally.

The Chairman.

Someone asked me what Government funds are available. The Radio Research Board exists solely for wireless research and it makes grants for researches by private individuals as well as by the Services. Its grants for private individuals, however, are only made when the research is definitely stated. Then the private individual is responsible to the Radio Research Board in all matters respecting the publication of results. The Board can very rarely give support to what you may call imaginative investigations. As regards other researches than wireless, the funds are mostly now granted by the Department of Scientific and Industrial Research. Under this body industrial research associations are formed for various industries—there are 20 or 30 of them now—and the Government provides funds on what is known as the £ for £ basis, and the Associations administer these funds in the way they think best. These are all the resources available just now from the Government for private researches, apart from the Royal Society's Fund, which is about £5,000 a year, which has been distributed by the Royal Society for many years for the purpose of research work. The only thing we can do, I think, is to express our cordial support and wish the Derby Club the best of luck. We are not asked to run the thing at the present moment for the reasons you have heard, but we can, if the Derby Society elect, pass a resolution approving the scheme and suggesting that they keep in close touch with the General Committee on the matter, and that the General Committee be asked to support it. I take it that the Derby Society will be satisfied with that?

A Delegate (Derby).

Certainly. It was a great surprise to us to find so many societies were not affiliated.

The Chairman.

Many of them do not fulfil the conditions. They must have 30 members.

A Delegate (Derby).

We think this Fund may bring all the Societies together. The Fund could certainly be invested.

The Chairman.

I will propose from the Chair that this meeting approves cordially of the aims of the Derby Wireless Club and wishes them every success, and asks the General Committee and the Derby Wireless Club to keep in close touch on the matter.

The motion was agreed to.

A Delegate (Derby).

I beg to thank the delegates very much. We have had a large number of suggestions by letter, all of which will help us to work out a scheme. We have not worked one out yet.

STANDARDISATION OF WIRELESS APPARATUS AND PARTS.

General Holden.

There is not much to report concerning this matter. I have had a letter from the British Engineering Standards Association and they require that all parties interested in the subject of standardisation should be represented on the Committee when it is formed by them. In order to get it formed, we shall have to make application, in conjunction with the manufacturers through their Association, to the British Engineering Standards Association, saying that we want standardisation to be effected and that we are willing to co-operate on a Committee which they will form to carry out standardisation. That is as far as the matter has gone. As far as I can make out, that Committee will be formed next month and then it will probably sit weekly, and you may expect to get some results. Undoubtedly it will be very useful to everyone, manufacturers and users, and to the radio systems and the industry generally.

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Mr. Reeves.
I should be pleased to sell a considerable amount of apparatus at about one-third what I paid for it. I think there are very few here who can say that during the course of the year they do not put aside something each year to provide for this. Grid leaks which are supposed to be 2 megohms are anything from 8 to 1, and so-called 0.0005 condensers often are 0.0003. Standardisation does not mean merely making parts which fit exactly. When we buy a coil we hope it will fit comfortably into its holder but we do get a lot of hopeless stuff which is not up to standard. I am speaking personally because that is one of my ambitions. I want it to be possible to go into a shop and ask for a certain marked condenser or grid leak or anything else and feel confident that it will be reasonably within the limits it is supposed to be. That is a thing which we can only get, however, with the support of everyone. It will be a matter which will be brought before the General Committee, I hope very soon, and I hope the General Committee will take it up with the Radio Society and that the matter will be pushed forward in every possible way.

A Delegate.
I should like to say that standardisation will not protect you in the way Mr. Reeves seems to think in getting a 5 megohm grid leak which is not a 5 megohm grid leak. You get standard specifications for all sorts of things issued by the British Engineering Standards Association but they are no guarantee of quality. They are only a guarantee of dimensions, and therefore I do not think that the question of the capacity of a condenser or the resistance of a grid leak comes in at all in the ordinary way with standard specifications.

Mr. Stanley.
The British Engineering Standards Association has two distinct specifications; one for quality and the other for dimensions.

The Chairman.
I ought to tell you that the Council nominated its Standardisation Committee representatives at its last meeting. The gentlemen who will represent the Radio Society on the Committee which the British Engineering Standards Association will appoint are General Holden, Mr. Reeves, Mr. Carpenter and Mr. Stanley. The Chairman is General Holden and the Secretary is Mr. Reeves. The manufacturers have to appoint their own representatives and we understand that this is now being done.

AMATEUR TRANSMITTING LICENCES

The Chairman reported the position with regard to obtaining amateur transmitting licences.

OTHER PROBLEMS.

The Chairman, dealing with other matters to be taken in hand by the Radio Society and the General Committee, said: We have to deal with the people who use non-radiating aerials with huge currents, and therefore make them radiate, and also the people who send out gramophone records which really perform no service to the owner and are a nuisance to other people. We have got to tackle that whole problem of the legitimate or illegitimate use of transmitting facilities. There is a great deal of work of this nature before the General Committee and anyone who has any suggestions to make we hope will write to the Secretary of the General Committee.

Another matter to be reported is that the Broadcasting Company and ourselves have been co-operating during the last six months or more in endeavouring to trace down the sources of disturbance to broadcast programmes. The Company has sent us, since the beginning of last November, copies of many letters of complaint which they have received. We have analysed them for November, December and January. I did it myself on one occasion, and Mr. Child went through the papers again and we tried to see how much of the disturbance to programmes was due to the experimenter. It was clear from these complaints that 78 per cent. of them were due to oscillation by beginners listening in to the broadcast programmes, not the transmitter or the experimenter. I think about 3 per cent. were due to intentional oscillation; 12 per cent. appeared to be due to interference by transmitting stations, including Government and commercial stations, and about 1 per cent. appeared to be due to intentional interference by transmitters; finally 6 per cent. appeared to be due to various other causes not wholly connected with wireless, like switching, tramways, and things of that kind. Thus there is only 12 per cent., or 16 per cent. at the most, that can concern us. We cannot be held responsible for learners using valve sets unconsciously in an oscillating condition, but we can assume some interest in the 16 per cent. of disturbances due to transmitters. Of that 16 per cent. something like 10 per cent. must be due to Government stations or commercial stations, with or without harmonics (laughter), and therefore we, as amateurs, are left with about 6 per cent. to account for. It is that 6 per cent. which we must try and tackle during the coming year, and we can pass the task on to the General Committee as soon as it has got started.

This is the last matter I have to report to you, and I will now ask if there are any other matters which any of the delegates desire to raise.

NEWSPAPERS AND WIRELESS ARTICLES.

Mr. Matthews (Birmingham).
A point has come before the Birmingham Club as to general newspapers publishing misleading information on wireless circuits, some of which will oscillate violently. These articles give no hint whatsoever of the oscillating properties of these circuits, and we think it is a matter which ought to be tackled in some form. A very bad case is now before us of an article published in a local paper at the end of January. The matter has been reported to the Broadcasting Company, and they asked me to mention it at this Conference. A certain tradesman in Birmingham is selling all the parts and pushing them for this local paper's circuit, and we are being howled down.

A Delegate.
I am Secretary of the East Anglian Society, and owing to complaints we thought we would have a portable station to take about the district and try and see if we could find anything out. We already had an experimental licence, but asked the Postmaster-General for permission to use a portable station. We were then told that a new licence would be issued for another 10s, but we are not going to send it.

Mr. Child (Golders Green).
I am very glad to hear that someone has refused to pay money to the Post Office. I asked formally a little while ago for permission to conduct experiments in conjunction with the Radio Society to send messages, if possible, across the Atlantic. I was to provide the power and the apparatus, but the Post Office asked for £4 10s. I have refused to pay it, and I have a letter saying that because I have refused to pay it they have withdrawn the permit. That is sufficient for me to go on with. They are still trying to get the money, but they will not get it if I can help it, and I am hoping that the Radio Society will back me up and see that they do not get it.

Mr. Taylor.
There is one point upon which I should like, if possible, to get some information from Lancashire members. Three or four months ago it was stated that **2 US** had been heard in Manchester. Owing to the distance we doubt very much whether it is this station's transmissions that have been heard in Manchester, and we are wondering whether someone is using our call sign illegitimately or whether the Post Office has inadvertently allotted the same call sign to another transmitter.

Mr. Dixon (North Middlesex).
Could the Society do anything to stop spark transmitters, because this is an intolerable nuisance. You are asking a distant station, and you suddenly hear a nearby neighbour start up with spark transmission. If it is possible to shut down all spark transmission I think it should be done.

Mr. Coursey.
At a meeting of the London transmitters held some time ago under the auspices of the Society, members voluntarily bound themselves not to use spark transmission. The matter will probably come before the Transmitter and Relay Section with a view to getting some such agreement all over the country.

The Chairman.
I suggest that these complaints should be brought to the notice of the Secretary of the Transmitter and Relay Section. It will then be for the General Committee to take it up from the national point of view, and the Council will then act.

Mr. Sutton.
I have a licence for spark transmission, but I have not used it for years, and I should not think of doing so now. Could this Conference suggest to the Council of the Radio Society the desirability of taking the step of asking the Postmaster-General to withdraw all spark licences.

Mr. Dixon (North Middlesex).
I shall be pleased to second that.

Mr. Child (Golders Green).
I do not think, as a matter of general policy, it would be wise on the part of a body like this to suggest that the Postmaster-General should withdraw anything. I quite agree about the nuisance from spark transmission, but I think it would be a mistake for us to ask for limitations or to prevent anybody from using a spark transmitter. We must bear in mind that in some research work going on at the present time spark transmitters must be used. I do not see any objection to a spark transmitter if it is well tuned. Then the spark transmitter is no worse than any other transmitter. The matter should be left to the Transmitter and Relay Section to regulate the wavelengths on which spark transmitters should work

Mr. Sutton.
In face of that, I will not move my resolution.

It was agreed to refer the matter to the Transmitter and Relay Section.

A cordial vote of thanks to the Chairman closed the Conference.

The WIRELESS WORLD AND RADIO REVIEW

THE BROADCASTING HANDICAP.

By THE EDITOR.

THE dissemination of news by wireless has always been regarded as one of the most important services which a broadcasting organisation can perform for the benefit of the general public, and unless we are mistaken, when broadcasting first developed on a national scale in America even more attention was paid to providing a really efficient news service than to making use of the microphone as a means of providing public entertainment.

One of the outstanding advantages which wireless broadcasting has over any other means of communicating news is due to the almost total absence of delay in communicating the intelligence to the general public. Music can wait, speeches can wait, but news, if it is to be appreciated by the public, must be communicated with a minimum of delay.

Broadcasting in this country is now a national institution and the public is not really interested in the question as to whether it is run as a monopoly by one company or an association of companies, provided that they enjoy the utmost benefit which this new development of science can provide, even though some other industries might have to suffer through competition with broadcasting which might result.

Some time ago the organisers of broadcasting in this country experienced a good deal of difficulty as a result of the attitude adopted towards broadcasting by interests in the musical profession. Many of these difficulties have now been surmounted. Even where competition has come about it has been recognised that it is necessary to bow to the inevitable in the interests of development and new enterprise.

There is still, however, an outstanding obstacle to progress in broadcasting in this country in the attitude of the general Press towards the broadcasting of news. So strong was this opposition at the time that the Broadcasting Company's licence was drawn up that a clause was introduced limiting the Broadcasting Company in respect to the transmission of news items and in which they might broadcast matter to be supplied by recognised press associations.

No restrictions of this kind have been imposed in establishing the broadcast service in the United States. In this country, too, we believe that the Broadcasting Company is not prevented from making its own arrangements to collect news for broadcast, but if this is the case it would seem that there is some lack of enterprise on the part of the officials of the Company. Whatever the cause of the present poorness of the broadcast news service, it is deplorable, and steps should be taken at an early date to effect a remedy.

It is only necessary to mention the recent case where the result of the boat race was broadcast as a *news item* hours after everyone interested had been able to obtain the information from other sources.

Broadcasting must be developed in all possible directions and the public have the right to demand that this should be done. If other industries or enterprises have to suffer somewhat through the competition then let it be so. History shows that in no other direction has development in any public service been hindered out of consideration for existing but inferior services. Hansom cabs in London were all very well in their day but it would be difficult to find justification for retaining them and suppressing the introduction of taxi-cabs. Yet this may be cited almost as a parallel to the present deadlock in the matter of the broadcasting of news.

AN EXPERIMENTAL DIRECTION FINDING STATION.

The first of its kind, this article gives detailed instructions for the setting up of an experimental direction finding station suitable for amateur use. The design has been specially considered to suit the conditions usually met with when installing wireless equipment in the home. All necessary data is included and easy modifications can be made according to circumstances. Articles under this heading in the two previous issues of this journal deal in detail with all the theoretical considerations involved.

By R. KEEN, B.Eng., A.M.I.E.E.

It is not proposed to give anything in the nature of dimensioned working drawings of the individual pieces of apparatus, but some suggestions will be found in Figs. 16 and 17 as to the lines on which to start out in constructing a set to work on the circuit just described. The windings and other details given below have been taken from a set having a waverange of approximately 300 to 800 metres, but can be modified to include the amateur transmitting range with slight alterations to some of the windings, or by the use of the two or three range variable condensers now on the market. If the frame be mounted above the roof of a low building the central spindle may be of steel or brass tube, which will allow the lead from the gauze, and also the two pairs of leads from the frame, to be brought down inside it, and the lower end must be provided with a footstep bearing and a handle for rotating the frame. It is an advantage to make the frame removable, because prolonged wind and rain will ruin anything in the nature of a temporary structure. The scale should be marked in degrees from 0 to 359 in a clockwise direction, wireless bearings always being measured in "Degrees East of True North." The double pointer can be made from sheet metal and clamped on to the spindle in such a way as to allow of rotation relative to the spindle when calibrating. These are all simple mechanical details, ideas for the construction of which will readily occur to the reader.

The frame, 3 ft. square, may be wound with 6 turns and about ½ in. spacing between them. Various numbers of turns may be tried but the frame should not be made much larger or it will be unwieldy to handle —particularly in a wind. Two leads from the centre of the frame winding come to a variable air condenser of 0·001 mfd. capacity (maximum), and from the extremities of the frame is another twisted flexible pair to the primary of the open aerial coupling. This winding is on an ebonite former 1½ ins. in diameter, and is in two equal sections as shown in Fig. 17, each consisting of 20 turns of No. 20 D.W.S. copper wire. The leads from the centre of the primary sections had better be taken through holes in the former and brought out through the inside so as to prevent any chance of a section being shorted. A layer of empire cloth or paraffin waxed paper is placed over the primary to a thickness of about 1/16th of an inch, and on this is wound the secondary. The exact number of turns will depend upon the frame dimensions and its height above the ground and a number of other factors, but it may be made of 160 turns of No. 32 D.W.S. copper wire, and provided with tappings at points corresponding to 10, 20, 30, 40 and 50 turns from each end. It is advisable to provide these tappings at each end so that in stepping down, say, 20 turns, 10 turns may be taken from each end, thus maintaining the symmetry of the secondary with respect to the two sections of the primary. The jigger is 165 turns of No. 22 D.W.S. copper wire on a 1½ in. former, which should be mounted at right angles to the open aerial coupling so as to avoid any mutual induction between them. The jigger primary may be wound over the secondary with a layer of insulating material in between, as in the case of the open aerial coupling, and this winding would consist of about 70 or 80 turns of No. 22 D.W.S. copper. Tappings for varying the coupling must again be arranged symmetrically, for if

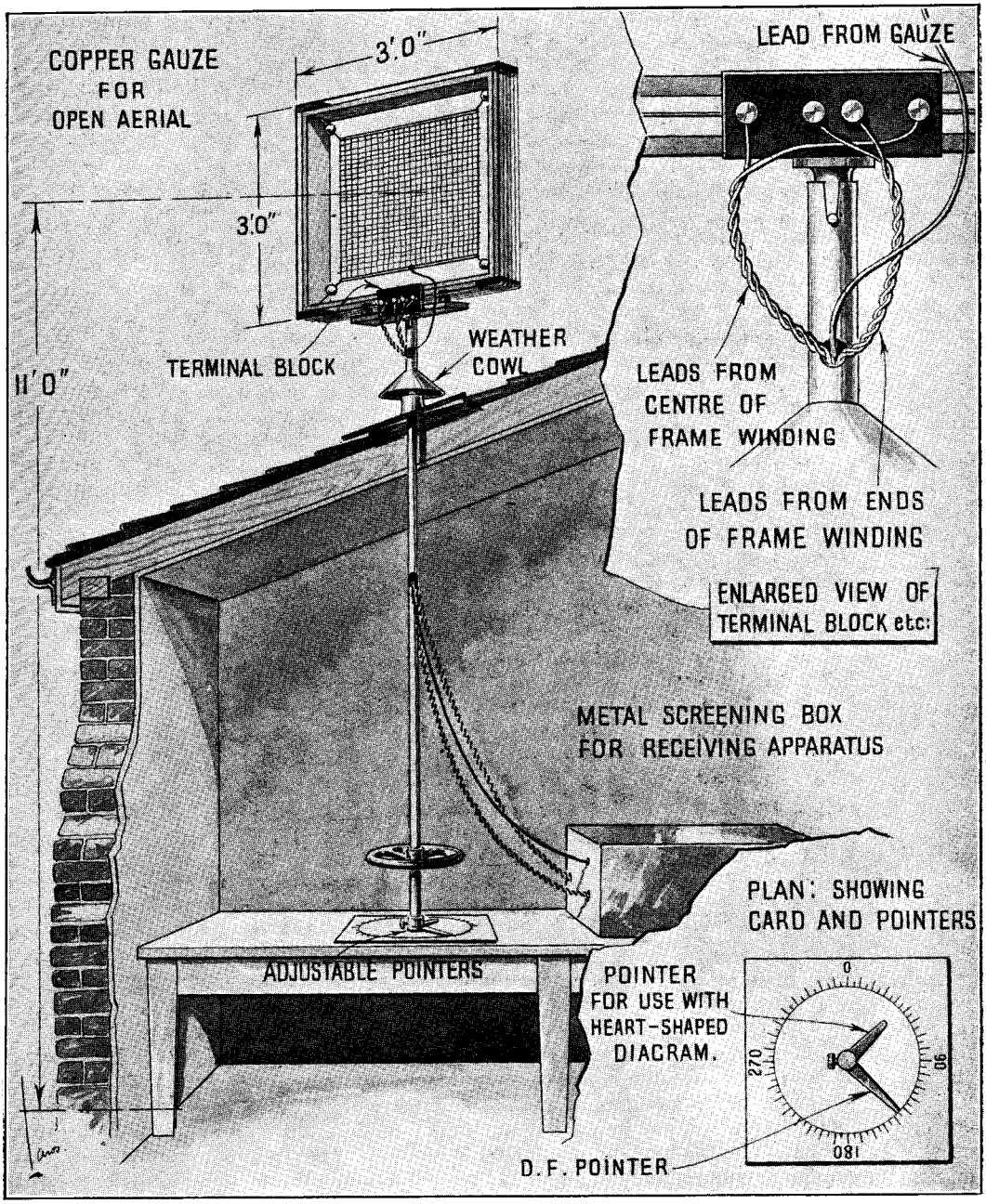

Fig. 16. *General arrangement of the D.F. described in this article.*

one half of the primary be coupled more tightly to the secondary than the other half, then the "mid" point connection will no longer be electrically symmetrical and vertical will be introduced. For this reason, a sliding coupling cannot be used, although, to avoid making tappings, a spherical former might be mounted to rotate inside the secondary former if this latter be made larger than stated above and with correspondingly fewer turns. In any case, the primary winding should be placed near to the end of the

secondary which is joined to the B or filament terminal of the amplifier. The jigger condenser for a 300 to 800 metre range, with the above-mentioned secondary winding, should have a maximum value of about 0·001 mfd. The resistance for stabilising the phasing of the open aerial may be made from Eureka, or some similar high resistance wire, and should be wound non-inductively by using a flat strip instead of a cylindrical former, the non-inductive effect not being obtained by the common process of doubling back the wire, as this introduces a large capacity between the ends. In the present case the resistance should have a maximum value of about 6,000 ohms, capable of being varied in steps of 100 ohms. No. 44 Eureka wire has a resistance of approximately 90 ohms per yard, but the wire is delicate to handle, and reference should be made to a good handbook on the construction of wireless apparatus as to the best methods of making this resistance or any other parts of the apparatus which present difficulties. The apparatus can be mounted on an ebonite or wooden base, and it is advisable to keep the whole set reasonably compact, or the screening box will be rather large. The valve amplifier used must, of course, be adapted to the wave range over which it is desired to work, and it will be found better to use a fairly high magnification.

Having wound the two sets of couplings and the resistance and erected the frame, preliminary tests may be made before the apparatus is mounted or permanently connected up. First of all buzz the jigger and frame aerial circuits separately, and ensure that they cover the desired waverange, and then connect up the amplifier and get buzzer signals on 600 metres, the open aerial coupling coil being disconnected. Ship stations should be heard, and choosing some station which is working traffic, note carefully whether the points of minimum signals are crisp and exactly opposite one another on the scale. If the minima seem indefinite or are not opposite, make sure that there is the shortest possible connection from the coupling coil mid point to earth. The earth lead should not be more than 6 or 8 ft. long, and should be connected to a sheet of metal about 3 sq. ft. in area, and buried. If this does not give sharp minima, try the effect of a grid condenser as in Fig. 6, or else put the complete receiving instruments in a metal screening box which has a lead soldered to it so as to make a good earth connection if required. With a set exactly as described in this article, the writer found that the best minima were obtained with the apparatus, including batteries, in a sheet iron box *not* connected to earth, the mid-point of the coupling coil being soldered to this screen, and this arrangement is accordingly shown in Fig. 17. The box was about 3 ft. by 2 ft. by 1 ft. 6 ins., and it was found permissible to have one side open and the tuning condensers outside, but a number of different arrangements must be tried until the best minima are obtained.

Now connect one end of the open aerial coupling coil to earth, the other end being connected to the open aerial, *via* the open aerial tuning inductance, of about 1,500 mhy. (maximum), and set the frame in the position of minimum signals from the station on which tests are being made. Any signals heard are due to the open aerial effect, and the tune must be adjusted by means of the variable inductance until these signals are a maximum. The finer the tappings, the better for this purpose. Next insert the resistance and try to picture just what is happening when the frame is rotated. We are adding to the figure eight diagram a circle the size of which we do not know at all accurately, and the resulting diagram may be any one of the series shown in Fig. 12, and may also have indefinite minima if the tune of the open aerial circuit is not approximately 600 metres. It is almost certain, however, that on turning the sense pointer first to one and then the other position at which minimum signals were heard on the simple frame, the signals at one position will now be found to be much louder than at the other. This is promising, and the procedure now is to set the pointer at the weak direction, and then to try various values of the open aerial inductance, coupling coil and resistance until the best heart-shaped diagram is obtained. Take care that the open aerial coupling coil is placed at the bottom of the open aerial circuit. If the resistance be connected between the coupling coil and earth, the potential of the coil will be raised above that of the frame coupling coil and there will be capacity coupling between them.

If the heart-shape reception is required

simply for sense determination, there is, of course, no necessity to go to great trouble to obtain a perfect heart-shaped diagram since, so long as the sense pointer indicates a definite inequality in signal strength under the conditions mentioned above, this gives all the information required. With a simple set of this kind, however, it is possible to get a perfect heart-shaped diagram, and is well worth trying, although lack of space unfortunately makes it impossible

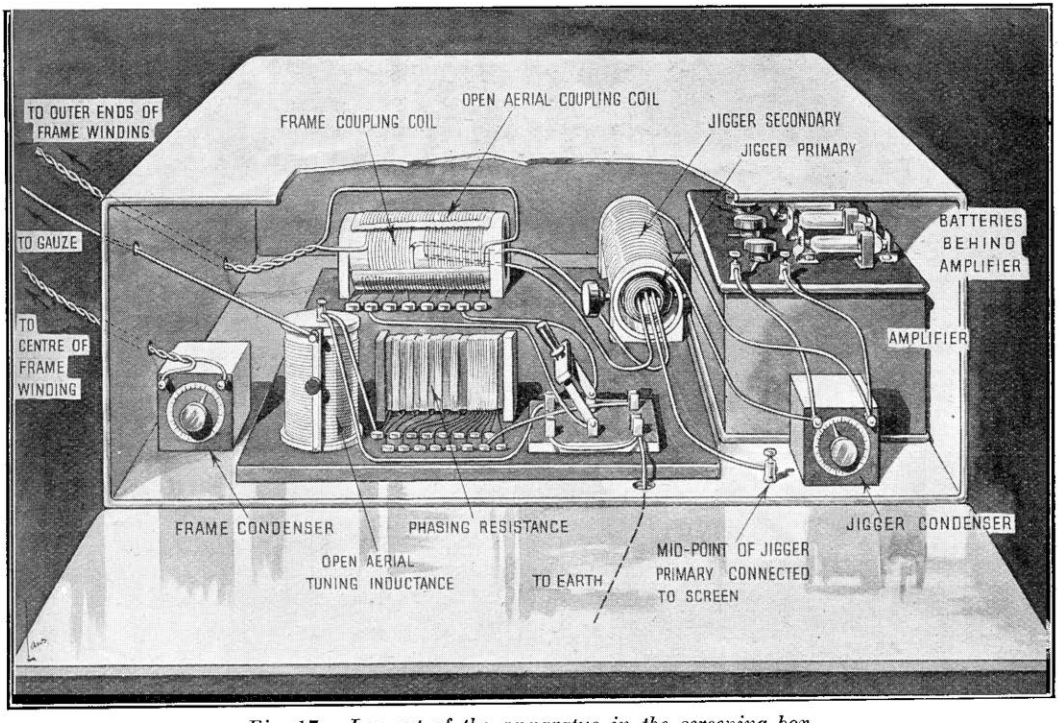

Fig. 17. *Lay-out of the apparatus in the screening box.*

to go into further details on this point. So long as unilateral reception has been definitely accomplished, the apparatus, so far as direction finding is concerned, may be wired up, and is ready for calibration.

The first requisite is a fairly large map on which scales of latitude and longitude are marked, and which includes a radius of 100 miles or so from the place where the D.F. station is to operate. On this map are plotted the positions of all the transmitting stations which are heard, their positions being obtained from the *Year Book of Wireless Telegraphy and Telephony* or some other available source. Also mark accurately the position of the D.F. and join all the stations to the D.F. by fine straight lines. Through the position of the D.F. also draw a line due North and South and note that if meridians are not shown on the map, it is *not* safe to assume that the sides of the sheet are due North and South. From this meridian through the D.F., now measure off, with a protractor, the angles clockwise from the direction of true North, of all the transmitting stations plotted. The process of calibrating consists in taking bearings on as large a number of stations as possible and comparing the observed bearings with those measured from the map. Until the pointer of the D.F. is fixed in the correct position on the spindle it is, of course, impossible to take any true bearings, but, clamping the pointer in any position whatsoever, take a number of bearings and tabulate the results against the true bearings in the way illustrated in the following example.

Suppose that the station has been erected somewhere in Surrey, and the exact position

has been plotted on a map of the South of England. The true bearing of North Foreland station (**GNF**) has been measured to be 88½°. On tuning the station in and rotating the frame with the switch on "D.F." it may be found that one minimum is at about 25°, and if it is not very crisp take swing bearings between, say, 15° and 35° and note the exact angles at which the signals seem of equal strength, the mean of which is the required angle. If the minimum is fairly definite, the swings may be made smaller than this and a little practice will soon show the best and quickest way of getting the result. Next rotate the pointer through 180° and examine the other minimum in the same way, the reading of which should be 205° if no vertical is present. If there is vertical, the second minimum may be found to be 207°, which is 2° away from the exactly opposite angle, and if nothing can be done to improve this it is permissible to split the difference between the two minima and call them 26° and 206° instead of 25° and 207°. If the reason for this is not quite clear it should be sketched out on paper, when the whole operation will be easily understood. To determine which of the two minima is to be written down as the bearing, switch over to "Sense," and using the sense pointer (which is at right angles to the D.F. pointer), examine the two directions and note which one coincides with the minimum of the heart-shaped diagram. (This is, of course, a purely arbitrary point, but it is usual to work on the minimum in commercial stations, and so it has been followed in this case.) If the minimum is in the 206° direction, write this angle down as the observed bearing of **GNF**, and continue to carry out this operation for as many stations as are in range and tabulate all the observed bearings against the true bearings measured from the map. On looking down this list, the first station, **GNF**, is found to be actually 88½°, whilst his observed bearing is 206°, which means that the pointer must be rotated on its spindle through 206° − 88½° = 117½° in an anti-clockwise direction to make the D.F. register his true bearing. Before doing this, however, find the complete list of errors, which may not all be quite the same owing to a large variety of causes which produce inaccuracies. It will be found, of course, as a rule, that all the bearings are wrong by about the same amount, and the pointer can then be swung through such an angle that as many as possible of the observed bearings are correct or else so that it is correct in some special sector in which it is particularly desired to work. If all bearings in a certain sector are incorrect by a definite amount and the remainder are right, an error chart may be prepared and a correction applied whenever bearings are taken in this direction.

In taking these calibrating bearings it is important that the work should be carried out during the daylight hours and not within about an hour of the time of sunset. As soon as the light begins to fail, minima may become indefinite and bearings are uncertain, and may vary several degrees from their normal value, continuous wave stations being worse in this respect than spark, however. Another point to bear in mind is that the bearings of stations, as measured on the average map in the way mentioned above, are not strictly correct, and should not be used for distances much greater than 100 miles. Special maps or calculation of the great circle angle should be resorted to for long distance work.

A single D.F. station will, of course, only indicate the *direction*, and not the *position*, of a transmitting station, and if the latter is required, then two D.F.s must be used, situated a distance apart which is comparable with the distance of the station to be observed, so that simultaneous bearings may be taken which, when plotted out on a map, should intersect at the position of the transmitting station. These bearings, or "position lines," should intersect as nearly at right angles as possible for the greatest accuracy, and it will be clear that the more acute their angle is the greater will be the error in position for a small error in the observed bearing in either case. Long distance position finding is therefore almost ruled out for the amateur, except by the use of synchronised watches, in the case of two stations situated many miles apart or by line telephone or wireless communication. For instance, two D.F.s a mile apart taking bearings on a station 60 miles away would only perceive one degree difference in bearing under the most favourable conditions and as the errors of the set may easily exceed this figure it would clearly be absurd to

attempt to plot such results. This is an exaggerated case, but illustrates the point.

When some success has been attained with the D.F. in the open, experiments should be carried out such as the wilful introduction of vertical and the erection of the frame close to buildings, wires, etc., so as to observe just what effects are to be expected in these circumstances, and whether anything can be done to eliminate them. Later the frame may be tried indoors, but owing to the gas and water pipes, electric light and telephone wiring, and the general masses of brick and stone, it is very unlikely that accurate D.F. work will be possible. The heartshaped diagram, however, will be found a valuable adjunct to a broadcast receiver with which a frame aerial is used when, owing to the fact that a jamming station is in exactly the opposite direction from the broadcast transmitter, the simple figure eight diagram is useless.

Such, then, is the outline of how a simple radio compass may be made and the owners of a small group of such stations might, if suitably organised, get a great deal of entertainment and also interesting technical information, by locating users of intensive reaction in their neighbourhood. The stations would log all sounds heard, together with the exact time and observed bearing, and then the results would be compared later and plotted out on an ordnance survey map of the neighbourhood, which may be purchased for a shilling or two. In doing this, it must be borne in mind that in every case two bearings will be obtained, one corresponding to the broadcast transmitter, and the second one to the receiving aerial, which is radiating and giving the beat effect or howl. (The writer is not advocating that any action should be taken in the above case. Anyone who, on the strength of bearings taken on a home-made D.F., tells a perfect stranger that his receiver is oscillating should be prepared for all eventualities !)

No sooner, however, does one start on serious directive reception than a multitude of fascinating problems begin to present themselves which are never met with in ordinary non-directional reception. Some of these points have been cleared up, and information is available in text books on the subject, but a number remain which still deserve attention. Amateurs can do quite useful work in the systematic observation of, say, the apparent variation in bearing of fixed stations round about the time of sunset and during the dark hours. It is not uncommon to find, under certain conditions, the bearings of a continuous wave station wander 20° or 30° away from its correct value, and cases are on record in which far more violent variations have occurred. It is also exceedingly interesting to note that these swings in bearing have often been observed to coincide exactly with the periods of fading in signal strength, and all these " night effect " phenomena may be observed on a carefully erected and calibrated rotating frame circuit having the appropriate wavelength range and a shielded local oscillator for C.W. reception. There are also many other points, such as the way the times of variation of a given transmitting station's apparent bearing will differ for two D.F. stations a mile or two apart ; the minimum and maximum distances between transmitting station and D.F. at which variations are noticed ; the value of the heartshaped diagram of reception for detecting night effect conditions, and so on. A number of articles have appeared on these matters, a list of which will be found in the chapter on " Night Effect " in the present writer's book on " Direction Finding,"* and the whole subject bristles with similar problems, which will be found to hold the attention of anyone who dips into this branch of reception, long after the rather amusing " broadcast detective " work mentioned above has been forgotten.

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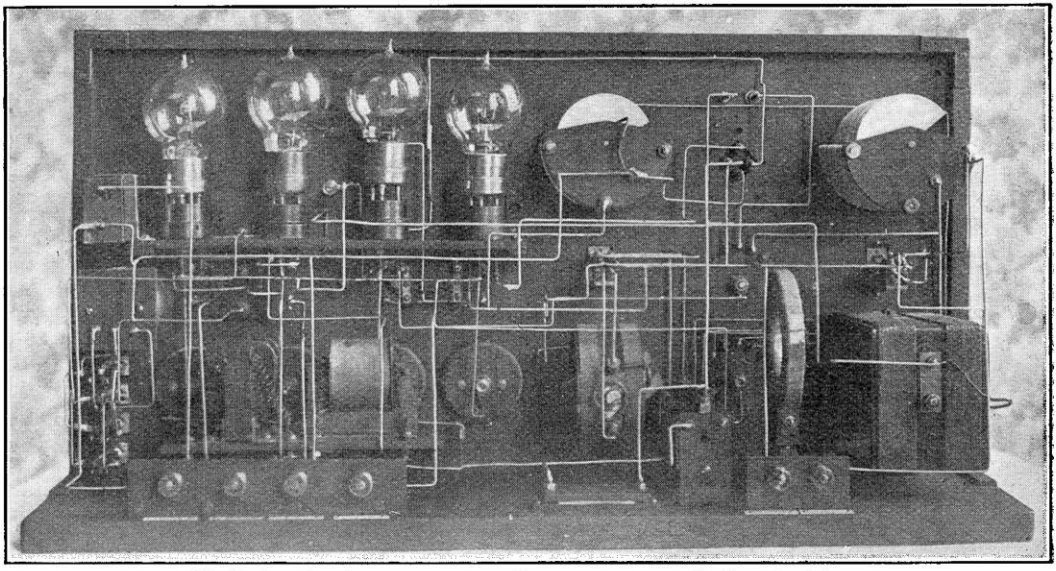
* " Direction and Position Finding by Wireless," by R. Keen. (*Wireless Press*).



Back view showing arrangement of components, terminals and wiring.

FOUR-VALVE EXPERIMENTAL RECEIVER.

By J. C. MACVIE.

(*Concluded from page 39 of previous issue.*)

THE H.F. COUPLING UNITS.

1. *Transformer.* This has proved the most stable, efficient, and selective coupling of all, and after many experiments with different windings, the following one was decided upon for broadcast and ship

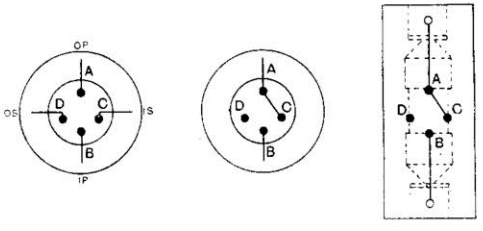


Fig. 7. The H.F. coupling units.

reception. The former is one of the standard four-pin variety, and is 2 ins. in diameter, with a groove 3/16 in. wide and 7/16 in. deep turned in its edge. The primary and secondary each consist of 76 turns of No. 30 S.C.C. wire, wound in *opposite* directions, with a double layer of empire tape between them. The ends of the windings are soldered to the pins on the base of the former in such a manner that, when plugged into the sockets on the panel, the following connections are made, IP to +H.T., OP to plate of H.F. valve, IS to grid of rectifier, OS to −L.T. (*via* potentiometer slider).

This transformer, in conjunction with the 0·0003μF variable condenser, gives sharp tuning and very good amplification between 300 and 600 metres.

TUNED ANODE COIL.

This is wound on a similar ebonite former to that already described, the winding, of course, being a single coil having its ends soldered to the pins which plug into sockets A and B, with an additional connection made underneath the former between the pins which plug into A and C, *i.e.*, from the plate of the H.F. valve via the grid condenser to the grid of the rectifier.

Eighty turns of No. 26 D.C.C. wire on this former give good amplification and sharp tuning from 300 to 600 metres, whilst a former 2¼ ins. in diameter, groove ¼ in. wide, and ⅝ in. deep, wound with 250 turns of No. 32 enamelled wire, gives good results between approximately 2,000 and 3,000 metres. In ordinary circumstances resistance capacity coupling is used on all waves above 1,000 metres.

THE RESISTANCE UNIT.

This is a small ebonite panel ¼ in. thick, 3 ins. long, and 1½ ins. wide, in the centre of which are mounted four valve pins which plug into the H.F. coupling socket. At each end on the upper surface are two brass spring clips, which hold a cartridge-type resistance of 60,000 ohms. The two pins which plug into the sockets A and B are connected to the two spring clips, the extra connection to the pin fitting into the socket C being made as in the case of the anode inductance.

The cartridge-type resistance is an ebonite tube, 2 ins. long and ½ in. external diameter, fitted with brass end plugs, and filled with a mixture of graphite and chalk powdered together. The correct proportions of graphite and chalk are found by trial under working conditions, and it may be mentioned that it is not at all difficult to make very efficient resistances in this way.

THE SHORT WAVE REACTION COIL.

This is so constructed that it may be plugged into the two valve sockets above the H.F. coupling and swung into any desired position over the anode inductance or transformer in use. The former is a thin ebonite "spool" having a centre 1 in. in diameter by ⅛ in. thick, its cheeks being two inch discs of 1/16 in. ebonite, one (the upper) of which is extended to the shape seen in the diagram (Fig. 8A) in order to accommodate the knob and spindle.

The plug is a small bar of ¼ in. ebonite, ⅜ in. wide and 1¼ ins. long, into which are screwed two valve legs ⅞ in. apart. Midway between these valve legs a 4B.A. clearance hole is drilled, and a 4B.A. screw, 1 in. long, passing upwards through this bar carries the extension of the former and a small ebonite knob on its upper end. A ¼ in. ebonite collar is used to raise the former to the necessary height for it to clear the transformer when swung across it, and a spring washer under the head of the 4B.A. spindle provides sufficient tension to hold the coil in any desired position, and at the same time allows a smooth and easy movement when the knob is turned. The construction and assembly of the coil and plug will be more clearly understood on reference to the sketch (Fig. 8B). The reaction coil itself has 65 turns of No. 30 S.C.C. wire, the ends of which are connected to the

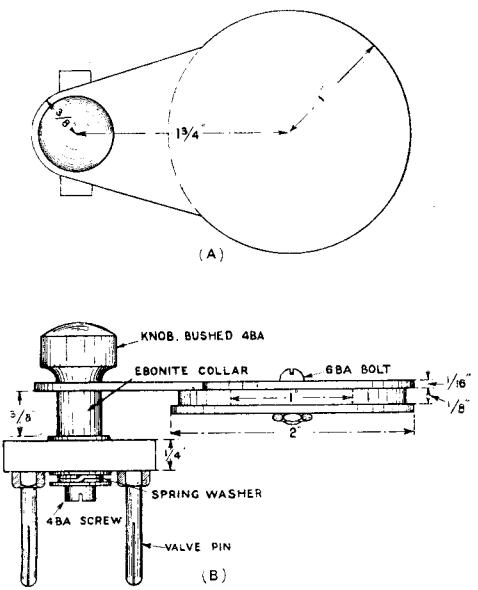


Fig. 8. Short wave reaction coupling coil.

valve pins by short lengths of very light "flex."

THE POTENTIOMETER.

An ebonite tube 1 in. in external diameter and 4 ins. long is wound full of No. 40 enamelled Eureka resistance wire, leaving ½ in. clear at each end. Two ebonite end pieces support a standard ¼ in. square brass rod, 4½ ins. long, and a standard slider-knob and plunger makes contact along the resistance coil, a narrow strip on the top of which has been carefully scraped free of enamel. In order to economise in space the potentiometer is screwed to

the baseboard of the set, end-on to the panel. A $\frac{1}{8}$ in. brass rod, one end of which is screwed into the "slider knob," projects through a hole in the face of the panel, and is fitted with a small ebonite knob (seen immediately to the right of the eleven-stud switch in the photograph). Adjustment of the potentiometer is effected by drawing out or pushing in this knob. In practice, a movement of about one inch over the negative end of the resistance has been found sufficient.

RECTIFICATION.

Grid Condenser.—Capacity 0·0002 μF, made of two pieces of copper foil with overlap of two square centimetres, separated by a piece of mica approximately 0·002 in. thick, and clamped between two pieces of $\frac{1}{8}$ in. ebonite.

Grid Leak.—A variable grid leak is used, and has proved very useful when experimenting with certain continental valves as rectifiers.

The Crystal Detector, seen in the photograph, is only used for reception of 600 metre spark and local broadcasting when no accumulator is available.

LOW FREQUENCY AMPLIFICATION.

Two stages of low frequency amplification are available, the switching arrangements being very simple, as will be seen from the circuit diagram. (Fig. 10.)

The L.F. transformers used are of French manufacture, having a "turns ratio" of three to one. Across the primary winding of each transformer a 0·001 μF condenser is connected, these being identical in construction with the grid condenser already described, except that the copper foils overlap ten square centimetres.

The transformers are mounted on an ebonite shelf supported by two $2\frac{1}{2}$ ins. iron shelf brackets on the back of the panel. This shelf stands $1\frac{1}{2}$ ins. clear of the panel, and leaves room for the mounting of four standard filament resistances on the panel itself.

Amplifier Switches.—Four knife switches are used, of the single-pole double-throw type. The particular ones used were altered slightly, so as to occupy less panel space, by reducing the length of the "blade" to $1\frac{3}{8}$ ins., and drilling a new pivot hole.

TELEPHONE CIRCUIT.

So that either high or low resistance telephones could be used, and in order to avoid an unsightly collection of terminals on the panel, four "ex-W.D." telephone jacks were screwed into the panel, and all telephone cords and loud speaker fitted with plugs. Two of the jacks are wired so that H.R. telephones may be plugged direct into the plate circuit, but on withdrawal of the plug a telephone transformer is automatically brought into circuit (via the inner contacts on the jack), the remaining two jacks for L.R. telephones being connected across the secondary of this transformer. (Fig. 9.)

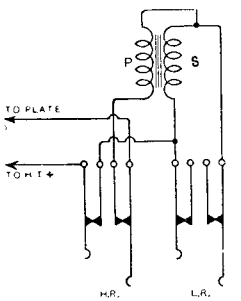


Fig. 9. Switching for H.R. or L.R. telephones by means of break-jacks.

THE TELEPHONE TRANSFORMER.

This is an auto-transformer very similar to one described some time ago in *The Wireless World and Radio Review.** The core is made up of a bundle of soft iron wires $\frac{1}{2}$ in. in diameter and 3 ins. long, enclosed in a fibre tube $\frac{5}{8}$ in. external diameter and 3 ins. long, to which are fitted two $\frac{1}{4}$ in. ebonite cheeks $2\frac{1}{8}$ ins. square. This "bobbin" may be secured to a wooden spindle with a crank for winding, and the ends of the windings brought out through small holes drilled in one of the cheeks and soldered to small brass 6B.A. screws, situated close to the holes, for convenience in soldering heavier connecting wires. The windings are of No. 38 enamelled wire, four ounces

* Page 314, December 5th, 1923.

of which are wound on first and the ends brought out to two of the terminal screws. After covering this winding with two layers of empire cloth, one more ounce of wire is wound on in the same direction, the final connections being made as shown in the diagram (Fig. 9), *i.e.*, the whole five ounces serving as the primary, but only the last ounce wound on functions as the secondary. With care, this auto-transformer is easy to construct, and works remarkably well with 120 ohm telephones.

THE VALVE PLATFORM.

The valve holders are set on a narrow ebonite shelf behind the panel, and $1\frac{1}{2}$-in. strips at the back edge of the baseboard, and, since the photographs were taken, extra terminals for H.T. and grid bias batteries have been added.

Both condenser dials, the variometer and long wave reaction controls are fitted with aluminium screening discs which are connected to earth, as also are the iron shelf-brackets and cores of the L.F. transformers.

The wiring is carried out entirely with No. 16 S.W.G. tinned copper wire, leads being kept as short as possible, well spaced, and all bends "rounded off" right angles. With regard to spacing the wiring, it might be mentioned that there is nothing to be

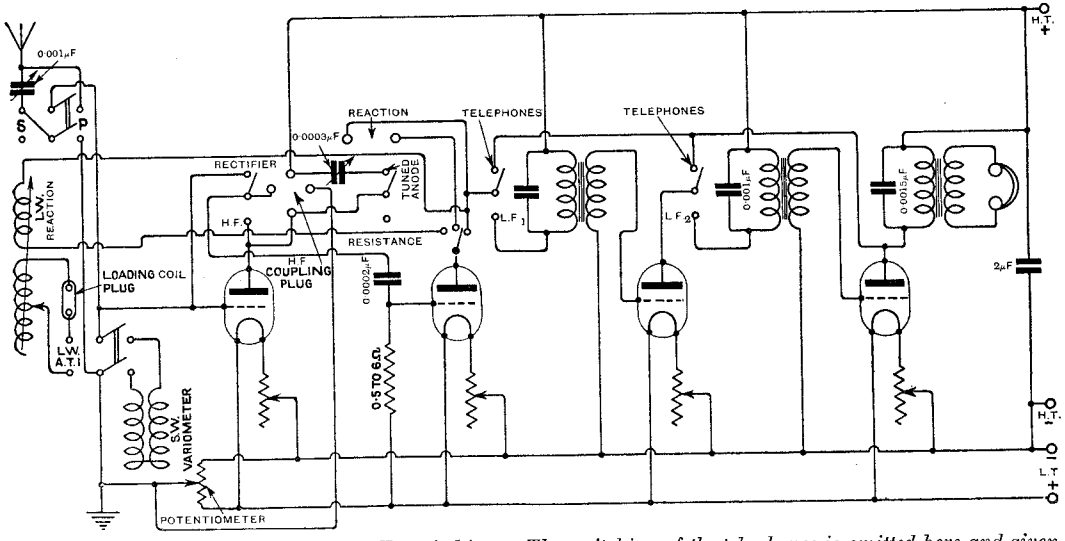


Fig. 10. *Circuit diagram showing H.F. switching. The switching of the telephones is omitted here and given in Fig.* 9.

windows cut in the latter and covered with copper gauze enable the brilliancy of the filaments to be observed from the front. These copper gauzes are held in position by flat aluminium rings screwed to the face of the panel by 6B.A. screws. The valve shelf measures $9\frac{1}{2}$ ins. by $1\frac{1}{2}$ ins., and is supported on two iron brackets which hold it 1 in. clear of the back. An aluminium strap secures a 2μF Mansbridge condenser for the H.T. battery to one end of this shelf.

GENERAL NOTES.

The aerial, earth, H.T. and L.T. terminals are mounted on narrow vertical ebonite gained by spacing wires across which large condensers are connected, but it is important to keep all grid and plate leads well apart.

All connections are soldered, of course, and as at first an annoying crackle in the telephones was traced to Fluxite remaining around some switch connections, the whole panel was literally swamped with methylated spirits and cleaned up with a small mop brush.

Results with the receiver are good with almost any type of valve, though for economy in filament heating current D.E.3 type dull emitters are used.

Three standard dry cells have been running four of these valves for a considerable time

now without showing much sign of exhaustion and the valve appears to function equally well as a rectifier or as an amplifier in both high and low frequency stages.

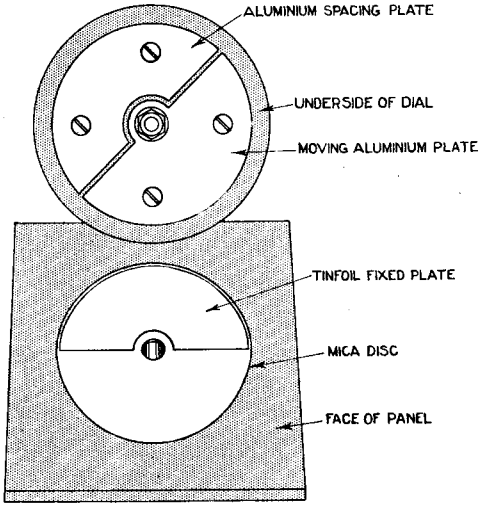
Nothing exceptionally remarkable in the way of results is claimed for this receiver. All the B.B.C. stations and School of Posts and Telegraphs in Paris can be received on the short wave section, at comfortable strength, using one H.F. and detector valves only; although when using this single circuit tuner it is very difficult to tune out the local broadcasting station (one mile away) on the lower broadcast band of wavelengths.

Amateur transmissions, 600 metre coast stations, and ships all come in well, using the same combination of valves. On long waves, aerial reaction and the detector valve alone have brought in **WSO** (Marion, Mass., U.S.A.), Moscow, Sofia, Bucharest, Prague, Budapest, Rome, Malta, Gibraltar, Madrid, etc., and of course **GBL**, **GLD**, **GLA** and other stations such as **POZ**, **LP**, **UFT**, etc., are always obtainable at almost any hour of the day.

In conclusion, it may be said that a receiver of this type will amply repay the time and trouble spent in its construction, and, after the hour at which our broadcast stations close down, will provide plenty of interest for those experimenters who have not entirely forsaken the longer wavelengths.

A VERNIER VARIABLE CONDENSER.

Of simple construction and occupying very little space, the condenser shown in the accompanying diagram is particularly suited for providing fine tuning adjustment. The construction is simple and embodies a condenser plate secured to the underside of the usual form of instrument dial. In order that a smooth movement may be obtained, another metal plate is attached to the dial for the purpose of spacing, and this plate too can be made from a condenser vane. The fixed plate is attached to the face of the panel, and may consist merely of a piece of tin foil held down by means of a circle of mica. Alternatively, of course, a condenser plate may be attached to the panel, whilst the dial can be lifted from it by means of suitable spacing washers so that the variable condenser thus produced has the requisite capacity and has air as a dielectric.



Vernier condenser.

The moving plate and dial may be secured in position with a spindle which passes right through the ebonite panel and may be clamped up in the usual manner by means of a spring washer and a pair of lock-nuts.

A development of the principle consists in building this vernier arrangement into the dial of a variable condenser so that the spindle that operates the main plate passes through a clearance hole in the knob whilst the dial operates the vernier.

An objection of course to this design is that the setting of the calibrated dial relates only to the position of the vernier plate and not to the setting of the main condenser.

A. R. T.

MEASUREMENT OF CAPACITY AND INDUCTANCE.

By E. J. HOBBS, M.C., Assoc.I.R.E.

A PROPERLY designed bridge is usually employed for measuring capacities, but if a calibrated condenser is available, the following comparative method will give reliable results. Suitable materials for this "bridge" can be provided from the usual "junk" box, or, if purchased, they should cost only a few shillings.

The "bridge" consists of two essential parts: a radio frequency oscillator and a receiver. Fig. 1 (*a*) is the circuit diagram of a suitable oscillator, and Fig. 2 is the simplest form of receiver. In the case of

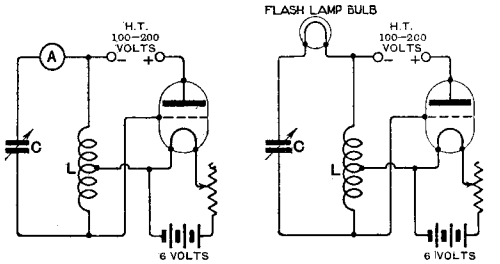


Fig. 1a and 1b. Circuit diagrams of radio frequency oscillators. In the case of (a) the H.W. ammeter indicates when oscillations are being generated and is replaced by a 2-volt flash-lamp bulb, as an alternative in (b), the bulb glows when the valve is oscillating. The frequency of the oscillations is controlled by C.

Fig. 1 (*a*) a hot wire ammeter or thermo-couple is inserted in series with the condenser at A to show that oscillations are being generated. Where expense is a consideration A may be replaced by a 2-volt flash-lamp bulb, which will glow brightly or otherwise according to the strength of the oscillations, see Fig. 1(*b*). If LC Fig. 1(*a*) or (*b*) and L_1C_1 (Fig. 2) are inductively coupled and tuned to resonance, the former will transfer energy to the latter and, provided the oscillations are strong enough, the flash lamp bulb filament (Fig. 2) will glow. Immediately either circuit is mistuned, however, the transferred energy will be too small to light the filament.

If, therefore, the condenser Fig. 2 is an unknown capacity and the frequency of the oscillations in LC Fig. 1 are varied until

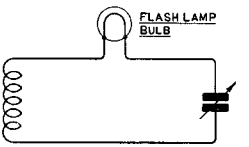


Fig. 2. Substitute for Townsend Wavemeter, or the valve receiver of Fig. 3. A D.P.C.O. switch can be added as in Fig. 3 to facilitate charging condensers.

resonance is obtained (shown by the maximum brilliancy of the bulb filament Fig. 2), a calibrated variable condenser may then be substituted in the circuit (Fig. 2) and adjusted until resonance is again obtained, when, obviously, at that point the capacity of the known condenser must be equal to the unknown value previously used. Other settings are then compared in a similar manner.

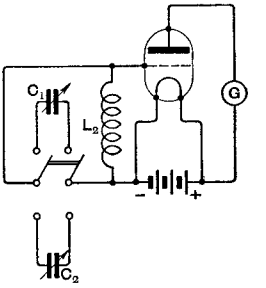


Fig. 3. When L2 is coupled to L, Fig. 1 (a) and (b) and by means of C_1, is brought into resonance with the frequency of the oscillator, the galvanometer will show a maximum reading. By changing over to C_2 and varying it until resonance is again obtained the capacity of C_2 must be equal to C_1 at that point.

When less than 100 volts H.T. is used for the oscillator (Fig. 1) it will be preferable to use the more senstive receiver shown

in Fig. 3. G is a moving coil galvanometer which, when connected between the anode and *positive* filament, will register very feeble currents. A D.P. change-over switch is included to enable comparisons to be made rapidly; this switch could also be included as a refinement in the case of Fig. 2.

A Townsend wavemeter employs the principle shown in Fig. 2, and may be used

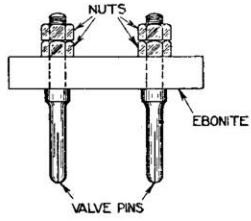


Fig. 4. Plug for use if Townsend Wavemeter is employed instead of the valve receiver and galvanometer (Fig. 3).

as the receiver. A small plug should be made as shown in Fig. 4 to which the condenser under test should be connected and the plug inserted in the sockets instead of the plug provided with the wavemeter.

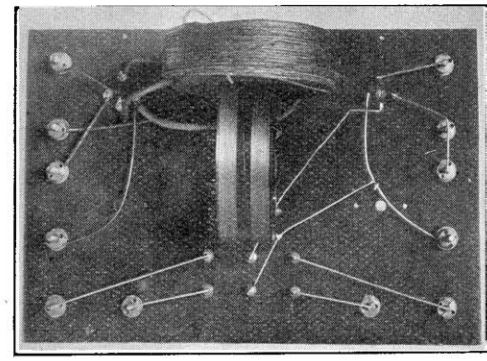


Fig. 5. View of the interior of the box containing apparatus of Fig. 1a and 3. The coil wound in two sections is L_2 (Fig. 3), and rotates on a spindle through 180 degs. for the purpose of varying the coupling between it and L (Fig. 1a). Space between the two sections of winding is to make room for spindle; a coupling handle as used on the old Mark III tuner, controls it on other side. The other coil is L (Fig. 1a) and the two coils are shown in position of loose coupling.

The interior of a box containing the principal portions of Figs. 1(*a*) and 3 is shown in Fig. 5 (condensers and galvano-

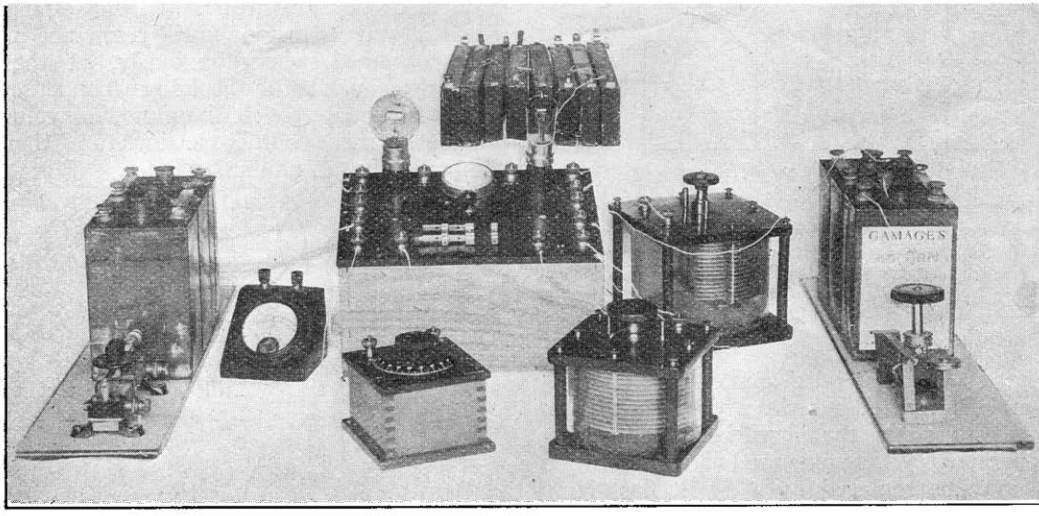


Fig. 6. The complete equipment in use. Central box (with 2 valves), H.W. ammeter, D.P. change over switch, etc.), contains the apparatus shown diagrammtically in Figs. 1a and 3. The two condensers in foreground are C_1 and C_2 (Fig. 3), and the other variable condenser is C Fig. 1a. The Weston galvanometer is G in the plate circuit of Fig. 3.

As the wavemeter contains a variometer, the inductance may be varied as well as the capacity to obtain a suitable resonance point.

meter have not been included for the sake of economy). L_2 (Fig. 3) is the coil wound in two sections and rotates through 90° to vary the coupling.

Fig. 6 is a photograph of the apparatus in use, *i.e.*, Fig. 1(*a*) and 3 complete in detail (the components will be easily recognised).

Fig. 7 is another photograph showing the oscillator and a Townsend wavemeter (latter is virtually the circuit of Fig. 2) in use instead of the valve indicator (Fig. 3).

Some constructional details will now be given. L, Fig. 1, may be any convenient size, but a tapping must be made exactly in the centre.

A single layer coil of 50 turns No. 22 D.C.C. copper wire on a $3\frac{1}{4}$ in. tube with a tapping taken at the 25th turn gives very good results. Using a variable condenser of 0·001 μF maximum across the coil (C. Fig. 1) the oscillator will function over a band of frequencies from 1,000,000 to 375,000 (300-800 metres).

A piece of an old Mark III tuner coil former wound with 72 turns No. 22 D.C.C. wire in four layers (bank winding) with a tapping at the 36th turn will do equally well. Other coils may also be used, but the two suggested will enable the reader to compare a wide range of capacities. The inductance of suitable coils for the receiving portion can be ascertained from the writer's article on pages 472 to 476 of *The Wireless World and Radio Review*, July 14th, 1923.

As a guide, it may be mentioned that if coils of the dimensions mentioned above (or nearest) are used in the oscillator, the H.W. ammeter should show a reading of at least 0·3 amp. when the capacity of $C = 0{\cdot}001\mu F$ and a high tension voltage of 200 is used with an ordinary " R " valve. Reduction of the capacity will cause a corresponding reduction of current.

It should also be noted that much greater accuracy will be obtained when the receiving portion of the " bridge " is loosely coupled. When a flash-lamp bulb is used as the visual detector, the coupling of L_1 (Fig. 2) should be loosened until the filament is just red (of course, the tuning must be slightly readjusted to compensate for the changed coupling. Should two apparent resonance points occur during a test the coupling must be loosened until one disappears.

It will now be apparent that this system may be readily applied to the comparison of inductances such as anode coils, radio frequency transformers, etc., and particularly where exact similarity is desired. Other applications will occur to readers as occasion arises.

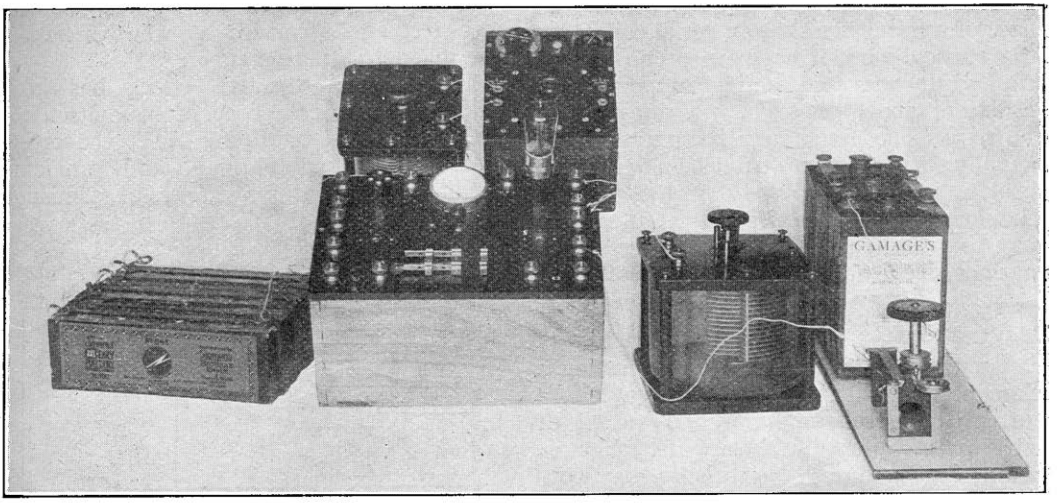


Fig. 7. Instead of the apparatus indicated in Fig. 3, only the oscillator and a Townsend wavemeter need be used. This photograph shows the wavemeter in use instead of the valve, L_2 and galvanometer; the wavemeter and condenser are represented by Fig. 4. A coil, condenser and flash lamp bulb may be used instead of the wavemeter wired up as shown in Fig. 4 and coupled behind the oscillator.

PATENTS AND ABSTRACTS

Wireless Reception.

It is well known that wireless signals may be easily received while travelling in a car or train fitted with receiving apparatus. In place of a frame aerial or an aerial consisting of a vertical wire, it has been proposed * to employ an elevated aerial supported on insulators above the roof, or slung below the roof. The aerial may be built into or actually form the roof, care being taken to insulate it from the body of the vehicle. The lower conductor of the aerial system may be the chassis, or a copper gauze mat put on the floor of the vehicle.

Magnetrons.

A magnetron comprises a valve having a filament and an anode arranged so that a current between them may be varied or interrupted by a suitably applied magnetic field. For example, the cathode may consist of a simple linear filament, and the anode of a cylinder symmetrically arranged about the cathode. In magnetrons now being used as detectors, the controlling magnetic field is parallel to the cathode, and is generated by a current flowing through a winding surrounding the magnetron tube. Assuming a given voltage to be applied to the cathode and anode, and the magnetic field value to be progressively increased from zero, the anode current in the valve at first is substantially unaffected over a range of field values; then as the magnetic field exceeds a critical value, depending on the characteristics of the valve and the applied voltage, the anode current rapidly decreases, and finally, with a sufficiently high field value, the anode current becomes zero.

When the diameter of the filament is small, the magnetic field of the filament may be neglected. When the applied anode-cathode voltage is small, and the filament diameter above a certain size, the heating current is sufficient to produce an appreciable decrease of anode current by what is termed the magneto-strictive effect.

The magneto-strictive effect has been utilised * in a new type of magnetron for the purpose of rectifying A.C., converting D.C. to A.C., amplifying, and providing oscillatory current for wireless transmission purposes.

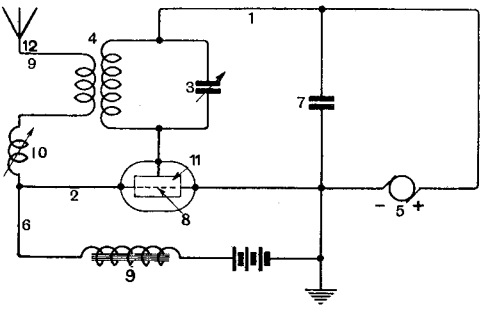


Fig. 1.

For example, high frequency currents may be produced by the method of Fig. 1. The filament 8 is supplied with current from a D.C. source, through the choke coil 9. The input circuit 1, 2, which is connected to the electrodes 8 and 11, contains a D.C. generator 5, preferably shunted with a condenser 7. The output circuit 9, which preferably contains a variable inductance 10, is coupled to the circuit 1 by a transformer 4, and terminates in an aerial 12. The load

* British Patent 211,201, by N. H. Clough.

* British Patent 189,125, by the British Thomson-Houston Co., Ltd.

circuit 9 is connected to an earthed conductor 6 through the filament battery. As the load current builds up, the magnetic field about the filament increases until it reaches a value sufficient to interrupt the current. Due to this unstable characteristic, a surging or oscillating condition is produced, the frequency of the resulting oscillations depending on the capacity and the inductance of the aerial circuit.

Generating Electrical Oscillations.

The usual method of generating electrical oscillations is by attaching suitable circuits to a three-electrode valve. It has been proposed * to use a two-electrode valve in the manner shown in Fig. 2. The heating current is supplied by the battery 1 through a coil. The anode circuit contains the anode battery 4, and a tuned circuit 5, which is coupled through 6 to the coil contained in the filament circuit. Oscillations in circuit 5 thus act through circuit 6, to the filament, so that the emission of electrons decreases and increases in rhythm with the oscillations occurring in circuit 5.

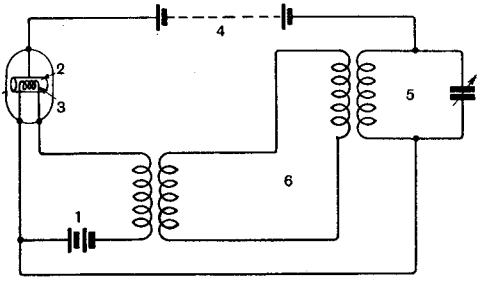


Fig. 2.

In order to influence as effectually as possible the emission of electrons, it is preferable to employ electrodes having large surfaces, and arranged near together, and to form the cathode of coiled wire which possesses as small heat capacity as possible.

Wired Wireless Transmission over Long Distances.

In certain circumstances it is not practicable to use very high frequency oscillations for wired wireless transmission owing to the constants of the line not being suitable. In such cases a lower frequency must be used, but this may entail distortion of the speech. One method of removing this difficulty is to use a two or three phase current, and to transmit each phase separately, recombining them again at the receiver.* Thus in Fig. 3, G is a three phase radio frequency generator feeding the three lines L_1, L_2, L_3 through the windings of the three modulating transformers T_1, T_2, T_3, which are controlled by a common modulating circuit MM. Thus if the fundamental frequency of the generator G is say 10,000 cycles, each of the three lines

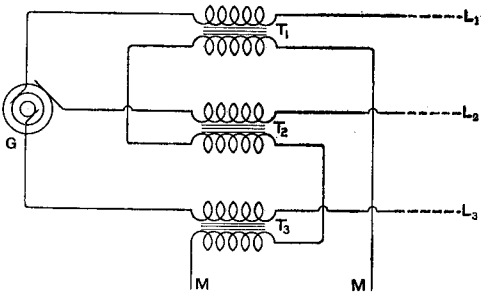


Fig. 3.

will have to carry currents of this frequency only, whereas as far as the speech is concerned the arrangement is equivalent to a 30,000 frequency current owing to the phase displacement between the three phases.

* British Patent 193,379, by Gesellschaft für Drahtlose Telegraphie.

* *British Patent* No. 175245, by Gesellschaft für drahtlose Telegraphie.

CATALOGUES ETC., RECEIVED.

The General Electric Co., Ltd. (Magnet House, Kingsway, W.C.2.). Leaflet No. O 3184, giving revised prices of "Geeko" accumulators. Leaflet No. B.C.3076, dealing with the "Gecophone" Two-Stage Low Frequency Amplifier.

Ward & Goldstone, Ltd. (Frederick Road, Pendleton, Manchester). Radio List No. 104, covering the firm's wide range of receiving sets and components.

Sterling Telephone & Electric Co., Ltd. (210-212, Tottenham Court Road, London, W.1.). Publication No. 374A, dealing with Sterling Radio Head Telephones. Publication No. 390, containing illustrated details of the Company's Loud Speakers and Amplifiers. Publication No. 392, Press Notices and Testimonials.

A. H. Hunt, Ltd. (H.A.H. Works, Tunstall Road, Croydon, Surrey). Catalogue No. 50A, describing and illustrating a varied range of wireless batteries and accessories.

SAMPLES RECEIVED.

Goswell Engineering Co., Ltd. (12A, Pentonville Road, London, N,1.). Combination Panel Brush and Condenser Cleaner. A useful item for the amateur's equipment.

"**Sparks**" **Radio Supplies** (43, Gt. Portland Street, London, W.1.). "Fynetune" micro-adjuster for permitting vernier adjustment of condensers, variometers, etc. The device employs a rotating rubber disc.

THE POSSIBILITIES OF TELEVISION

WITH WIRE AND WIRELESS.

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

(*Concluded from page 56 of previous issue.*)

Since 1911, when I first got out this scheme for television by means of cathode rays, there have been many improvements in electrical technique which are available for apparatus of this kind, and will probably render its practicability much more possible.

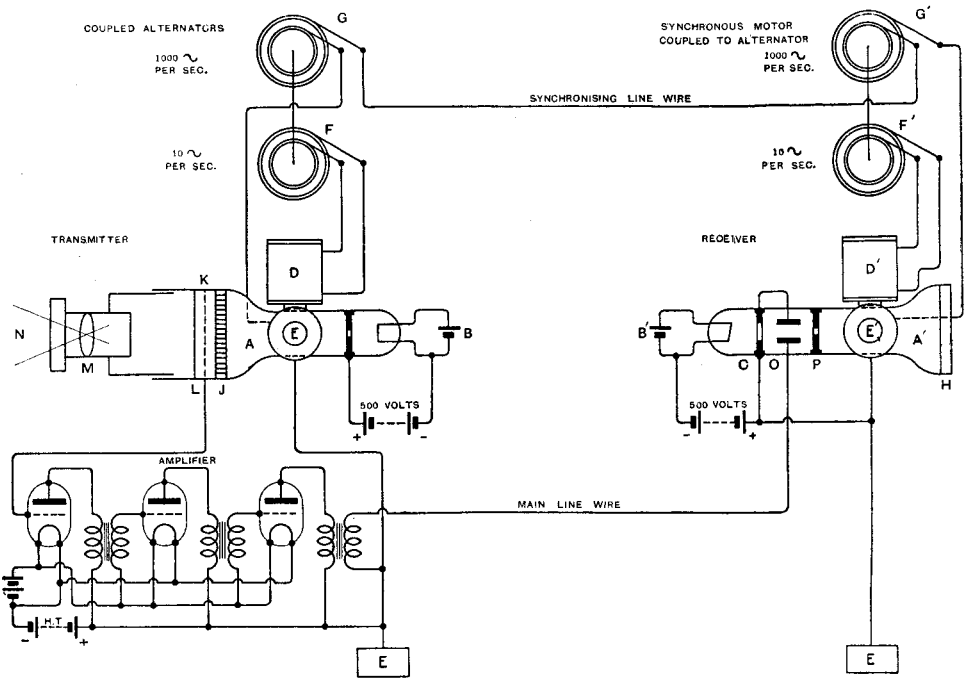


Fig. 2. Suggested connections for television by wire.

For instance, cathode ray oscillographs have been much improved by the adoption of electrically heated cathodes, which may also be chemically treated or coated with suitable oxides, with the result that cathode rays have become much more manageable, and can be produced with a few hundreds of volts, whereas previously many thousands of volts were necessary. Furthermore, by the same means cathode rays of much lower velocity are obtained which are much more easily deflected by electromagnetic and electro-static fields.

Much work has also been done in improving the focussing quality of the rays, and in keeping them in a uniform thin stream such as is required. Again, improvements have been made in fluorescent screens which enable these to show brilliant effects with these slow cathode rays.

Then, as suggested by Mr. Ll. B. Atkinson in his presidential address to the Institution of Electrical Engineers in 1921, when he made some reference to electric television, it is obvious that the introduction of the thermionic valve amplifier affords a ready

means of strengthening the very feeble electric effects that are produced by photo-electric cells, such as are proposed for the apparatus.

Fig. 2 gives a diagrammatic representation of the apparatus and connections as is suggested it might now be constructed for television by wire. In the main, it still works on the same principles as are embodied in the diagram Fig. 1, of 1911. It will be noticed, however, that in both the transmitting and receiving Crookes tubes a hot cathode has been adopted, consisting of a strip of metal electrically heated from one or two battery cells, thereby enabling the actuating voltage to be reduced to some 300 to 500 volts instead of the very much higher figure previously contemplated. Then a thermionic amplifier which may be of any convenient kind, has been added to amplify the minute electrical impulses given by the photo-electric cells J of the transmitter to the gauze L before they are transmitted to the line wire.

Again, a method has been introduced whereby instead of two synchronising wires being required, one can be made to suffice. This result is obtained by mechanically coupling the two alternators of widely different periodicities at the transmitting and receiving stations respectively, so that the ratio between their frequencies is constant. The low frequency synchronising line wire can then be suppressed, as a single high frequency line wire will suffice to maintain synchronism provided the high frequency alternator at either end is maintained in synchronism with the similar alternator

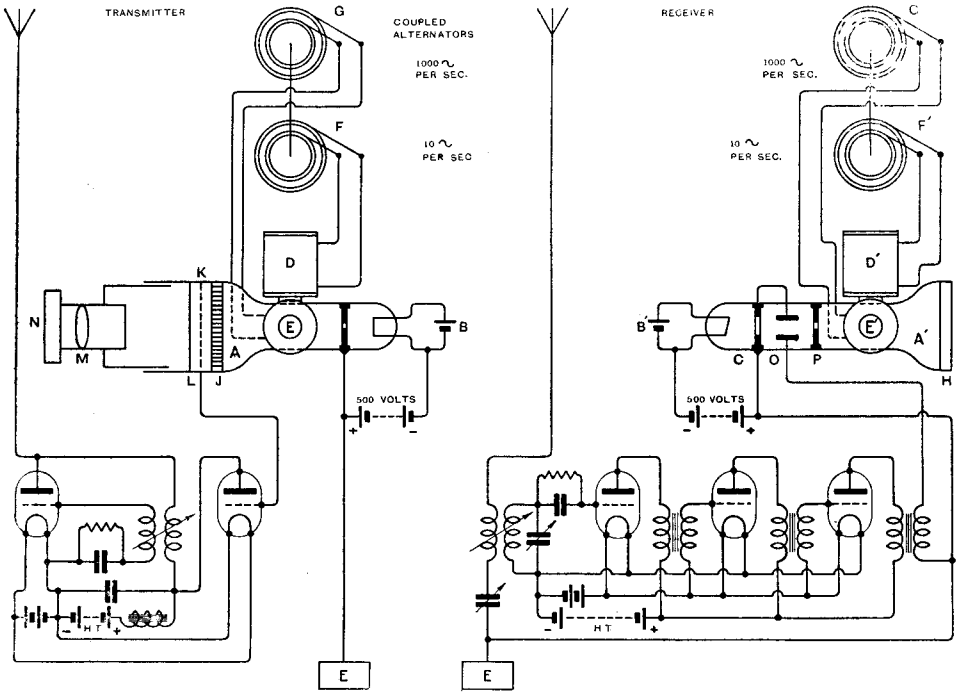


Fig. 3. Pooposed circuits where tke line wires are suppoessed.

NOTE.—For particulars of improvements that have recently been made in cathode ray oscillographs, see the following papers :—

Article by Mr. D. A. Keys, based on suggestion by Sir J. J. Thomson, "Engineering, 1919, pp. 543-544.

Mr. A. Dufour's oscillograph. "Journal de Physique," November, 1920, p. 146.

Mr. D. A. Keys. "Phil. Mag.," 42, pp. 413, 488, October, 1921. "A Low Voltage Cathode Ray Oscillograph," in the Journal of the Optical Society of America and Review of Scientific Instruments. Vol. 6, pp. 701-12, September, 1922.

"The Cathode Ray Oscillograph," by A. B. Wood. Proceedings of Physical Society of London, February 15th, 1923. Vol. 35. Par. 2, pp. 109-124.

"A Practical Demonstration of Some Applications of the Cathode Ray Oscillograph," by N. V. Kipping, *The Wireless World and Radio Review* for March 5th and March 26th, 1924.

at the other end by being run as a synchronous motor.

In this way the whole apparatus should be able to work with only three line wires, or two line wires and earth connection. Indeed, it might be possible to do away with the synchronising line altogether, as if the two coupled alternators say at the transmitting end could be governed to run at a very uniform speed, then it might be possible by means of a sufficiently accurate governor capable of very delicate adjustment, to run up the two coupled alternators at the receiving end until they attained exactly proper speed.

We come next to the suggested arrangement shown in Fig. 3, in which line wires altogether are suppressed, and the whole apparatus is worked by wireless.

The main transmitting and receiving apparatus is exactly the same as in Fig. 2, but instead of line wires a wireless equipment is substituted. It will be seen at the transmitting end the electric impulses imparted by the photo-electric cells to the wire gauze are caused to actuate an ordinary wireless transmitting apparatus which may, of course, be of any suitable form, and as shown in the diagram is one of an ordinary two-valve description supplying a radiating aerial in the ordinary manner.

Then again, at the receiving stations the signals intercepted by an aerial are shown as received on a tuner and amplifier, before they are passed on to the receiving Crookes tube.

No special means are shown for effecting synchronisation, as it is hoped that the method suggested above whereby any special synchronising connection may be eliminated, could be used. If necessary, however, synchronisation could be effected by a further wireless transmitter and receiver used solely for the purpose of synchronisation and operating by means of separate aerials, and a sufficiently different wavelength, so as not to interfere with the main transmission.

In his interesting lecture of November last at the Royal Society of Arts, Monsieur Belin confidently stated that we should have television within the year. As, however, Mr. Shelford Bidwell in his communication to *Nature*, in 1908, quotes another distinguished French scientist, Monsieur Armengaud, as then (that is 16 years ago) promising that within a year we should be "watching one another across distances hundreds of miles apart," I am not inclined to be too sanguine as regards a speedy solution of the problem.

Indeed, I think I am fairly safe in prophesying that anyone who takes on the problem seriously, will be kept fairly busy for quite some time.

(*The Discussion on this paper will be included in a subsequent issue*).

Book Review.

The 1924 edition of the *Year Book of Wireless Telegraphy and Telephony** maintains the well-known features of former editions, with the addition of a mass of useful information on the recent development of wireless.

The Directory of the World's Stations has been carefully revised and is now printed in a more compact manner than formerly; it comprises the names, positions, call signs, ranges, control and wavelengths of all land and aircraft stations of the world and is followed by an alphabetical list of call-signs in which the nature of service of each station is indicated. The corresponding list of Ship Stations has been omitted this year from lack of space as its inclusion would have made the volume too bulky. The Historical Record of Development has been re-written and carefully revised by Mr. W. H. Nottage and the Laws and Regulations relating to wireless telegraphy and telephony in all countries of the world has been brought up to date.

The important section relating to Meteorological, Time, Hydrographic and General Signals has been carefully compiled by Mr. W. G. W. Mitchell, F.R.A.S., and includes a complete list of all these transmissions throughout the world.

Dr. R. L. Smith-Rose again contributes the section on Direction Finding and Mr. Duncan Sinclair that relating to Aviation.

Among the special articles is an interesting discussion on "The Ideal Empire Chain," by Dr. Robert Donald, the Chairman of the Committee, whose report on the Imperial Wireless Scheme was recently issued. Commander J. R. Slee writes an instructive account of the progress of wireless telegraphy in the British Mercantile Marine. Dr. E. V. Appleton describes some recent experiments on the nature of atmospherics. Mr. R. Keen contributes an article, profusely illustrated, on "Polar Diagrams of Reception for Systems of Spaced Aerials," and Capt. C. F. Trippe, an authoritative treatise on Dull-emitter Valves. The remainder of the book follows the lines which have proved so serviceable in the past and includes a carefully revised atlas of 56 pages.

We can confidently recommend the book to all wireless enthusiasts, whether professional or amateur.

*The *Year Book of Wireless Telegraphy and Telephony*. (Wireless Press, Ltd., 12-13, Henrietta Street, W.C.2. Pp. 910 and 56 maps.) 15s.

NOTES & CLUB NEWS

The estimated deficit in connection with the operation of Post Office wireless stations during 1923-4 is £43,000.

* * * *

A "Farmers' Corner" has been started by the Newcastle Broadcasting station.

* * * *

Mr. J. A. Beveridge, one of the original members of the Edinburgh and District Radio Society, has been appointed engineer-in-charge at the Edinburgh Relay Broadcasting Station.

* * * *

A broadcast programme from Newark, New Jersey, was heard for the first time at Tokio on April 6th.

* * * *

Another DX Record.

Mr. Gerald Marcuse (**2 NM**) has received confirmation from America, **6 ZAR,** of Los Gatos, California, that his Morse signals were received there on February 23rd.

We believe that Mr. Marcuse is the first British amateur to be heard on the Pacific Coast.

Two-way working with American **1 XAH, 1 XJ, 1 BCF,** and Canadian **1 BQ,** has been accomplished by Mr. R. L. Royle (**2 WJ**), of Palmers Green, London. **1 XAH** has reported Mr. Royle's signals as very strong on two occasions. The power input of **2 WJ** is just under 100 watts.

The King's Broadcast Speech.

In view of the great interest aroused in the broadcasting of the speech of His Majesty the King on April 23rd, the B.B.C. is taking steps to ensure freedom from interference as far as is possible. The Radio Society of Great Britain has been asked to request its members to refrain from transmission or oscillation during the short period taken up by the speech and a similar appeal is made to amateurs throughout the country. While the importance of maritime and other spark transmissions is realised, the G.P.O. has been asked to extend sympathetic consideration to the desire for a minimum of interference.

Two-Way Communication with Switzerland.

Two-way communication with Geneva **XY** is reported by Mr. H. Stopher (**5 GF**), who answered the Swiss station's CQ call with a radiation of 0·19 amps. His signals were reported as weak.

Death of Irish Society's President.

The Radio Association of Ireland has sustained a great loss in the death of its President, Professor W. J. Lyons, which occurred recently after a short illness. Professor Lyons was identified with the Association in its earliest stages and his valued help in all matters pertaining to this rapidly growing organisation will be much missed.

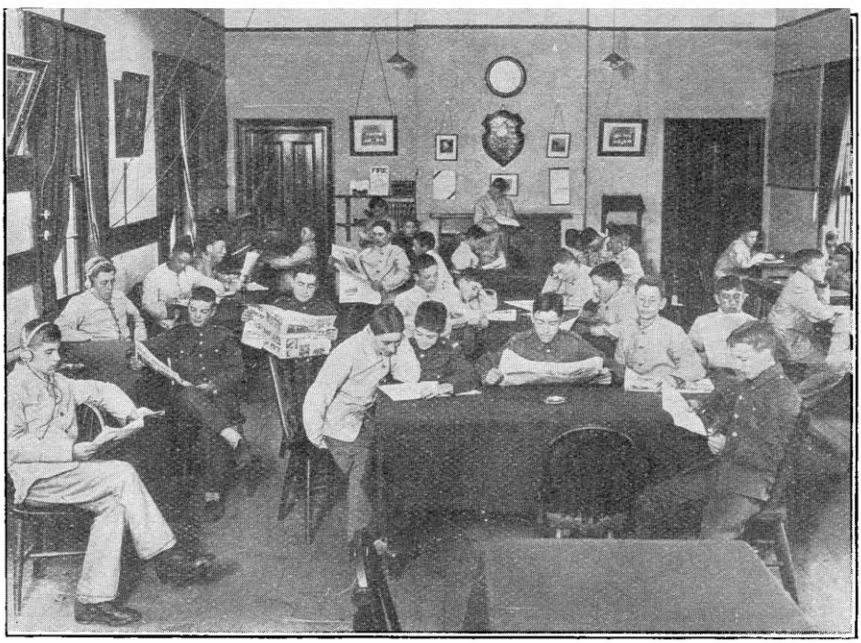
Single-Valve Reception over 6,500 miles.

Listening-in with a single-valve set, Mr. W. Rogers, of Worthing, has on several recent occasions heard the signals of **LPZ,** on approximately 20,000 metres, working with Nauen (**POZ**), and he enquires as to the identity of the former station.

LPZ, operating on the Telefunken system, is situated at Monte Grand, Argentina, a distance of approximately 6,500 miles.

Broadcasting from Boston, U.S.A.

That a new American broadcasting station, comparable in signal strength



Listening-in forms part of the recreation provided at the new Army School at Woolwich.

with **WGY** and **KDKA**, is making itself heard in this country, is evident from several reports we have received concerning **WBD**, announcing itself as "The Boston Studio, Massachusetts."

Mr. J. W. Claridge, of Rushden, Northants, states that in the early hours of March 30th, he tuned in this station on approximately 330 metres. Two valves (1—v—0) were used, and the transmission was remarkably strong. Pianoforte and vocal selections were rendered, and although fading was noticeable at times, four valves gave excellent reception on the loud speaker.

Broadcast Reception in Uruguay.

The "Revista Telegrafica" publishes an account of the reception of American broadcasting at Punta del Este, a well-known Uruguayan seaside resort. An experiment in this direction was recently carried out by Mr. J. C. Braggio, who, with a single-valve regenerative circuit, was successful in receiving dance music from Pittsburg, **KDKA**. The distance is over 3,000 miles and Mr. Braggio claims to be the first person to receive America in this region with such simple apparatus.

Valve Infringement Appeal Dismissed.

The House of Lords on Monday, April 7th, dismissed the appeal of Marconi's Wireless Telegraph Co., Ltd., in their action for infringement of patent rights against the Mullard Radio Valve Co., Ltd.

The Marconi Company, who hold Round's patent, contended that the Mullard valve exhibited characteristics of the Round invention in that in operation it was unnecessary constantly to change the value of the grid. The respondents maintained, however, that whereas in the Mullard valve the grid and filament were open ended, in the Round construction it was necessary that the grid, and possibly the anode, must have one or both ends physically closed.

Lord Dunedin, who submitted the leading judgment, said that where the subject of a patent worked well with results not hitherto obtained, he did his best to uphold that patent. In this case, however, he found it impossible, though against his will, to come to any conclusion but that the appeal had failed. He had to consider Round's own explanation that he could not claim as a new arrangement a vacuum tube, a grid and a third electrode. In the Company's claim it was impossible to read the word "closed" except in its ordinary and natural meaning, physically and geometrically closed.

American Ether.

The U.S. Senate has adopted a bill preventing a monopoly of wireless communication. The bill states that the ether within the territorial jurisdiction of the United States will be the inalienable possession of the people and their Government. Licences of a duration of more than two years are prohibited and the State reserves the power to revoke all licences in time of war.

Cologne Wireless Prosecutions.

Several prosecutions have recently occurred in the Cologne area of Germany in respect of owners of illicit wireless receivers, which are forbidden under the general terms of the peace treaty. Exceptions to the rule have been made in the case of the University and a few of the higher grade schools. One offender, having used his set for some time, has been fined £25 before the British Summary Court at Solingen.

Educational Broadcasting Experiment.

The first attempt at educational broadcasting to schools in the London area took place on April 4th, and, according to reports sent in, was an undoubted success. Loud speakers were installed in over 70 schools, and Sir Henry Walford Davies, who spoke on school music from **2 LO**, had an audience of more than 10,000 children. A visible audience of 25 children was present in the studio, and musical illustrations, chiefly drawn from Shakespeare's songs, were provided by six boys of the Temple Church Choir.

Mr. C. P. Trevelyan, President of the Board of Education, expressed himself as greatly impressed by the possibilities of this method of simultaneous lecturing.

A Radio Heckler.

A new form of political heckling has appeared at Kansas City, where, on April 6th, Senator James Reed delivered a firebrand speech on behalf of the Democratic Party. The Senator's oratory was wasted, however, for listeners-in were only able to hear a confused jumble of words and squeaks, due to a series of violent oscillations which occurred throughout the duration of the speech.

The Democratic Committee of Kansas is offering a reward of £100 for information leading to the detection of the miscreant.

South African Wireless Progress.

A scheme is afoot for establishing wireless communication between Salisbury and Pretoria by means of a 6-kilowatt duplex installation at a cost of £12,000 to £15,000. The scheme, however, cannot be put into operation for nine months.

Archiv fur Elektrotechnik.

We are informed by the Publishers, Messrs. Julius Springer, of Berlin, that the above periodical ceases publication with the 13th volume.

The Pope's Thanks.

A gratifying message from the Pope has been received by Messrs. Burndept, Ltd., of Bedford Street, London. In expressing his pleasure at the presentation of an "Ethovox" broadcast receiver, His Holiness directs his Secretary to convey to Messrs. Burndept the Apostolic Benediction.

Another Transatlantic Broadcasting Experiment.

A "house to house" broadcasting transmission, from the well-known Wanamaker Store in New York to the firm's offices in Pall Mall, London, was the subject of an experiment conducted during the early hours of Wednesday, April 2nd.

An organ recital by M. Marcel Dupré and selections by the Wanamaker orchestra were broadcast through **WGY** on 107 metres, and picked up clearly on a three-valve set installed and operated by Mr. B. Clapp, of Messrs. Hambling, Clapp & Co., 11, Agar Street, Strand, London, W.C.2. Mr. Clapp would be pleased to hear from any amateurs in this country who were successful in picking up the transmission.

The Radio Society of Great Britain.

Members of the Radio Society of Great Britain are asked to note that the Ordinary General Meeting of the Society, originally arranged for April 23rd, has been postponed until Wednesday, April 30th, 1924. The meeting will be held at 6 p.m. at the Institution of Electrical Engineers, Savoy Place, and will be the occasion of an interesting lecture by Captain P. P. Eckersley on "Faithful Reproduction by Broadcast."

Radio Association of Ireland.

In the Physics Lecture Theatre, University College, Dublin, on Thursday, March 20th, 1924, the Rev. Father Gill, S.J., M.A., M.Sc., gave a very interesting lecture on the subject of "Electrons and their Radio Possibilities," illustrating his remarks by means of vacuum tubes, some of which gave very beautiful effects. He showed how the study of electrons has progressed, and explained the electron theory in detail.

At a Committee meeting of the Association, held on March 24th, the following resolution was passed: "That this Committee learns with great sorrow of the death of our President, Professor W. J. Lyons, and tenders to his wife and son their deepest and sincerest sympathy in their sad bereavement."

The Association rooms in No. 3, Molesworth Street are now open every Tuesday and Wednesday from 7.30 to 9.30 p.m.

Liverpool Co-operative Radio Association.

An instructive lecture on "Constructional Hints" was delivered by Mr. J. Worthington at a recent meeting.

Very useful tips were given regarding the working of that intractable composition, ebonite, so much used in wireless work. The lecturer detailed the best method of cleaning this material to secure a matt surface, and also described some valuable methods of squaring, filing, drilling and cutting of panels. Mr. Worthington contended that the use of four-ply wood dipped in paraffin wax gave superior results to certain grades of commercial ebonite, and when used with ebonite terminal bushes, the cost of panels was considerably reduced and a higher insulation was effected. In support of his contention he exhibited a crystal set mounted on a wooden panel and which when tested had given excellent results.

Hon. Sec., Jas. Kearns, 107, Walton Breck Road, Anfield, Liverpool.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 16th.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Lecture: "Workshop Wrinkles." By Mr. W. Winkler.

Golders Green Radio Society. At 8.30 p.m. At the Club House, Willifield Way, N.W.11. Lecture by Mr. Leslie McMichael.

Clapham Park Wireless and Scientific Society. At 8 p.m. At 67, Balham High Road Lecture by Mr. H. Hodgson.

THURSDAY, APRIL 17th.

Sale and District Radio Society. At 37, School Road. Open Club Night.

Radio Association of South Norwood. At 8 p.m. At the Stanley Halls, South Norwood Hill. Lecture on "Transmission," by a Transmitter.

MONDAY, APRIL 21st.

Ipswich and District Radio Society. At 55, Fonnereau Road. Open Night.

Kingston and District Radio Society. Lecture: "Inductances for Universal Wavelength Reception." By Mr. W. J. Thompson.

Bradford Wireless Society.*

At an ordinary meeting of the Society held on February 21st in the Technical College, a lecture was given by Philip R. Coursey, Esq., B.Sc.F.Inst.P., on "Grid Leaks and Condensers." About 100 members and friends were present, and the chair was taken by the President.

The lecture, which was illustrated by a considerable number of lantern slides, kindly loaned by the Dubilier Condenser Co., Ltd., proved exceptionally interesting, and the lecturer dealt very fully with all types of condensers, from the small ones used in receiving sets, to the large patterns used in commercial stations. The materials used in the manufacture and all the processes through which they were put, were described, and this description, coupled with the slides, made the lecture a very instructive one.

Hon. Sec., S. R. Wright, 14, Bankfield Drive, Shipley, Yorks.

Ilford and District Radio Society.*

On Thursday, March 25th, Mr. A. N. Gregory, read a paper on "Selectivity in Receiving," dealing in a very thorough manner with this important branch of the radio art. Mr. Gregory commenced with the ordinary single circuit tuner, and spoke of coupled circuit working, multiple tuners, wave traps, rejectors, finally explaining the latest aid to selectivity, viz., the "Hinton" rejector circuit. The speaker used many illustrations and gave a very extensive survey of the whole question.

Hon. Sec., L. Vizard, 12, Seymour Gardens, Ilford.

Hounslow and District Wireless Society.*

On March 6th an interesting evening was spent when Mr. Maurice Child delivered an excellent lecture entitled "Detectors for Electric Wave Reception."

Another very interesting evening was spent on March 13th, when Mr. Percy Harris gave a lecture and demonstration on "Dual Amplification." On this occasion the Society experienced what almost proved to be an overflow meeting, owing to the fact that other Radio Societies were represented, including the Feltham, Ealing, West London, and T.O.T. Societies.

March 20th being "Test Night," and in view of the fact that the Society contemplate the purchasing of a new loud speaker, a loud speaker demonstration was held. The results mainly proved the real difficulty of comparing the various makes of loud speakers, as those that came out lowest in the test, in the opinion of the members, were not intended to deal with the same signal strength. The Society hopes to spend a very enjoyable time (on a date not yet fixed) during the month of May, when the first Annual Outing will take place. A charabanc trip to the Surrey Hills is being arranged, when a temporary aerial will be erected and a number of interesting experiments will take place.

In view of the fact that the Society has recently received a number of complaints from local residents with reference to the enormous amount of interference from oscillating valve sets, the Hon. Secretary will be pleased to arrange for members to assist or advise anyone contemplating the installation of a wireless receiver, or who is experiencing difficulty in the operation of an existing receiver if they will apply to him at the address mentioned below, or at the Society's headquarters, the Council House, Hounslow, any Thursday evening between the hours of eight and ten.

The Hon. Sec., Arthur J. Myland, of 219, Hanworth Road, Hounslow, will be pleased to furnish particulars of the Society's activities to intending members.

Golders Green Radio Society.*

A most profitable afternoon was spent by the first party of members on visit at the London Station of the British Broadcasting Company, on Wednesday March 26th.

On arrival at Marconi House they were whirled to the seventh floor and conducted to the room which was originally used as **2 LO's** first studio. Here the Marconi service to Austria was picked up in high-speed morse on the loud speaker and the party was entertained to a film showing the sending of a radiogram to Switzerland and the receipt of a reply within ten minutes.

A very compact transmitter and receiver was then pointed out by the lecturer and the party proceeded to view the telephony transmitter which broadcasts daily.

Tracks were then made towards Savoy Hill, where Commander Carter (Capt. Eckersley's Assistant) received the visitors and conducted them through the "drawing room" and the amplifier room, in which is situated the "Clapham Junction" of all simultaneous broadcast for the British Isles. It is in this room also that the apparatus for broadcasting the Greenwich time signal is located.

Particulars of Membership, etc., can be obtained from the Hon. Sec., W. J. T. Crewe, "The Dawn," 111, Prince's Park Avenue, N.W.11.

Wimbledon Radio Society.*

An informal meeting of this Society was held at headquarters, The Red Cross Hall, 59, Church Road, Wimbledon, S.W.19, on Friday, the 21st instant. Mr. Babbage, a member, brought along a compact three-valve receiver of his own construction, contained in a small suit case. This gave excellent results on long-distance stations on the outdoor aerial, while the symphony concert broadcast from **2 LO** was being received on an indoor aerial at the other end of the room.

Improvements have now been carried out on the Society's aerial with a view to improving its efficiency.

The Hon. Sec., Mr. C. G. Stokes, has now returned to London, and will be pleased to answer enquiries concerning the activities and terms of membership of the Society, addressed to him at 6, Worple Avenue, Wimbledon, S.W.19.

Birmingham Wireless Club.*

On March 21st Mr. Ireland opened a debate on "Aerials and Earths." A very interesting evening was spent in comparing various systems which members had tried. The meeting closed with a hearty vote of thanks to Mr. Ireland.

Prospective members should apply to the Hon. Sec., Mr. H. G. Jennings, 133, Ladywood Road, Edgbaston, Birmingham.

Sheffield and District Wireless Society.*

On March 21st, Mr. W. E. Burnand, M.I.E.E., delivered an exceedingly interesting lecture on "Loud Speakers." The lecturer pointed out that the loud speaker was frequently blamed for evils which were really due to the amplifying equipment, and he emphasised the care that was necessary in order to ensure that each valve in the receiver was operating at the correct point of an appropriate characteristic. The problems confronting the maker—he could not say designer—of loud speakers were very difficult, being mostly dynamical, rather than electrical. The nature of some of these problems was briefly indicated, and attempts at their solution were described.

The lecture was illustrated by a number of interesting experiments.

At the instance of the President, the local section of the Institution of Electrical Engineers was invited to be present, and several members availed themselves of this opportunity. In consequence, a more than usually vigorous discussion followed.

Hon. Sec., R. Jakeman, "Woodville," Hope, Sheffield.

Leyton Radio Association.*

On March 18th, the Association gathered to witness a demonstration of transmission by Mr. Williamson, using apparatus of his own construction, which was new to most members and was highly appreciated. Tests of various wires for tuning coils were announced for the ensuing session.

The Committee, in drawing up the spring programme, have leaned toward the practical rather than the theoretical, a departure which has already borne fruit in increased interest and attendance.

Hon. Sec., Capt. Thorley, C.A. Social Centre, Goldsmith Road, E.10.

The Southampton and District Radio Society.*

At a well-attended meeting held on Thursday, March 20th, Capt. West, Assistant Chief Engineer of the B.B.C., famous for his experimental work at Biggin Hill in connection with the relaying of American Broadcasting, gave a most interesting lecture on "Wireless Broadcasting," which was illustrated by blackboard diagrams and lantern slides.

The Society will, in future, meet at new headquarters, at the Works of Messrs. Eucryl, Ltd., Oakley Road, Shirley, the Company having generously lent a large and well-appointed room for this purpose.

Hon. Sec., P. Sawyer, 55, Waterloo Road, Southampton.

The Belvedere, Erith and District Radio and Scientific Society.*

On Friday, March 21st, Mr. T. E. Morriss gave a lecture and practical demonstration on "Testing Wireless Components."

By means of blackboard diagrams, Mr. Morriss commenced by defining the term "microfarad," and the usual methods of measuring capacity. He emphasised the growing importance of knowing more or less exactly the values of various component parts used to make up a radio set. Parts bought at shops represented to be of a certain value, when actually tested could often be found to vary from this value sometimes by quite a considerable amount.

A universal shunt was next described and demonstrated, following which an explanation and description of the Ballistic reflecting mirror galvanometer was ably given.

The room having been suitably darkened so as to make easy observation of the spot of light moving on a transparent scale, actual measurements were made on condensers by comparing the throw of the spot of light obtained on the condenser under test with that of a standard $\frac{1}{4}$-microfarad condenser.

A 1 microfarad condenser came out to be exactly 1 microfarad, whereas a 0·0002 mfd. condenser proved to be 0·0017 mfd.

Having carried out many other interesting measurements, Mr. Morris stated that the apparatus was at the disposal of members of the Society. Mr. Boyce on behalf of the meeting thanked the lecturer, and congratulated the Society on their good fortune in having access to such valuable testing apparatus.

Hon. Sec., S. G. Meadows, 110, Bexley Road, Erith, Kent.

Sale and District Radio Society.

On Thursday, March 20th, Mr. Dan Godfrey Junr., Director of the Manchester Broadcasting Station, **2 ZY**, gave an

entertaining lecture on the "Management and Programmes of the **2 ZY** Station." The lecture room being full, many being unable to get in, Mr. Godfrey promised to come again on some future occasion

The Second Exhibition of Wireless Apparatus (Trade and Amateur), will be held on April 12th. The space devoted to the exhibition has been doubled to cope with the said number of visitors as last year.

Hon. Sec., H. Fowler, Wh. Ex., A.M.Inst.M.E., 'Alston," Old Hall Road, Sale.

Hinckley Radio Society.

A "Simple Method of Constructing Coils" was described by Mr. E. J. Vigars, at a well-attended meeting held on Wednesday, March 26th. Mr. Percy Roberts exhibited a one-valve set, which, with a 7 ft. indoor aerial, received five of the B.B.C. stations. The meeting concluded with a short but interesting address on "Television," delivered by Mr. D. E. Price, who described the apparatus used for transmitting pictures and photographs.

On the 17th March, Mr. Bartlett read a paper entitled "Short Wave Transmission," kindly lent by the Board of Radio and Scientific Research. Mr. Bartlett, in addition to giving helpful remarks during the reading of the paper, also gave some very illuminating ideas on the theory of the Heaviside Layer and a lively discussion followed.

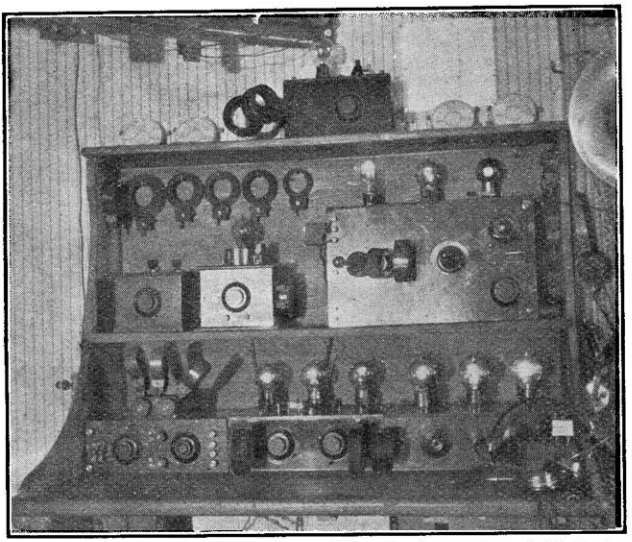
All enquiries regarding membership should be sent to the Hon. Sec., Harrie King, 2, Henslowe Road, East Dulwich, S.E.22.

The Honor Oak Park Radio Society.

On Friday, March 21st, the Society held a "Reflex Evening" The Secretary, Mr. McVey, demonstrated a one-valve dual and note magnifier set working both with and without aerial and earth. This was followed by Messrs. Crook, Newcombe and Blandey using two-valve dual circuits.

For purpose of comparison, Mr. Gandon also demonstrated the three-valve straight circuit receiver, which recently won first prize at the Society's exhibition.

Hon. Sec., J. McVey, 10, Hengrave Road, Forest Hill. S.E.23.



The receiving equipment at French **8 AP**, *the station of M. J. J. Peugot at Audincourt. The apparatus includes a high frequency amplifier, heterodyne wavemeter, transformer and resistance-capacity coupled low frequency amplifiers. Transmissions are given by this station on* 100 *metres with a power of* 100 *watts, almost daily at 8 p.m. G.M.T.*

Dulwich and District Wireless and Experimental Association.

Mr. L. Skinner gave a very able and lucid lecture on the "Neutrodyne Receiver" on March 3rd. The lecturer dealt very fully with the question of balancing condensers which are peculiar to the Neutrodyne circuit, and explained how very practical and efficient condensers could be made by using a small piece of systoflex and a length of wire of appropriate gauge.

On March 10th, an excellent lecture on "Methods of Valve Rectification" was given by Mr. Bartlett. The lecturer dealt very exhaustively on the potentiometer method of rectification, and also on the leaky grid method. In the lively discussion that followed, Mr. Bartlett answered all questions in his usual lucid manner.

North Middlesex Wireless Club.

This club held its tenth annual meeting on the 19th inst. at its headquarters, Shaftesbury Hall, Bowes Park, N. There was a good attendance of members, and from the reports presented by the officers of the club things seem to be going strong. The Secretary gave a short account of the year's work and drew the attention of the members to the very wide field covered by the lectures and papers given before the club in the past year. He also referred to a very interesting visit paid to the National Physical Laboratory at Teddington, and expressed a wish that further outings on the same lines would be arranged during the ensuing year.

The financial side was ably dealt with by the Treasurer, Mr. W. H. Saville, who presented a balance sheet which revealed a very satisfactory state of affairs, and although during the year the club had acquired several new instruments, including a five-valve receiving panel, there was still a satisfactory balance in hand.

The operation of the scheme for the loan of instruments was next described by Mr. L. C. Holton, the club's Installation Officer, and members were urged by Mr. E. W. Cornford to make more use of the club's library.

In thanking the Officers and Committee for their work, the President, Mr. A. G. Arthur referred to the fact that the North Middlesex Wireless Club was founded in March, 1914, just ten years ago, and was therefore one of the oldest wireless clubs in the country. Mr. Arthur then announced that in accordance with the rules all Officers and Committee had retired and asked members to elect a Chairman for the evening. This was done and the honour fell to Mr. F. T. Chapple. The business of electing Officers and Committeemen was then taken in hand.

Mr. A. G. Arthur, who has been President of the Club since its foundation, was unanimously re-elected in spite of some demur on his part, as he wanted, as he expressed it to "take a back seat" for a little while. The other elections were as follows:—Vice-President, Mr F. T. Chapple; Hon. Secretary, Mr. H. A. Green; Treasurer, Mr. W. A. Saville; Installation Officer, Mr. L. C. Holton; Librarian, Mr. E. W. Cornford; Committee, Messrs. J. H. Forbes, W. Gartland, F. C. March, G. H. Wass, and W. E. Wilman.

Hon. Sec., H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

The Dulwich and District Wireless and Experimental Association.

On March 24th the Association was favoured with a very interesting lecture by Mr. H. J. Camplin on Neon lamps, with particular reference to the application of these lamps for radio work.

After the lecture the agenda for the forthcoming month was considered, and the Association has arranged for a full programme of lectures on all branches of radio science for every Monday up to May 5th.

Full particulars of membership will be gladly forwarded to all enquirers. Letters should be addressed to the Hon. Sec., Harrie King, 2, Henslowe Road, East Dulwich, S.E.22.

Battersea and District Radio Society.

At the headquarters, 374, Wandsworth Road, Clapham, S.W., at 8 p.m., on Thursday, the 27th March, Mr. Carriett of the General Electric Co., Ltd., gave a most interesting lecture and demonstration on a "Gecophone" set, comprised of their well-known crystal set, power amplifier, and loud speaker.

During the demonstration, various points were discussed on the reproduction of speech and music, and it was finally acknowledged that the results were as good as any yet heard, and infinitely better than a good many.

The sets were then dismembered, and passed round for inspection, while the lecturer gave blackboard illustrations of the more intricate parts.

A thoroughly enjoyable evening was spent, and closed with members being wiser than they were before.

Readers desirous of attending these lectures should communicate with the Hon. Sec., 39, Warriner Gardens, Battersea, S.W.11.

SHORT WAVE TRANSMISSIONS FROM EIFFEL TOWER.

A series of transmissions are being conducted at the present time by the Eiffel Tower in order to make observations on the efficiency of short wavelengths.

Some readers may already have heard transmissions on 115 metres, but it is doubtful whether anyone has been successful in intercepting the 50 metre and 25 metre transmissions.

We have received particulars of the transmission programme for April, together with a request that our readers should be asked to make observations where possible on these transmissions. Reports, if sent in to the offices of *The Wireless World and Radio Review*, will be forwarded to the authorities organising the experiments.

Transmissions will take place on Friday, 18th April, and on Saturday, the 19th, on 50 metres. On Monday, 21st, Tuesday, 22nd, Friday, 25th, and Saturday, 26th, further transmissions will take place, this time on a 25 metre wavelength. The transmissions on 115 metres took place earlier in the month, but may be repeated next month and in that event the programme will be published in *The Wireless World and Radio Review*.

Transmissions will take place at the following hours on each of the days mentioned above and the identification signal indicated will be transmitted.

Time-Table (G.M.T.).	*Identification Signal.*
from 0500 to 0510 a.m.	f.f.f.f.f.
0515 0525	h.h.h.h.h.
0530 0540	f.f.f.f.f.
0545 0600	h.h.h.h.h.
from 0300 to 0315 p.m.	f.f.f.f.f.
0320 to 0335	h.h.h.h.h.
from 0900 to 0915 p.m.	f.f.f.f.f.
0920 0935	h.h.h.h.h.

The transmission will consist of a message as follows :—v.v.v. de **FL** — **FL** — 115, 50 *or* 25 metres—emission f.f.f. *or* h.h.h. This will be followed by signals of several seconds duration transmitted for the purpose of observations.

In sending in reports of reception of these transmissions it should be clearly stated at what time the observation is made and whether the message was f.f.f. or h.h.h. and the weather conditions at the time should be reported, together with approximate signal strength.

CORRESPONDENCE.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have received a request from Mr. Schnell, the Traffic Manager of the American Radio Relay League, for a list of hours of operation, wavelengths and power used by various British amateur transmitters interested in Transatlantic communication.

Will all those, therefore, interested in Transatlantic tests kindly communicate this information to me at the address below, embodying at the same time any special points they wish me to raise, as I shall be in Hartford on May 14th, and as I am very anxious to further international radio, I shall be glad to receive observations by return, together with full details of stations.

GERALD MARCUSE,
British Representative International Amateur Radio Union.
Hon. Sec. T. & R. Section, R.S.G.B.
Coombe Dingle, Queen's Park,
Caterham, Surrey.

Resistance-Capacity Audio Frequency Coupling.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—In the issues of *The Wireless World and Radio Review* of October 10th and 17th, 1923, a constructional article by Mr. F. H. Haynes, showed the application of the resistance-capacity method of valve coupling to amplification at speech frequencies for the purpose of minimising distortion.

Since that date and in the issue of December 5th, I described a resistance-capacity coupled note magnifier.

It is interesting to note that articles have not appeared so far elsewhere giving constructional details of such an excellent principle set, although prejudicial criticism has been made.

One finds it hard to understand the prejudice that exists. May be it is thought that the wrath of manufacturers of transformers would be incurred if this method of magnification were strongly advocated.

However, the bare facts remain that two or more stages of L.F. transformer coupling *do* produce an alarming amount of distortion unless grid biassing is expertly applied and certain value resistances shunted across the secondary winding. Even then, certain note frequencies are decidedly more prominent.

These troubles, coupled with a doubtful loud speaker, are the cause of the caustic remarks one hears so often of broadcasting.

Resistance-capacity intervalve coupling, at any rate, overcomes inherent receiver distortion to a very considerable degree.

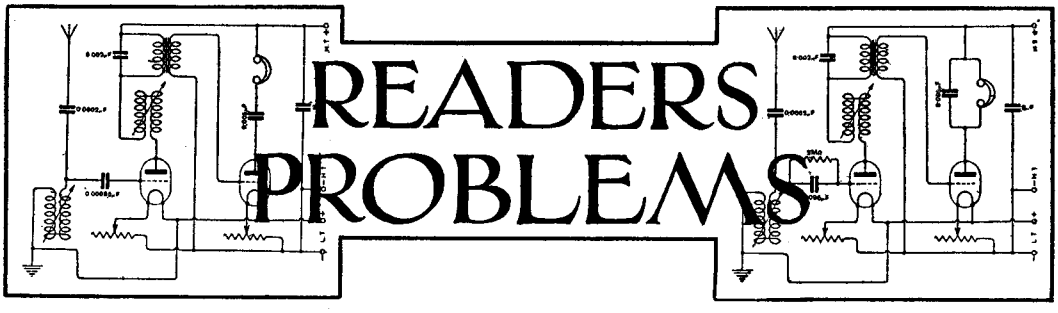
I recently demonstrated a three-valve resistance capacity amplifier at the local radio society and the members expressed delight at the results, so much so that many have made up similar sets.

That this is at present the most successful method of pure telephony reception is borne out by the B.B.C's. Chief Engineer. It is interesting to note also that a five-valve model (1—1—3) has recently been placed on the market by one of the leading firms interested in wireless instrument manufacture, employing the magnifier stages coupled by this method.

I also learn that the handsome set presented to H.M. the King is fitted with this type of coupling for the L.F. stages.

Wishing your journal continued success.

March, 26th 1924. S. J. HEX.



READERS' PROBLEMS

1. *All questions are answered through the post. A selection of those of general interest is published.* **2.** *Not more than four questions may be sent in at any one time.* **3.** *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* **4.** *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

"*D.F.*" (*S.E.*25) **has good results with his reflex receiver when bright emitter valves are used, but the results are not satisfactory when dull emitter valves are used.**

The results will not be satisfactory because the anode voltage and the grid bias to be used is not the same in each case. If the anode voltage is 100 when bright emitter valves are used, a single cell connected in the grid circuit will give the correct bias. When a dull emitter valve is used with 100 volts on the anode, the grid bias should be 3 or 4½ volts—that is, two or three dry cells. There are two harmful effects produced by using insufficient negative on the grid of the valve. The first is that an excessive current is taken from the anode battery, and the second is that the life of the valve is reduced. So far as the signals are concerned, it will be found that they are rectified as well as amplified, whereas when the right potentials are employed, there will be practically no rectification.

"*G.H.*" (*Carnarvon*) **has made a three-valve receiver, H.F. detector and note magnifier, and also a two-valve note magnifier, and is troubled with a low frequency howl.**

The howling is probably due to the coupling between the three low frequency connected valves, and it is therefore necessary to alter the natural frequency of one of the transformers. Try connecting a condenser of 0.002 mfds. across one of the primary windings, and reversing the connections to one of the other primary windings. A resistance of 0.2 megohms should be connected across the secondary windings to reduce resonance effects. Signals will be distorted if an attempt is made to stop the howling by reducing the filament temperature and the H.T. voltage. It is always advisable to connect a large capacity condenser, such as one of 2 mfds. across the high tension battery. If the battery is old, it would be as well to use a separate battery for the note magnifier unit.

"*G.W.T.*" (*Leeds*) **asks what size of duolateral coil will be required to increase the wavelength of a crystal set to 1,600 metres.**

If the crystal receiver is at present designed to tune over the B.B.C. band of wavelengths, the load coil may be a No. 150 Igranic duolateral coil. For best results, the load coil should be so connected in the circuit that the telephones and crystal are tapped across both the load coil and the existing A.T.I. The position for this load coil will be made clear by reference to Fig. 1. When the load coil is not in use, the coil holder should be short circuited by means of a switch, or by a special short-circuiting plug.

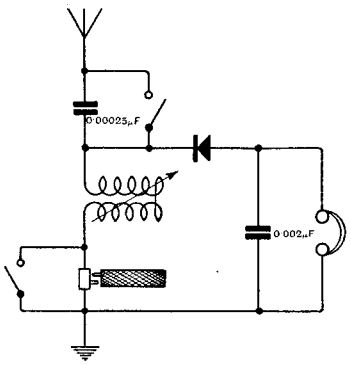


Fig. 1. "*G.W.T.*" (*Leeds*). *Connections of a simple crystal receiver provided with a loading coil for extending the wavelength range.*

"*Perplexed,*" (*Newcastle-on-Tyne*) **has difficulty in reception, due to his aerial being situated near tram and other wires.**

It would appear that your aerial is badly screened by the neighbouring wires, and under the conditions it is doubtful whether you will be able to rearrange things so that you have a fair chance of receiving distant telephone stations. The noise which is heard is of course a local disturbance, and will be heard every time the receiver is adjusted to its most

sensitive condition for the reception of distant signals. We generally recommend the use of an aerial wire, but without an earth. You have apparently tried this, and not found any improvement. We think the best plan would be to use a frame aerial, and connect one stage of high frequency amplification. We would not care to say that this would ensure your getting the distant signals, but you would have a much better chance of doing so.

"*R.T.*" (*Oundle*) **asks by what means interference from the ignition system of a motor-car may be eliminated.**

The only satisfactory method of doing this is to totally enclose all the parts carrying magneto currents by means of metallic screens, which must be connected together and "earthed" to the chassis of the car. The high tension cable should be enclosed in flexible metallic braiding, and small covers should be fitted over the tops of the sparking plugs. A metallic housing for the magneto will also be necessary.

copper wire for use in the construction of an aerial.

Theoretically, the enamelled wire should have a lower high frequency resistance than the plain wire, since currents starting in any one strand are compelled to keep to that wire throughout the entire length of the aerial. In actual practice there would be little to choose between the results obtained with these two types of wire, so far as small amateur aerials are concerned.

"*E.A.R.*" (*Feltham*) **asks if a basket coil could be used as a choke coil in the dual circuit given in Fig. 2, page 338, of the issue of December 12th, 1923.**

A basket coil could certainly be used, and might be wound with 200 turns of the No. 36 D.C.C. wire which you have at hand. If the coil is treated in any way to exclude moisture from the cotton covering, the quantity of wax or varnish used should be reduced to an absolute minimum, in

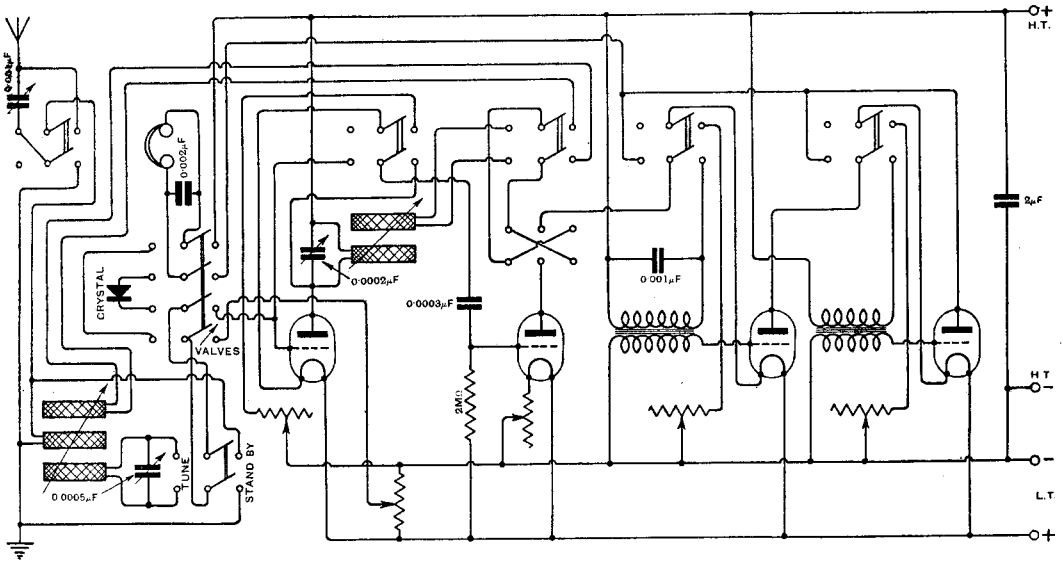


Fig. 2. "*A.H.F.*" (*London, S.E.*). *A receiver permitting reception using a crystal detector or any combination of valves.*

"*A.H.F.*" (*London, S.E.*) **asks how to modify the circuit diagram given in reply to** "*A.N.*" (*Northwich*), **on page 606 of the issue of February 6th, 1924, in order that a crystal receiver may be used while the L.T. battery is being charged.**

The diagram is given in Fig. 2, and it will be seen that the change from valve to crystal reception is made by means of a four-pole change-over switch. A switch of this type is necessary, in order that the telephones may be entirely disconnected from the H.T. battery when the crystal detector is being used.

"*F.V.C.*" (*Dover*) **asks whether 7/22 enamelled copper wire is preferable to 7/22 plain**

order to reduce as far as possible the self-capacity of the coil. For a similar reason, the minimum quantity of insulating material should be used in the mounting of the coil.

"*B.W.B.*" (*Farnborough*) **is only able to receive signals for a few seconds after switching on his valves. Signals gradually fade away and then disappear with a click.**

We have examined the circuit diagram of your receiver, and we are of opinion that the trouble you experience is due to a faulty grid leak. If the grid leak has a very high resistance, or is completely open-circuited, the charges accumulating on the grid of the detector valve will continue to grow until the valve is no longer able to function properly.

Calls Heard

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

Herne Hill, S.E.24 (February 1st,1924-March 13th).
2 AIU, 2 BZ, 2 FJ, 2 FL, 2 FP, 2 KF, 2 KV, 2 KT, 2 LP, 2 MJ, 2 NM, 2 ON, 2 PB, 2 PX, 2 PY, 2 SH, 2 SZ, 2 YH, 2 VO, 2 VY, 2 XO, 2 XR, 2 XZ, 2 YK, 5 AC, 5 BT, 5 CP, 5 DT, 5 FL, 5 FR, 5 HI, 5 IO, 5 LN, 5 MY, 5 OB, 5 OX, 5 RZ, 5 UO, 5 WN, 6 AH, 6 IM, 6 MZ, 6 NF, 6 NH, 6 PS, 6 QB, 6 RJ, 6 TS, 6 VO, 6 WN. French: **8 CT.** (1 valve.) (K. C. Wilkinson.)

London, S.E.
2 AFK, 2 BZ, 2 DF, 2 HV, 2 KG, 2 LU, 2 MK, 2 PY, 2 QZ, 2 QC, 2 VO, 2 VY, 2 ZO, 5 HN, 5 OB, 5 OX, 5 RZ, 5 ST, 5 SZ, 5 ZO, 6 AH, 6 DF, 6 DW, 6 GZ, 6 IM, 6 IV, 6 NH, 6 NF, 6 PS, 6 CH, 6 VR, 6 WM, 6 XG, 0 BA, 0 AG, 8 SSU, 8 DA, 8 QA, 2 CXL, 3 HGN, 4 OX, 9 BS, 7 DF, 7 CC. (o—v—1.) (A. G. Nihcro.)

Malvern, Worcestershire (March 16th).
2 KP, 2 XG, 2 ZD, 5 CX, 5 FH, 5 MO, 5 YW, 6 HU, 6 VP, 8 AQ, 8 AU, 8 CZ, 8 HR, 8 OH, 8 OU. (1—v—1.) (N. H. Gwynn Jones.)

Mablethorpe, Lincs. (February 7th, March 7th).
2 AW, 2 GK, 2 IF, 2 JA, 2 KV, 2 LH, 2 OQ, 2 PC, 2 RB, 2 TA, 2 AGU, 5 AW, 5 BT, 5 GF, 5 KW, 5 LN, 5 MQ, 5 NW, 5 OC, 5 OK, 5 OL, 5 OT, 5 SL, 6 AH, 6 BZ, 6 CV, 6 DW, 6 FG, 6 FQ, 6 JL, 6 JX, 6 NH, 6 PD, 6 QB, 6 UD, 6 XG, 2 AGT, 8 AP, 8 CF, 8 CG, 8 CN, 8 DA, 8 DK, 8 DP, 8 DY, 8 EI, 8 EN, 8 JD, 8 OH, 8 PX, 8 UA, 8 US, 8 XS, 8 ZY, 8 AAA, 8 SSS, 8 SSU, 0 AG. 0 BA, 0 BW, 0 KA, 0 KN, 0 MR, 0 NN, 0 PB, 0 PO, 0 RA, 0 US, 0 ZN. American on 100 metres: **1 AKL, 1 ALJ, 1 AOL, 1 APY, 1 AUK, 1 AUR, 1 IBF, 1 IIL 1 XAH, 1 XAM, 1 XAR, 1 BQ, 1 AJJ, 1 XJ, 1 BSD, 1 XAK, 1 BV, 1 DQ 1 AJP, 1 CAK, 1 CMP, 1 CQK. 1 SW, 2 CEI, 2 OMF 2 AWF, 2 AGB, 2 AJA, 2 AJF, 3 PZ, 3 OT, 3 MB, 3 BA, 3 XI, 4 XE, 4 BY, 4 CX, 4 HS, 5 AIR, 8 COI, 9 ZL, 9 CJI, 9 AR, 1 TH(?), NKF, ACD, 3 YX.** (Telephony.) (o—v—1.) (A. Timms), Langside, Glasgow. (March 1st to 12th).
2 DF, 2 DR, 2 KT, 2 NM, 2 OM, 2 TA, 2 TO, 2 TV, 2 WA, 2 WD, 2 ZT, 5 AW, 5 BV, 5 FD, 5 FV, 5 ID, 5 IK, 5 MO, 5 OT, 5 QV, 5 RD, 5 RZ, 5 SL, 5 ST, 5 SZ, 5 UP, 5 US, 6 WV, 6 NF, 6 NH, 6 QZ 6 RY, 6 VP, 6 XG, 6 XX, 8 AA, 8 BE, 8 BF, 8 CE, 8 CJ, 8 CH, 8 CM, 8 CT, 8 DA, 8 DP, 8 DX, 8 DY, 8 JD, 8 OH, 8 QB(?), 8 ZY, 0 AA, 0 AB, 0 AG, 0 KX, 0 MK, 0 MR, 0 XO, 0 ZN, 7 EC, P 2, 8 SSU, 4 ZZ, 4 AU. (1—v—1.) (A. Ballantyne.)

Margate.
2 DY, 2 KX, 2 OD, 2 SK, 2 SL, 2 XR, 5 CA, 5 DT, 5 FL, 5 LN, 5 MO, 5 PZ, 5 TR, 5 UL, 5 UO, 6 BV, 8 AZ, 8 CC, 8 CT, 8 CZ, 0 AA, 0 PB, 0 SA, 0 XO. Swiss: **XY.** American: **1 EF.** (Arthur O. Milne, **2 AIF.**)

Cambridge (during February).
2 ACU, 2 AP, 2 CW, 2 DR, 2 JF, 2 MN, 2 OM, 2 OS, 2 PC, 2 VF, 2 VQ, 2 WK, 2 WD, 2 XG, 2 XY, 2 ZK, 5 DN, 5 JP, 5 KD, 5 KO, 5 MO, 5 OC, 5 SL, 5 SZ, 5 QV, 5 UG, 5 WK, 6 SO, 6 XX, 7 EC, 8 AE, 8 BM, 8 BN, 8 BP, 8 CG, 8 CJ, 8 CZ 8 DA 8 DE 8 EI, 8 EB, 8 OH, 8 SS, 0 AA, 0 AG, 0 BA, 0 KX, 0 ZN, XY, 1 JW, 1 MT. (Indoor aerial, no earth.) (1—v—0.) (N. Johnson-Ferguson.)

Bradford-on-Avon, Wilts.
2 AS, 2 CV, 2 CW, 2 DD, 2 DM, 2 DS, 2 FL, 2 GG, 2 GO, 2 IL, 2 KP, 2 KW, 2 LF, 2 MP, 2 NL, 2 NM, 2 OM, 2 QN, 2 ST, 2 SX, 2 WU, 2 XM, 2 ZT, 2 ZU, 5 CC, 5 DO 5 FD, 5 GX, 5 II, 5 KO, 5 NW, 5 OT, 5 PS, 5 QV, 5 RQ, 5 TZ, 5 WI, 5 YM, 6 JX, 6 NH, 6 QP, 6 RS, 6 RY, 6 TH, 8 AE, 8 AL, 8 AP, 8 AQ, 8 BP, 8 BV, 8 CG, 8 CN, 8 CT, 8 CZ, 8 DU, 8 DX, 8 DY, 8 EB, 8 EI, 8 OH, 0 AA, 0 BA, 0 DX, 0 KX, 0 QX, 0 ZN, 1 JW, XY, P 2(?). (Leslie E. Boxwell.)

S.S. "Myriam," heard at sea during Transatlantic Tests.
December 20th to 21st. 2,180 miles W.S.W. Ouessant (France), 500 miles S. Newfoundland: **G 2 FQ, F 8 CT, 2 FM, 2 BM, 2 SQ** (probably American). December 23rd, 1,730 miles W.S.W. Oussant, 530 miles W. Fayal (Azores Islands): **2 FP 2 FQ, 2 IN, NAB 2, 2 OD, 2 SZ, 5 AT, 5 HI, 5 KO, 5 NNG, 5 PU, 5 QV, 6 NI, 6 XX, 8 BM, 8 CT, 6 AM.** December 23rd to 24th, 1,520 miles W.S.W. Ouessant: **2 NM, 2 ON, 2 WJ, 5 AT, 5 CX, 5 HI, 5 KO, 5 LC, 5 NNG, 5 RZ, 6 NI, 6 XX, 8 AE, 8 AP, 8 AQ, 8 ARA, 8 BE, 8 BM, 8 CM, 8 CS, 8 CT, 8 LY, PAG, NAB 2, 2 MT, 5 FD, 5 SZ, 5 PU.** December 24th to 25th, 1,300 miles W.S.W. Ouessant: **2 FU, 2 IN, 2 KW, 2 OD, 2 ON, 2 NM, 2 SZ, 2 WJ, 5 AT, 5 LC, 5 NNG, 5 PU, 5 RZ, 6 NI, 6 XX, 8 AB, 8 BE, 8 EB 8 CS, 8 C1, PCII, PAG, ACD, 2 CW, 2 FN, 2 SH, 2 VF, 2 VS, 2 ZK, 5 KO, 5 LT, 5 SZ, 8 ARA, 8 LS, 0 FN.** December 26th, 1,080 miles W.S.W. Ouessant: **2 IN, 2 KW, 2 NM, 2 SZ, 2 UF, 2 WJ, 5 AT, 5 CX, 5 KO, 5 NNG, 5 WR, 6 NI, 6 XX, 8 AB, 8 AP, 8 AQ, 8 ARA, 8 BF, 8 BM, 8 CD, 8 CK, 8 CT, 8 LY, PAG, ACD.**
(Albert Vasseur, Operator of s.s. "Miriam.")

Broadcasting.

REGULAR PROGRAMMES ARE BROADCAST FROM THE FOLLOWING EUROPEAN STATIONS:—

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres; **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **PLYMOUTH 5PY** (Relay), 330 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. Daily, 5.40 to 6 a.m. Weather Forecasts; 9.50 a.m. (Thursday and Friday), 10.15 to 10.30 a.m., Time Signal and Weather Forecast; 11.0 a.m., Live-stock prices; 2.40 p.m. (Saturday excepted); Financial report, 4.30 p.m. (Saturday excepted) Bourse Closing Prices; 5.10 p.m. Concert or Address; 6 p.m., Weather Forecast; 6.20 p.m. (Sunday), Concert and Address; 9.10 p.m., General Weather Forecast.

PARIS (Compagnie Francaise de Radiophone Emissions "Radiola"), SFR, 1,780 metres. Daily, 11.30 p.m., Cotton Oil and Café Prices, News, Concert; 12.45 p.m, First Bourse Report; 3.30 p.m., Bourse Closing Prices; 3.45 p.m., Concert; 4.45 p.m., News and Racing Results; 7.30 to 8 p.m., News; 8 p.m., Concert; 9 p.m. to 9.45 p.m., Radio Dance Music.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres. 8 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 7.15 p.m. to 8.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert.

LYONS, YN, 3,100 metres. Daily, 8.45 a.m. to 9.15 a.m., Gramophone Records: 450 metres. At 10 a.m., Concert and News. 2.45 p.m., Market Reports. 4 p.m. and 8 p.m., Concert and News.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 1 p.m. and 5.30 p.m., Meteorological Forecast; 9 p.m. (Tuesday), Concert.

BRUSSELS ("Radio Electrique"), 410 metres. Daily, 5 to 6 p.m., 8.30 p.m. to 9.30 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 3 to 5 p.m. (Sunday), 8.40 to 10.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 9.40 to 10.40 a.m. (Sunday), Concert; 8.40 to 9.40 p.m., Concert; 7.45 to 10 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 8.40 to 9.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 8.10 to 10.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 8.10 to 9.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular). 7.40 to 9.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres. 8 a.m. and 4 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 7.30 to 8.45 p.m., Concert (Sunday excepted).

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,800 metres (Sunday), 10.50 a.m. to 11.50 a.m., Orchestral Concert; 650 metres, 4.30 p.m. to 6 p.m. (Weekdays), 4,000 metres, 6 to 7 a.m., Music and Speech; 11.30 to 12.30 p.m., Music and Speech; 4.0 to 4.30 p.m., News; 650 metres, 8.30 to 9.30 p.m., Concert.

EBERSWALDE, 2,930 metres. Daily, 12 to 1 p.m., Address and Concert; 7 to 8 p.m., Address and Concert; Thursday and Saturday, 7 to 8 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 8 to 9 p.m. Concert.

FRANKFURT-AM-MAIN, 440 metres. 7.30 to 10 p.m. Tests. Gramophone records.

CZECHO-SLOVAKIA.

KBELY (near Prague), 1,150 metres. Daily (Sundays excepted). 9 a.m., 10.30 a.m., 12.30 p.m., 5 p.m. Financial News and Bourse Prices. 6.15 p.m. and 7.15 p.m., Concert, News, etc.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 2.15 p.m. Concert or lecture.

LAUSANNE, HB 2, 780 metres Daily, 8.15 p.m., Concert and Address.

SPAIN.

MADRID, 1,650, 2,200 metres (Irregular). 12 to 1 p.m., Tests.
MADRID, PTT, 400 to 700 metres. 4 to 5 p.m.. Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 11 a.m., Gramophone Records.

The WIRELESS WORLD AND RADIO REVIEW

WIRELESS AND WEMBLEY.

By THE EDITOR.

THE appearance of this page in print will coincide with the date arranged for the opening, by His Majesty the King, of the British Empire Exhibition at Wembley.

It is fitting that the first Exhibition of its kind in the history of the British Empire should also serve to mark a striking event in the history of wireless. We refer to the simultaneous broadcasting from all stations in the British Isles of His Majesty's speech on the occasion of the opening of the Wembley Exhibition. An opportunity will thus be afforded to a very large proportion of His Majesty's subjects to hear his voice for the first time.

To have brought about the possibility of the King's voice being heard in homes throughout the British Isles, and still further afield, is an achievement which can do much to further the democratic spirit of the British Empire.

Almost every day science is finding new channels through which to assist the development of civilisation. Little by little prejudices give way with the realisation of the services which science can provide. As a consequence, broadcasting at the present time is becoming just as much part of our national life as our daily newspaper, but it provides us with a human interest and personal touch which newspaper print can never achieve. The present instance of the broadcasting of a speech by the King is a striking example. Kings' speeches have often appeared before in our newspaper columns, but no comparison can be drawn between reading a speech and hearing the words spoken by His Majesty himself.

It is difficult to conjecture just how significant is this event, but one possibility appears to stand out so prominently that it may almost be regarded as a certainty. Just as on this occasion the King will address his subjects simultaneously throughout the British Isles, so within the next year it will almost undoubtedly be made possible for the King to address his subjects throughout the greater part, if not the whole, of the British Empire by the same means.

Whether Broadcasting Stations overseas will be operated direct by wireless or whether the connecting links will be achieved through existing cables is a matter which experiment and research will decide, but the outstanding fact stands that the achievement of this result is no longer to be regarded as a remote possibility, but should be looked forward to as a certain and natural development which, assuming progress at the present rate, should reach fulfilment within a comparatively short space of time.

TWO-WAY AMPLIFICATION.

The problem of two-way amplification, that is of amplifying signals simultaneously in two directions, is one which has had the serious attention of engineers since the very earliest days of electrical communication.

By L. T. HINTON, B.Sc.

THE first system of two-way amplification to be achieved naturally applied to the first method of communication, namely telegraphy. Wireless telephony represents the other end of the scale of development, and

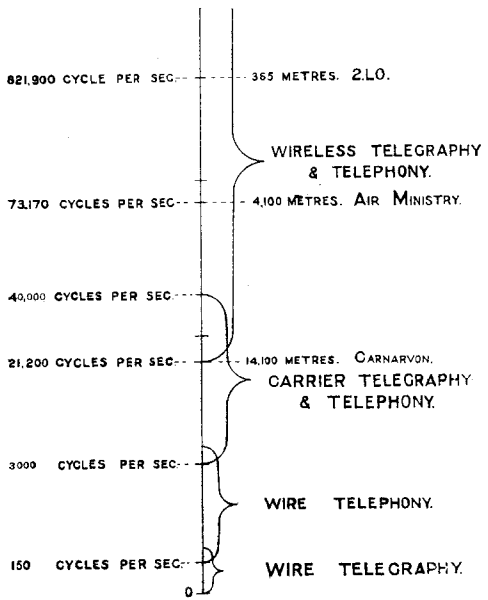


Fig. 1.

is engaging the attention of engineers at the present time. Between the two extremes lie the cases of long-distance wire telephony and carrier current telephony and telegraphy.

All the examples cited above may be arranged in a frequency table. In Fig. 1 these various methods of communication are tabulated and they will be dealt with in ascending order of the frequency which it is desired to amplify. In actual practice the divisions between the bands are not very definite, and a considerable amount of overlapping exists as shown.

From the telegraph problem there are two points which may be noted as having a bearing on the development of the apparatus used for the other cases. In the first place the distortion of a received signal over a long circuit was very marked. This was corrected for at each "repeater" or amplifying point. The telegraph amplifier being a relay device, sent out a square-topped wave of the same type as the original key impulse, and therefore only the distortion of the last section of circuit was introduced into the received signal. Hence distortion is one problem which has to be considered.

The second item of interest is the well-known duplex arrangement which allows signals to be sent in both directions simultaneously over the same wire by means of a balanced circuit. Fig. 2 shows the principle employed.

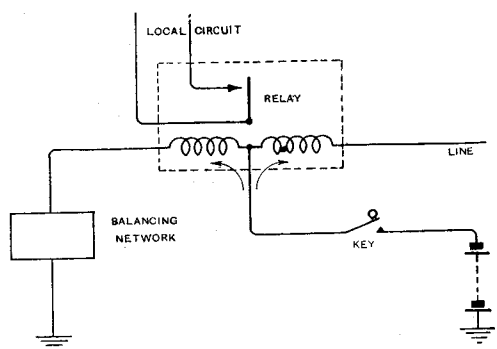


Fig. 2.

Outgoing signals from the key pass through the two windings of the relay in opposition, and if the characteristics of the balancing network are the same as those of the line these two currents will be equal and the relay will be unaffected. Incoming signals, however, pass through the windings in series, and the relay is operated.

Passing on to the case of telephone amplification, mention must be made of the three-electrode valve. The properties and action of this device have been dealt with at length by many authors, and we need only bear in mind the fact that a three-electrode valve when associated with its correct battery potentials, etc., and operating in a properly designed circuit, amplifies all frequencies equally.

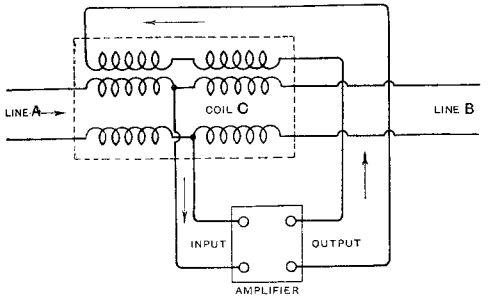


Fig. 3. The two-way one element or type 21 repeater.

There are three types of two-way amplifiers used commercially at the present time for amplifying frequencies between about 200 and 3,000 cycles per second, and they will be dealt with in the order of the length of circuit to which they are applied.

In Fig. 3 is shown in a simplified form a type of repeater whose practical application is, however, very limited. The coil C consists of three windings inductively coupled on one core and so designed that the impedance of the windings and the transformation ratios are correct for the circuits associated with them. Provided that this is done and the impedance of the lines, the input circuit and the output circuit bear the right relations to each other, no energy will pass direct from Line A to Line B. Half of the incoming energy from either line will pass into the input grid circuit and half will be lost in the output plate circuit. The incoming signal will be magnified by the amplifier and the output will flow in series through the two lines.

It will be seen that unless the two lines have similar characteristics at all the frequencies to be transmitted, the input leads will not be at equi-potential points with regard to the output, and a portion of the output will re-enter the grid circuit. This is a regenerative effect which results in " singing " or the generation of oscillations by the repeater when the unbalance current re-entering the grid circuit is equal in magnitude to the original incoming current from the line. This necessity of balance for successful working, makes it essential that the repeater be located within 5 per cent. of the electrical centre of the line, or of the geographical centre when the same line construction is used on each side of the repeater station.

Further, the fact that even when this balance condition has been met, half the output energy goes back to Line A means that only one of these repeaters can be used in a circuit, since two would amplify round and round each other. This type of unit, known as the " 21," or two-way, one-element type, has been described in more detail than its use warrants in order to bring out the vital problem of balance which is associated with all repeater working.

The next type of amplifier to be described is the " 22," or two-way, two-element unit which is used on cable circuits up to about 300 to 400 miles, and works up to 10 or 12 in tandem on open-wire circuits 3,000 miles long.

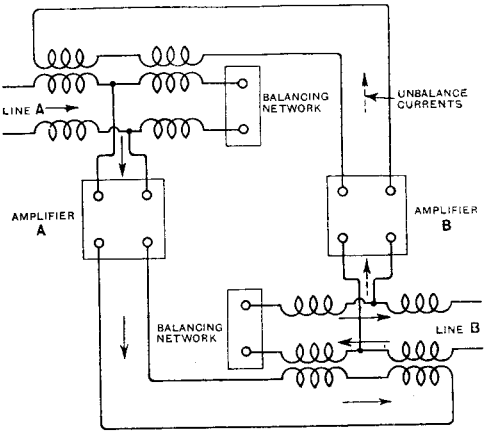


Fig. 4. The two-way two element or type 22 repeater.

Fig. 4 shows one of these units in its simplified form, and in comparing this with Fig. 3 it will be seen that Line A is no longer joined directly to Line B, but that each line has associated with it an artificial

line or balancing network, which can be made to simulate the impedance of any type of line of regular construction at all the frequencies which it is desired to transmit. Tracing the path of a current coming in from Line A, half the incoming energy enters the input circuit of amplifier A and half is lost in the output of amplifier B. The amplified energy then goes through the third winding of its output transformer and is induced into Line B and its balancing network in series. Should there exist any unbalance between Line B and its network a certain amount of this amplified energy will enter the amplifier B and will be amplified and sent back to Line A. If there is unbalance on this side also, a similar action will occur here, and if the unbalances are sufficiently serious the repeater will howl.

This can be avoided by the design of the networks, and this type of repeater is in service on the London-Manchester circuits, and will be used on cable from London to Newcastle.

A portion of Fig. 4 has been drawn out in detail in Fig. 5 to show the apparatus which goes to make up the complete repeater in order to deal with subsidiary problems arising in the development of commercial units. The chief of these are reliability, control, distortion and similarity of results from unit to unit.

The reliability of the amplifier depends very largely on the frequency characteristics and life of the valve E, and the stability of the batteries C, D and F associated with it. Valves are now produced which amplify all frequencies equally, and which have an average life of 10,000 burning hours without diminishing their amplification constant when the battery currents and potentials are kept within close limits.

Control of the gain in " Miles of Standard Cable " furnished by the repeater to the line in either direction is effected by the potentiometer A, which is connected to the low side of the input transformer B. A filter H is connected into the output circuit, and is arranged so that it passes to the output winding of transformer K, without appreciable loss, all frequencies below some predetermined value. This filter helps in the problem of balancing by limiting the range of frequencies over which it is necessary for network N to simulate line L; however, it is so designed that a sufficient band of frequencies for good speech are amplified in the repeater.

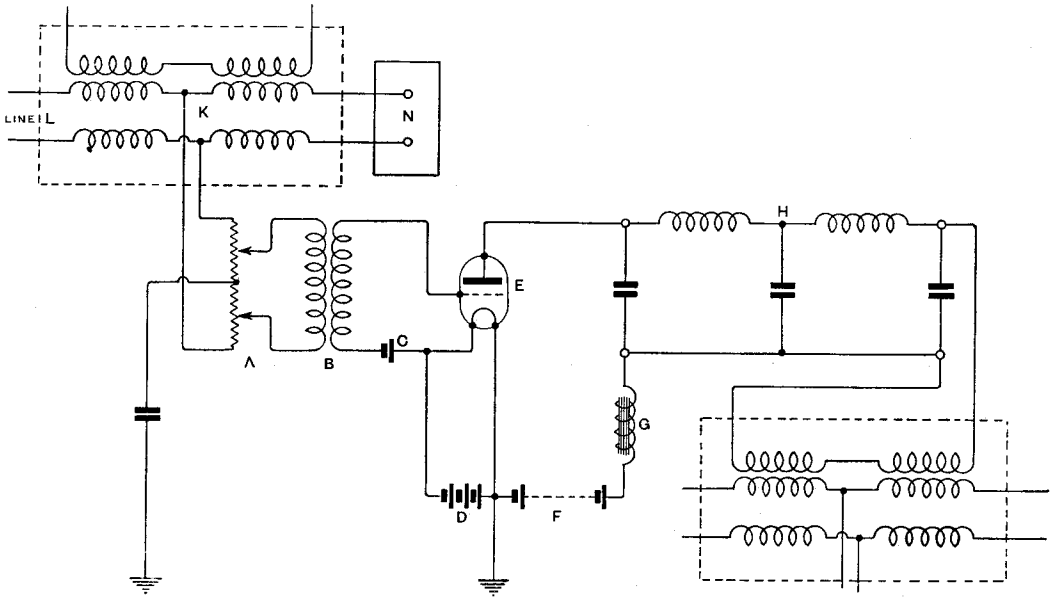


Fig. 5. Details of the repeater of Fig. 4.

Lack of distortion and similarity of results are obtained by very careful manufacture and assembly of the valves, transformers and other apparatus associated with the repeater unit.

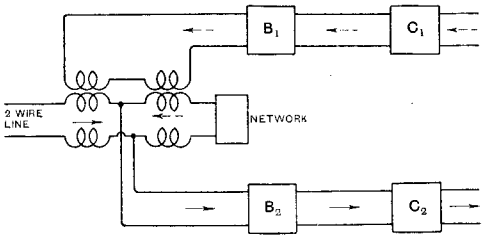


Fig. 6. The "four-wire" system.

It has been found that for distances greater than about 300 miles of cable it is at present not possible to work on circuits using two wires and employing the repeater previously described. This is due to unbalance currents which are called "echo-currents" because they affect the talker and listener by being heard late in the receiver, and sound like an echo of the spoken words. Recourse is therefore made to the "four-wire" system in which one pair of wires is used to transmit in one direction and another pair to transmit in the other, as shown in Fig. 6.

resolves itself into a study of two separate one-way amplifiers located at the same station, but so designed that they do not howl by a feed-back from output to input and arranged so that one amplifier does not cause overhearing from its circuit to a similar circuit at the same station.

In Fig. 7 are shown the various parts which go to make up the two-stage amplifier used in four-wire working. The battery supply to the valves has been omitted for the sake of simplicity. The line A is coupled to the grid of the first valve D by means of a specially designed input transformer C, which has its secondary winding brought out to a series of contacts by means of which the gain of the repeater can be controlled in large steps. The output of the first stage is coupled to the second stage by means of the intervalve transformer E, which is designed in a somewhat similar manner to transformer C; in this case the tappings on the secondary side are arranged to control the gain of the repeater in fine steps. The output of the second stage is coupled to the line B by an output transformer G. All three transformers mentioned have to be designed so that they are of the correct ratio and impedance for their associated circuits and transmit all necessary voice frequencies equally.

This system has been described to illus-

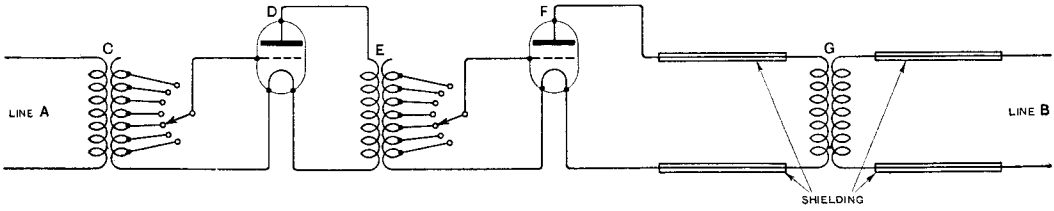


Fig. 7. Connections of two-stage amplifier.

When talking, the subscriber's current passes through the terminating set in the same way as it enters a "22-type" repeater, and is transmitted along the line to the first amplifier B_2; from there it passes along the line to the second amplifier C_2, and so on to the end of the circuit. The current coming in the opposite direction comes from the last amplifier B_1, and goes in series through the subscriber's line and balancing network. It will be seen that the problem of two-way amplification now

trate a method of working which brings into the normal problem of overhearing or "crosstalk," a factor depending on the amount of power put out by the amplifier. It has been found necessary to shield the leads carrying the amplified output currents of one repeater from the leads carrying the weak input currents to another repeater at the same station, in order to reduce this value of crosstalk to a minimum. This is done by wrapping the output leads in copper braiding or copper tape which is

connected to ground, thus effectively interposing an earthed screen between the two types of circuit.

Continuing up the frequency scale we come to carrier or "wired-wireless" transmission. In this system the voice currents are made to modulate a carrier frequency, and to produce a side-band as in wireless telephony. At carrier repeater stations a "22-type" repeater, designed for carrier frequencies may be set up in the manner shown in Fig. 4, but as this necessitates the somewhat difficult task of balancing the lines at frequencies of the order of 30,000 cycles per second, it is usual to employ band filters and to use different carrier frequencies for transmitting in the two directions.

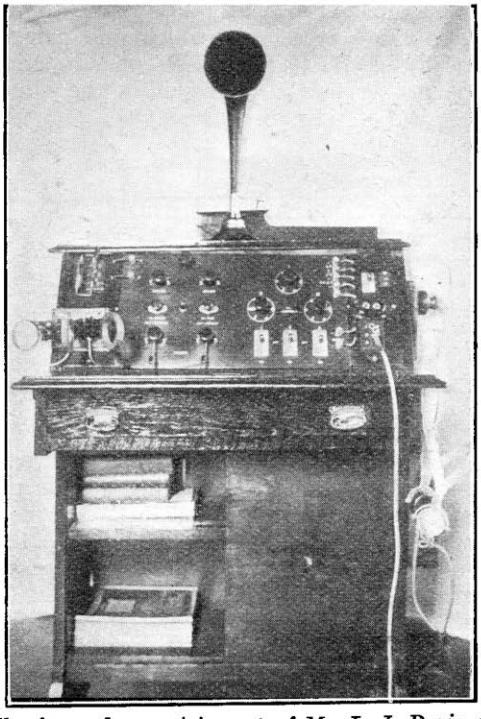
A band filter consists of an arrangement of inductances and condensers so designed that they introduce a small loss over the band of frequencies which it is desired to transmit, but introduce a high loss to frequencies on either side of this band. Suppose that the carrier frequency in one direction is 10,000 cycles per second, and in the other direction it is 15,000 cycles per second. Then at the two-way amplifying station a band filter passing 10,000 to 13,000 cycles is bridged across the line and impresses this band on the grid of the tube amplifying in the one direction, while a second filter does the same for a band from 15,000 to 18,000 cycles passing in the opposite direction. The outputs of the amplifiers are coupled to the line by means of suitable transformers.

When we arrive at the stage of two-way amplification as applied to wireless telephony, it is possible that a system somewhat akin to that described for carrier working would be employed. Two different carrier frequencies or wavelengths would be used, one to carry the speech currents in each direction, and they would be received at the repeater station on antennæ tuned sharply to each wavelength only. Such antennæ would have the effect of the band filters mentioned, but in this case the amplified output would be sent out over equally sharply tuned antennæ to prevent singing.

Such a system in its completed form is only for the future to bring forth, and since large powers and high frequencies have to be handled in wireless transmission it would be well to note the main difficulties which it has been necessary to overcome in the other types of amplification which have been dealt with.

(1) Prevention of howling. This difficulty increases with both the power handled and the frequency.
(2) Absence of distortion. This necessitates careful design of apparatus.
(3) Balancing. This is eliminated by using different wavelengths, but is replaced by the necessity of very sharp tuning.
(4) Prevention of crosstalk. This is allied to (1) and becomes increasingly difficult as the power and frequency increase.

While this article has dealt with the broad aspect of the methods used in obtaining two-way amplification at telephonic and carrier frequencies, there are many other cases of repeater work which are equally interesting. As an example, we have not considered how it is possible to ring over circuits using such amplifiers, nor of the methods employed in installing and maintaining repeater stations, each of which is a lengthy study in itself.



The four-valve receiving set of Mr. L. J. Davis, of Leigh-on-Sea. Switches control the number of valves in use, and provide for a varied range of circuits.

BUILDING A

SHORT WAVE HETERODYNE WAVEMETER.

Now that so many stations are operating on wavelengths between 90 and 200 metres it has become necessary for the experimenter to possess a wavemeter covering this range. Constructional data is to be found in this article for setting up such an instrument.

By A. CASTELLAIN, B.Sc., A.C.G.I.

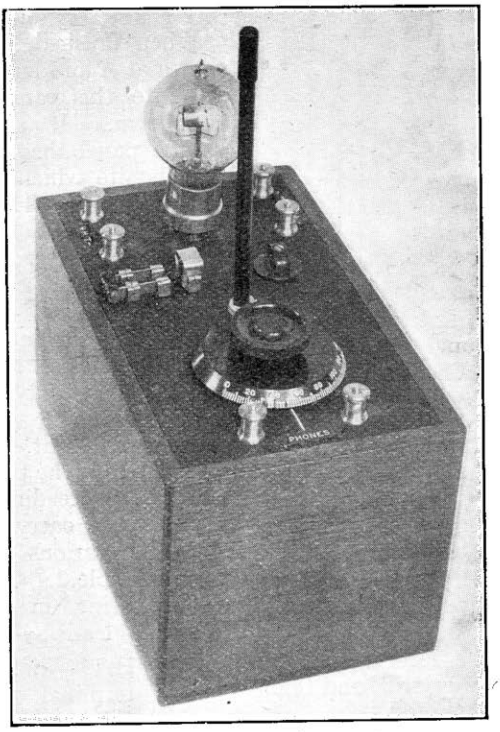
THERE seems to be a growing tendency among amateurs to transmit and receive at shorter and shorter wavelengths, so that a description of a wavemeter to cover these short wavelengths will not be out of place.

The instrument is designed to cover the wavelengths below 360 metres as far as 40 metres directly, though it is possible to determine wavelengths down to at least 15 metres by the harmonic method.

The chief points kept in view in the design are (1) Simplicity, (2) Reliability, (3) Low cost, (4) Compactness, and (5) Ease of construction.

A Hartley circuit was chosen as the oscillator, for only one coil is required for each range instead of two coupled coils, as is more usually the case.

The H.T. supply is not fed to the plate of the valve through a choke, and the plate connected to the oscillating circuit through a condenser, as in the more usual Hartley transmitter circuit, in order to avoid the use of a radio frequency choke coil, which would have to be very carefully constructed and a position found for it out of the fields of the two oscillating coils.



Heterodyne wavemeter covering a wave range of 40 to 360 metres.

CONSTRUCTIONAL DETAILS.

A list of the components used by the author, together with suitable substitutes, is given below :—

One tuning condenser, 0·0005 mfds. maximum. In the design given the total depth of the condenser does not exceed 4½ ins.

Fixed condenser, value 0·001 mfds. (type 600 Dubilier).

Ebonite panel, 9′×5″×¼″.

Vernier friction pencil (Igranic).

Double-pole change-over switch. Six terminals.

A small tumbler switch for filament single-pole knife switch. (The author used a small ex-army filament switch, but in the working drawings a position is shown for a single-pole switch.)

Four valve sockets.

One yard No. 16 S.W.G. (round or square) tinned copper wire.

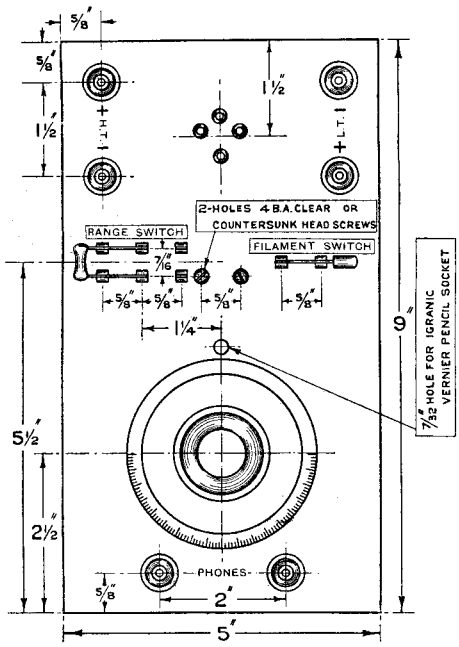
8 feet of No. 18 D.C.C. copper wire and 22 feet of No. 26 D.C.C. copper wire will be required for the coils.

2½ ins. length of 3¼ ins. ebonite or waxed cardboard tubing.

Four ¾ in. 4B.A. screws with nuts and washers, also four ⅛ in. small condenser spacing washers.

Box, 9″×5″×5″ inside dimensions to fit panel and lined with copper or tinfoil except on one 5 in. side, which is at the valve end of the panel.

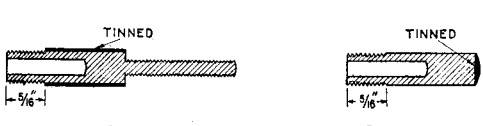
A small piece of springy brass or copper to short circuit switch contacts not in use.



Dimensional drawing of panel showing location of fitments.

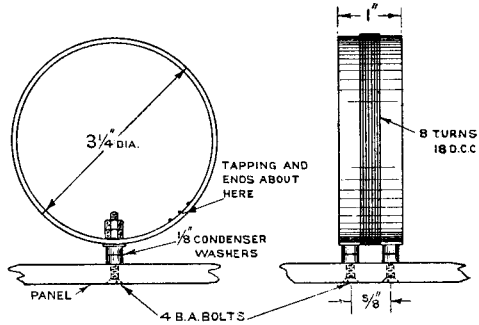
The first thing to be done after obtaining the components is to mark out and drill the panel. Positions and sizes of the various holes are given in the dimensional drawing of the panels.

The holes for the valve legs should be drilled with a ¼ in. tapping drill and then tapped ¼ in. Whitworth thread.



Treatment of valve sockets for mounting flush with the panel face.

After threading the sockets with a ¼ in. thread for 5/16 in. length, the B.A. threaded part of three of the sockets may be cut off with a hacksaw.



Details of the smaller coil.

When finished, one socket should be as shown at A and three as at B. Before screwing into the panel they should be tinned as shown. If tinned while in position on the panel they will get hot and soften the ebonite which is holding them, and so become loose. They may be countersunk when in the panel.

The condenser indicator line can be scratched with a broken hacksaw blade, using a steel rule to ensure straightness.

All the terminals and switch contacts should be placed into their respective holes and their nuts put on. The stems should then be tinned, after which the nuts may be screwed up tight. The condenser can now be secured to the panel.

Before proceeding to make the coils it is advisable to carry out some of the wiring while the various components on the panel are accessible.

The wiring on the panel comprises the following leads :—

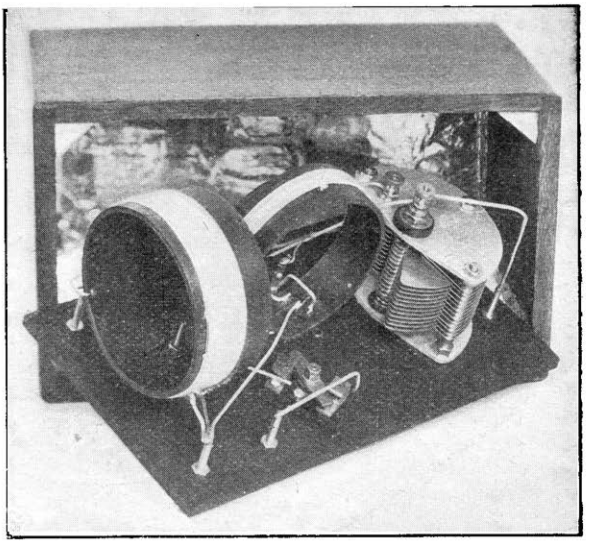
(1) H.T.— terminal to telephone terminal.
(2) Filament socket to L.T.— terminal.
(3) L.T.+ terminal to switch and from switch to filament socket.
(4) Grid socket to centre of double-pole switch to fixed plates of condenser.
(5) Other centre of double-pole switch to moving plates of condenser to other telephone terminal.

(6) H.T.+ terminal to plate socket.
(7) Two straight 1½ in. lengths of wire should be soldered to the two switch contacts nearest the centre of the panel.

The ebonite or cardboard tubing should be cut so as to give when finished one tube 1 in. long and the other 1½ ins. long. The tubes should be drilled and set up as shown in the accompanying diagrams. The smaller coil consists of 8 turns of No. 18 D.C.C. wire tapped at the 5th turn. To wind the coil 8 ft. of wire should be cut off and stretched slightly to remove kinks. One end must be bared for ½ in., and put through small holes in the end of the former. Five turns are then wound and the wire brought to the inside of the tube and out again by means of holes provided. The remaining three turns are completed and the end of the wire fixed in the same way as the beginning. The wire should be wound as tightly as possible.

It will be seen that both ends and the centre tapping are on the inside of the coil, and the reason for this will be apparent when actually wiring up. The ends and tapping should be scraped and tinned, and then the coil is ready for mounting.

The larger coil consists of 25 turns of No. 26 D.C.C. tapped at the 13th turn, and is wound in the same manner as the smaller coil. The method of tapping, however, is different, as a loop is taken and a knot tied in it. It should be noted that this knot should come on the opposite side of the coil to the starting place. When the coil is finished, the knot is carefully pulled away from the coil for about a quarter of an inch, and the wire bared just below it, and



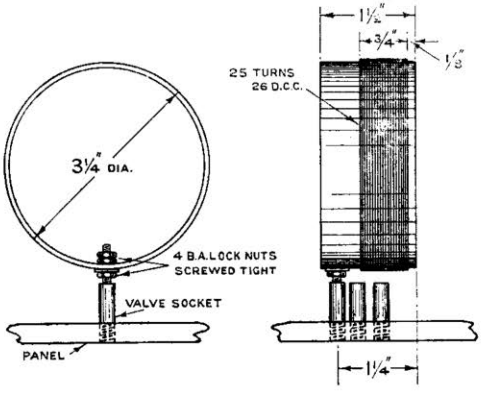
The interior, showing the arrangement of the coils.

tinned. On turning the knot one or two turns these tinned wires come together and can be fixed in position by a touch with the soldering iron, after which the knot may be cut off.

The smaller coil may now be fixed on the panel as shown in the illustration, and the ends wired up to the nearest switch contacts. The 5th turn should be connected direct to the filament minus terminal. The beginning of the coil should go to grid through the switch.

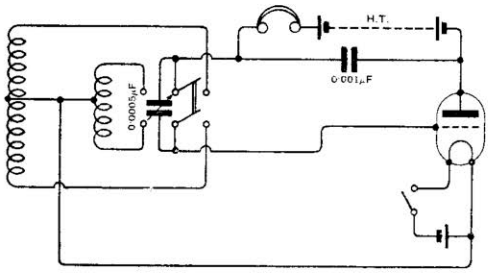
It is now convenient to connect up the 0·001 mfd. condenser. This is placed, with the tags upwards, between the switch contacts and wired in position with short wires to plate and the wire which connects to the moving condenser vanes. It is possible to fix this condenser quite rigidly in the manner stated.

To secure the larger coil in position, a nut should be put on the grid valve socket, then the coil followed by another nut, which should be tightened well up to hold the coil firmly in position. This coil is at right angles to the smaller one. The ends may be wired



The larger coil, showing method of mounting.

up to the remaining switch contacts and the tapping point to the filament negative terminal.



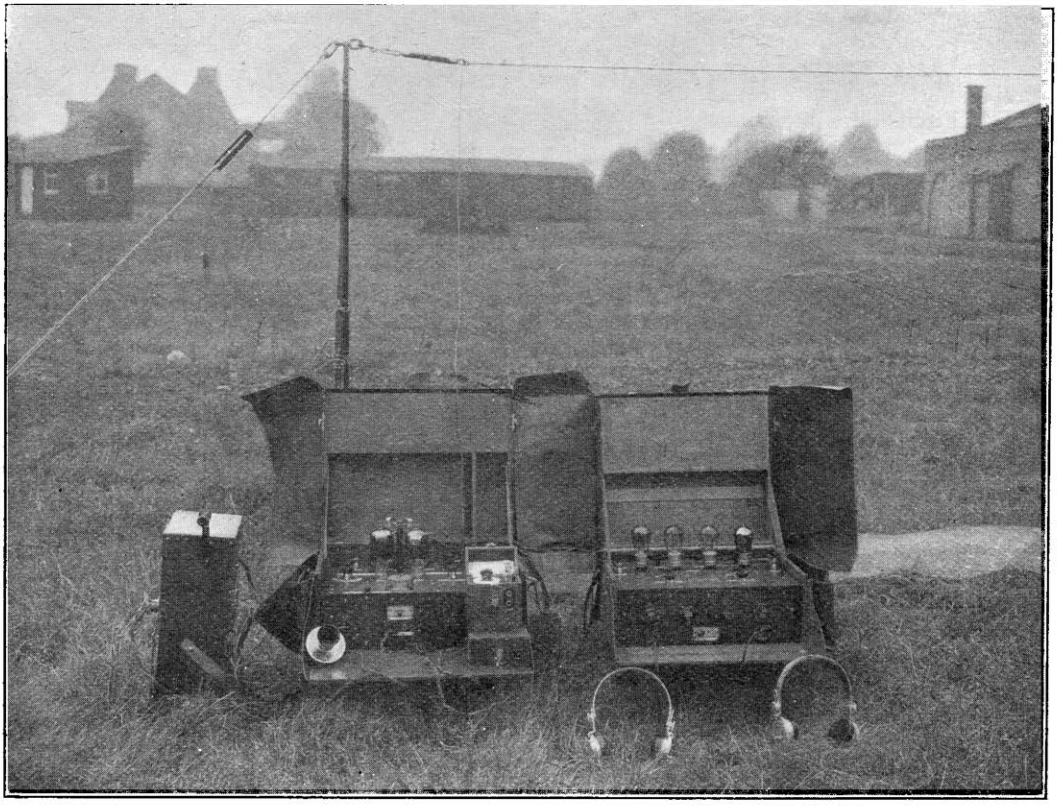
Circuit of short wave wavemeter.

Care should be taken that the condenser dial reads 180° when the condenser is at maximum value, and also that it is firmly clamped on to the spindle.

The name tags, if used, may be secured with a little seccotine, and the panel fixed into the tinfoil lined box, which completes the instrument. The tin foil is kept in place by being stuck on with shellac.

It must not be overlooked, of course, that the calibration of this instrument only remains reliable with one particular valve, and that H.T. and L.T. voltages must be kept within certain narrow limits.

PORTABLE DUPLEX TELEPHONY SET.



[Courtesy Marconi's Wireless Telegraph Co., Ltd.

The outfit is very compact, easily portable, and will withstand rough handling. Power is obtained from the hand-driven generator shown on the left. Transmission and reception are carried out simultaneously on one aerial. This should be an ideal set for club outings during the coming summer season, and shows what can be achieved in the construction of portable transmitting sets.

A SIMPLE SHORT WAVE RECEIVER.

The following description of a simple receiver should appeal to those who may have experienced trouble in reception on short waves, because it has been designed with special regard to short wave reception.

By W. J. JOUGHIN, F.R.S.A.

NOW that so much interest is taken in transmission on short wavelengths of 200 metres and lower, it follows that the amateur must devote his attention to setting up a simple receiver to bring in signals transmitted on these wavelengths. Whilst the construction of a suitable receiver embodying high frequency amplification presents many difficulties, the design of a single valve set given here has been drawn up to be as simple as possible and is quite an efficient arrangement.

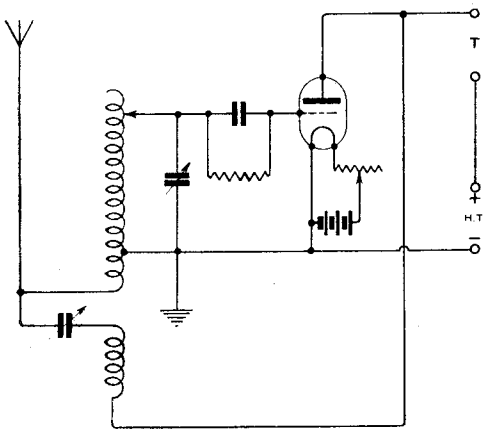


Fig. 1. *The circuit arrangement.*

The difficulties met with in reception on short wavelengths is a state of affairs which is rather welcomed by many of the transmitters, as the effect is that there is considerably less interference on these wavelengths than on 300 metres and upwards.

One of the most useful circuits to employ for short wave reception is the Reinartz arrangement. The merits of this circuit are that it lends itself to short wave reception down to practically the fundamental wavelength of the aerial, together with stable reaction all the way, with a further advantage that there is no appreciable wavelength change with variations of reaction coupling.

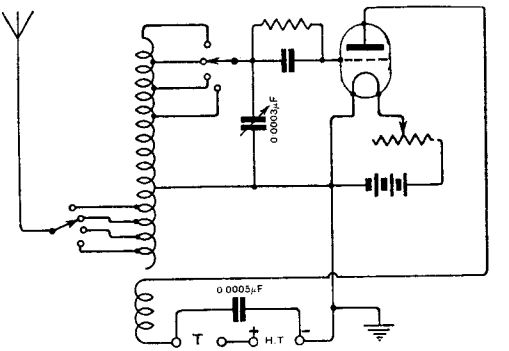


Fig. 2. *The circuit modified as in the arrangement described.*

Fig. 1 shows the arrangement of the circuit, from which it will be seen that reaction is obtained by both electromagnetic and electrostatic coupling, and to get the best and most even results these two couplings have to be correctly proportioned.

After spending considerable time in investigating the circuit and its components, it was decided to make certain modifications,

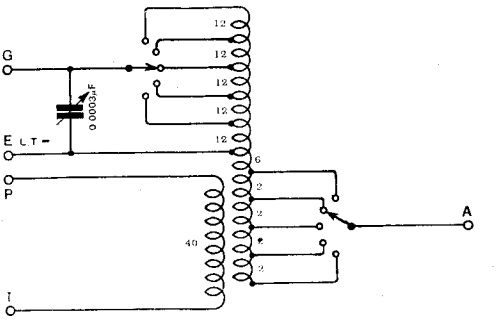
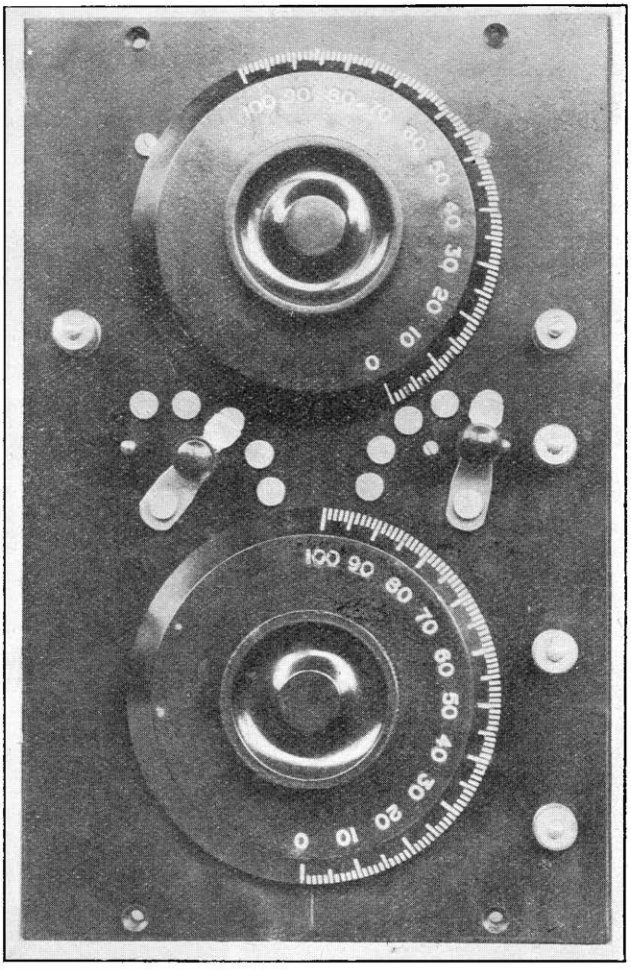


Fig. 3. *The tuner, giving details of turns.*

with the result that a sensitive circuit is produced with all the advantages of the Reinartz arrangement, and making use of no additional apparatus and no further complication of the tuning adjustments.

The circuit is shown in Fig. 2, and whilst this is more or less a well-known arrangement, it is the correct proportioning of the grid condenser is 0·0003 mfds., whilst the H.T. by-pass condenser is 0·0005 mfds.

The following are the exact particulars of the coils. The inductance is wound on a cardboard former $3\frac{1}{2}$ ins. in diameter by $3\frac{1}{2}$ ins. long. There are five sections of 12 turns of No. 26 D.S.C. wire. It is necessary to make a gap between the first



Photograph illustrating the front of the panel with condenser dial, reaction dial and switches.

parts which gives it a superiority. The aerial circuit can practically be regarded as being aperiodic, and consists of six turns of wire, with a four-point switch adding steps by two turns. The grid coil is proportioned to have similar values to a normal secondary circuit. The grid leak is 1 megohm, and the and second sections to allow for the reaction rotor spindle which passes through. The rotor is out of a standard variometer, and is wound with 40 turns of No. 26 S.S.C. wire. The original spindles are retained to allow a good contact being made, without recourse to the introduction of flexible leads. The

grid circuit tuning condenser has a value of 0·0003 mfds.

With regard to the operation of the instrument, it will be found that when used on an aerial of the average dimensions used by amateurs, that the first stud tunes to wavelengths around 200 metres, while the second and third represent 250 to 350, and on the last signals on wavelengths of 350 to 500 metres may be tuned in.

A somewhat modified model on the same principle has been experimented with, and instead of employing condenser tuning with cylindrical inductance, two variometers are made use of. The purpose is to produce a tuner of much neater appearance, easy to operate, and to do away with the fitting of the grid circuit tapping switch.

In conclusion it may be stated that this simple set can be got going very easily, without a great deal of trouble or experiment, and that record can be kept of tuning adjustments corresponding to the various wavelengths.

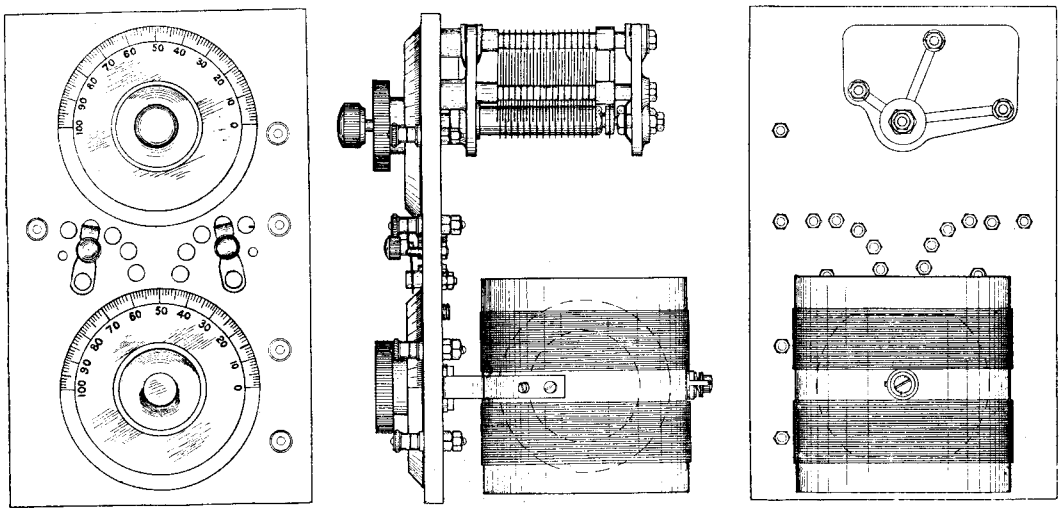


Fig. 4. Sketches giving details of the components and their location on the panel.

RADION VALVES.

WHEN a valve of a new kind is sent to us for test we endeavour to find out its particular quality of interest, and to see where it differs from others. In some cases the answer is obvious, while in others one wonders if it is worth while.

The number of new valves put on the market recently has been very great, and the latest to reach us are the products of Messrs. Radions, Ltd., who market their valves under the trade name of "Radion." These valves are obviously intended to fill the gap between bright and dull emitters and are stated to consume an average current of 0.25 ampere at 4.0 volts.

Two separate types are made, one for use as an amplifier, "A.2," and the other, known as the "D.4," for use as a detector. Unfortunately only one valve of each type passed through our hands, and to record an opinion on a type as represented by one valve is somewhat difficult, and it may be that much of what follows may only be applicable to the particular valves we tested.

Both valves are fitted with the same filament, the characteristics of which are shown in Figs. 1 and 2, the current at 4 volts being 0.27 and

0.25 ampere respectively. Although the normal filament volts are stated to be 3.5 to 4.0 the curves show that below the latter figure the emission is very small. Indeed, one might say, at any rate, as far as the samples we tested are concerned, that unless the L.T. battery is well charged the resulting emission will be lower than is desirable.

Static Test.

The anode current grid volts characteristics of the amplifying valve are given in Fig. 3, the curves being obtained for anode potentials of 30, 60 and 90, and give a magnification factor (*m* value) of 5.5.

The impedance which works out at 42,700 ohms is, when compared to the magnification, essentially on the high side. The curves of Fig. 4 refer to the detector valve, and are taken at the same values of anode voltage as previously mentioned.

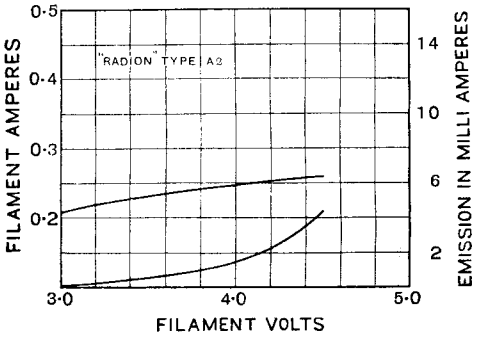


Fig. 1.

In this case the *m* value is 11.5 and the internal impedance 55,800 ohms. Generally speaking, therefore, the foregoing figures would predict the "D.4" to be the better valve.

Circuit Tests.

We next tested the valves on our usual receiving circuit, which is normally arranged for detector with one stage of high frequency.

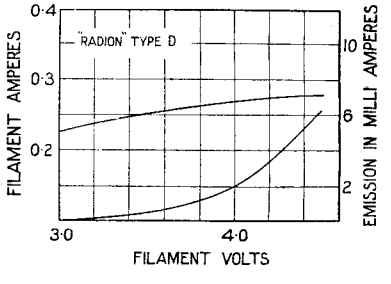


Fig. 2.

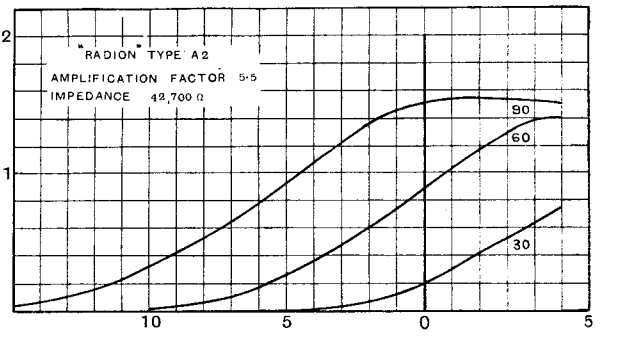


Fig. 3.

Using the Radion "D.4" (detector valve) with an anode potential of 45 in place of our usual detector, equal signal strength was obtained, and rapidly switching over to our standard failed to give any noticeable difference in volume.

Although not designed for the purpose, we next tried the "D.4" as an H.F. amplifier, and as such it gave satisfactory results. With the Radion amplifier valve, however, we were much less successful, and a marked decrease in signal strength when using the "A.2" was observed.

Summing up, our experience shows the "D.4" to be a reasonably satisfactory all-round valve,

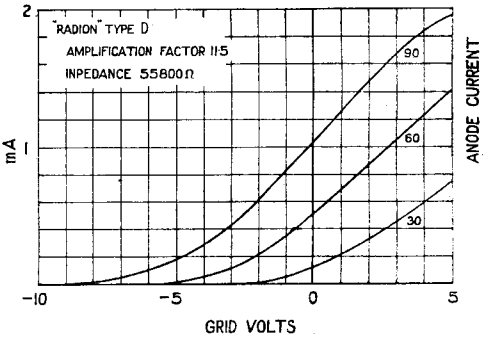


Fig. 4.

whereas the performance of the "A.2" was somewhat poor.

Whilst we freely admit that outside appearances are nowise an indication of performance, yet undoubtedly a well-finished valve appeals to a large number of enthusiasts who are fastidious as to the appearance of their apparatus. We are, of course, becoming accustomed to discoloured bulbs, those of the Radion valves reminding one of the photographic dark-room. We have a suspicion, however, that the filaments are running much hotter than would at first be thought, although it is difficult to judge in view of the red bulb.

THERMIONIC VALVES WITH DULL-EMITTING FILAMENTS.

By THE RESEARCH STAFF OF THE GENERAL ELECTRIC CO., LTD.

(*Work conducted by M. Thompson & A. C. Bartlett.*)

THERE are two methods by which the efficiency of the valve can be improved. One method consists in so balancing the operating characteristics of the valve against the electrical constants of the circuit of which it forms part, that the maximum output is obtained from the valve with the minimum dissipation of power in the anode of the valve itself. The second method consists in reducing the power consumed in heating the cathode to a temperature at which the necessary electrons are emitted.

Dr. Richardson gives two equations connecting the emission of electrons from the substance with its temperature. If i = saturated emission current in amperes per unit area of the emitting surface, and T = absolute temperature of surface, then

$$i = AT^{\frac{1}{2}}e^{-b/T}$$
$$\text{or } i = CT^{2}e^{-d/T}$$

where A C b and d are constants characteristic of the emitting surface.

It is obvious that at a constant temperature the magnitude of the saturated emission from a substance will almost entirely depend upon the value of the factor b (or d). This constant b is related to ϕ, the work necessary for an electron to escape from the surface of the emitting surface, by the simple equation $b = \phi/k$, where k = the gas constant for a single electron. Then, at the same temperature, substances having a low value of ϕ (that is electro-positive), will emit more electrons than will substances having a high value of ϕ.

Two forms of electro-positive cathode have been introduced. The first is the cathode covered with oxides of the alkaline earth metals. The second form of electro-positive cathode is the thorium coated tungsten cathode, with which alone this article is concerned. It is usually known as the "dull emitting" filament, because it gives the requisite emission at a temperature much lower than that of the plain tungsten filament.

One of the first problems undertaken by the Research Laboratory of the General Electric Company was that of investigating the electrical behaviour of thoriated tungsten filaments, with the object of stabilising their enhanced emission, so that use could be made of them in valves. It was found necessary to take great care in the preparation of the valves, and a method was evolved for producing regularly and with certainty a higher degree of vacuum than that obtained in the average hard valve of the time. Further, it was also essential that all surfaces which collected electrons during operation of the valve should be free from adsorbed layers of gas. It was a comparatively easy matter by electron bombardment to free the anode of the valve from gas, but much more difficult to do so with the grid. It proved possible, however, to cover the surface of the grid with a gas-free deposit or varnish, after which deposition an electron current could be passed from filament to grid for long periods without liberating harmful gas from the surface of the grid.

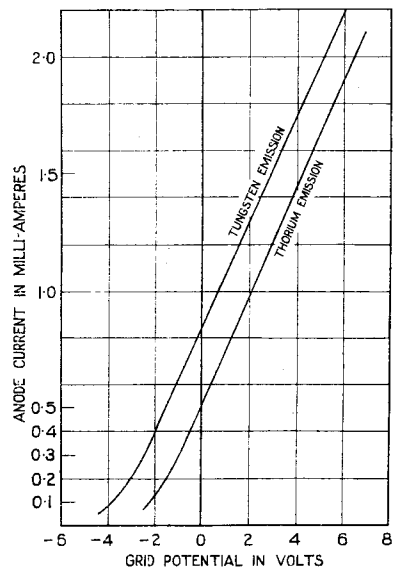


Fig. 1. Anode current-grid voltage characteristics for one valve, with the same total emission from the filament with (1) tungsten emission and (2) thorium emission.

The first type of dull emitter manufactured (March, 1921) was known as the L.T.1, and, except for small modifications, has been in continuous production ever since, although it is now known as the D.E.R. valve. The filament of this valve required 0·38 to 0·40 ampere of heating current at 1·5 to 1·8 volts, the total emission being 5 milli-amperes.

When the anode of a valve is freed from gas by the usual method of electron bombardment, there is filament wastage, and it is therefore not possible to use filaments having less than a certain diameter. It was found that the anode could be heated by induction with radio-frequency currents generated

* Abstract of paper read before The Institution of Electrical Engineers, April 2nd, 1924.

by a valve oscillator. By this method it became possible to manufacture valves with very thin filaments, requiring only 0·06 ampere at 3 volts.

When carrying out the first experiments on thorium emission in a complete trial, a valve of standard type was used. Thorium emission having been stabilised, there appeared to be a considerable reduction in the grid current at zero grid volts, and on plotting the usual anode and grid current characteristic curve, it was clear that both curves were shifted bodily to the right, when compared with a valve containing the ordinary tungsten filament. The amount of shift was equivalent to 1·5 volts on the grid. In addition to the bodily shift of the curves, the anode voltage characteristic was also less steep with the dull emitting filament, while in 2-electrode valves the saturation part of the curve was less flat than it is for tungsten emission. Both these effects are illustrated in Figs. 1 and 2 respectively.

The three chief factors upon which depend the constancy of the electron emission from a dull emitting filament were found to be (1) filament temperature, (2) anode voltage, and (3) degree of vacuum.

(1) After the production of enhanced electron emission by heat treatment at 2,900° K. for about a minute, followed by treatment at 2,250° K. for several minutes, the emission was found to be steady over very long periods during which the filament remained at a temperature of 1,700° to 1,800° K. If, however, the filament temperature was raised above 2,250—say to 2,500° K.—the emission rapidly decreased, until only the characteristic emission of pure tungsten remained. By bringing the filament back to 2,250° K., however, the enhanced emission was again restored.

Very numerous life tests carried out on valves have shown that with filament temperatures not exceeding about 1,900° K., practically constant electron emission is obtained during periods which are very seldom less than 1,000 hours. In general, the life of the emission is longer the lower the temperature of the filament.

(2) In general, and with other factors constant, the life of thorium emission in a valve was found to decrease with increasing anode voltage; also the maximum anode voltage which would allow of a satisfactory life was a function of the size and shape of the enclosing bulb, the permissible voltage increasing with increased bulb diameter. For a life of 1,000 hours or more, the V.24 tubular bulb (of 15 mm. diameter) was found to give this maximum at about 40 volts, while a tubular bulb of 25 mm. diameter allowed about 80 volts, and so on.

In the light of these results, a safe anode voltage was always stipulated for the various types of valves manufactured; for example, 30 volts in the V.24 bulb, and 50 volts in the L.T.1 bulb of 25 mm. diameter.

(3) In the early days of the development of dull emitters, it was apparent from the results of life tests that although thorium might be shown by the filament in any particular valve, this emission was not stable under operating conditions for more than 100 or 200 hours, unless the degree of vacuum were very high, and generally speaking, the higher the pressure of residual gas, the shorter was the satisfactory life.

In order to obtain stable emission during a life approximating to 1,000 hours, the pressure of residual gas had to be not much more than 0·00001 mm. of mercury.

(4) *Life Test.* A small percentage of the Marconi-Osram works production is collected periodically (actually two or three times a week), and this small percentage is subjected to various tests at the laboratories, including life tests.

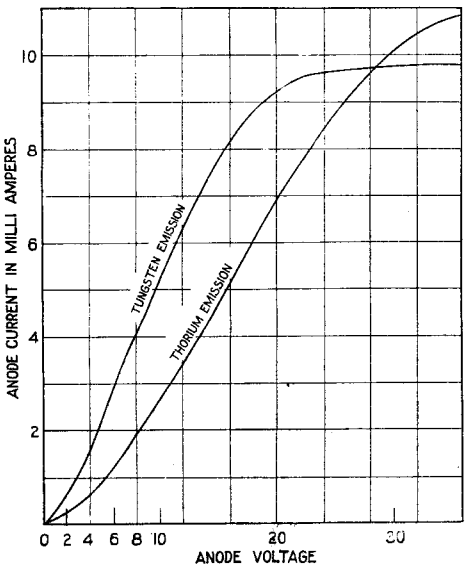


Fig. 2. Anode current-anode voltage characteristics for two similar diodes (1) tungsten filament and (2) dull-emitting filament.

With regard to the life tests of dull-emitters, we may take the D.E.R. valve as an example. In our routine tests the valves are run with a steady A.C. filament voltage of 1·8 and anode voltage of 50, the grid being connected to one filament lead, so that the grid potential virtually oscillates between zero and 1·8 volts positive. The test is run on each particular collection of valves for 1,000 hours, measurements of emission, etc., being made at the end of 50, 100, 300, 600 and 1,000 hours.

(5) *Valve Noises.* Under this heading are included the two effects generally known as (*a*) crackling, and (*b*) microphonic noise. Both phenomena only become important in receiving circuits in which more than two stages of audio-frequency amplification are employed. Dull-emitting filaments are almost entirely free from the first effect, but are offenders in respect of the second.

Very numerous experiments in connection with the microphonic noise characteristic of dull-emitter valves have driven us to the conclusion that the effect is entirely due to the filament retaining a high degree of elasticity at its normal operating temperature. At present the only practicable method of eliminating these noises seems to be to mount the valve on a special type of holder designed to prevent any except very low frequency vibrations from reaching the valve.

A DUOLATERAL VARIOMETER.

The following is a brief description of a variometer with a maximum inductance of about 350 microhenries which has proved very satisfactory for broadcast reception with a crystal set.

THE method of winding this type, in fact, this particular coil, is described in *The Wireless World and Radio Review* of October 3rd, 1923. The theory of the variometer is explained in the issues of October 17th and 24th. It therefore only remains to describe a few practical details.

Two formers are required, 3 ins. and 3¾ ins. diameter respectively. The writer used a two-pound and a one-pound jam jar, the difference in diameter being just right.

On each former are wound two layers of empire cloth strip, 4 ins. wide, stuck together with shellac varnish. The varnished cloth must then be left till thoroughly set.

The cylinders thus formed are marked off into 15 equal parts and cut with a pair of scissors as indicated in Fig. 1.

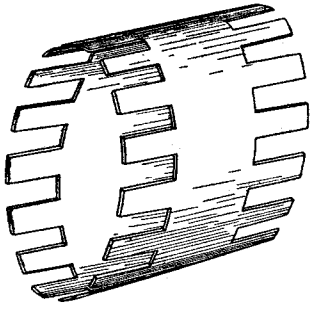


Fig. 1. *Method of cutting the formers.*

The fifteen tags on each side act as the pins around which duolateral coils 1 in. wide can be wound. No. 22 S.W.G. double cotton covered wire should be used. 30 turns are wound on the larger and 31½ are wound on the smaller coil, spaces diametrically opposite each other being left on each coil during winding to accommodate spindle washers.

The details of construction of the whole variometer are best explained by reference to the Figs. 2 and 3. Fig. 2 shows the series connection between inner and outer coils. The spring A is important to combine ease of rotation with a thoroughly sound connection. The top spindle B grips shellaced cardboard washers on the inner coil, and passes through

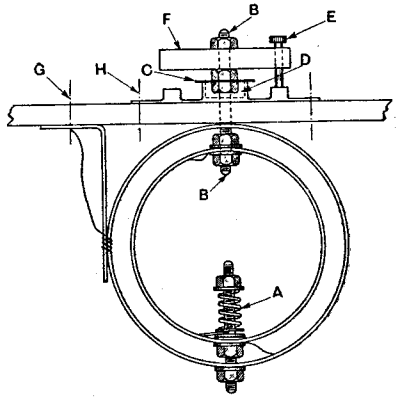


Fig. 2. *Constructional details of the variometer. Easy modification can be made in the method of setting up, according to materials available.*

similar washers secured to the outer coil. The thin copper diaphragm C makes a good connection with its aluminium bearing D and at the same time provides the necessary friction to make fine adjustment of the variometer possible. Note the screw E, which protrudes through the ebonite hand disc F and limits the rotation to 180°. The coil ends are at G and H.

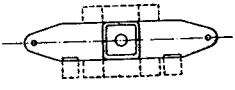


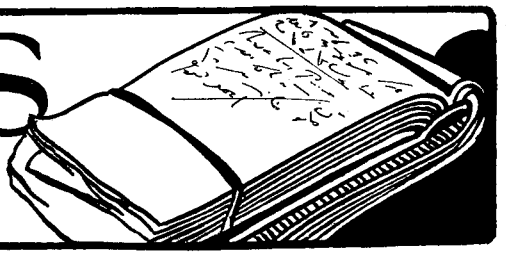
Fig. 3. *Details of the bearing plate* D.

If the coil is carefully wound a close approximation to its maximum inductance may be deduced from the simpler former of the two given on page 45 in the October 10th, 1923, issue of *The Wireless World and Radio Review.*

A. C. V.

C

NOTES & CLUB NEWS



Chinese citizens have been forbidden the purchase and use of wireless sets, according to the *Chinese Economic Bulletin.*

* * * *

A broadcasting station transmitting on 400 metres is to be installed at Marseilles under the direction of a local newspaper

* * *

One of the large hotels in Berlin is fitting wireless receivers in all its rooms, which number some hundreds.

* * * *

The First Annual International Radio Exhibition is to be held at Madison Square Garden, New York, from September 22nd to 28th.

* * * *

From a Bournemouth paper: "Wireless set for sale, cheap; or would exchange for intelligent parrot."

* * * *

No Broadcasting of Commons Debates.

Asked whether the Government would take steps to have the chief debates in the House of Commons broadcast, the Prime Minister replied that such a proposal was not considered practicable.

Experimental Short Wave Transmissions.

A very active French transmitter is **8 AÉ**, the experimental station of our contemporary, *La T.S.F. Moderne*, of 11, Avenue de Saxe, Paris, VIIe.

In addition to the short wave transmissions from **8 AÉ**, which have been taking place on Friday evenings recently, similar transmissions are now being made in addition on Mondays and Wednesdays. Tests are carried out on wavelengths between 150 and 200 metres, and the following programme came into force as from April 14th.

Monday.

p.m. (Summer Time).

8.0 to 8.10. Test transmission of 400 words on 200 metres.

8.10 to 8.20. Test Transmission of 800 words on 200 metres.

8.30 to 8.35. **CQ de 8 AÉ NNN** on about 170 metres.

8.40 to 8.45. **CQ de 8 AÉ DDD** on about 160 metres.

8.50 to 8.55. **CQ de 8 AÉ BBB** on about 150 metres.

Wednesday.

p.m.

8.0 to 8.10. Test transmission of 400 words on 200 metres.

8.10 to 8.20. Test transmission of 800 words on 200 metres.

Friday.

p.m.

8.0 to 8.10. Test transmission of 400 words on 200 metres.

8.10 to 8.20. Test transmission of 800 words on 200 metres.

8.30 to 8.35. **CQ de 8 AÉ. TTT** on about 200 metres.

8.40 to 8.45. **CQ de 8 AÉ. AAA** on about 190 metres.

8.50 to 8.55. **CQ de 8 AÉ. UUU** on about 180 metres.

A Leicester Wireless Exhibition.

An exhibition designed to bring together wireless traders from the Midlands and the North of England is to be held in Leicester in the early autumn.

Principal features will include lectures by experts, a "Wireless Ball" and facilities for displays by radio societies. Special ante-rooms for demonstration purposes will be allotted to trade exhibitors.

A Grievance in Southampton.

Wireless enthusiasts in Southampton are perturbed by the likelihood of increased costs in accumulator charging in the district. According to the *Daily Mail*, a meeting of accumulator recharging businesses was recently held, when it was decided to increase the usual charge of 1s. 6d. to 3s. Although, in view of criticism, the increase may be slightly less, considerable feeling has been aroused among amateurs.

Wavelength of Ecole Supérieure des P. et T.

It is possible that in the near future an alteration will be made in the wavelength of Ecole Supérieure des Postes et Télégraphes, Paris, which at present transmits on 450 metres.

Constant interference on certain evenings by ships and coast stations working on the same wavelength has occasioned many complaints, hence the likelihood of the change referred to.

Broadcasting in Sweden.

Three broadcasting stations are in actual operation in Sweden, two being located at Stockholm and one at Gothenberg.

Telegraverts, Stockholm, transmits on 450 metres on Monday, Wednesday and Saturday, between 7 and 8 p.m., while *Svenska Radioboglets, Stockholm*, transmits from 8 to 9 p.m. on Tuesday, Thursday and Sunday on between 440 and 470 metres.

Nya, Varvet Gothenburg, broadcasts on 700 metres, between 7 and 8 on Wednesday evenings.

Radio Club for Czecho Slovakia.

On April 2nd the Czechoslovakian Radio Club was formed at Prague, and on the same evening an announcement of the event was made from the broadcasting station at Kbely. At the inaugural meeting Mr. Ludvik Simek, Dean of the Technical High School, was unanimously elected Chairman.

The address of the Secretarial offices is Praha II, Karlova Namesti, Ceska Technika, Czechoslovakia.

The Faraday Medal.

The Faraday Medal of the Institution of Electrical Engineers will be presented to Dr. S. Z. de Ferranti on Thursday, April 24th, at 6 p.m. At the same meeting Mr. G. Semenza, of Milan, will deliver the Fifteenth Kelvin Lecture, and will take as his subject "Kelvin and the Economics of the Generation and Distribution of Electrical Energy."

German Broadcasting Stations.

New broadcasting stations are operating at Berlin and Munich respectively, on wavelengths of 430 and 450 metres. Transmissions take place between 7.30 and 10 p.m.

Programmes are opened with the following awe-inspiring announcement: "Hier Oberhauptdirektion der Reichverwaltungtelegraph in Berlin (or Munich)."

Leipsic broadcasting station is also functioning on a wavelength slightly higher than that of Frankfort-am-Maine (440 metres). Test transmissions occur daily at 5 p.m.

Rome Station's Increased Power.

According to our contemporary, *La T.S.F. Moderne*, Rome, **ICD** (Centocelle), has increased its power to 6 kilowatts.

Transmissions occur at 3 p.m. and 7.30 p.m. (G.M.T.) daily, on a wavelength of 1,800 metres, and consist of news and gramophone records.

Norway's Most Northerly Radio Station.

The new wireless station at Vardoe, Norway, is now in operation, and it is believed that its weather reports will be of immense service to British and other trawlers fishing in Arctic waters.

At present only a day service is being maintained. Although of moderate power, the new station has performed excellently in the transmission trials, having been heard at Jan Mayen, 300 miles east of Greenland.

Broadcasting Famous Belgian Chimes.

In the near future the B.B.C. hopes to conclude arrangements for broadcasting the celebrated chimes of Malines. The carillon peal would be relayed to Brussels, whence it would be broadcast and picked up by B.B.C. engineers near London. It would then be relayed to **2 LO** and broadcast simultaneously to all stations

Scottish Broadcasting Controller.

An interesting appointment is that of Mr. Miller Craig, as broadcasting controller for Scotland. It is understood that he will co-ordinate the operation of the Glasgow and Aberdeen stations, and the Edinburgh relay station.

Southend Radio Exhibition.

Under the auspices of the Southend and District Radio Society a Radio Exhibition was held on Saturday, April 12th.

A number of firms exhibited apparatus, whilst in addition special interest attached to the amateur exhibits, which were entered in a competition, arranged by the Society, prizes being awarded by Mr. Hugh S. Pocock, and Mr. W. Dent, who acted as judges.

The exhibition was opened by the Major and was extremely well attended.

The amateur exhibits for the most part showed a high standard of work although the Society is comparatively young. The organising secretary of the exhibition, Mr. Fred Waller, is to be congratulated on the success of his arrangements, as well as the Chairman, Mr. H. H. Burrows, and other officers and prominent members of the Society.

Dutch PA 9.

One of the most successful Dutch Transatlantic transmitters is **PA 9,** operated under the licence of the Technical University at Delft. A photograph of the instrument room appears on this page.

The I.E.E. Benevolent Fund.

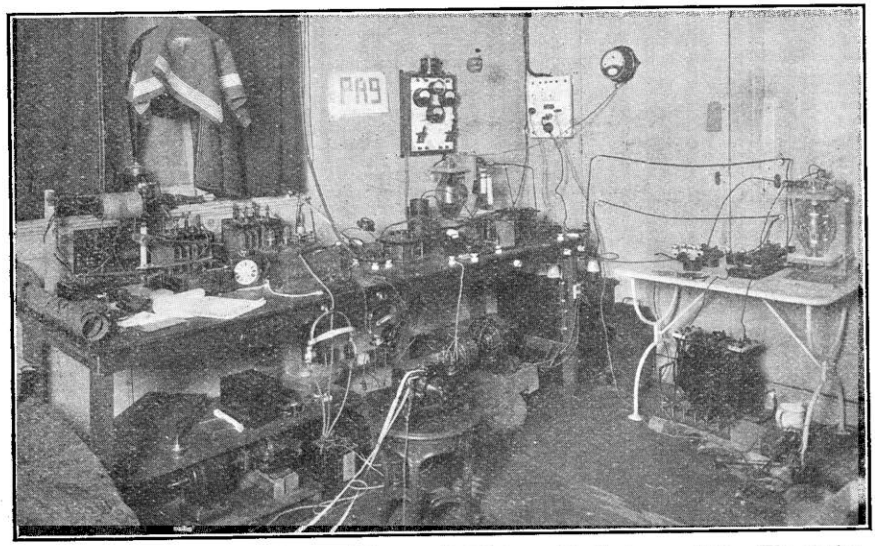
In presenting the list of annual subscribers and donors to the Benevolent Fund of the Institution of Electrical Engineers, Dr. A. Russell, Chairman of the Committee of Management, states that grants made during 1923 amounted to £1,034 2s. 4d., distributed amongst members and families of members.

For an Institution of the size and importance of ours, continues Dr. Russell, the Benevolent Fund ought to have a larger accumulated capital than £10,000, and a considerably larger number of donors and new permanent subscribers is hoped for during the present year.

Mapping Territory by Radio.

Captain P. K. Boulnois, in the course of a paper read at the Aeolian Hall on April 7th, in which he related experiences in mapping parts of the boundary between the Anglo-Egyptian Soudan and French Equatorial Africa, mentioned that part of the equipment of the expedition included a wireless receiving set, and time signals were picked up from the Eiffel Tower, Lyons, the Lafayette Station near Bordeaux, and Nauen (Berlin).

These, combined with astronomical observations, for local time and latitude, enabled the position of the Nile-Congo watershed to be gradually and accurately determined.



The instrument room at **PA 9,** *a well-known Dutch transatlantic transmitter. The station undertakes tests on* 108 *metres.*

The whole installation was completed within a week, and began working with a power of 150 watts. The aerial is a 6-wire cage, 55 ft. long and 32 ft. high, and earth connection is made with the water and gas mains, and the central heating system. The present power of the station is 500 watts, double rectified A.C., derived from a Telefunken generator driven by a 2 h.p. 3,000 r.p.m. 3-phase motor.

PA 9 works on Thursday and Sunday mornings, generally on 108 metres, between 00.00 and 08.00 G.M.T. The operators state that they are glad to carry out tests with any serious experimenter.

A Broadcasting Song.

We have received a copy of a song entitled "Little Piggies," which is "dedicated by permission of the British Broadcasting Company to all the 'Aunties,' 'Uncles' and 'Kiddies,'" and is described as the Kiddies' Broadcasting Song.

Although we are not in the happy possession of an office piano, we imagine the music to be of a stirring character. The words are written by Graham Squier and George Wood, and the composer is Fred Cecil. (London: Reynolds & Co., 62A, Berners Street, W.1. Price 2s. net.)

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 23rd.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Informal Meeting. Questions and Discussion.

Clapham Park Wireless and Scientific Society. At 8 p.m. At 67, Balham High Road. Testing Night.

THURSDAY, APRIL 24th.

Institution of Electrical Engineers. At 6 p.m. At Savoy Place, W.C.2. The Fifteenth Kelvin Lecture. "Kelvin and the Economics of the Generation and Distribution of Electrical Energy." By Mr. G. Semenza.

Hendon Radio Society. At 8 p.m. At the Society Hut, Brent Works. Practical Evening: "Measurements with the Capacity Inductance Bridge."

Sale and District Radio Society. At 37, School Road. Lecture by Mr. Tidswell.

Liverpool Wireless Society. At 7.30 p.m. At the Liverpool Royal Institution, Colquhitt Street. Lecture: "Crystals, Crystal Rectification and Reception." By Mr. S. Lowey.

Blackpool and Fylde Wireless Society. Lecture: "My Experiences on Starting Wireless." By Mr. E. Hollingworth.

FRIDAY, APRIL 25th.

Radio Society of Great Britain (Transmitter and Relay Section). Informal meeting. Mr. Simmonds will open a discussion on "Short Wave Transmitters."

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture: "Air Transport and its Communications." By Mr. D. Sinclair (Air Ministry, London).

MONDAY, APRIL 28th.

Ipswich and District Radio Society. At 55, Fonnereau Road. Illustrated Lecture: "How to Start Wireless." By Mr. H. E. Barbrook.

Sale and District Radio Society. At 37, School Road. Experimental Work.

Hornsey and District Wireless Society. At Queen's Hotel, Broadway, Crouch End, N.8. Lecture: "Detecting Apparatus for Electric Waves." By Mr. Maurice Child (Vice-Chairman of the R.S.G.B.)

WEDNESDAY, APRIL 30th.

Radio Society of Great Britain. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Faithful Reproduction by Broadcast." By Captain P. P. Eckersley (Chief Engineer of the B.B.C.)

The Radio Society of Highgate.*

The Society was honoured on March 28th by a visit from Prof. A. M. Low, D.I.C., A.C.G.I., who gave a most fascinating talk on "Sound and Wireless." He said that in order to interest the general public in wireless more attention must be paid to sound and not so much to noise. Further, a receiving set must be foolproof, simple to operate, and not an eyesore to the lady of the house, who will want to put a flowerpot on it. Prof. Low then gave a brief outline of the principal laws of sound, such as reflection and refraction, and explained some interesting applications of these laws as used during the war to detect the approach of aeroplanes and submarines.

On April 4th, Mr. J. F. Stanley, B.Sc., A.C.G.I., gave a lecture entitled "The Acoustic Properties of a Room and their Effect on the Performance of a Loud-speaker." The lecturer said that the conditions for satisfactory hearing in a room are—(1) Uniform and adequate loudness; (2) distinctness, *i.e.*, absence of undue overlapping between successive sounds; and (3) absence of distortion. Uniform loudness is obtained by avoiding curved walls, and it was shown that satisfactory hearing in a large hall cannot be obtained merely by increasing the amount of sound energy given out by the source. Distinctness depends on the size of the room and on the total absorbing power of the room, the latter quantity being dependent on the nature of the covering of the walls and the contents of the room. For speech a highly absorbing covering is best, while for music a certain amount of overlap between successive sounds is essential. For speech distinctness is much more important than loudness, and reverberation should be avoided.

All those interested in wireless are invited to communicate with the Hon. Secretary, 49 Cholmeley Park, N.6.

West London Wireless and Experimental Association.*

"Some Important Points in Radio Design," formed the subject of a lecture given by Mr. O. S. Puckle, on March 25th. The lecturer dealt first with tuning arrangements, giving hints on the avoidance of losses in coils and condensers, and on the use of acceptor and rejector circuits. The selection of suitable valves was next covered and amplification factors were considered.

Headquarters, Acton and Chiswick Polytechnic, Bath Road, Chiswick.

Hon. Sec., Horace W. Cotton, 19, Bushey Road, Hayes, Middlesex.

Golders Green Radio Society.*

A most interesting lecture on "Crystals and their Characteristics" was given by Mr. A. Hinderlich on Wednesday, April 2nd, 1924, and, judging from the number of visitors who were present, the activities of the Society have a very strong measure of support in the district.

Although 20 per cent. of the Society are holders of "transmitting" licences, yet the needs of the veriest tyro are not lost sight of, and it is to this broad policy and the remarkable enthusiasm displayed by officers and members alike that the rapid growth and prosperity of the Society must be attributed.

Full particulars of membership of the Society may be obtained from the Hon. Secretary, Mr. W. J. T. Crewe, "The Dawn," 111, Prince's Park Avenue, Golders Green, N.W.11 (Telephone, Hampstead 3792).

"The Golders Green Gazette" is the official local organ of the Society, and notices of all forthcoming events and items of interest are published in its columns from week to week.

Wireless and Experimental Association.*

In response to the unanimously expressed desire of the members of the Wireless and Experimental Association at Peckham, on Wednesday, April 2nd, they will, in future, set apart the night of the first Wednesday in the month in order that members may bring along their home constructed receiving sets for criticism and advice.

Hon. Sec., George Sutton, 18, Melford Road, S.E.22.

The Leicestershire Radio and Scientific Society.*

A very interesting lecture on "Oil and Transformers" was given on April 1st, by Mr. T. R. Palmer.

After a brief explanation of the methods used in refining and testing, the lecturer went on to describe his experiments with oil-immersed intervalve apparatus.

These created considerable attention, and the discussion mainly centred around the value of oil for this class of work.

Several members were inclined to doubt the use of this substance, but as Mr. Palmer has promised to demonstrate in the near future there will be an opportunity for further tests. All communications regarding the Society to be addressed to Hon. Sec., Mr. J. R. Pallett, 111, Ruby Street, Leicester.

The Southampton and District Radio Society.*

At a well-attended meeting of members held on March 27th, some interesting experimental work in connection with tuned and untuned aerials was carried out with the Society's new apparatus, and much useful information was gained.

Mr. Bateman also gave a short talk on a new method of obtaining high frequency amplification.

Hon. Sec., Lt.-Col. M. D. Methven, O.B.E., 22, Shirley Avenue, Southampton.

Blackpool and Fylde Wireless Society.*

On March 20th, Mr. C. S. Doeg gave a demonstration, by means of the gramophone, of the Marconi official records, published by the H.M.V. As a change from the Morse of these records, musical items were introduced. Perhaps the demonstrator became a little mixed when he gave "Felix" as a wireless record!

On March 27th, Mr. L. R. Blackburn, lectured at the request of members on the subject—"An Ideal Set for Reception of Broadcast Items in Blackpool." The lecturer said that, in his opinion, such a set must include 1 H.F. and 1 detector valve in order to obtain fair volume on all the B.B.C. stations.

The Society would like to see more of the wireless amateurs of Blackpool and Fylde in its midst, and would welcome any offers and suggestions.

Hon. Sec., B. D. Taylor, 58 Regent Road, Blackpool.

The Belvedere, Erith and District Radio and Scientific Society.*

A lecture on "The Elementary Principles of Wireless" was delivered by Mr. W. Bibbey on Friday, March 28th. Mr. Bibbey assumed that his listeners knew nothing of wireless, and his remarks were much appreciated, particularly by beginners.

The Secretary announced that the equipment engineer (**5 QY**) hoped to transmit every Sunday morning between 11 o'clock and noon.

On Friday, April 4th, an interesting lecture and demonstration entitled "The Measurement of Small Capacities," was given before a meeting of the Society, by Messrs. S. Burman and S. G. Meadows, the former acting as lecturer and the latter as demonstrator.

After pointing out the unsuitability of the direct deflection galvanometer method of measuring small capacities with any degree of accuracy, the lecturer went on to explain the capacity-bridge method and its suitability for measuring both small and large capacities. The relationships between the various quantities involved in the measurements were arrived at from first principles and then applied.

A special designed hummer was used, giving an alternating current of almost pure sine-wave form at frequency of about 800 cycles per second, which fed the capacity bridge.

The inter-electrode capacity of several different types of valves was tested and tabulated, showing the unsuitability of certain types for high-frequency work, due chiefly to the relatively high capacity value between plate and grid.

Hon. Sec., S. G. Meadows, 110 Bexley Road, Erith, Kent.

Tottenham Wireless Society.*

A surprise evening awaited the members of the Society on Wednesday, March 26th. Each member was given a numbered slip of paper, and on his number being drawn from a hat he was called on to talk for five minutes on a given subject. A most varied and interesting series of "potted pars" resulted. The arrangements for the purchase of a hut to use as a club-room is being pushed forward, and members are asked to hand in their donations at their earliest convenience.

Hon. Sec., S. J. Glyde, 137 Winchelsea Road, Bruce Grove, Tottenham, N.17.

Wimbledon Radio Society.*

At an informal meeting held on Friday, March 21st, Mr. Babbage, a member, demonstrated a compact three-valve receiver of his own construction, contained in a small suit-case for portability. This was used on the outdoor aerial, while **2 LO** was received on an indoor aerial at the other end of the room.

A constructional evening was held on the following Friday, when the wiring-up of the Society's 4-valve receiver was further advanced.

The second year of the Society's existence commences with the first meeting held in April, and prospective members are advised to communicate with the Hon. Sec., C. G. Stokes, of 6 Worple Road, Wimbledon, S.W.19, without delay.

Sheffield and District Wireless Society.*

On April 4th the Society enjoyed one of the most interesting lectures in the present session, that of Mr. Wade, of the Marconi-Osram Valve Co., Ltd., on "Valves."

After dealing with the choice of suitable raw materials, the lecturer explained in detail the various operations which went to produce an ordinary "R" valve, besides special types of receiving valve and high power valves.

The lecture was adequately illustrated by a series of good slides, and by a still more interesting set of specimens.

The Secretary announced that a certain box, which, during the evening, had stood upon the lecture table, contained a number of valves which the Marconi-Osram Valve Co., Ltd., had most generously presented to the Society. A hearty vote of thanks was accorded to Mr. Wade, and to the M.-O. Valve Co., Ltd.

The Leeds Radio Society.*

Mr. G. P. Kendall, B.Sc., was elected General Committee representative to the Radio Society of Great Britain at a special meeting held recently.

On March 21st, Mr. R. E. Timms, Hon. Treasurer, continued a discussion on "Crystal Reception in Leeds," much interest being aroused.

There is room for more members in the Society, and applications will be welcomed by the Hon. Sec., D. E. Pettigrew, 37, Mexborough Avenue, Leeds.

North Middlesex Wireless Club.*

"Measuring Instruments used by Radio Amateurs" was the title of a lecture given on April 2nd by Mr. G. A. V. Sowter, who is well known to North London wireless amateurs.

Mr. Sowter started from first principles, showing several experiments designed to demonstrate the magnetic effect of an electric current.

He then went on to describe the various forms of volt and ampere meters and showed how it was that moving coil instruments, though more accurate than the moving iron type, are not adapted to the measuring of high frequency alternating currents met with in radio work.

An ingenious model of a hot wire ammeter was demonstrated and a thermo-junction device was described, which was capable of measuring extremely minute currents, whether direct or alternating.

Perhaps the most interesting part of the lecture to the majority of the audience was Mr. Sowter's account of the construction and operation of a distinctly novel type of wavemeter, particularly his description of how he had calibrated his own instrument without laboratory assistance.

The Hon. Sec., H. A. Green, 100 Pellatt Grove, Wood Green, N.22, will be pleased to forward particulars of membership to anyone interested.

Stoke-on-Trent Wireless and Experimental Society.

The annual meeting of the Society was held on March 27th. The Secretary's and Auditors' reports having been read and confirmed, the following officers were elected for the ensuing year:—President, Col. F. E. Wenger; Vice-Presidents, Dr. A. W. Ashton, L. F. Fogarty, Esq. (of the Radio Society of Great Britain), Col. W. J. Kent, and H. S. Pocock, Esq. (Editor of *The Wireless World and Radio Review*); Chairman, F. Jenkinson, Esq.; Vice-Chairman, T. R. Clark, Esq.; Hon. Secretary, F. J. Goodson, B.Sc.; Hon. Asst. Secretary, E. A. Haliburton; Hon. Treasurer, H. Marshall.

A General Committee having been elected, a vote of thanks was accorded the officers and committee for their work during the past year.

Hon. Sec., F. J. Goodson, B.Sc., Tontine Square, Hanley.

The Honor Oak Park Radio Society.

On April 4th, Mr. McVey, Hon. Secretary, read a short paper on "How the Valve Works." An open discussion followed, in which particular interest was shown in the design of wave traps and rejector circuits. Several members gave experiences when using one of the four usual circuits, and much interest was taken in some curious results in tuning reported by Mr. Newcombe.

Hon. Sec., J. McVey, 10, Hengrave Road, S.E.

Beckenham and District Radio Society.

An interesting exhibition was held on April 2nd at the Church, High Street, and an attractive competition drew many entries. Some very novel features were on view, and prizes were later awarded by Mr. Knight, A.M.I.E.E.

Local enthusiasts who are interested should get in touch with the Hon. Secretary, J. F. Butterfield, 10, The Close, Elmers End, Beckenham.

Bromley Radio and Experimental Society.

At a recent meeting of the Society held at the United Service Club, London Road, Mr. A. H. Howe, of the M.O. Valve Company, gave a most interesting lecture on the manufacture of wireless valves.

His lecture was well illustrated by numerous lantern slides and an excellent display of specimen valves.

The subject was handled with great ability, and gave all present a very clear insight into the construction of this important piece of apparatus.

The lecture being open to the public there was an attendance of about 200.

The Hon. Sec., L. R. Stephens, 73 Masons Hill, Bromley, Kent, will be pleased to hear from anyone interested and wishing to join this Society.

Croydon Wireless and Physical Society.

Members of the Society listened with close interest to a lecture delivered recently by Mr. G. F. Mansbridge, M.I.E.E. well known in the electrical and wireless world for research and invention.

"Some Wireless Fundamentals" was the subject, and the lecturer emphasised that wireless progress had been so extremely rapid as to have outrun the average man, and many writers did not help very much in giving a real grip of the principles which were at work. He had a great love for the crystal and believed it was capable of far better results than had been realised. He did most of his work with crystal, and some of his achievements, which he later on described, were certainly illuminating to many who had not persevered with a crystal set. One of the things a serious worker in wireless required was to get some knowledge of the quantities with which he was dealing, and here the lecturer had a word to say about articles being given their proper names when sold.

Hon. Sec., H. T. P. Gee, 51-52, Chancery Lane, London, W.C.2.

Nottingham and District Radio Experimental Association.

At the first meeting of the new session, held on March 3rd, Mr. L. H. Cocks (Asst. Hon. Secretary), delivered a lecture on "Direction Finding on Aircraft." Much interest was aroused and many questions were asked.

Particulars of membership may be obtained from the Hon. Sec., A. P. Gosling, 63, North Road, West Bridgford, Notts.

Radio Association of South Norwood and District.

After buzzer practice, on April 3rd, a short lecture on a Gambrell four-valve set was given by Mr. Purkiss, and proved of great interest. A demonstration of loud-speaker reception followed, after which Mr. Law described his portable H.F. and crystal set, on which he receives all the B.B.C. stations.

Hon. Sec., Miss D. M. B. Cullis, 51 Quadrant Road, Thornton Heath.

Westminster Wireless and Experimental Association.

On Tuesday, April 1st, the Society had the pleasure of hearing Mr. W. D. Gwynne deliver an informative and interesting lecture on "Valves." About fifty different types were dealt with, from the old Fleming two-electrode to the modern transmitter. Dull emitters came in for their share of criticism, as also the four electrode. Very useful hints were given on how to select valves for particular purposes.

Application for membership of the Society should be addressed to the Hon. Sec., J. Dove, 77 Pimlico Road, S.W.1.

Croydon Wireless and Physical Society.

There were unusual sounds at a recent meeting of the Croydon Wireless and Physical Society, produced by Mr. L. F. Hammond's experiments in sound and vibration. Although not strictly a wireless topic, sound comes within the realm of physics, said the Chairman, Mr. F. C. Reynolds, and in wireless use was made of sound vibrations.

Mr. Hammond explained fundamental vibrations and harmonics, etc., and illustrated his remarks by experiments.

Hon. Sec., H. T. P. Gee, 51 and 52, Chancery Lane, London, W.C.2.

The Clapham Park Wireless and Scientific Society.

On Wednesday, March 19th, Mr. Goldup, representing the Mullard Valve Co., gave a detailed description of the manufacture of valves, and passed round for inspection parts and valves in various stages of manufacture. A large high-power silica valve was also shown, and aroused much interest.

On March 26th the Society held its monthly "Testing Night," when valve characteristics were measured, and a two-valve receiver, built by a member, was tried out.

The Society meets every Wednesday evening at 67, Balham High Road, at 7.30 p.m. Enquiries should be addressed to the Hon. Sec., H. C. Exell, B.Sc., A.I.C., 41, Cautley Avenue, S.W.4.

Sydenham and Forest Hill Radio Society.

The first annual general meeting of the Society was held at its commodious new headquarters, The Meeting House, Venner Road, Sydenham, on March 31st.

Satisfactory reports having been submitted by the Secretary and the Treasurer, the executive of the Society was re-elected *en bloc* with the exception of the President. The new President is Mr. S. C. Tucker (**5 DT**).

The Society has many progressive schemes under consideration, such as the formation of a Beginners' Section, and the opening of an experimental laboratory. All interested are cordially invited to attend the meetings, which take place on Mondays at 8 p.m., or application for membership may be made to the Hon. Sec., M. E. Hampshire, 139, Sydenham Road, S.E.26.

The Honor Oak Park Radio Society.

On Friday, March 28th, Mr. H. J. Camplin, of Dulwich, gave a lecture on the "Ideal Set of an Experimenter." The lecturer varied his talk with some highly humorous remarks. He exhibited a set in an attaché case, with switching arrangements to use up to three valves, or dual or a simple crystal set.

Hon. Sec., J. McVey, 10, Hengrave Road, S.E.23.

Clapham Wireless Society.

The proposed 1,600 metre station of the British Broadcasting Company, formed the basis of a recent discussion by members of the Society. Doubt was expressed regarding the simplicity and cheapness of the alterations required by existing sets to suit the proposed station, but these were dispelled by Mr. F. M. Grethe, who described inexpensive methods of adjusting sets for the new wavelength.

Hon. Sec., M. F. Cooke, 13 Fitzwilliam Road, Clapham, S.W.4.

THE POSSIBILITIES OF TELEVISION

WITH WIRE AND WIRELESS.

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

At the conclusion of the lecture before the Radio Society of Great Britain under the above title and reprinted in our two previous issues, the following discussion took place.

DISCUSSION.

Mr. Ll. B. Atkinson.

I have not been disappointed in expecting and receiving a most interesting discourse from our friend Mr. Campbell Swinton, to whom this subject is no new one. I will touch for a moment on one or two little points of history which may be useful more from the point of view of record than of criticism. I believe, but I may be mistaken, that before that article in "Design and Work" the general principles of a multiple wire transmission system, using selenium cells, were outlined by Ayrton and Perry. That is a matter of looking up dates, but that is my own recollection of the dates. The first published suggestion of an image made up by integrating movements of a single spot of light appeared, as far as I know, in the *English Mechanic* of 1881 or 1882, and was by a man who wrote a letter on the subject, making such a suggestion and illustrating it by a picture—a man with whom I had for some years some rather interesting exchanges of correspondence and experimental work. I may say that—going back an enormous time for me—when I was 18 years of age I was already experimenting with seeing by electricity. I fully realised the immense number of positions required to form any definite sort of image, but I thought that if one could begin with small things one would advance slowly. The forms of lighting, or movement of lighting, which I worked on were threefold. First, I used an apparatus which was more or less like a telephone, but with a chamber in front, through which gas was passing, which caused a flame to move up and down at different heights either opposite the hole or away from it. That was one method of getting alternating degrees of light and dark. The second method, which was quite hopeless, because it needed currents and forces which were inapplicable, was to try what was known as the Kerr effect, where you get movement of the plane of polarisation on the face of a magnet; and the third method was, again coming to a telephonic plate or pair of plates, using a thin colour film, that is to say, Newton's rings, as we term them, and a monochromatic light, in which I got a spot which alternately showed light and then was black. Those were the methods which, when I was 18 years old, I was experimenting with, for receiving. At that time we knew nothing about the Braun cathode ray receiver or any such delicate apparatus. But even at that time the difficulty was not so much in the need for a simple apparatus as in the fact that the selenium cell, which was at that time the only sensitive method of transmission, was so far behind what you could do in the way of receiving that the transmission was far too insensitive and far too slow to produce any effect with the magnitude of current that was required for the purpose. I have at home, thrust away in a box, some of these early models, with which I was experimenting. I distributed my picture and my ultimately received picture—I mean the transmitted picture and the received picture—by simply a series of mirrors which were on a revolving frame, and were inclined at different angles, so that they swept out the whole surface of the picture, by synchronised mirrors, without moving the spots of light at all. That is going back to early history, and I mention it only as illustrating the fact that for about 40 years I have had this matter in my mind, and have read and followed all I can on it. I do not think Mr. Campbell Swinton has laid sufficient stress on the difficulty that occurs when trying to use a line wire at all, or the properties of the line, the distortions and slowing down movement that take place in the line when you are attempting to use the number of changes in a second that have to be considered, and that is why I think, if anything is going to be done, a great opening has occurred; I think I mentioned in the course of my Presidential Address that the great hope lies, to my mind, in wireless transmission, where we, at one step, get over the whole of the difficulties that occur with the line wire. The methods that Mr. Campbell Swinton has mentioned of producing his sensitive note is a matter I have no personal experience of. Whether he thinks that rubidium tubes or plates, with the sodium carriers behind them, will be sufficiently rapid I do not know. He may have some data on the subject which will perhaps be put into the paper, but I cannot form any opinion on that—whether they are sufficiently rapid, whether the changes are sufficiently rapid and defined to give us the result we require. It also appeared to me—but I may not be quite clear on that—that there is a gauze grid behind these rubidium cells, which is all the time receiving some action from all of them, so that if the action of any one of them is not instantaneous, the next cell is getting, not only its own action, but the action from some number of the cells that may be in front of it. My own feeling in regard to development is that there is not sufficient financial inducement to anybody to launch out into it. I do not believe there is sufficient call for seeing by electricity to lead any body or any corporation to lay out the large sum of money which is necessary to complete the

investigation. I believe, if there were really a big financial demand behind it, that we are, as our lecturer has said, within reach of doing what is necessary by perhaps one or two years' research. These are only rambling ideas, because I did not intend to come here to speak to-night. I do feel that we have had a most interesting lecture, and that we owe the lecturer our thanks.

Dr. E. E. Fournier D'Albe.

As Mr. Campbell Swinton has referred briefly to a method I proposed a little time ago, I might perhaps say something as regards synchronism and ways of getting over it. We have seen, in *The Wireless World and Radio Review* a method proposed by Mehaly for synchronising two small oscillating mirrors by means of tuning forks. That is, no doubt, a very formidable proposition, and I do not suppose any of us can now express an opinion as to the practicability of that proposed method. If, as Mr. Campbell Swinton has remarked, we could get rid of synchronism altogether, and yet use wireless transmission, it would, of course, be a very great advantage, and, if you will permit me, I should like to say a few words about the method by which I have proposed to get rid of this, and have, to some extent, succeeded. It is to employ sound waves to carry the light waves, *i.e.*, you assign a frequency to any patch of the picture you wish to transmit, convert that patch into a note, transmit the note by wireless telephony, and make the note produce a corresponding patch in a certain position at the receiving station. That is a matter of no great difficulty. You can, if you have the patch of intermittent light at the transmitting end, easily get the sound, as we all know, by means of selenium, and then transmit that in the ordinary way, either by making it act on a microphone, or direct on to the transmitter. Then, at the receiving end, you must receive this sound and re-convert it into light. That has been, of course, the difficulty, but I think there is a simple way of getting over that. You take a resonator which responds to that particular note. There are quite a number of resonators which can be employed. You can, for instance, have a film of rubber, or any other flexible membrane, at the end of a resonating tube, which takes up that note from the air, and is set into vibration, as Graham Bell did in his original photophone. A rather better method is to have a Helmholtz resonator, with a reed mounted at the mouth, a reed of mica or some such flexible substance, which might be silvered, so that it throws, by reflection, a small patch on a screen. Then, when it receives that note, the patch is drawn out by the vibration of the reed into a line. With that line of light, of course, you can arrange that only the centre is blocked out, so that if there is no sound there will be no light transmitted across whatever obstacle is blocking the centre, whereas if there is a sound there will be some light transmitted on each side of the block, which can be concentrated by a lens into a patch in the proper position. It is a method which can be used so long as you have a certain number of resonators. I have made a few experiments to see how many resonators I could get reasonably at work, and I find that I can use about 30 in each piano octave. The method is capable of great selectivity (I think within 3 per cent., or something like that), so that one can actually have two resonators within a half or a third of a semi-tone of each other, and yet have them respond each to its own note and not the neighbouring note. In that way I have been able to transmit the movement of a luminous object, for instance, a lamp hanging and swinging to and fro, so that I could see it swing at the receiving station; also, a line of light with a shadow passing along it. Imagine a line of lamps and then a thick rod or a hand moving in front of them; such an object can be transmitted in that way. All that is required is a number of intermittent sources of light. This may be a siren disc with a dozen or twenty different concentric series of circles of holes, which give as many frequencies as required, say twenty to the octave. There you have a line of dots, each with its own frequency (twenty different frequencies altogether), and as you pass over this there will be an instantaneous response of the corresponding dots at the receiving end. When I say instantaneous, I mean of the order of one-tenth or one-twentieth of a second. Anyhow, the effect is sufficiently instantaneous that the eye cannot detect any lag at all. You have heard to-night something about the "lag" of selenium. I, for one, deny that there is any lag in selenium. It may, perhaps, be a little unorthodox to say so, but it cannot properly be called a lag. There is, of course, a certain time interval which must elapse between the stimulus given to selenium and the *final* effect obtained in selenium, but that is not properly called a lag at all. A lag would be properly described as an interval between the stimulus and the beginning of the effect of it. There is no more lag of that kind in selenium than there is, for instance, in a quick photographic plate. I do not suppose anybody talks of a lag in an instantaneous photographic plate, and yet it is exactly the same process as in selenium. You illuminate a plate, and the effect, in some respects, is instantaneous. It is a chemical action which begins at once, however slight the light stimulus, I suppose, until you get right down to the quantum, which, of course, is irreducible, but it is that kind of action; the cause acts and the effect is produced to some extent instantaneously, and, as a matter of fact, there is so little lag that, as optophone experiments have shown, you can transmit at least 600 signals per second. If you could not do that, the present rate of reading print with the optophone, of 80 words per minute, would be impossible. That involves actually the transmission and interpretation by the ear of 600 signals per second. With that number you can do something in television, especially as you can send several hundred of those simultaneously. Supposing you could send 30 simultaneous signals with 30 resonators, and could do that even 20 times a second, it would give 600 signals per second right away. With 600 signals per second you could not do much, but you could produce a recognisable likeness. In a little experiment which I did at **2 LO** last year, of transmitting the King's portrait, I only used 600 dots, and all the 250 reproductions sent in from various parts of the country were certainly recognisable. You could not have mistaken His Majesty's portrait for, say, a portrait of the Prince of Wales, or even for the portrait of King Edward. Of course, that would be helped very much if the original were in motion. You can

understand, if a thing is in rapid motion, that a coarse screen or the heavy bars of a window, or an obstacle like that, would not matter very much. What you would lose in one position you would gain in the other. So that there is already quite a good field so far as the resonators are concerned, and I do not suppose you can have more than about 400. I have not made that experiment, but, even if you could not, all these 400 could be transmitted by one selenium cell, and also transmitted over one radio wavelength, so that if you want more than 400—say two or three times that amount—all you would have to do would be simply to use two or three different wavelengths. There, of course, you are up against the powers that assign wavelengths, and which are sometimes a little arbitrary in their action. If such a case arose, it would be a matter for an influential body such as this Society to deal with. I need not say that I came to this lecture with very great expectations of having an authoritative and masterly exposition of the problem, and I was certainly not disappointed. I think it is most desirable that this most promising of all methods of cathode ray transmission described by the lecturer should be tried, and I do hope that something will be done very soon about it. I am one of those unfortunate people who have committed themselves to a somewhat optimistic prophecy of something being done in the way of television within a year. I have not been so rash as to propose to transmit the face of one speaker to a distance for the other to see. That would be very rash, but I should say we are already within easy distance of such a thing, let us say, as a silhouette, a shadow outline, of a speaker. I think that is not at all very difficult, and I should certainly look forward to a final solution of the problem, in principle, perhaps, I hope this year, but, if not, in a few year's time. It seems, therefore, appropriate, when, so to speak, the whole atmosphere, and probably the ether too, is thrilling with anticipation of this impending solution, that the matter has been ventilated in this assembly. I should advise Mr. Atkinson to preserve his relics of 40 years ago very carefully in case they are required for storage and exhibition in one of our national museums when the problem has been solved.

Mr. G. G. Blake.

As persistence of vision is a very important factor in Mr. Campbell Swinton's proposed method of Television, it has occurred to me that I saw an experiment some time ago, by means of which visual persistence was prolonged.

A light was arranged at a certain angle above the eyes. The image of an object remained impressed upon the retina for a very much longer time after the object had been removed, than would have been the case under ordinary conditions.

Whether this idea would be of any use is rather doubtful in the case of moving objects. It might prove a drawback rather than a gain. We might have things moving so fast that the images on our retina blurred one into the other.

However, I thought the suggestion might perhaps be of interest.

Mr. Frank Phillips.

I am afraid I know nothing about this subject. I have been listening to Mr. Campbell Swinton with the greatest of interest, and it has astonished me to hear his exposition of a possible solution by means of cathode rays. I had always imagined that cathode rays produced by low voltages had not the necessary velocity to produce a rapid image, to produce an image of the same intensity as a cathode ray in the old Braun tube, produced at a potential, say, of 100,000 volts. The velocity is so much greater, I believe, that the image is sharper and very much more luminous. If we are going to move the cathode ray, if we are going to deflect it a large number of times per second, with the idea of making a series of dots reproduce themselves so many times a second that persistence of vision gives us a defined image, it will be necessary to consider whether the luminous intensity of the cathode ray when projected from a cathode at a potential of 400 volts would be sufficient. I am sure Mr. Campbell Swinton would not suggest the introduction into the home of the ordinary broadcast listener of potentials of the order of 100 kilovolts.

Mr. Philip R. Coursey.

I do not think there is much I can add usefully to this discussion, beyond thanking Mr. Campbell Swinton for his very interesting account of the methods proposed for television. The method of his own, which he described, utilising cathode rays, appeals to me as an extraordinarily pretty method of obtaining synchronism. Ability to keep those two beams in synchronism by means of two alternating potentials should provide a very simple solution of the synchronisation difficulty, especially if it were combined with wireless transmission, whereby one could obtain those two required frequencies by, for instance, a heterodyne method. If three definite wavelengths were transmitted, so close to each other as to produce audible beats, then the two beat notes would be the same at any receiving station, and should be quite definitely related to the frequencies at the transmission station. Or, of course, two tonic-train wavelengths could be used, with suitable note amplifiers for each audio frequency. With some such scheme it would seem that the double deflection of the cathode rays would give a convenient and easily operated method of obtaining synchronism, and that method certainly appeals to me as being one worthy of further experiment and development. I can only again express my thanks to Mr. Campbell Swinton for his most interesting lecture

Captain Plugge.

I came to this meeting this evening feeling very ignorant on this subject of television, and I feel very much indebted to our lecturer for the very interesting description he has given. I should like to say one or two words on a point brought up by Mr. Atkinson, in reference to the commercial value, or the commercial attraction there would be in putting television on a proper basis. Just as it has become possible at present to listen to functions and debates that take place, so, with television, it will be possible, in our homes, to see events that are taking place either in this

country or abroad. But it seems to me that there is another commercial side of television. We have learned this evening that television can be summarised by the possibility of sending a great number of signals, of the order of 600 per second, that vary either by position or intensity. I believe it has been the aim of the wireless telegraph companies to be able to send as many signals as they can per second, and it seems to me that in this respect television could be used as a means of transmitting from one station a considerable number of messages in a small period of time.

The President.

I think that most of us are feeling that this subject is a very new one, and that we have not had an opportunity of thinking deeply about it. We therefore liked the way in which the lecturer began at the beginning, and told us how the matter had progressed historically. Of course he might have gone further back, because the search for the connection between electricity, light and magnetism began before the time of Faraday, and Faraday himself made considerable discoveries in that region. His heavy glass was used in the discovery of the magnetic rotation of the plane of polarisation and gave the first connection ever discovered between electricity and light. But modern times have brought many other discoveries of connections between electricity and light, and it is possible that we now have reached a stage where there is not likely to be many more phenomena of that kind discovered for some years to come. A time has arrived, in fact, when the inventor can say that such and such phenomena are provided for him. He can write them down on a sheet of paper, and say, "I must accomplish the task of transmitting a picture or a scene by the aid of these specified phenomena." He knows better now what he can command than he did fifteen or twenty years ago. Moreover, the discovery of the electron, and the development of methods of controlling electron streams, has given us levers, one might say, which can be moved rapidly to and fro at speeds enormously greater than material levers or even small mirrors can be moved. These are the principal changes that are fundamentally affecting the situation as it is to-day. Mr. Atkinson pointed out that another fundamental thing is the provision of money. That is, of course, always a trouble, but it occurred to me, while Captain Plugge was speaking, that if people, by means of the machinery that is now about to be invented, could see a play without going to the theatre, the more likely event is that the theatrical managers will put up money to prevent this being developed. (Laughter.) The suggestion by Captain Plugge that transmission of signals at high rates of speed are in view in any invention like this, is a very good one. It makes one ask what would happen if an atmospheric came along while a picture was being transmitted. I suppose a man would be seen for a moment without a nose or without a leg in that event. (Laughter.) The trouble, you see, of the atmospheric discharge haunts this subject just as it has haunted all wireless telegraphy and telephony from the beginning. To work it by line wire is safer, perhaps, from that point of view, than to work it by wireless. What is possible to one is possible to the other. I think that, although this television, when it comes, will add another terror to life, like the telephone, and wireless, and broadcasting, yet these things, although they are unwelcome to some, seem to be welcome to others, and I have no doubt that it will receive a warm reception from all concerned when it does arrive. After all, seeing is believing, it is said, and perhaps we can transmit by this means in the future evidence which would not be credited or accepted as evidence if sent by any of the other means. I think, then, the conclusion is that the whole situation is very hopeful. It is more hopeful at this moment than it has been for many years, and it is very interesting to know that Mr. Campbell Swinton's vision, or dream of years ago, is so very near the path that may have to be followed during the coming months in the solution of this problem. I will ask Mr. Campbell Swinton to reply to the questions that have been raised.

Mr. Campbell Swinton, replying to the discussion, said :—

I am afraid, in reply to Mr. Atkinson, I do not know accurately the date of Messrs. Ayrton & Perry's paper. I have some recollection that they wrote a letter to the *Times* on the subject, and I remember that they invented a method with a row of oscillating selenium cells, in which there were a large number of such cells and a large number of wires. But I think that this suggestion was later than the paper I mentioned in "Design and Work." Mr. Atkinson made some reference as to whether my photo-electric cells would be able to work quickly enough. I have pointed out, and I wish to make it quite clear again, that in the case of my arrangement, each photo-electric cell has only to act about ten times per second. There are a large number of them. It is not the same as in the case of some of the other methods, where one cell has to do the whole of the work. In my case they each take up the work in turn, and each one has only to work once in ten seconds. Even if there is leakage and things of that kind, I think nowadays, with the use of a thermionic amplifier, that if you can get the photo-electric cell to do anything at all, however small, you will always be able to amplify the effect up to get good results. I think the whole aspect of this problem has been very much changed by the invention of the thermionic valve and the possibility of amplification.

I did not personally pursue the subject of Mr. Fournier D'Albe's method, because it is off the line that I was working on, but I would recommend anybody interested in the subject to look up the paper by him in the *Illustrated London News*, of which I have given you the date, because it is really a pretty idea. It is quite a novel idea of getting the position, not by synchronous apparatus, but by alteration of the frequency. The trouble I see is that in using sound, even if you can have three positions to a semi-tone, there are not so many notes in the whole piano scale, and you will not get a very long way towards getting a large number of positions. If Mr. Fournier D'Albe could go a step further and do the whole thing electrically, and not have to revert to sound, then he would be able to employ a very much bigger gamut of wavelengths—almost an infinite number. That is an idea which I present to him.

I have thought of various ways for making use of this last idea myself, but I cannot think of any one that could possibly work. (Laughter.)

With regard to what Mr. Blake said as to the persistence of vision, of course, as I pointed out, you can produce the same result by using for your fluorescent screen a substance which persists a little in its fluorescence. That is quite easily arranged. There is a large range of these substances, and some persist much longer than others.

As to Mr. Phillips' remarks about getting sufficient brilliancy with these comparatively slow cathode rays, I think that is a problem which has been pretty well solved. I do not know whether he has seen the modern cathode ray oscillographs, such as are being used for the delineation of the wave forms of atmospherics. They work with only 300 volts, so that the velocity of the cathode rays is quite small, but they give the most brilliant images. To what extent the images would be bright enough if distributed over a large surface I do not know, but that is a matter of degree, and I should not have thought that we have nearly reached the end of the research that can be done in the way of improving fluorescent screens.

In conclusion I wish to say that I agree entirely with Mr. Atkinson that the real difficulty in regard to this subject is that it is probably scarcely worth anybody's while to pursue it. That is what I have felt all along myself. I think you would have to spend some years in hard work, and then would the result be worth anything financially? If we could only get one of the big research laboratories, like that of the G.E.C. or of the Western Electric Co. —one of those people who have large skilled staffs and any amount of money to engage on the business —I believe they would solve a thing like this in six months and make a reasonable job of it. I do not say it would be perfect, but they could get something worth having in six months quite easily. For the ordinary amateur, however, it is not an easy class of experimental work, and would take a great deal of time, and probably cost a large amount of money. I thank you for having so patiently listened to my paper.

The President.

I will now ask you to accord to the lecturer a very hearty vote of thanks.

The vote of thanks was carried with acclamation.

The President then announced the election of new members and associate members, and the names of the societies affiliated since the last meeting.

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

Sanderstead.

2 AHB, 2 BZ, 2 DX, 2 DY, 2 DZ, 2 FP, 2 FQ, 2 GO, 2 ID, 2 KF, 2 KT, 2 KZ, 2 LP, 2 LT, 2 MF, 2 MK, 2 MS, 2 NM, 2 OD, 2 OM, 2 ON, 2 PX, 2 PJ, 2 SH, 2 SL(c.w.), **2 TI, 2 TX, 2 VJ, 2 VL, 2 VQ, 2 XO, 2 XR, 2 XZ, 5 AC, 5 BV, 5 CP, 5 DB, 5 DT, 5 FL, 5 HL, 5 HW, 5 NN, 5 OX, 5 OY, 5 PU, 5 UO, 5 WK, 6 IM, 6 IV, 6 NH, 6 PJ, 6 PS, 8 AB, 8 DX, 1 MO.** (F. McMurray)

Louvain, Belgium (during February. Saturdays and Sundays).

2 AP, 2 IB, 2 PC, 2 PF, 2 WA, 2 ZT, 5 BA, 5 BN, 5 CO, 5 CV, 5 GX, 5 ID, 5 MO, 5 PU*, 5 QV, 5 RX, 5 RZ, 5 SI, 5 SZ, 6 NF, 6 NH, 6 NI, 8 AZ, 8BP, 8 CC, 8 CG, 8 CJ, 8 CT, 8 DA, 8 DP, 8DU, 8 DY, 8 EL 8 EM 8 JA, 8 OH, 8 OS, 8 OU, 8 OV, 8 PD, 8 SSU, 0 AA, 0 AG, 0 BA, 0 KK 0 NY, 0 PB, 0 XO, 0 XQ, 0 ZN, YBM 7 MX, 4 ZZ, 1 JW, P2, ECZ. * Loud speaker strength.
(A. Stainier.)

Ealing Common, W.5

2 AC, 2 AH, 2 AJ, 2 AM, 2 AU, 2 AX, 2 ABH, 2 ABR, 2 ABZ, 2 ACU, 2 AGT, 2 AIU, 2 AKS, 2 BT, 2 BZ, 2 DY, 2 FG, 2 FZ, 2 GO, 2 ID, 2 IO, 2 JU, 2 KC, 2 KG, 2 KT, 2 KV, 2 KZ, 2 LI, 2 LR, 2 MF, 2 MJ, 2 MK, 2 ML, 2 MO, 2 MS, 2 NM, 2 NP, 2 OC, 2 OM, 2 ON, 2 OS, 2 PX, 2 PY, 2 QD, 2 QQ, 2 QS, 2 SF, 2 SG, 2 SL, 2 SX, 2 SZ, 2 TI, 2 TP, 2 TQ, 2 TX, 2 TY, 2 UC, 2 US, 2 UV, 2 VH, 2 VJ, 2 VW, 2 VY, 2 WD, 2 WJ, 2 XL, 2 XO, 2 XR, 2 XT, 2 XX, 2 XZ, 2 YR, 2 YS, 2 ZO, 2 ZT, 5 AB, 5 AC, 5 AR, 5 AS, 5 BB, 5 BT, 5 BV, 5 CB, 5 CP, 5 DK, 5 DT, 5 FL, 5 FM, 5 FN, 5 FR, 5 GF, 5 GM, 5 GS, 5 HI, 5 HY, 5 IO, 5 JW, 5 KD, 5 KH, 5 KS, 5 LB, 5 LF, 5 LP, 5 MA, 5 MJ, 5 MK, 5 NO, 5 OB, 5 OS, 5 OX, 5 PD, 5 PS, 5 PU, 5 PY, 5 QV, 5 SA, 5 SG, 5 SN, 5 SO, 5 SP, 5 SU, 5 TB, 5 UL, 5 UO, 5 VR, 5 VL, 4 VX, 5 WN, 5 WF, 6 BF, 6 BO, 6 BT, 6 BV, 6 DJ, 6 DW, 6 GT, 6 HD, 6 IM, 6 IV, 6 KI, 6 KM, 6 KO, 6 KV, 6 NH, 6 PD, 6 PF, 6 PS, 6 QA, 6 QB, 6 QL, 6 QV, 6 QX, 6 QZ, 6 RJ, 6 RS, 6 SF, 6 SO, 6 TM, 6 UV, 6 VL, 6 VO, 6 WH, 6 WX, 6 XS, 6 XX, 6 ZH, 6 ZL. German: **4 CVB.** (Three valves, 1—v—1.)
(F. B. Kettle.)

Southampton.

2DC, 2 DX, 2 FK, 2 FL, 2 IL, 2 ON, 2 VI, 5 AW, 5 DO, 5 JJ, 5 SZ, 5 TZ, 6 JW, 6 XX, 8 AS, 8 BP, 8 BV, 8 CM, 8 DTM, 8 DX, 8 EGE, 8 SSU, 8 ZY, 0 KX, 0 MR, G 5 ST. (Flewelling 0—v—0.)
(Wilfred G. Miller.)

Kingston, Surrey (February 10th to March 2nd, on 95-125 metres).

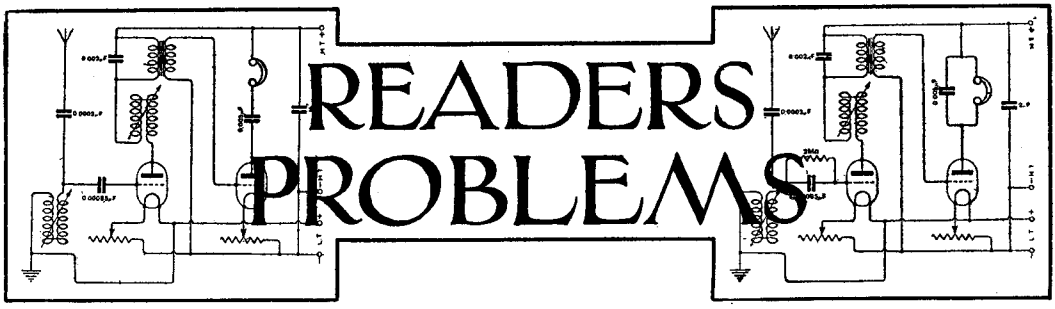
British: **2 KF, 2 NM, 2 OD, 2 FQ, 2 MM, 5 MO, 5 NN, 5 KO, 2 PC, 5 BV, 2 SZ, 2 WJ, 2 WY, 2 KW, 2 CZ, 2 OM, 5 FS.** French: **8 AB, 8 BM, 8 BF, 8 QF, 8 EB, 8 CT.** Dutch **PA 9, PCII, PCTT.** American: **1 BDI, 1 BCF, 1 CMP, 3 XAO, 1 XAR, 3 OT, 3 EH, 1 XM, 1 XAM, 1 XAH, 2 AGB, 8 XBH, 9 XAX, 5 AIC**(?), **1 AJF, 1 AJA, 3 XN, 4 XC, 4 BY, 1 CAK, 3 MB, 1 XJ, 1 XW, 2 AWF, NKF, 1 TT**(?). Canadian: **1 BQ, 9 BL.**
(W. J. Thompson.)

West Norwood, S.E.27.

2 AC, 2 AH, 2 AJ, 2 AN, 2 AO, 2 AP, 2 BO, 2 BZ, 2 CA, 2 CT, 2 DA, 2 DX, 2 FK, 2 FN, 2 FP, 2 FQ, 2 FU, 2 FZ, 2 GG, 2 GO, 2 HF, 2 HS, 2 IB, 2 JF, 2 JU, 2 JX, 2 KA, 2 KG, 2 KT, 2 KW, 2 KY, 2 KZ, 2 LH, 2 LT, 2 LU, 2 LZ, 2 MC, 2 MI, 2 MK, 2 NS, 2 OD, 2 OJ, 2 ON, 2 OS, 2 PB, 2 PC, 2 PX, 2 PY, 2 QQ, 2 QU, 2 RS, 2 SH, 2 SX 2 SZ, 2 TP, 2 UF, 2 US, 2 UV, 2 VQ, 2 VW, 2 VX, 2 VY, 2 WK, 2 XB, 2 XD, 2 XL, 2 XO, 2 XP, 2 XX, 2 XY, 2 YR, 2 YU, 2 ZK, 2 ZT, 2 ZU, 5 AC, 5 AT, 5 AW, 5 BA, 5 BT, 5 CB, 5 CN, 5 CP, 5 CS, 5 CX, 5 DB, 5 DN, 5 DS, 5 FL, 5 FS, 5 GJ, 5 GX, 5 HA, 5 HI, 5 HY, 5 IC, 5 IO, 5 IS, 5 KD, 5 KO, 5 LF, 5 LP, 5 LZ, 5 MA, 5 MO, 5 MQ, 5 OB, 5 OL, 5 OT, 5 PD, 5 PS, 5 PZ, 5 QJ, 5 QV, 5 RW, 5 SI, 5 SU, 5 TE, 5 UC, 5 UL, 5 UR, 5 US, 5 VD, 5 VX, 5 WF, 5 WN, 5 WR, 5 XC, 5 XN, 5 XX, 5 ZJ, 5 AT, 6 BY, 6 CV, 6 DA, 6 DW, 6 EA 6 HS, 6 IM, 6 IY, 6 JX, 6 LJ, 6 NB, 6 NH, 6 NI, 6 OM, 6 OY, 6 PS, 6 QF, 6 QM, 6 QZ, 6 RH, 6 RJ, 6 RM, 6 RY, 6 SO, 6 TM, 6 UD, 6 VP, 6 VR, 6 VT, 6 XG, 6 XQ, 2 AAH, 2 ABR, 2 ACU, 2 ACX, 2 AIU, 2 AJA, 8 AA, 8 AB, 8 AE, 8 AQ, 8 AU, 8 AY, 8 BA, 8 BE, 8 BF, 8 BG, 8 BJ, 8 BM, 8 BP, 8 BU, 8 BV, 8 BX, 8 CC, 8 CF, 8 CJ, 8 CS, 8 CT, 8 CW, 8 CZ, 8 DA, 8 DU, 8 DY, 8 EB, 8 EC 8 EI, 8 EM, 8 EN, 8 ER, 8 ML, 8 OH, 8 QA, 8 SSU, 0 AA, 0 AG, 0 BA, 0 BQ, 0 FL, 0 KX, 0 MX, 0 NY, 0 OM, 0 PB, 0 US, 0 XO, 0 YS, 0 ZZ, 1 JW, P 2, 7 ZM, 7 EC, PCII, PCTT, ACD, XY, GG, UX, YTE. (0—v—1.)
(Alfred D. Gay, **6 NF.**)

Glasgow.

British: **2 AP, 2 CW, 2 FN, 2 HF, 2 JF, 2 KT, 2 KW, 2 KZ, 2 LH, 2 MG, 2 NM, 2 OD, 2 OG, 2 OM, 2 ON, 2 PC, 2 RH, 2 VQ, 2 WA, 2 WD, 2 XR, 2 XY, 2 YQ, 2 YT, 2 ZG, 2 AAB, 5 AW, 5 BA, 5 BV, 5 FD, 5 KO, 5 MO, 5 NW, 5 OL, 5 OT, 5 OW, 5 PU, 5 SI, 5 ST, 5 SZ, 5 TG, 5 US, 5 WM, 5 WV, 5 XH 6 NF, 6 NH, 6 OW, 6 PK, 6 RY, 6 XG, 6 XK.** Danish: **7 EC, 7 QF, 7 ZM.** French: **8 AQ, 8 AU, 8 AZ, 8 BF, 8 BP, 8 BY, 8 CT, 8 CZ, 8 DA, 8 EI, 8 EK, 8 EM, 8 OH, 8 SSU, 8 ZA, 8 ZZ.** Dutch: **0 AG, 0 BA, 0 KX 0 MX, 0 NN, 0 RZ, 0 YU, 0 ZZ, 0 AAD, 0 AAL.** American **1 AUR, 1 CMP, 1 XAM.** Unidentified: **4 UA, 4 ZZ, AGS.** (1—v—0).
(J. G. Ritchie.)



READERS' PROBLEMS

1. All questions are answered through the post. A selection of those of general interest is published. 2. Not more than four questions may be sent in at any one time. 3. Every question should be accompanied by a postal order for 1/-, or 3/6 for four questions, and by a coupon taken from the current issue. 4. A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.

"*E.T.H.*" (*Tunbridge Wells*) **has a dual magnification receiver employing crystal rectification, but finds that best results are obtained when the crystal is disconnected. He asks for the reason and remedy for this trouble.**

It would appear that the first valve of your receiver is operating as a rectifier as well as an amplifier. We therefore recommend that you carefully examine the grid circuit of the first valve, to make sure that the filament end of this circuit is connected to —L.T. It is probable that the insertion of one or two grid cells, giving the grid a small negative bias, would considerably improve matters. It is of course assumed that the crystal detector is functioning properly, and naturally the first thing to do would be to test the detector apart from the dual receiver. Before experimenting with grid cells, make quite sure that the valve is being supplied with the correct anode and filament voltages.

"*J.D.*" (*Preston*) **asks what size of Burndept plug-in coils will be required in the three-valve receiver described on page 399 of the issue of December 27th, 1923, in order to receive the transmissions from the B.B.C. stations.**

We recommend that you try a No. 75 Burndept coil for reaction, an S4 for the tuned circuit, and either an S3 or an S4 for the aerial circuit. The size of the latter coil will depend, of course, upon the constants of your aerial.

"*E.W.*" (*Plymouth*) **wishes to erect an aerial across the roadway, and asks if it will be necessary to obtain permission before doing so.**

We understand that it is necessary to obtain the permission of the Borough Surveyor before an aerial may be erected over the roadway. From your letter it would appear that the aerial would also have to pass over the telephone wires and the overhead system of the tramway. The Postmaster-General requires that aerials erected over telephone or power wires should be protected by means of guards, to the reasonable satisfaction of the authorities concerned.

"*W.N.*" (*Ladybank*) **finds that his L.F. amplifier works better when the transformer secondary winding is disconnected from the filament, and asks why this should be.**

The increase in signal strength when the filament side of the intervalve transformer is disconnected is probably due to the fact that the grid potential of the L.F. valve is not properly adjusted. We recommend that you try connecting small dry cells between the negative L.T. lead and the secondary of the transformer. The batteries should be so connected that a negative voltage is applied to the grid, and the number of cells used should be adjusted until best results are obtained. It is probable that the normal potential of the grid adjusted itself to a suitable value when one side of the secondary was disconnected, owing to the self-capacity of the secondary winding.

"*P.M.G.*" (*Coventry*) **submits samples of tinfoil and waxed paper, and asks for particulars of the size and number of sheets required to give various capacities; also the voltage that the finished condensers will be capable of withstanding.**

The waxed paper has a thickness of 0·0015" and the tinfoil 0·00075". In calculating the capacities of the condensers, it is assumed that the paper has a thickness of 0·002", in order to allow for the fact that air spaces often occur between the sheets of foil and the dielectric. Assuming that the area of overlap of sheets on opposite sides of the condenser is 1½ square inches, the capacities of the condensers required will be as follows:—

Number of Sheets.	*Calculated Capacity.*
2	0·0003 μF.
3	0·0007 μF.
7	0·0020 μF.
13	0·0041 μF.

Condensers built from the above materials would be suitable for use in circuits in which the voltage does not exceed 200 volts.

"*A.B.*" (*Golcar*) **asks if it would be possible to dispense with the grid biassing arrangements in the five-valve Neutrodyne receiver**

described in the issue of December 19th, 1923.

The grid cells and potentiometer resistances may be omitted if the filament voltage and H.T. voltage applied to each valve are carefully adjusted.

"*S.G.J.*" (*London, N.*1) **asks for a diagram showing how to use a key switch with twelve contacts and three positions, to control the number of valves in use in a three-valve receiver consisting of one detector and two L.F. valves.**

The method of using this type of switch is shown in Fig. 1. When the key is in position 1, the plate circuit of the detector valve is connected through the telephones with + H.T., while the filament currents to the remaining valves are switched off. In position 2, the output from the detector valve is passed through the primary winding of transformer Tr. 2, and the filament current of the last valve is also switched on; thus the last valve in the diagram becomes the first L.F. valve. In position 3, the primary winding of Tr. 1 is connected in series with the reaction coil, and the filament current of both L.F. valves is switched on. The last valve now becomes the second L.F. amplifier, and the middle valve the first. The 0·001μF by-pass condenser should be connected between one side of the reaction coil and + H.T., when it will be automatically connected across whichever primary winding happens to be in circuit. The filament current of the first valve may be switched off by means of its filament resistance.

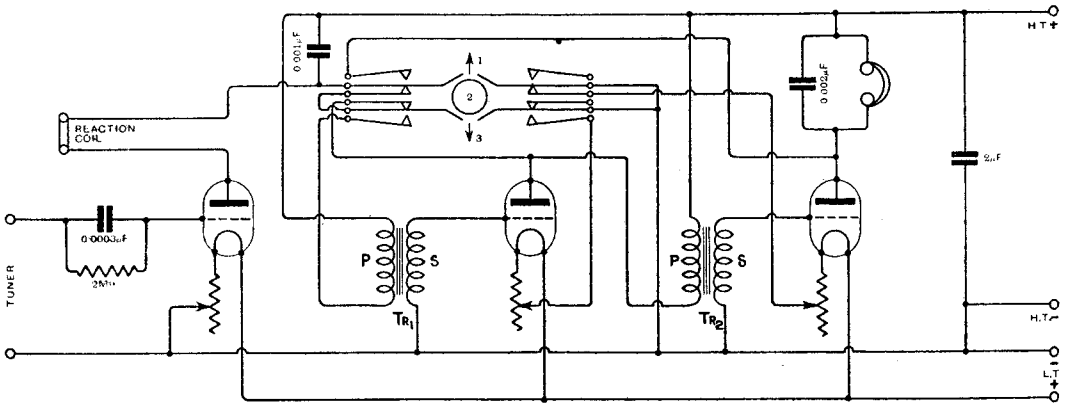


Fig. 1. "*S.G.J.*" (*London, N.*1). *Circuit for detector and two low-frequency valves using a twelve contact 3-way key switch for controlling the number of valves required.*

"*E.G.L.*" (*London, S.W.*12) **submits the circuit diagram of a receiver for criticism.**

The selectivity and efficiency of the aerial circuit would be improved by connecting the 0·001 μF aerial tuning condenser in series instead of in parallel with the aerial tuning inductance. A fixed condenser of 0·001 μF should be connected across the primary winding of the first intervalve transformer, in order to by-pass the high frequency component of the anode current from the detector valve. It is also possible that an improvement in quality will be obtained if a 0·002 μF fixed condenser is connected across the telephone terminals. This condenser is not always necessary, and may be omitted if it is found to make no appreciable difference in the reception. As selectivity is of first importance, we do not recommend the use of slab inductances for tuning purposes. For short wavelengths, single layer cylindrical coils or basket coils will be found very efficient, while if it is required to cover a wide band of wavelengths, we recommend the use of coils of the plug-in type. In order to obtain best results, the tuning coils should be chosen so that the minimum amount of capacity is required to tune the circuit to a given wavelength. In other words, the ratio of inductance to capacity should be kept as large as possible if it is required to obtain maximum efficiency and selectivity.

"*G.A.*" (*Oxford*) **asks if a Weston relay could be used for recording Morse signals.**

This instrument could certainly be used for recording, but the maximum speed at which it will operate will not be very high, owing to the damping which has been purposely introduced into the instrument, in order to render the motion "dead beat." One of the best types of instrument to use for recording is the Siemens polarised relay, in which the damping and the inertia of the moving parts are comparatively small. A simple method of using this type of relay was described in the issue of this journal for October 24th, 1923.

"*R.A.K.*" (*Douglas*) **asks if the stator and rotor windings of a variometer could be used as tuned anode and reaction coils respectively.**

A variometer could certainly be used in this way, but the windings would have to be separated. The number of turns on the stator and rotor should be carefully counted, as it is possible that the inductance of the stator winding taken separately would not be sufficient to tune to the wavelength of the B.B.C. stations. The stator winding of an ideal variometer for this purpose would have 70 turns of No. 26 D.C.C. on a former 3″ in diameter, while the rotor or reaction coil might consist of 50 turns of No. 30 D.C.C. on a former 2½″ in diameter.

The WIRELESS WORLD AND RADIO REVIEW

THE WEMBLEY OPENING.

THE broadcasting of the opening ceremony of the Wembley Exhibition was an event looked forward to with intense interest, not only throughout the British Empire, but, one may safely say, throughout the world.

It marked a pioneer British effort, and one which is likely to lead to still greater broadcasting enterprises in the future.

The success of the transmission exceeded the most sanguine expectations, even of those who were intimately associated with the carrying out of the work.

The British Broadcasting Company must feel justly proud of the achievement, whilst their satisfaction will be shared by member Companies of the B.B.C., whose staff and whose enterprise contributed to the success.

THE NEW TRANSMITTING WAVELENGTH REGULATIONS

Elsewhere in this issue there is published a statement made by the Postmaster-General regarding the regulations which will govern the use of experimental transmitting apparatus and the issue of transmitting licences in the future.

The principle alterations which have been brought into force are (1) the withdrawal of licences for experimental spark transmissions, (2) prohibition of transmission on the amateur 440 metre wavelength during broadcasting, and (3) the granting of an alternative wavelength band for transmission on the shorter wavelengths between 115 and 130 metres.

There is no suggestion on the part of the Postmaster-General that existing licences will be recalled for revision in accordance with the new regulations, and it is therefore presumed that this statement is to be regarded as modifying all existing licences.

The withdrawal of permission to employ spark systems of transmission will not prove a disappointment to the majority, since most experimenters regard spark transmission as somewhat of a back number at the present time. Nevertheless we sincerely hope that where responsible experimenters desire to make use of spark transmitting systems, that the Post Office will not refuse to consider such cases individually, because by refusing to grant any facilities in this direction they would be robbing the individual of freedom to experiment with, and possibly introduce improvements to a system which is by no means obsolete, and in certain cases has advantages over other systems in respect of simplicity.

The withdrawal of permission to use the 440 metre wavelength for transmission during broadcast hours is simply a question of putting on record a regulation which has been voluntarily enforced by amateurs for many months past.

The authorisation of the use of a lower band of wavelengths is distinctly a step in the right direction, and it is a concession which amateurs have been looking for for a considerable time past, though perhaps a good many will feel disappointment because the band does not include other wavelengths on which certain amateurs at the present time are working with special permits. No doubt, however, in this case also the Post Office will be prepared to consider individual applications, particularly when it is remembered that it is the work of the amateur, especially illustrated in recent trans-atlantic short wave successes, which has opened up a new field in short wave transmission.

WHAT IS THE BEST CIRCUIT FOR CRYSTAL RECEPTION?

This is an important article, inasmuch as it draws attention to certain details in the operation of crystal receivers which are so often overlooked. Of particular value in this article is the data compiled from actual tests with various tuning arrangements.

By F. M. COLEBROOK, B.Sc.

FOR headphone reception within a 15 mile radius from a transmission centre the simple crystal detector has nearly everything in its favour. Ease of operation, purity of tone against a background of silence, cheapness, all these can justly be claimed for it, and there is little doubt that there are at present far more crystal sets than valve sets in operation.

A crystal set has, however, one severe limitation, a limitation which constitutes the essential difference between crystal and valve reception.

In the case of the latter, the energy which is emitted as sound from the telephones comes from a local source, *i.e.*, the batteries of the valve set. The function of the electro-motive forces picked up from the ether by whatever form of collector is used, is mainly the control of the supply of energy from these local sources, and, within reasonable limits, this local supply of energy can be made as large as is required for any given purpose. An important consequence of this fact is that there is no need to strive for the maximum possible efficiency of the aerial and other component parts of the outfit since the operation of the set, particularly the judicious use of reaction, can usually be made to compensate for any minor deficiencies in these respects.

In the case of crystal reception, on the other hand, the whole of the energy available for conversion into sound has to be drawn from the ether by means of the aerial, and there is no way of adding to this energy by means of any local supply. This means that with crystal reception every feature of the set must be as right as it can be if the best possible results are to be obtained.

Practical experience, however, would seem to show that no great refinements of design are really necessary. A variety of different arrangements can be tried—variometers, tapped inductances, solenoids with sliding contacts, fixed coils with parallel condenser tuning, etc., etc., and provided reasonable care is exercised in the construction and due attention paid to insulation and other details, there seems to be very little to choose between the results in each case. Are these various arrangements, then, equally satisfactory?

They would certainly appear to be so, but it must be remembered that, as a gauge of comparatively small differences of average intensity, the ear is a very insensitive organ, even when, by means of a change-over switch, the sounds to be compared are heard in the closest possible time proximity. With sounds of moderate intensity 5 per cent. is probably the best accuracy of comparison that can be obtained by ear alone, and this only after considerable practice, and with a time interval of not more than a small fraction of a second between the two sounds. If the time interval between the sounds is appreciable, say, ten or fifteen seconds or more, it is doubtful whether a 50 per cent. change could be detected with any certainty.

It may be urged that since the ear is thus insensitive to small differences of average intensity there is little to be gained by seeking the utmost efficiency. To this several replies can be made.

In the first place it is more than probable that though the ear may not respond immediately to a small change of average intensity, it has nevertheless what may be described as a sort of integral appreciation of it over a more or less extended period of time, that is, it gradually appreciates the fact that more strain, or less as the case may be, is being put upon it. Again, a low efficiency of reception, even though not

immediately detectable, may involve the loss of some of the finer shades of the transmission and consequently a poorer tone quality. Finally there is, at least for most listeners, a definite feeling of satisfaction in the knowledge that the results one has obtained are as good as they can be under existing conditions.

These considerations have led the writer to carry out a few simple experiments with a view to determining what are actually the best conditions of reception with a crystal detector. The measurements are admittedly somewhat crude, but they have produced a very definite result by the application of which he has been able to bring

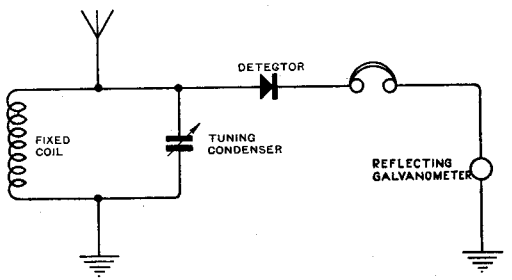


Fig. 1. Measurement of rectified current.

about a considerable improvement in the quality and intensity of his own reception. Since it is more than probable that not one in ten of the crystal sets at present in use are giving the best reception that can be obtained in this way, he is giving the results of these measurements in the hope that they may be of general service.

The method of measurement adopted was very simple, Fig. 1, and consisted of inserting in series with the crystal and telephones of the various arrangements to be tested a sensitive reflecting galvanometer of fairly low resistance (about 100 ohms). The crystal used for the majority of the measurements was a piece of Hertzite with a silver contact. Care of course was taken that this contact was maintained constant for any one series of measurements, and the readings obtained were checked by repetition.

The quantity that is actually measured by the galvanometer is clearly the mean value of the rectified high frequency currents flowing in the telephone circuit. It is assumed that this is a measure of the intensity of the sound emitted by the telephones. A little consideration will show that this assumption is justified.

In the first series of measurements five coils were tried in succession, the arrangement being as shown in Fig. 1. The coils were of exceptionally good quality, having well spaced windings of stranded wire. They were, in fact, the standard double plug type of tuning coil supplied by a well-known firm, though, for the purposes of the experiment some of the coils had been re-wound with a much smaller number of turns than is usual in any of the standard sizes.

Each coil in turn was tuned by means of the parallel condenser to the transmission from **2 LO** (the actual transmission at the time was the symphony concert of January 14th), and the galvanometer deflection in each case was noted, together with the magnitude of the parallel capacity required for tuning. Judged by ear alone, the coils all gave very good reception, and there was very little difference between them. The actual galvanometer deflections obtained, however, tell a very different story. They are shown on curve 1 of Fig. 2. Each point on the curve corresponds to one of the coils, and the tuning capacity of the coil is shown on the bottom or abscissa scale.

The conclusion to be drawn from the shape of the curve is obvious. The smaller

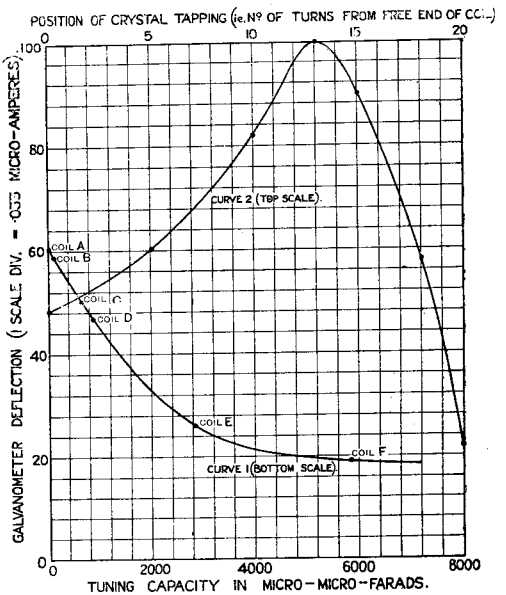


Fig. 2. Current curves obtained with various coils.

the tuning capacity across the coil the more efficient will be the reception, and the best result of all will be given by the coil which requires no parallel tuning capacity at all. (It should be mentioned that two other coils, requiring a series condenser to tune them, were also tried. In each case the galvanometer deflection was less than that given by coil B.)

It might be imagined from the above that a variometer of any of the usual types would satisfy the condition for maximum efficiency, since they tune by inductance only and require no external capacity. Two such variometers were tried, one with concentric spherical windings and one with a ball rotor and a cylindrical stator. They gave galvanometer deflections of 45 and 54 respectively, and are thus proved to be slightly inferior to the best of the parallel-condenser tuned coils of the first series of measurements.

The reason for this comparative inefficiency is not far to seek. It lies in the self capacities of the two windings and the capacity between them. These self capacities play a far larger part in variometer tuning than is generally realised. More especially is this the case when, in order to obtain as wide a range of variation as possible, the windings are very closely coupled, as in the concentric sphere type. Variometer tuning could probably be made quite satisfactory, but only by using a type of construction which permitted the wide spacing of the windings in order to minimise self capacity. Variometers of the type usually met with cannot therefore be regarded as the most efficient method of tuning, though their simplicity and compactness are undoubtedly advantages from a practical point of view.

Curve 2 of Fig. 2 illustrates the behaviour of a coil of special construction which was made the subject of the final series of measurements. It consisted of a solenoid of 22 turns of bare No. 20 copper wire wound on a hexagonal frame formed by six grooved ebonite bars equally distributed round the circumference of two circular end plates of about 12 ins. diameter made of three-ply wood. The wire was held in the grooves of the upright ebonite supports, there being a distance of about 3/16ths of an in. between successive turns. The coil was provided with a terminal going to one end of the winding, and two wandering clips by means of which contact could be made with any two other points on the winding. The coil was connected to the aerial and earth as shown in Fig. 3, tuning being effected by means of the wandering clip in the usual way.

First, for comparison with the series of fixed coils the crystal contact to the coil was made at the same point as the aerial contact, by means of the second wandering clip. This point was found to be about four turns down from the top of the coil. The galvanometer deflection obtained is shown by the point marked A in Fig. 2, and is seen to be slightly larger than that given by the best of the fixed coils.

The next experiment was to see whether any increase of deflection could be obtained by varying the position of the crystal tapping point. The results of these measurements are shown by curve 2 of Fig. 2. The scale on the top of the diagram shows the number of turns from the top of the coil at which contact was made and the corresponding height of the curve gives the galvanometer deflection. The aerial tapping point was kept constant throughout, as it was found

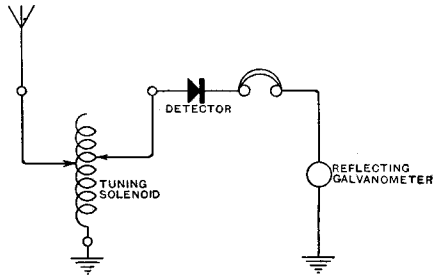


Fig. 3. Variable tapping for crystal detector to regulate the energy taken from the oscillating circuit.

that the tuning was not appreciably affected by the position of the crystal tapping point. It is seen that the crystal contact has a sort of tuning curve on its own, and that the choice of the right position may make a difference of between 60 and 70 per cent. in the intensity.

This result is, of course, neither new nor surprising, though it is probably not very generally known. If the crystal and telephones be regarded as a load and the aerial as a source of energy it will be in accordance with a very general law that the most efficient combination of the two is that

in which the total available energy is equally divided between the resistance and other losses in the aerial and the useful work and associated losses in the load. The crystal tapping point which gives the nearest approximation to this condition can only be found by trial. It will, of course, vary with the effective resistance of the crystal and telephone circuit, and with the resistance or other losses in the aerial. This is shown in Fig. 4, which gives two curves similar to that of Fig. 2, the first corresponding to a better point on the crystal, and the second to a different type of crystal (zincite-bornite combination). In general, however, it is clear that the best tapping point will not be where it is usually found in crystal sets of ordinary types, *i.e.*, across the whole of the tuning inductance.

It may reasonably be concluded from the foregoing that the very best type of crystal receiving circuit consists of a bare wire solenoid of low resistance (No. 18 or 20 wire), wound with well-spaced turns (the distance between turns being at least two diameters of the wire), and preferably supported on a frame of insulating material rather than on a cylindrical former (which might introduce dielectric losses). The coil should not have many more turns than are required for the tuning of the aerial, to prevent any "dead-end" effect, and should be provided with two variable contacts

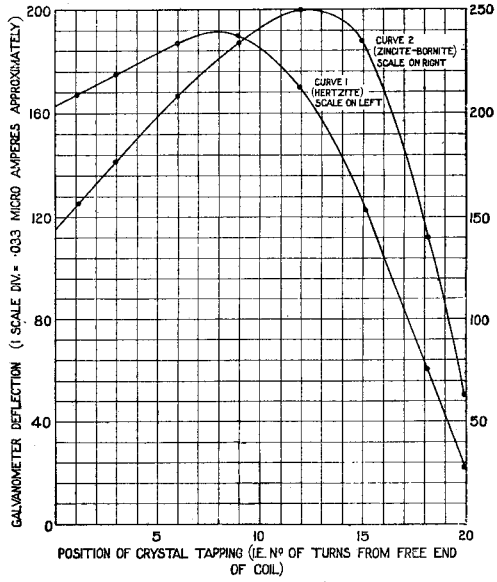


Fig. 4. Curves showing the relation between signal strength and energy taken from the oscillating circuit as regulated by the position of the tapping point.

of some sort, one for the aerial and one for the crystal. Such an arrangement can hardly be made very compact in construction, but this is a comparatively unimportant defect in view of the increased efficiency given by a receiving coil of this type.

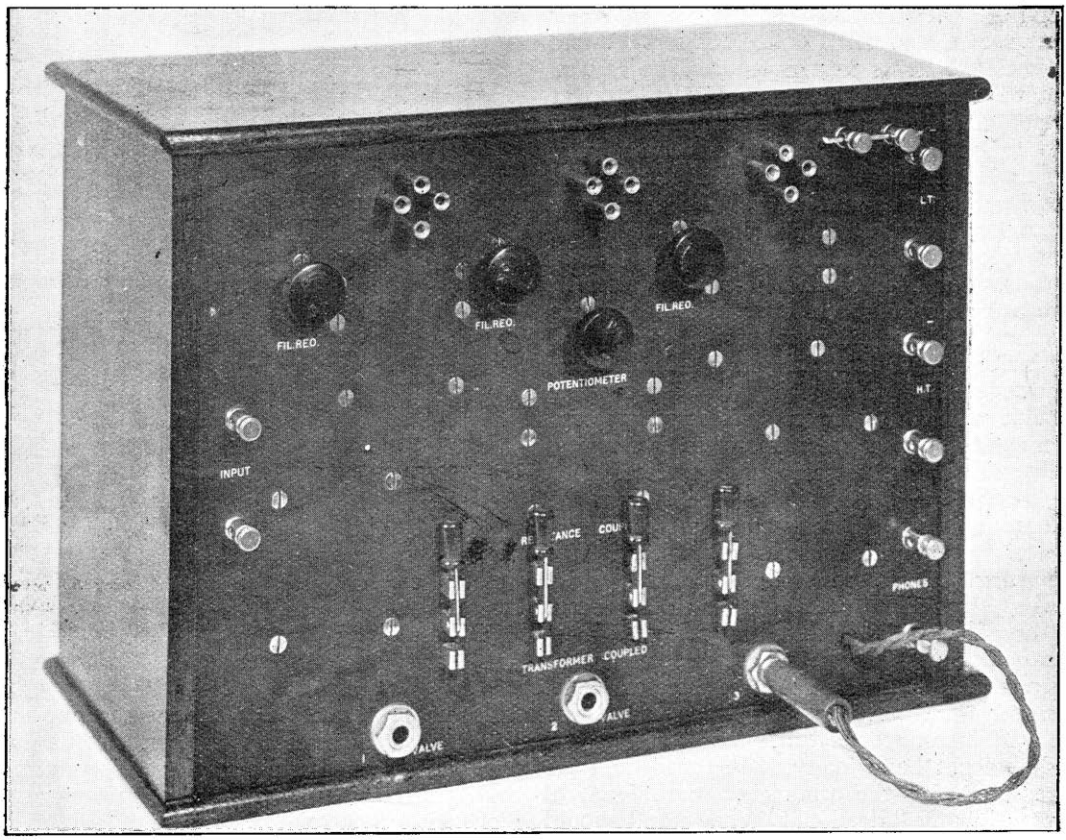
EXPERIMENTAL TRANSMITTING LICENCES.

POSTMASTER-GENERAL'S IMPORTANT DECISION.

The Postmaster-General has recently been considering, in consultation with the various interests concerned, the question of revising the conditions applicable to experimental sending licences, with the view of reducing as far as possible the risk of interference by amateur stations with the reception of broadcast programmes, while, at the same time, affording liberal facilities for *bona fide* experimental work.

The conclusion has been reached that there is now little need for experimental work in spark transmission, and it has been decided that no licences for such work should in future be granted. Existing permits will be amended as soon as possible. It has for some time past been the practice, when granting new sending licences, to prohibit the use of the 440 metres wave during the main broadcasting hours, and it has been decided to apply this restriction to all licensees.

As a set-off against these restrictions, authority will be granted for the use of wavelengths between 115 and 130 metres (C.W. and telephony only) in cases where the Postmaster-General is satisfied that *bona fide* research work is carried on and that the circumstances justify the concession.



The completed instrument.

A TWO-CIRCUIT LOW FREQUENCY AMPLIFIER.

Provision is made in this instrument for interchanging the transformer and resistance methods of low frequency intervalve coupl ng. By means of break jacks the number of amplifying valves in circuit can be varied.

By R. H. COOK.

THE aim in the design of this amplifier has been to keep distortion to an absolute minimum, and in consequence provision has been made to remove from circuit the iron core intervalve transformers and substitute resistance coupling when the original signal strength is sufficiently good to allow of this. Distortion in telephony can, for all intents and purposes, be overcome by using the resistance method of low frequency amplification, whilst it is useful to have the transformer system available for amplifying morse signals. Although the resistance method of low frequency coupling does not produce quite the same degree of amplification as the transformer method, there is certainly considerable gain in quality when amplifying speech and music, which is rendered practically free from distortion. These considerations led the writer to design an amplifier in which both the transformer

and the resistance arrangements could be made use of as required.

The two circuits to be used are shown in Figs. 1 and 2, the former being the well-known transformer arrangement and the latter a typical low frequency resistance-

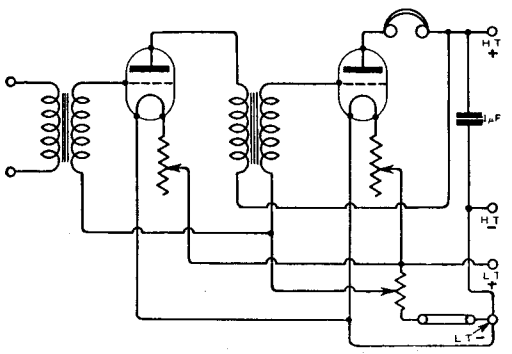


Fig. 1. The transformer-coupled circuit.

coupled set. It will be seen that a potentiometer is fitted in the grid circuits so that suitable adjustment of grid potential may

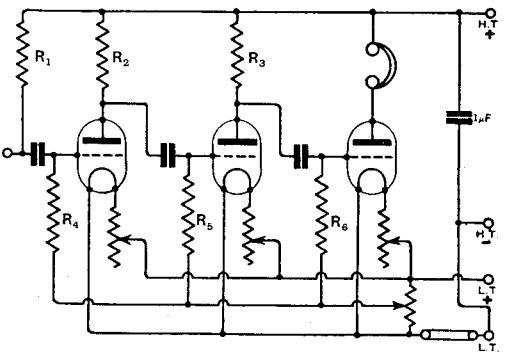


Fig. 2. The resistance-coupled L.F. circuit which is substituted by means of switches.

be made, and particularly is this desirable when changing from one circuit arrangement to the other. The theory underlying these circuits has been very completely dealt with in the pages of this journal, and it is only proposed in this article to deal with certain practical details concerning construction. It might be mentioned, however, that the higher the value of the resistances

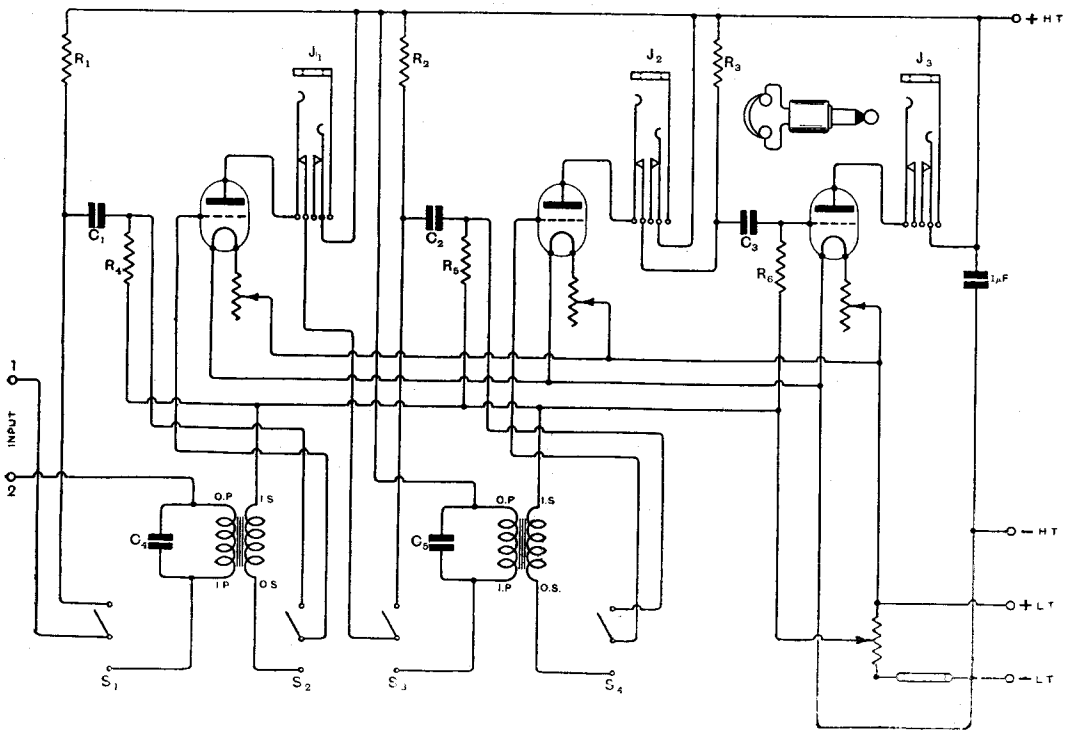


Fig. 3. Circuit diagram of the amplifier.

connected in the plate circuit of the resistance amplifier, the greater will be the drop across them, though of course their value should not exceed the internal impedance of the valve. As these resistances are in series with the H.T. battery the more one increases their value the higher will be the anode battery voltage required. Using resistances having a value of 70,000 ohms it was found that a fairly high amplification could be obtained without employing an unreasonable size of H.T. battery. If resistances having a value of 100,000 ohms are employed, greater amplification may be obtained, but of course, one must make use of an additional potential from the H.T. battery.

For the purpose of switching the valves in and out of circuit as required, and also for interchanging the two systems of low frequency amplification the circuit shown in Fig. 3 was decided upon, and it will be seen to consist of the necessary amplifying apparatus with the addition of four single-pole two-position switches and three break-jacks. Filament switching has not been introduced into the circuit as most filament resistances are now made with an off-position, and it is only necessary to turn off the filament resistances of the valves not in use.

The plate circuit of the detector valve set which precedes this amplifier is connected in at the terminals 1 and 2, and it will be noticed that the high value H.T. which is supplied to the amplifier is not fed to the detector valve. When resistance amplification is made use of, however, it is necessary to feed the higher H.T. to the detector valve to make up for the voltage drop through the resistance R_1, and an examination of the circuit will show that provision has been made for this. In order to complete the circuit it will be necessary to link across the L.T. minus terminals of the batteries used for filament heating on both the detector valve set and the L.F. amplifier. A circuit difficulty presents itself when amplifying

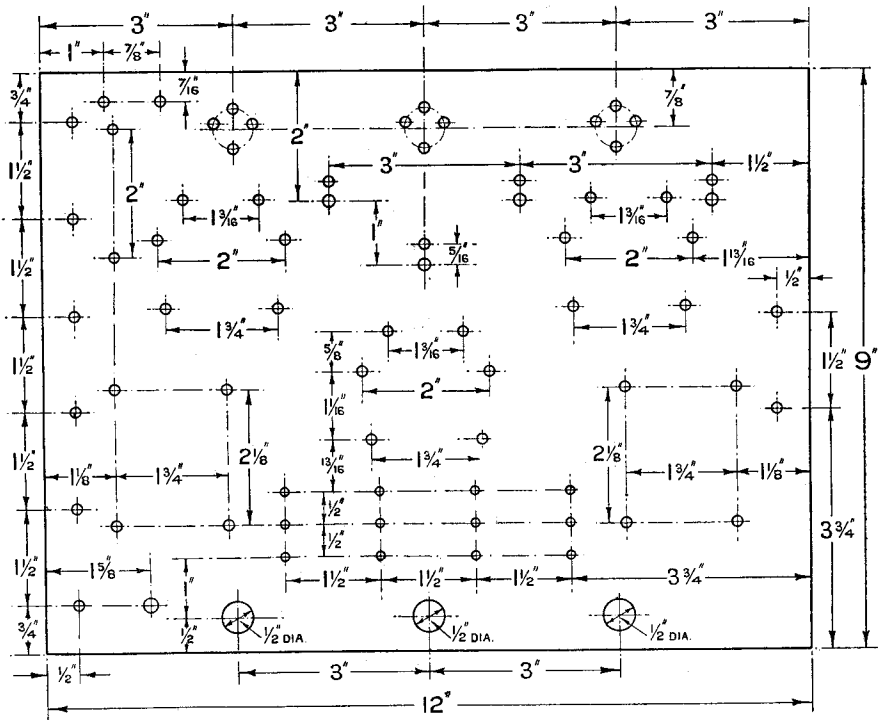
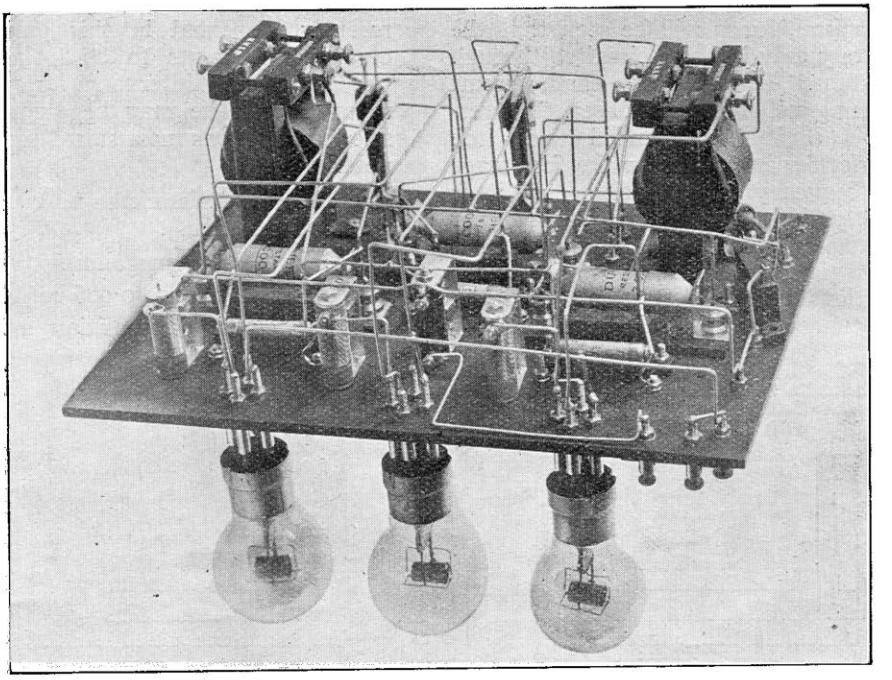
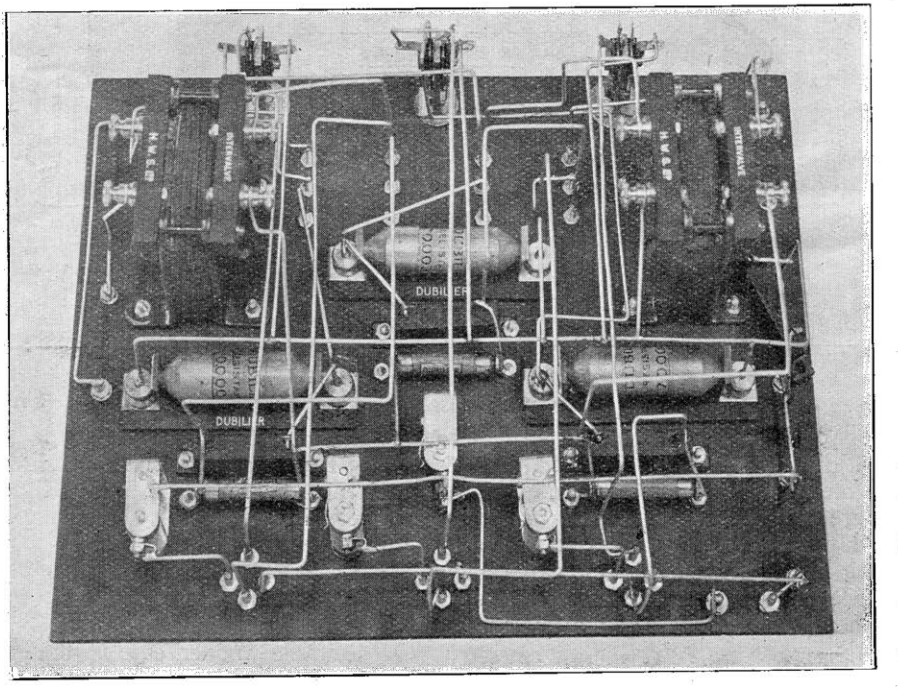


Fig. 4. Details for drilling the panel (scale ⅛ full size). The dimensions relate to the particular types of components shown in the accompanying photographs.



View showing the apparatus mounted on the underside of the panel.



Another underside view showing in more detail the arrangement of the components.

from a crystal, for it will be seen that the H.T. battery may be short circuited through the resistance R_1 and the earth circuit of the tuning coil of the crystal set. To overcome this it is recommended to switch the transformer in circuit for the first stage of low frequency amplification. If it is particularly desirable to avoid transformer coupling entirely when amplifying from a crystal, it is only necessary to introduce an additional switch so that resistance R_1 is disconnected from the H.T. positive

recently appeared in this journal concerning the points to be looked for in the design of intervalve transformers, in order that he may be guided in the selection of types most suited for the purpose.

3 Anode resistances and mounting clips (70,000 ohms).

3 Grid leaks (1 megohm).

3 Grid condensers (0·006 mfds.).

4 Single-pole two-position switches.

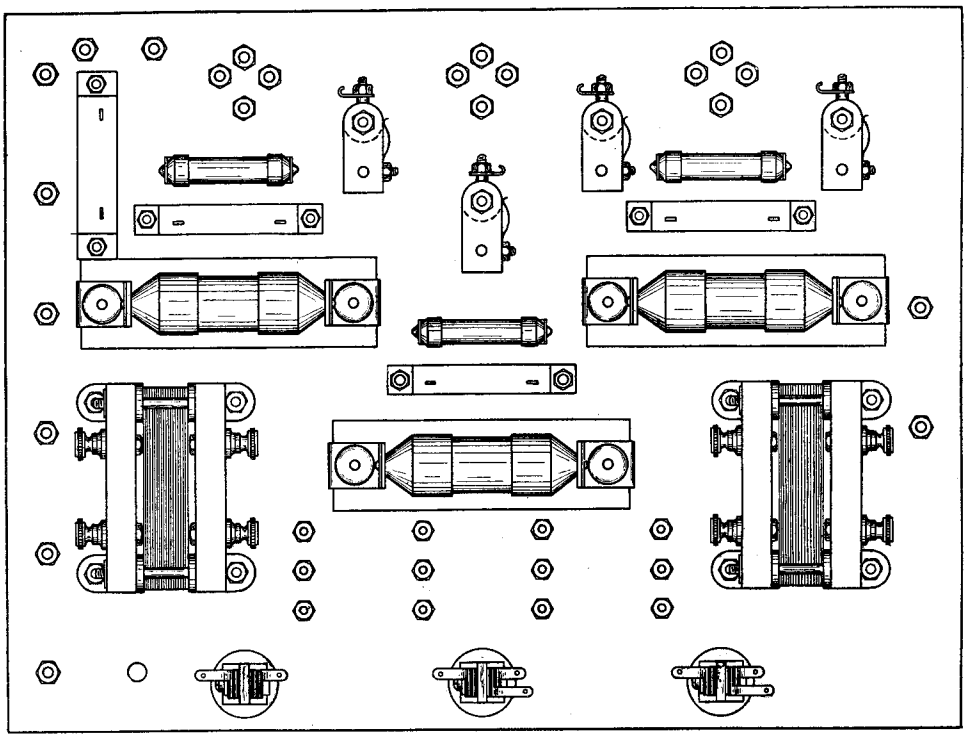


Fig. 5. The arrangement of the components

lead and joined to the input terminal No. 2. By this means the signals delivered by the crystal are fed to the resistance R_1 producing a potential drop across it which is passed on to the grid of the first valve.

To build an amplifier similar to the one shown here, the following materials are required :—

An ebonite panel, 12 × 9 × ¼ in.

2 Low frequency transformers. The reader is referred to the article which

3 Break-jacks of the type shown in the circuit diagram Fig. 3, and a suitable two-point plug.

10 Terminals.

12 Valve legs.

3 Filament resistances.

A potentiometer.

Suitable wooden case to take the panel 9″ × 12″ and 6″ in depth.

Some No. 16 tinned copper wire.

Various nuts and screws.

The first step in making up this amplifier is to square up the ebonite panel and suitably matt both surfaces by rubbing down with medium carborundum cloth.

Fig. 4 shows the exact setting out and size for all the holes for mounting the components. The measurements shown are of course for the particular type of components shown in the photographs, and it is quite a simple matter to make the necessary stretching, is shown in Fig. 6, and by carefully following this diagram, connecting up should not be a very difficult task.

It is important that all joints should be thoroughly cleaned, and brass parts tinned prior to attempting to connect the wire. Soft solder only should be used.

In the left-hand corner of Fig. 5 it will be noticed that two additional terminals have been fitted. These are normally

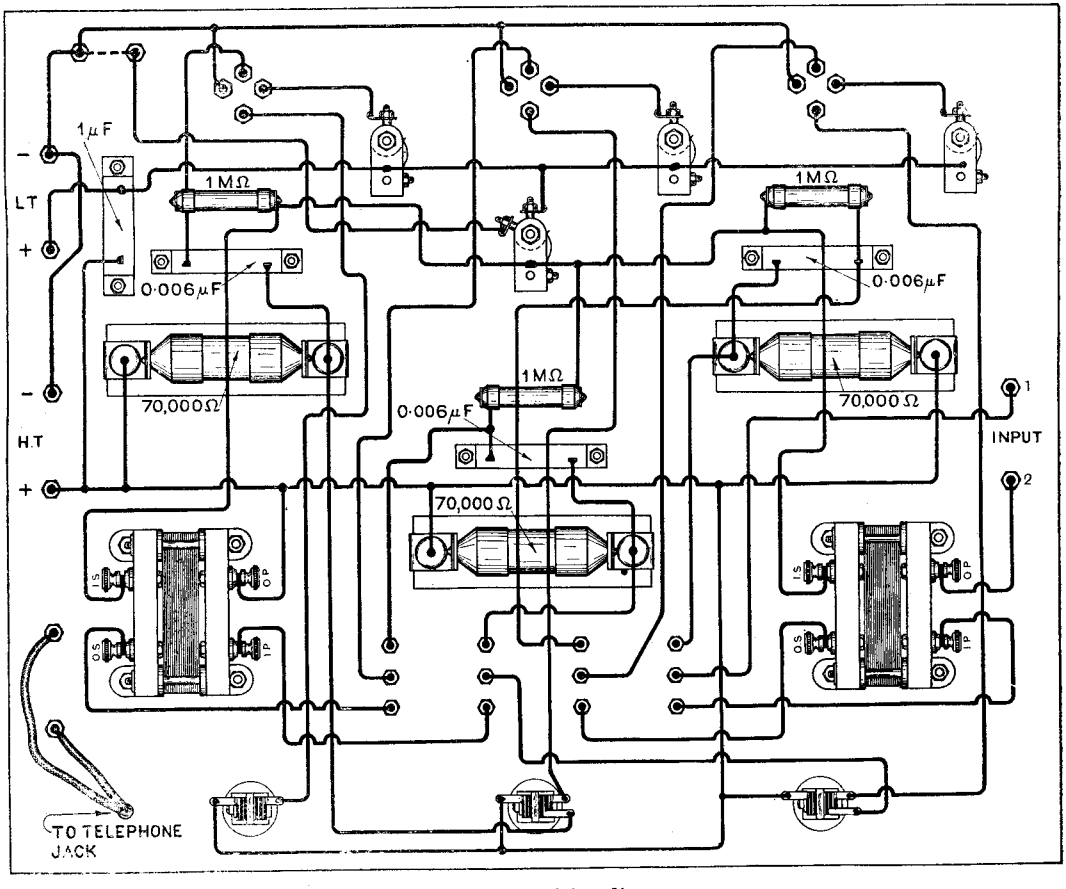


Fig. 6. Practical wiring diagram.

changes to substitute apparatus of other manufacture. If care is taken in the setting out and drilling of the holes, no difficulty should be experienced in attaching the components to the panel, and Fig. 5 shows the back view of the panel with the various component apparatus attached.

The wiring up, which is carried out with No. 16 wire previously straightened by strapped across, but if extra negative grid bias is required, a suitable number of cells may be introduced between these terminals. A schematic diagram of this arrangement is shown in Fig. 7.

The amplifier described here was found on actual test to be quite straightforward in its operation. The resistance capacity coupling gave perfect and ample amplifica-

tion using a 100-volt high tension battery and three valves in circuit. The volume of sound was perhaps slightly less than was given by the two transformer coupled valves, but the results were distortionless.

When very loud reproduction is required and it is felt that some sacrifice in quality is not of great importance, then the transformer coupled circuits may be utilised and by this convenient method of switching one will readily appreciate the merits of the two systems.

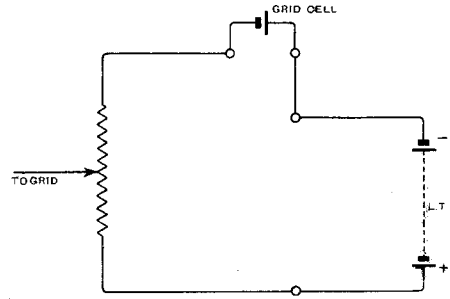


Fig. 7. The method of introducing grid bias.

FINE WIRE COILS.

Considerable controversy exists on the question of the correct gauge of wire and insulating covering that should be employed for tuning coil construction in valve receiving apparatus. The merits of fine wire inductance coils are here carefully discussed, and the author presents some theories, particularly with regard to self capacity and resistance, in their relationship to damping.

By J. H. REEVES, M.A., M.B.E.

OVER two years ago I was experimenting with single layer well-spaced fine wire coils, and the results were communicated in a paper read before the Radio Society of Great Britain in May, 1922. The views then expressed did not command general acceptance and I found that my continued advocacy of this class of coil was regarded more or less as an eccentricity, so I gave over talking about them but continued to use them.

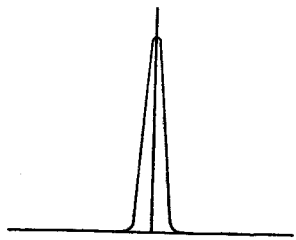


Fig. 1.

Late last year a paper was read before the Society on "Distortion,"* and although by that time I was firmly convinced that improvement in clearness of reception could be obtained by special coils, I took no part in the discussion because I could see no reasonable theoretical explanation. In his concluding remarks Dr. Eccles gave the desired clue, and pointed out that the types of resonance curve for the reception of C.W. and of music are fundamentally different. If we could obtain a coil free of all resistance and distributed capacity we would have the ideal for C.W., but unfortunately this would be useless for telephony as we could only get the carrier wave.

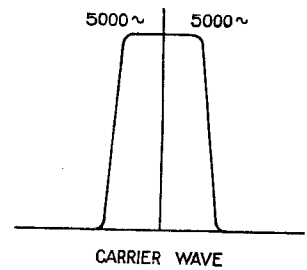


Fig. 2.

In Fig. 1 is shown highly critical tuning at the one wave with the result that all waves differing even very slightly from this would not be heard. In Fig. 2

*Distortion in Radio Telephony by H. A. Thomas, M.Sc., *Wireless World and Radio Review*, October 24th, 1923.

we would find equal strength reception over a band covered by 5,000 cycles either side of the carrier wave periodicity, this being generally considered as sufficient, although in theory this band should be to the highest note frequency used in music.

With regard to Fig. 2, let us consider figures. A wavelength of 400 metres corresponds with 750,000 cycles. A band of 5,000 cycles either side of this is equivalent to a variation of 1 in 150, or under 3 metres, or allowing a range of 10,000 cycles, a variation of under 6 metres. With such a resonance curve a number of close stations could be established, with their wavelengths less than 15 metres apart, each giving perfect definition in its own music, and each capable of being completely tuned out from the other.

However, we cannot get either ideal, and the ordinary everyday coil gives a curve of approximate shape as in Fig. 3, which is not to scale.

The effect of increased resistance, or of distributed capacity, or of both, is to alter the shape of this curve more and more as in *a*, *b*, and *c* of Fig. 4, that is to say the tuning broadens, and the strength falls off.

It will be seen that the summit of these curves more and more approaches the ideal of Fig. 2, so one might reasonably expect to find an increasing clearness of reception with a marked falling away in strength. My problem was to find out how far quality could be bought at the cost of efficiency and which of the coil

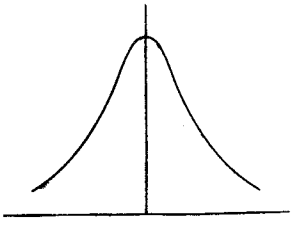


Fig. 3.

constants should be altered. To anticipate matters a little I will state my conclusion is that provided a set is not working too near the lower comfortable limit of audibility there is advantage in increasing resistance, but distributed capacity must be maintained at the absolute minimum possible.

The problem then was to wind coils of higher resistance but with no increase of capacity. The first obvious method

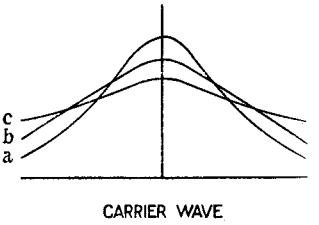


Fig. 4.

was to use resistance wire of the same gauge. I tried this method, but found decrease of signal strength excessive in the one coil I wound. The alternative is to use fine copper wire. The thickness of the coverings of all commercial wires varies roughly as their diameters, so that if coils are wound with turns touching, decreasing the diameter means increasing the capacity. Hence some means must be found to hold the turns mechanically apart, of such a nature that coils could be wound of as nearly as possible the same dimensions.

For coils covering the broadcasting band and under, the simple single layer cylindrical form does not land us into unwieldy dimensions, and as I possess a screw cutting lathe, I determined to wind a series of all the same diameter, all to the same pitch, of ever-increasing fineness of wire. I measured the largest size Burndept concert coil, S.4, as 3 ins. diameter, just under 1½ ins. overall width, and chose this as the starting point; 40 turns, spaced 1/32 in. covered 1¼ in., leaving a comfortable margin, and so a coil of these dimensions was wound of No. 32 S.W.G. on cardboard. This was tested in the tuned anode circuit, and found to cover from a little under 190 up to 420 metres, the then wavelength of **5 IT**, the longest of the B.B.C. stations. This was good enough for a start, and a complete set was wound with Nos. 28, 32, 36, 40, 44 and 47 S.W.G.

At my own station there was no doubt that each successive step in fineness gave

increased clearness in the reception of **2 LO**, and this persists even if reaction on the anode coil is pressed almost to the oscillating point, while I am so close that a falling off in strength is immaterial unless it means using two instead of one L.F. valve.

About this time I decided to make another set more suitable for B.B.C. work. As I had some I used cardboard tubing 4¼ in. diameter and decided on trying one of 50 turns of No. 32. In order to keep within the limit of 1½ ins., this necessitated winding with a pitch of 1/40 in., which was done. With this, Cardiff, then 350 metres, came in with about 12 degs. of condenser, Birmingham (**5IT**) 40 degs., ships 120 degs., and the maximum was about 730 metres. Another complete set was wound, but these so far as definition goes simply confirmed the former. I will refer to volume later. These results have been also confirmed by demonstrations before the Maidenhead and Golders Green Radio Societies. I then wound one on the same sized tube with No. 42, but spaced 1/32 in. and compared it with the No. 42 spaced 1/40 in. There was no perceptible difference in quality. I also noted that beyond No. 40 there was little improvement in definition, but diminution of volume began to be serious. So I looked on No. 40 spaced 1/40 in. as about the limit. Now every amateur does not possess a screw-cutting lathe, so I enquired for a copper wire about this size with extra thick covering, and found that the London Electric Wire Company, Ltd., make as a standard article a No. 38 S.W.G. quadruple cotton covered. This is used, I believe, in X-ray work. The wire winds 40 to 42 turns to the inch, turns touching, and for cases where the receiving station is reasonably close to a B.B.C. station I think this a very happy compromise for use in an anode, a reactance and possibly in the closed circuit of a coupled tuner. I have not tried it in basket coils, but cannot see why it should not be equally useful there. It winds excellent tuned transformers for short wave work.

As already stated, with the 50-turn coil Cardiff came in with 12 degs. of condenser to spare. My next effort was to see how far I could increase the turns while yet getting the shortest waved B.B.C. station. The panel is arranged so that one of the tuning condenser leads can be opened. When this was done the coil would tune down to 295 metres. (Incidentally this shows the enormous effect of the zero condenser capacity.)

A billi type of condenser was therefore added and is kept permanently across the anode coil. This tunes in between panel zero capacity and condenser o deg. capacity. Under these circumstances the turns could be raised to 60 or 65 with a little to spare on the billi and with increased efficiency.

So far I have referred almost entirely to improved definition. It is now desirable to consider diminution of volume. As a preliminary I protest against the fetish of "hearing with telephones on the table," and against the awful din too often associated with "hearing Aberdeen all over the house." There is such a thing as mere empty magnification just as there is in astronomy and microscopy. Often one can *read*—and by this I mean word perfect—a station such as, say, Birmingham, through the mush and spark jamming more clearly on quite weak strength than if a L.F. valve is used.

How far does diminishing the diameters of wires used in a series of coils all wound to the same diameter and pitch, decrease volume, or in other words increase the damping co-efficients? The differential equation giving the effect of imposing an applied periodic E.M.F. on to a circuit containing resistance, inductance and capacity is comparatively straightforward, and the solution appears in a number of text books, but in none of these have I been able to find a damping co-efficient, one of whose parameters is the distance between turns of the induction coil. There is a case, however, where the inductance is very small but the distributed capacity very large. I mean the case of the submarine cable. The equation here takes altogether a different form, and was first put forward by the late Lord Kelvin in the early days of submarine telegraphy. Here the distributed capacity causes a very appreciable time lag in the case of a directly applied steady E.M.F., and an enormous damping effect in the case of a periodic E.M.F. even of audio frequency. The two cases, the cable and a coil with capacity, are not exactly analogous, but my experience seems to indicate that the damping effect of capacity in coils, which I have presumed to call the Kelvin damping

effect, is of much greater magnitude than any amateur conceives, and that to reduce this by, say, 20 per cent. would be of much more use than the harm done by raising in like amount the ohmic resistance.

With a view of considering the possible effect of increasing resistance and simultaneously reducing distributed capacity, I will take that very popular cylindrical coil, viz., one wound with No. 22 copper, D.C.C., turns touching, and of which the covering (enamel) is, I believe, about 10 per cent. of the radius. Hence, if I take thickness of covering as 1 unit, the radius will be 10 and the centres 22 apart. Fig. 5 represents the cross section of such a coil.

The ohmic resistance is proportional inversely to the square of the radii, and although not mathematically correct the

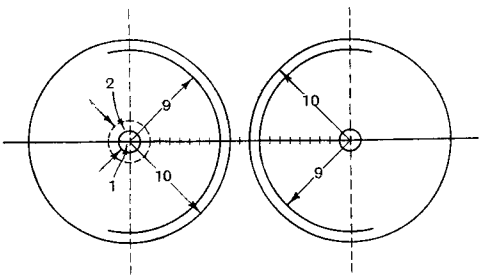


Fig. 5.

capacity may be regarded as that of a condenser whose plate area is proportional to the diameter and inversely as the closest distance between the metal. What happens if the radius 10 is reduced to 9 ? The ohmic resistance increases as $\frac{10^2}{9^2}$ or about 25 per cent. On the other hand the pseudo-plate area is reduced as $\frac{9}{10}$ and the distance between plates doubled, *i.e.*, on our assumption as to capacity this is less than one half. Assuming then equal weights for resistance and capacity as affecting damping co-efficient, efficiency is increased.

Next consider the other extreme when the radii are 2 and 1 respectively, the pitch remaining the same at 22 units. The resistance of the radius 1 wire is four times that of radius 2, *i.e.*, has risen 400 per cent. instead of 25 per cent.

As regards capacity the pseudo-plate area is reduced 2 to 1, and the distance apart increased as 20:18. Hence again the reduction of capacity is just over 50 per cent., and on the same assumption of equal weight efficiency falls off.

Hence at first efficiency rises, at the end it falls. Somewhere between these two extremes there is a point of maximum efficiency, and my very rough estimate for this at the pitch mentioned, 25 to 1 in., may be in the neighbourhood of No. 32 S.W.G.

This theory further offers an explanation to the facts already mentioned as regards gain in definition as compared with corresponding loss of efficiency. The damping effect of capacity goes up with the frequency, but that of resistance is constant for all frequencies. That is if capacity is appreciable the high notes in music will be more highly damped than the lower. We have seen that at the start of the series capacity is large, but falls off more rapidly than resistance rises ; hence we can expect relatively great gain in definition and small loss in efficiency. Towards the end of the series capacity is minute, and its changes unimportant ; resistance is large and its changes are great. Thus we should expect little gain in definition, great loss in efficiency, which two deductions are exactly in accord with observation.

Every aerial possesses resistance and distributed capacity. This latter is even more like that of a cable than is the self-capacity of a coil. In a well-designed closed circuit secondary or in an anode circuit there should be none of either except in the coil itself (valve capacity is *not* distributed, but a lumped capacity in shunt). With this type of coil one can only reduce capacity at the expense of resistance, hence it is only reasonable to expect that this can be pressed to a greater extent in an anode than in an aerial circuit. In the anode circuit these properties of the coil only are concerned, therefore it is possible to come to a fairly close approximation to the best form, but it is not so with an A.T.I.,for aerial constants, even of those strictly to a G.P.O. standard of 100 feet, vary considerably, and a coil which might suit one might not suit another, hence I shall make no attempt to dogmatise as to a suitable gauge and spacing for an A.T.I. In the ordinary double and triple

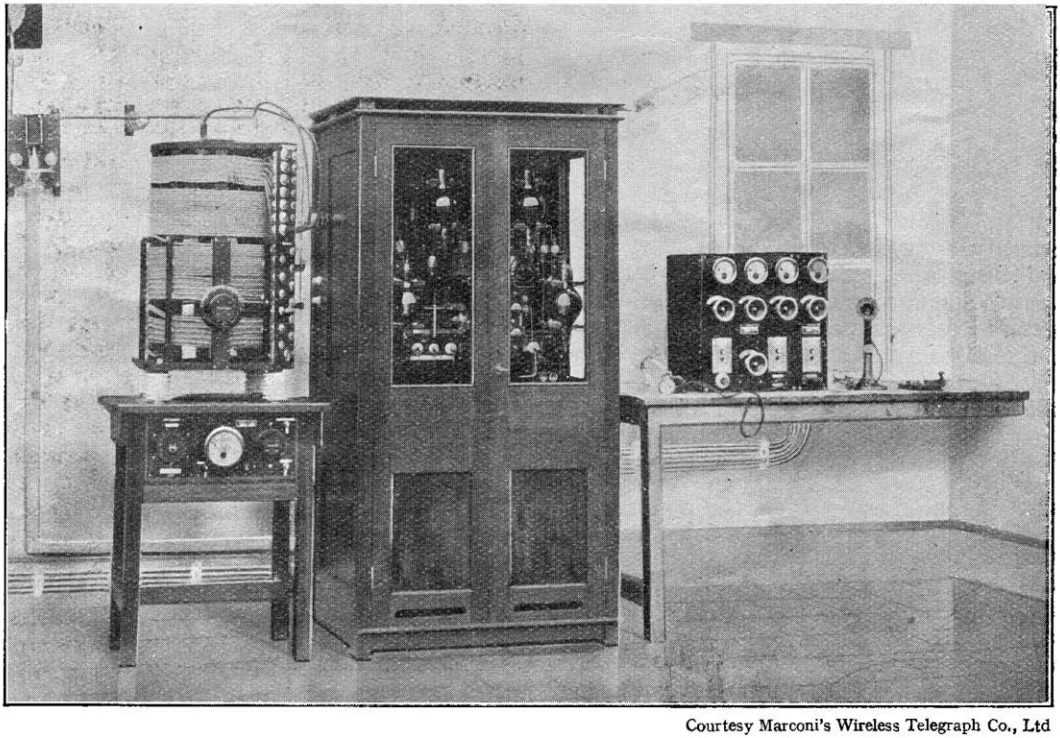
mount for honeycomb and like type coils the A.T.I. is put on the outside, hence considerable latitude is possible in the matter of dimensions. A useful size is one wound on a 3-in. ebonite former, of total about 60 turns No. 30 or 32 spaced 1/25 in. and tapped in as many points as the patience and industry of the "tapper" allows. This would cover, with a series condenser below 175 metres up to with a shunt condenser, ships, and the dead-end effects are practically negligible.

For really short wavelengths on C.W., I have heard recommended one of No. 22 spaced $\frac{1}{4}$ in. between turns.

One fine wire A.T.I. has another property noted some while ago and confirmed in part last week by independant observation. Using 35 turns on a 4-in. former with an 0·0005 series condenser, it brings in Bournemouth at 40 degs. condenser setting. On this station and on Cardiff the tuning is as sharp as, if not sharper than, with any other coil I have tried. At the ends of its range the tuning is broad, and the broadening is noticeable, in comparison with others, even so close as on Birmingham.

In conclusion, if I were asked how far I would go in the way of fineness, I would reply "this depends on the margin of volume of sound at your disposal. Go as far as you dare so long as the volume in a loud speaker just comfortably fills the room." The critical point is when you have to choose, for the sake of better definition, between finer wire and two L.F. valves or a coarser wire and one L.F. only. Here my practice would be to use the finer wire, more L.F. amplification, but to use a resistance coupled L.F. amplifier.

AIRCRAFT COMMUNICATION SET.



Courtesy Marconi's Wireless Telegraph Co., Ltd

Telephony and telegraphy transmitting and receiving equipment as used at ground stations for communication with aircraft.

AN INTERNATIONAL AMATEUR WIRELESS CONGRESS FOR 1925.

The following is a report of the meetings held in Paris on March 12th and 14th for the purpose of considering the formation of an international amateur organisation.

THE French Intersocieties Wireless Committee, known as the Comité Intersociétaire de T.S.F., which is composed of delegates from the three French amateur wireless societies, "Les Amis de la T.S.F.," "Le Radio Club de France," and the "Société Française d'Etudes de T.S.F.," organised meetings in honour of Mr. Maxim, President of the American Radio Relay League, between March 12th and 14th last, on the occasion of Mr. Maxim's stay in France prior to his visit to England.

The Intersocieties Committee invited to these meetings delegates from foreign amateur wireless societies and the principal French amateurs. A large response was received to this invitation, and amateurs from Belgium, Spain, Great Britain, Luxemburg, Italy and Switzerland, or their representatives, were present with their French comrades at this truly international event.

On March 14th the Committee organised a farewell banquet under the Presidency of General Ferrié, and in his speech in reply to a cordial welcome by the General, Mr. Maxim gave assurance on his side of the goodwill of the 16,000 American amateurs towards amateurs in Europe.

Before the meeting broke up the delegates discussed the advisability of forming, at an early date, means for maintaining touch between amateurs of different nationalities, and it was decided that an International League of Wireless Amateurs should be formed in the near future.

The following resolution was adopted with the approval of all the representatives present:

"The wireless amateurs of Belgium, Spain, United States of America, France, Great Britain, Luxemburg, Italy and Switzerland, having met, or being represented, at Paris on March 14th, 1924, to consider with Mr. Hiram Percy Maxim, President of the American Radio Relay League, the advisability of forming an International Amateur Wireless Organisation, were unanimous in approval of the proposal."

Subject to later ratification by those representatives who had not at the moment received full mandate from their national societies, it was decided to instruct the following representatives to consider in detail the establishment of such an organisation:—

Belgium ..	.. Mr. Henrotay
Spain ..	.. Mr. Balta Elias
United States of America ..	.. Mr. Hiram P. Maxim
France ..	.. Dr. Pierre Corret
Great Britain	.. Mr. G. Marcuse
Luxemburg	.. Mr. D. L. Groot
Italy.. ..	.. Mr. Giulio Salom
Switzerland	.. Mr. Cauderay

Denmark, having sent no representative, was to be informed of the proposals by Dr. Corret.

The delegates referred to above met again on March 14th, with the exception of Mr. G. Marcuse, who had been unable to extend his stay in Paris.

The Committee thus constituted adopted the name of "Provisional Committee for the Organisation of an International Union of Wireless Amateurs," and elected as President Mr. Hiram P. Maxim, and as Secretary Dr. Corret. The Committee was of opinion that after giving consideration to proposals to be put forward later by the American Radio Relay League, the definite formation of an International Association of Wireless Amateurs should form the subject of discussion at an International Congress to be held in Paris during the Easter holidays of 1925. The name "International Union of Wireless Amateurs" appeared to be the most suitable title for this Association.

It will thus be seen that it has been definitely decided to hold an International Congress in Paris in 1925, and the Intersocieties Committee of France is taking the necessary steps with regard to the organisation of this important event, with the support of French amateurs.

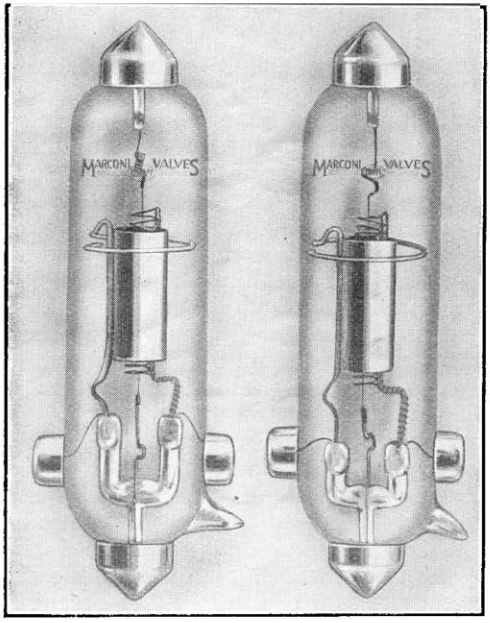
VALVE TESTS.

THE MARCONI-OSRAM DEV AND DEQ.

It is our intention to give in these columns results and figures obtained by ourselves in testing current types of valves, and in order that our readers may be in a position to compare one valve with another it is necessary to adhere to a standard testing schedule. It must, of course, be remembered that the actual performance of a valve depends upon its several constants and these vary according to design, over very wide limits. In order, therefore, to embrace all types we have arranged a general and comprehensive test from which it will be possible at once to predict the performance of a valve and the use for which it is most particularly suited. In addition, and bearing in mind the purpose for which it is intended to use the valve, a glance at the curves will show the correct settings of filament grid and anode potentials. A final test will, in each case, be actual working in a practical circuit. Generally speaking, our "bench test" will provide the necessary data for three sets of curves from which all the necessary information about the valve may be gleaned and its suitability for any particular function indicated. The significance of these curves and how they may be used will perhaps be more easily understood by taking an actual example and for this purpose some additional explanatory matter accompanies the report on the DEV and DEQ valves given here.

THE subject of our review this week is a valve which, although it was the first British dull-emitter to be marketed in this country, does not seem to be very well-known amongst amateurs.

Its bright emitting counterpart, the V.24, is, of course, well known to all wireless enthusiasts, and the DEV has the V.24 characteristics but with an expenditure of only one-sixth the filament energy, for the filament volts and current for the DEV are normally 2.75 and 0.2 respectively.



DEV and DEQ valves.

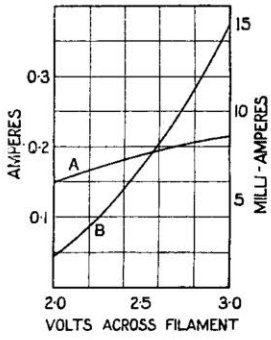


Fig. 1.

The voltage is perhaps a rather awkward value and a resistance of 7 ohms is required for a single valve when a 4-volt accumulator is employed.

In Fig. 1 we show the filament characteristics, which are similar in both types. Curve A represents the relation between the voltage across and the current through the filament. Curve B shows how the saturation emission changes with variation of filament volts and it is seen that ample emission is obtained with a filament voltage as low as 2.5. The

anode characteristics, taken with a filament voltage of 2.75, are illustrated in Fig. 2.

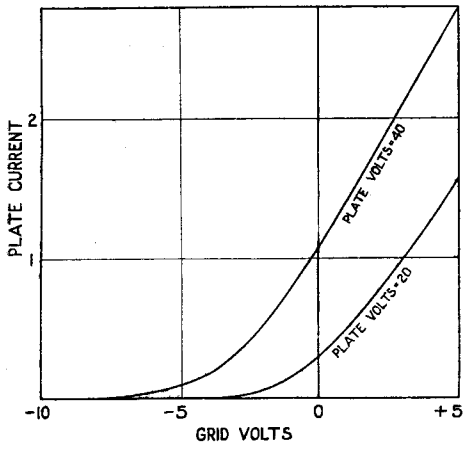


Fig. 2.

Fig. 3 shows three separate curves which represent the following relations :—

A. The plate current as a function of plate voltage, the former being read from the scale on the extreme left of the figure. This curve, it will be noted, has a good slope and indicates a moderate impedance.

B. Plate impedance as a function of plate voltage, the former falling to below 20,000 ohms at a plate potential of 45.

C. "M" value as a function of plate voltage. Throughout the whole range the magnification is seen to remain very constant at about 6 to 1.

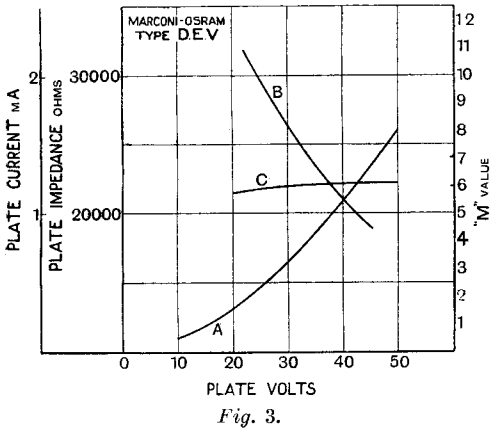


Fig. 3.

The grid potential for all the curves of Fig. 3 has been maintained at zero.

Summing up the information presented by all the foregoing curves we find the valve to give sufficient emission for all normal purposes, a constant magnification and a moderate impedance. One would, therefore, predict the DEV to function as a satisfactory general purpose valve and that this assumption is justified will be seen from the following.

Although designed primarily as a H.F. amplifier, we have for some time been using three DEV's in a receiver, comprising 1 H.F. detector, and 1 L.F., with marked success. 40 volts H.T. is used on all three anodes and a grid condenser and leak of 0.0003 mfd. and 3 megohms respectively on the grid of the rectifier. Our only adverse criticism is that, in common with most dull emitters, they are rather microphonic.

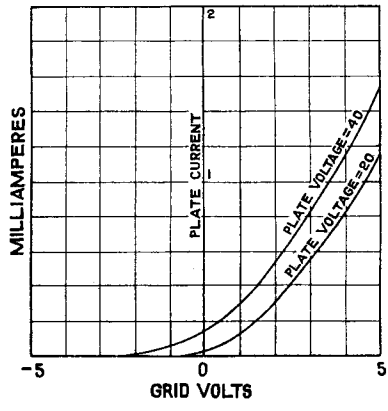


Fig. 4.

Due to the special design, all valves of the V.24 type have a very low internal capacity, which is a point of no mean importance in reception on short wavelengths.

The DEQ differs from the DEV only in that the "*m*" value has been increased, and the characteristics are given in Fig. 4. This valve has been designed to operate as a detector without a grid condenser, *i.e.*, it rectifies by virtue of the curvature of the anode current curve. It will be seen, moreover, that this curvature takes place around zero grid volts and therefore the grid return lead may be connected to the negative terminal of the L.T. battery, no biasing battery being required.

TELEPHONE RECEIVER MANUFACTURE.

DETAILS OF THE PROCESSES ADOPTED AT THE WORKS OF MESSRS. BRANDES, LTD.

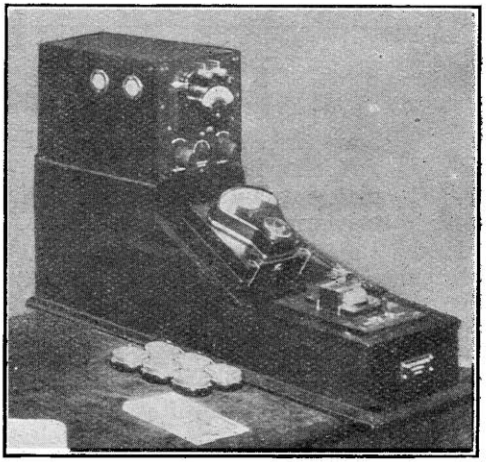
TELEPHONE receivers are so habitually handled and as our acquaintance with them starts from our introduction to wireless we rarely stop to consider details of their design or the processes employed in their manufacture.

The telephone receiver has now been manufactured for many years and the minor details of design have been given such careful attention, it is to be expected that the design now adopted lends itself to mass production. In the Brandes Works one immediately observes how all the operations have been carefully analysed, and how all the necessary parts are manufactured, examined and scrutinised by routine workers.

Winding the bobbins. The machine automatically counts the turns run on, and trips when the winding is completed.

The manufacture of telephone receivers commences with the pressing out of the soft iron pole pieces, and as it is essential for this part to be accurate to size within very narrow limits, the stamped pole pieces are passed through suitable gauges so that any small irregularities may be observed. A fibre washer, which is to form the lower end cheek of the coil, is slipped over the pole piece, after which a piece of Paxolin is secured to the upper end by means of a special press which forces over portions of the metal so as to grip the cheek.

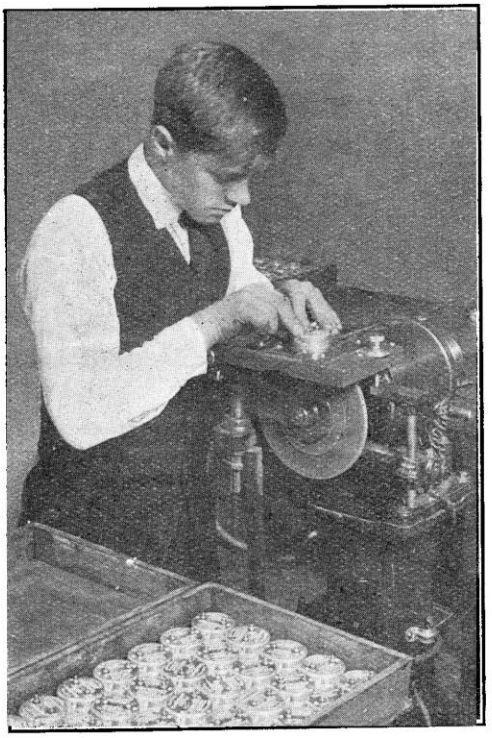
Before the winding is put on, a layer of insulating material is wrapped round the pole piece in order to prevent the inside turns of wire from making actual contact with the face of the metal.



The test set employed for determining the sensitiveness of receivers. The principle of operation of this set is shown diagrammatically on the next page.

The winding is accomplished by a rather interesting process in which the pole piece is rotated on a small face plate, and by means of a counting device the driving motor is automatically tripped when the requisite number of turns have been run on. This machine method of winding and counting turns permits of all bobbins having precisely the same impedance, which is verified on a test set in which alternating current is fed round the windings and a direct impedance measurement obtained. The impedance test is also necessary in order that bobbins having short circuited turns may be rejected at this stage. A

protective covering is placed over the winding and then the pole piece and bobbin are ready for assembly in the aluminium shell of the telephone receiver. To facilitate accurate assembly, jigs are used which guide the pole pieces accurately into position, and so avoid the necessity for careful observation by the operator.



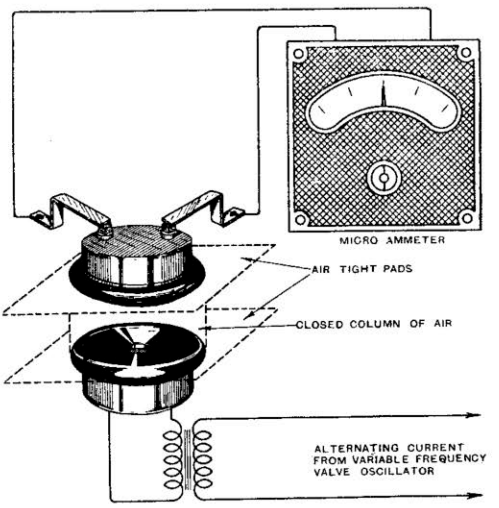
Grinding the pole faces.

The windings of two-pole pieces are connected in series prior to assembly, and the next step in manufacture consists of tucking away the joint between the two bobbins and scrutinising the setting up of the poles prior to introducing the nickel-plated polarising magnets. Two magnets are used in each receiver assembled symmetrically on either side of the pole pieces. They are held down by nickelled plates suitably gripped by a pair of screws. The magnets, which are made of a special grade of steel, are not rendered magnetic until after assembly, and this is accomplished by placing the pole pieces of the receiver across the poles of a powerful electro-magnet.

In order that the required spacing may be accurately obtained between poles and diaphragm a grinding wheel is arranged to grind the face of the poles so that they lie 13/10000ths of an inch below the top rim of the aluminium shell. This accuracy is achieved by grinding with the top edge of the wheel and with the rim of the aluminium shell resting upon a trued face accurately set in height, with regard to the top of the grinding wheel. A specially designed micrometer gauge permits the operator to check the depth of grinding.

It is only necessary now to place on the diaphragm and screw down the cap, which is made of an insulated moulded material. The cap is screwed down very tightly by means of a special grip, and from subsequent tests it is readily apparent that the cap must be screwed on as tightly as possible in order to press the diaphragm down firmly and to the top rim of the aluminium shell of the receiver which, it might be mentioned, is trued up on a suitable linisher.

Of special interest is one of the methods adopted in the test-room for examining the finished receivers. An alternating current from a low frequency valve oscillator, which can be adjusted to produce any note frequency, is applied to the terminals of



The sensitivity test. The diaphragm of the receiver on test is thrown into vibration and the current set up in its windings measured on a microammeter.

a telephone receiver so that its diaphragm is thrown into vibration. The note emitted sets in vibration the diaphragm of a receiver

on test, and in consequence a current is set up across its terminals. This current is accurately observed on a microammeter. This arrangement is without doubt a very reliable "overall" test for the efficiency of the receiver. The reverse process is also employed by throwing a key on the test set so that the alternating current is applied to the receiver on test and the induced current which is set up through the sound waves is read off from the terminals of the fixed receiver in the set. The arrangement will be readily understood by reference to the accompanying diagram.

It is interesting to observe that a receiver with the cap screwed "hand-tight," does not prove as sensitive on test as those screwed up by the special device used for assembling the receivers in the works, and for this reason one is not advised to tamper even with the caps of telephone receivers.

Our indebtedness is due to Messrs. Brandes in providing facilities for examining the modern methods employed in telephone receiver manufacture as adopted in their works at Slough.

CORRESPONDENCE.

Long Range Crystal Reception and Re-Radiation.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—During a recent visit to the island of Minorca I had an opportunity of experimenting in crystal reception.

The only stations on this island are two Telefunken crystal receivers operated by the Army and Navy, and on which telephony had never been heard. After installing a multi-valve receiver with reaction to aerial about four miles distant from the Army station, FL telephony was received very clearly on the crystal receiver on Thursday, January 10th. On this evening no further experiments were carried out, but on Saturday, the 12th, while listening to the opera "Pagliacci," S.B. from **6 BM**, this transmission was also heard on the crystal receiver, quite comfortably on the headphones. We kept in touch with the Army station and found that any station within the range of the valve set could be heard easily on the crystal so long as the valve receiver was sharply tuned and only just off the point of oscillation.

B. H.

The Measurement of Low Frequency Amplification.

To the Editor of THE WIRELESS WORLD AND RADIO REVIEW.

SIR,—I have read with interest the article on "The Measurement of Low Frequency Amplification," by Mr. R. L. Smith-Rose, appearing in your issues of March 5th and March 12th, and would like to ask the author why readings of the voltage amplification for lower frequencies than 500 cycles in his Table I, page 732, and 300 cycles in the curves given in Fig. 5, page 733, were not given.

It appears to the writer that in the amplification of music for reproduction in a loud speaker, the amplification of the lower frequencies is of great importance, that is, at least as low as the second octave below middle C, or approximately 64 cycles.

To judge from the curves given in Fig. 5, the amplification of the fundamental on any note much below middle C—256 cycles approx.—seems to be very poor for all of the transformers except C. With reactance-capacity coupling, Table I, it appears that with the secondary winding of transformer A used as reactance, the amplification curve has a decided upward tendency toward the lower frequencies, and it would have been of interest to see the figures for the amplification at lower frequencies than 500 cycles.

In view of the statement made by Capt. Round in his lecture to the Amateur Transmitters' Society that "the amplitude of a diaphragm at the lower frequencies had to be many times greater than at higher frequencies to give equal audibility," the performance of the transformers as given by Mr. Smith-Rose from the point of view of music reproduction seems to leave much to be desired.

Another point of interest is that from the measurements given by Mr. Smith-Rose the transformer coupling gives from two to three times the amplification obtainable by the resistance or reactance capacity coupling. This agrees with the figures obtained by calculation in the usual manner. It does not, however, agree with the results obtained by the writer in actual practice with the amplification of music or speech.

It has been found that practically the same degree of audibility in a loud speaker is obtainable with all three methods of coupling, and this is to some degree in accordance with the experience of Mr. H. A. Thomas as given in his Paper on "Distortion in Radio Telephony," read at a recent meeting of the Radio Society of Great Britain.

The writer suggests that these differences may have their origin in the fact that in calculating the amplification obtainable by different methods of coupling, a sinusoidal wave form is assumed, and it is presumed that in the measurements of Mr. Smith-Rose a source of sinusoidal waveform was used also, whereas in the actual amplification of speech or music the wave form is not sinusoidal.

It should be mentioned that the above results of practical equality of amplification with different couplings refer to one stage of amplification following a detector valve.

A. C. HUSKINSON.

Sydenham,
London, S.E.26.

NOTES & CLUB NEWS

Complaints are made that Hong Kong is being neglected in Empire wireless schemes.

* * * *

A wireless station is being established in Honolulu from which programmes in English will be broadcast to islands of the Pacific and Orient.

* * * *

An S.O.S. call from a vessel in the Bay of Biscay recently led to the suspension of broadcast programmes in Newark, New Jersey, for an hour and a half.

* * * *

An International Radio Exhibition is to be held at Amsterdam during the first week of September.

* * * *

Geneva Conference Upholds the Amateur.

The representative of *The Wireless World and Radio Review*, attending the Geneva Conference, informs us that important proposals were made at the preliminary conference for drawing up an International Wireless Telephony Agreement, held at Geneva on April 22nd and 23rd.

Conclusions reached were—(i) that certain wavelength fields should be exclusively reserved for wireless telephony, and (ii) that in view of the considerable contribution made by amateurs to the development and progress of wireless telephony, their rights should be taken into consideration and certain fields reserved for their experiments.

Amateurs in particular will welcome the recognition of their claims, and it is gratifying to note that in conclusion the Conference expressed the hope that those states which forbid the use of wireless telephony should reconsider their decision and license amateur stations.

Transatlantic Amateur Transmission.

A Washington amateur, **3 CJV**, has reported reception on February 14th, of the C.W. signals of Mr. L. Bland Flagg (**2 GO**), of Bayswater, London.

On the date referred to **2 GO** was using a power of 8 watts with a radiation of about 0·3 amperes. A reversed feed circuit was employed and a H.T. of 350 volts.

Mr. R. J. Cottis (**2 LD**), of Fulham, London, has received a report of the reception, on March 16th, of his C.W. and speech from Mr. D. Stoll, of 468, Riverside Drive, New York City. **2 LD's** radiation was 0·2 ampere, while the American employed a "5-tube neutrodyne."

Mr. R. L. Royle (**2 WJ**), of Palmers Green, who has successfully worked with several American and Canadian amateurs points out that at present he has not established two-way communication with **1 BCF**, as stated in our issue of April 16th, although his signals have been heard by that station. **1 BCF** is located at South Duxbury, Massachusetts.

Test Transmissions from WBAH.

WBAH, the broadcasting station of the Dayton Company of Minneapolis, U.S.A., is conducting regular high-power transmissions on 417 metres.

The present schedule of transmissions is as follows (B.S.T.):—

Monday .. 4.20 a.m. to 5.45 a.m.
Tuesday ..
Wednesday .. 2.0 a.m. to 2.20 a.m.
Friday ..
Saturday ..

We should be glad to receive reports from amateurs who are able to tune-in **WBAH**

Wolverhampton Transmitters' Society.

Many interesting experiments and tests have been arranged by the Wolverhampton and District Radio Transmitters' Society. The members would be glad to arrange tests with other societies interested in long-wave transmission and communications on the subject will be welcomed by the Hon. Secretary, Mr. J. A. H. Devey, 232, Great Brickkiln Street, Wolverhampton.

Broadcasting from Boston, U.S.A.

The transmissions from Boston, Massachusetts, which have recently been heard by amateurs in this country, emanate from **WBZ**, not **WBD**, as stated in a recent note.

A full programme from the station was heard on the morning of March 30th, by Mr. Sidney Osborne, of Kilburn, who was similarly successful on April 5th, many items being remarkably clear in spite of bad jamming.

WBZ is an exceptional station in that the transmissions are broadcast a hundred miles distant from the studio, which is situated at the premises of the Westinghouse Electric and Manufacturing Company at Springfield, Massachusetts. The aerial system is erected on the roof of the Hotel Brunswick, at Boston.

Proposed New Morse Abbreviations.

Writing in the "Journal des 8," a correspondent suggests the use of the following new abbreviations for Morse work:—

QVA ? .. Will you listen to my telephony ?
QVB ? .. What is the quality of my modulation ?
QVC ? .. Is my carrier wave strong ?
QVD ? .. Is my carrier wave weak ?

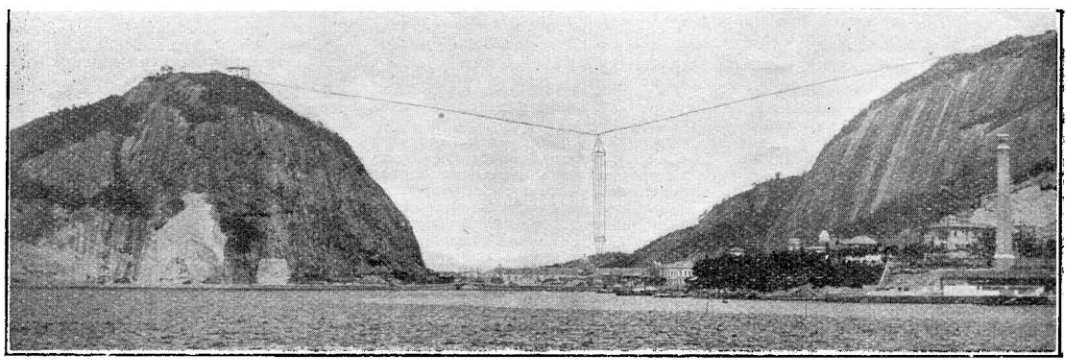
Interference with His Majesty's Reception.

The Windsor and District Radio Society has been informed by the B.B.C. that the King's wireless set at Windsor Castle has been considerably affected by local oscillation.

Occasionally programmes broadcast from near stations have been entirely spoilt by this interference.

Standing By.

The Middlesbrough Corporation has decided not to purchase a wireless tele-



The imposing aerial system of the Brazilian radiophone station of "Praia Vermellia" at Rio. The cage antenna is 330 feet high and is suspended from the Urca mountain (left) and the Babilonia mountain.

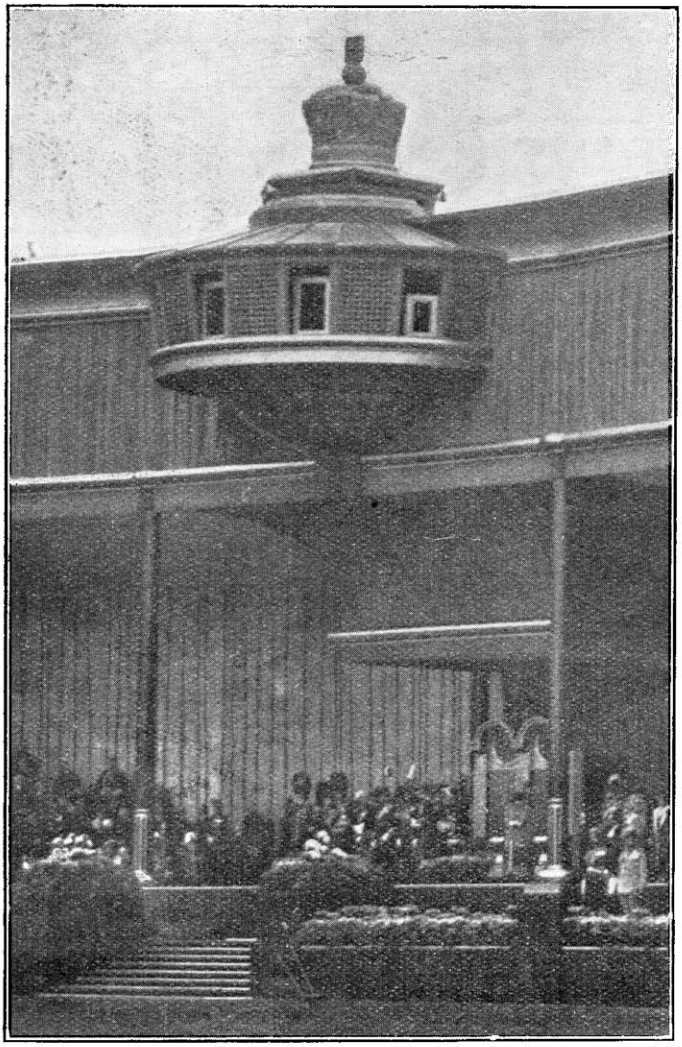


Photo : Barratts.

A photograph of the dais from which His Majesty the King delivered his broadcast speech at the Wembley Stadium on April 23rd. Note the loud speakers in the casements above. The microphone can be seen suspended before the throne.

phony installation for police purposes, because "it is felt that by deferring the matter for a further period of six months the improvements in the apparatus which were now being made would be advantageous."

It seems to us that perfection in such a progressive science as radio will hardly have been attained in half a year. The Middlesbrough Corporation might wait indefinitely, to the advantage of the Middlesbrough criminal.

2 LO Heard in the Red Sea.

An exceptionally interesting report of the reception of London broadcasting over 3,250 miles has reached us from Mr. J. H. Maade, operating on a vessel anchored at Kamaran Island, in the Red Sea.

The ship's aerial is a three-wire "T" type, 280 ft. long, and the receiver used was a single-valve set with honeycomb coils.

In the early hours of February 14th our correspondent tuned in a strong carrier wave in the neighbourhood of 360 metres, and although atmospherics were very strong, faint music was heard. At about 2.30 a.m. (G.M.T.), the British National Anthem was recognised and afterwards the announcer was heard to say quite clearly: "Hello, America; this is the London Station and all the stations of the British Broadcasting Company."

Mr. Maade is now bound for Calcutta, where he will carry out further experiments in the reception of B.B.C. stations with his single-valve receiver.

Reception in the Open Air.

Some informing statistics on the loud speaker reception of the King's speech in various parts of the country appeared in the *Daily Mail* of April 25th, and the results show that distance was but a small factor in determining the quality of the transmission.

In Birmingham, for instance, reception was reported as poor, while Aberdeen registered a "huge success." Leatherhead listeners heard His Majesty's speech plainly a quarter of a mile from the loud speakers, while at Bedford, those on the edge of the crowd heard very indifferently.

The *Daily Mail* demonstrations were established in conjunction with the Marconi and Marconiphone Companies.

A Correction.

In the advertisement of Messrs. Edison Swan Electric Co., Ltd., appearing on p. iii of our last issue, the price of the "A.R.D.E." valve inadvertently appeared as 27s. 6d. The correct price is 21s.

2 CA.

Some confusion has arisen over the identity of **2 CA.** The owner is Mr. C. E. Palmer Jones, of 20, Prince's Road, Wimbledon, S.W.19, Mr. Jones also owns a portable station, using the same call sign and operating in N.W. London.

Listening to the King's Speech.

A large and interested crowd assembled outside the offices of *The Wireless World and Radio Review*, in Henrietta Street, on April 23rd, when the broadcast speech of His Majesty the King was heard from two loud speakers. The demonstration was carried out with a four-valve cabinet set, recently described in this journal, embodying resistance capacity coupling.

Increased Power at Rome.

The Army Wireless Station at Rome (Centocelle, **1 CD**), has installed a Marconi 1 k.W. Telephony transmitter. The station transmits weather forecasts and news from 4 to 5 p.m. daily (B.S.T.) on 1,800 metres. The quality of speech and modulation is reported to be good. Have any readers intercepted these transmissions?

Two-way Working with Luxembourg.

Unprearranged working with a Luxembourg amateur, **LOAA,** using a power of approximately 1 watt only, is the achievement claimed by a Nottinghamshire transmitter. On April 1st, at 7.30 (G.M.T.), our correspondent answered **LOAA's** CQ call, with no real expectation of being heard as his power input was very small. The plate voltage was 190, supplied from dry cells. **LOAA** answered, however, giving his name as François Anen, of Rue Beaumont, Luxembourg, and communication was thus established over 450 miles.

Our correspondent's aerial was a single-wire type, 32 ft. high and 96 ft. long, with a three-wire counterpoise under the aerial. The Colpitts oscillator circuit was used with two slight modifications for low power working.

The Radio Society of Great Britain.

An informal meeting of the Transmitter and Relay Section will be held at 6.30 p.m. on Friday, May 2nd, 1924, at the Institution of Electrical Engineers, Savoy Place, at which a discussion will be opened by Captain P. P. Eckersley.

Blackpool and Fylde Wireless Society.*

On Thursday, April 3rd, a large number of members was present, when the Hon. Secretary, Mr. B. D. Taylor, gave an address on "Standard Wireless Circuits." The lecturer opened his remarks with the description of the usual crystal arrangement, and showed the methods of varying this to meet certain requirements.

Numerous thermionic valve circuits were given, followed by a description of the functioning of the various electrical circuits involved. Particularly of interest was the description of a four-valve circuit (1—v—2) which is, perhaps, the ideal arrangement for loud speaker work in Blackpool.

Hon. Sec., B. D. Taylor, 58, Regent Road, Blackpool.

Cambridge University Wireless Society.*

Members of this Society are able to look back on a very active winter session, just concluded. Eight lectures have been delivered, all by well-known authorities, and a wide range of subjects related to wireless has been covered.

Among those who have honoured the Society with lectures are Captain P. P. Eckersley, Dr. R. L. Smith Rose, Dr. E. V. Appleton and Capt. A. G. D. West. A number of informal meetings have also been held and four parties have visited **2 LO.**

Hon. Sec., H. G. MacColl, University Engineering Laboratories, Cambridge.

Wimbledon Radio Society.*

The "Works" Committee have been exceptionally busy on the Society's receiver, which now, as the result of their efforts, is nearing completion.

Mr. Stokes, the Secretary, recently demonstrated a remarkably neat crystal receiver, in appearance and size similar to an ordinary shrouded transformer, which gave excellent results over a wide tuning range. A one-valve receiver with which all the B.B.C. stations could be received has also been working on the Society's aerial.

The annual general meeting of the Society will be held at Headquarters, The Red Cross Hall, 59, Church Road, Wimbledon, S.W.19, on Friday, April 25th next, to receive the Hon. Secretary's and the Hon. Treasurer's reports, and for the election of officers for 1924.

Asst. Hon. Sec., R. G. West, "Bonchurch," 4 Ryfold Road, Wimbledon Park, S.W.19

Barnet and District Radio Society.*

Mr. Philip R. Coursey, Hon. Secretary of the Radio Society of Great Britain, visited the Society on the occasion of the last bi-monthly meeting, and delighted the members with a highly interesting lantern lecture on "Condensers."

Mr. Coursey described in detail the manufacture and use of condensers, from the small mica dielectric fixed condensers and air dielectric variable condensers, used in reception, to the huge condensers employed in high power transmitting stations, and in the overhead power lines on the Continent. Nearly one hundred slides were shown on the screen, illustrating the processes of manufacture at the well-known Dubilier Condenser works at Shepherd's Bush. Starting at the mica mines in India, the pictures took the audience through the various shops in the condenser works. The splitting and cutting of the mica, the tests applied to it, and its assembly with the other component parts to form the finished article, provided a really instructive story. Mr. Coursey's detailed description of the methods employed, rendered the evening as profitable as a personally conducted tour through the actual works. The final slides depicted the aerial and apparatus at **6 XX**, the famous trans-Atlantic transmitting station of the Radio Society of Great Britain.

Hon. Sec., J. Nokes, "Sunnyside," Stapylton Road, Barnet.

Tottenham Wireless Society.*

On Wednesday, April 9th, Mr. Vickery tested members' grid leaks and condensers. He is the fortunate possessor of a "megger" and by means of this instrument showed whether components were faulty or not. His demonstration was preceded by a description of various standard variable leaks. An ingenious and efficient variable leak designed by Mr. Vickery was much admired.

Hon. Sec., S. J. Glyde, 137, Winchelsea Road, Bruce Grove, Tottenham, N.17.

The Belvedere, Erith and District Radio and Scientific Society.

Disappointment on Friday, April 11th, at the inability through indisposition of Mr. C. Morriss to give his lecture on "Elimination of Interference in Wireless Reception" was in a measure compensated for by a very able lecture given by Mr. G. R. Harbottle, on "Transmission Systems and the Electric Light Cable." Mr. Harbottle traced the development of the modern system of power transmission from the old two-wire and balanced three-wire direct current systems of about thirty years ago, to the highly efficient alternating current systems that obtain to-day. He explained in general terms the construction of electric light cables from the drawing of the copper wire from the ingot through the stages of conductor, insulation and protection, and briefly outlined their electrical characteristics.

A most interesting discussion followed on the economic use of the super tension cable applied to modern conditions of working.

The Secretary reported that The British Broadcasting Company had given permission to members to visit the London Broadcasting Station.

Hon. Sec., S. G. Meadows, 110, Bexley Road, Erith, Kent.

The Clapham Wireless Society.

The rules of this new Society have now been approved, and several additions have been made to the membership.

Crystal detector testing took place at the last meeting of the Society, conducted by Mr. W. Brierley.

Hon. Sec., M. F. Cooke, 13, Fitzwilliam Road, Clapham, S.W.4.

Sydenham and Forest Hill Radio Society.

On Monday evening, March 17th, Mr. J. G. Barrett, a lecturer from the South London League of Radio Societies, dealt very ably with the subject of "Cabinet Work for Wireless Sets."

The lecturer first described the various joints used in cabinet work, such as the butt, the mitre, the tongue and groove, and the dovetail. Following this he gave some useful tips with regard to the selection of woods, and the use of tools and home-made appliances, and concluded a very interesting and instructive lecture with some remarks on staining and polishing.

As Mr. Barrett was unavoidably called away somewhat early in the evening, the Chairman invited discussion on general wireless topics, and a very interesting and informal hour was spent in this way. Capt. Huss gave some particulars of an "extraordinary protuberance" which has been noticed on his house, and stated that it was a novel aerial which he had recently put into use. Mr. Cox gave a *résumé* of a recent lecture on dull emitter valves given before the I.E.E. and Mr. Robartes gave a modified ultra audion circuit, which gave particularly good results on continental and long distance telephony.

Hon. Sec., M. E. Hampshire, 139, Sydenham Road, Sydenham, S.E.26.

Dulwich and District Wireless and Experimental Association.

A very interesting paper on the design and construction of the Cossor valve, which was kindly lent by Messrs. the Cossor Valve Co., Ltd., was read by Mr. Bartlett on March 31st. This firm also lent the Association the use of a set of lantern slides illustrating the paper. An interesting discussion ensued.

On Monday, April 7th, Mr. Skinner, a member of the Association, gave an able lecture on "Television," which was followed by a lively debate.

The Association is desirous of increasing its membership, and all enquiries should be addressed to the Hon. Sec., Harrie King, 2, Henslowe Road, East Dulwich, S.E.22.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 30th.

Radio Society of Great Britain. Ordinary General Meeting. At 6 p.m. At the Institution of Electrical Engineers. Lecture: "Faithful Reproduction by Broadcast." By Captain P. P. Eckersley.

Edinburgh and District Radio Society. At 8 p.m. At 117, George Street. Lecture: "Stationary Waves." By Mr. W. Anderson, M.A., F.R.S.E.

Clapham Park Wireless and Scientific Society. At 8 p.m. At 67, Balham High Road. Lecture: "H.F. Amplification." By Mr. A. D. Cowper, M.Sc., A.I.C.

North Middlesex Wireless Club. At 8.30 p.m. At the Shaftesbury Hall, Bowes Park, N. Lecture: "Crystals used in Wireless Reception." By Mr. A. V. Ballhatchet.

THURSDAY, MAY 1st.

Blackpool and Fylde Wireless Society. Lecture: "Natural Detectors." By Mr. W. Shufflebotham, F.R.S.E.

FRIDAY, MAY 2nd.

Radio Society of Great Britain (Transmitter and Relay Section). At 6.30 p.m. At the Institution of Electrical Engineers. A Discussion will be opened by Captain P. P. Eckersley.

Sheffield and District Wireless Society. At 7.30 p.m. At the Department of Applied Science, St. George's Square. Lecture: "Reflex Circuits." By Mr. L. Johnson.

Leeds Radio Society. At 7.30 p.m. At Woodhouse Lane U.M. Schools. Lecture: "A Frame Aerial Receiving Set." By Mr. J. Croysdale.

SATURDAY, MAY 3rd.

Bristol and District Radio Society. At 8 p.m. At the Y.M.C.A. Hall, St. James' Square, Bristol. Address by Captain P. P. Eckersley (Chief Engineer of the B.B.C.). Chair will be taken by the Rt. Hon. The Lord Mayor.

MONDAY, MAY 5th.

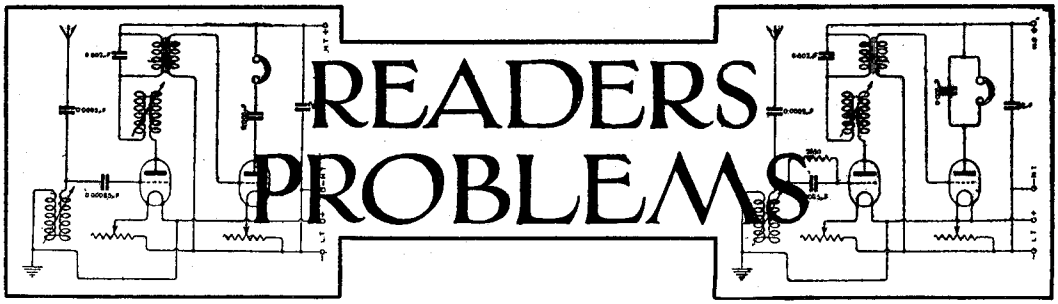
Ipswich and District Radio Society. At 55, Fonnereau Road. Open night.

Hornsey and District Radio Society. At Queen's Hotel, Broadway, Crouch End, N.8. General Discussion and Questions.

Kingston and District Radio Society. Lecture: "The Importance of Esperanto as a Factor in Modern Life." By Mr. Montague Butler.

WEDNESDAY, MAY 7th.

Institution of Electrical Engineers (Wireless Section). At 6 p.m. At Savoy Place, W.C.2. Lecture: "Faithful Reproduction in Radio Telephony." By Mr. L. C. Pocock, Associate Member.



READERS' PROBLEMS

1. All questions are answered through the post. A selection of those of general interest is published. **2.** *Not more than four questions may be sent in at any one time.* **3.** *Every question should be accompanied by a postal order for* **1/-**, *or* **3/6** *for four questions, and by a coupon taken from the current issue.* **4.** *A free coupon appears in the first issue of each month, and if this is sent in together with coupons from the three previous issues, the reader is entitled to have one question answered free of charge.*

"*E.H.B.*" (*Horley*) **asks if the shunted telephone method of measuring signal strength is capable of yielding reliable results, and whether a 650 ohm potentiometer would be suitable for the variable resistance.**

The method is not very reliable, since not only is the point of extinction of the signal somewhat badly defined, but the sensitivity of the ear varies from day to day. The amount of extraneous noise occurring at the time of the determination also influences to a large extent the result obtained. We do not think that the potentiometer would be suitable. Not only would the adjustment be very coarse, but the total resistance would be too high for the purpose of this experiment. The shunt resistance required to reduce the signal below audibility when sensitive telephone receivers are used is often only a small fraction of an ohm. We have found that a meter bridge wire forms an excellent resistance for this purpose. The total resistance of the wire is not more than one or two ohms, and the resistance in circuit can be measured to considerably less than 1 per cent.

"*J.E.*" (*London, S.W.*) **asks for a diagram of a four-valve receiver consisting of one detector valve, followed by three stages of resistance capacity coupled L.F. amplification.**

The diagram is given in Fig. 1. When the telephones are plugged into jack 1, only the detector valve will be in use, while the insertion of the plug into jack 2 automatically switches on the three L.F. amplifying valves. If it is desired to use telephones in conjunction with the detector valve and a loud speaker when the L.F. valves are in use, two separate telephone plugs will be required.

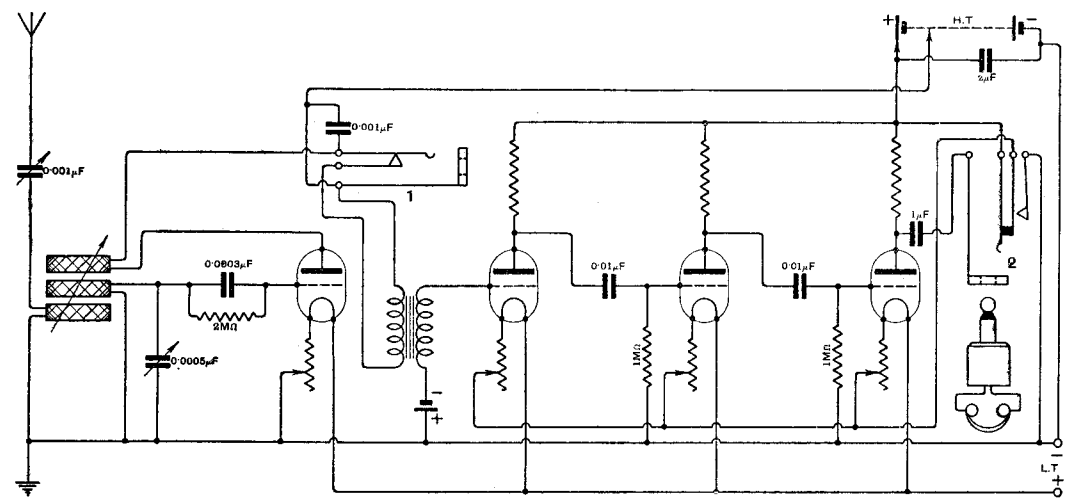


Fig. 1. "*J.E.*" (*London, S.W.*). *Four-valve receiver consisting of a detector and three resistance-capacity coupled L.F. valves.*

"*R.A.B.*" (*Watford*) **asks how many turns would be required for the primary and secondary windings of a transformer to charge accumulators through a chemical rectifier from the 200-volt single phase A.C. mains.**

Assuming that the cross section of the iron core is not less than 2 square inches in area, the primary winding may consist of 1,000 turns of No. 24 D.C.C. The secondary winding may be wound with 105 turns of No. 17 D.C.C. This ratio will give a secondary voltage on full load of approximately 20 volts, which will allow an ample margin for the drop of voltage through the rectifier cell. The transformer will safely carry a secondary current of between 2 and 3 amps.

and music, with the result that some notes are emphasised to the exclusion of others. The effect of connecting a resistance across the winding is to introduce sufficient damping into the secondary circuit to prevent resonance effects.

"*E.W.R*" (*Birmingham*) **asks for a circuit diagram of a two-valve and crystal receiver arranged so that any combination of crystal and valves may be used.**

The diagram is given in Fig. 2. When the H.F. valve switch is in the "OFF" position, and the telephones are plugged into jack 1, only the crystal detector will be in use. With the switch in the "ON" position and the telephones in jack 1, the crystal detector will be used to rectify the signals

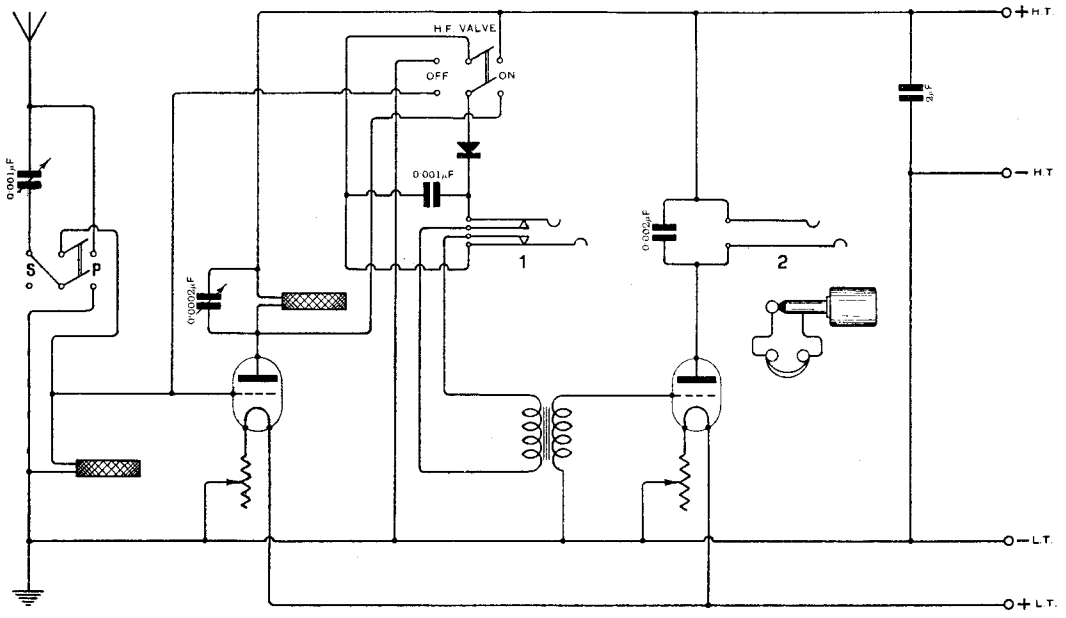


Fig. 2. "*E.W.R.*" (*Birmingham*). *Experimental circuit permitting any combination of crystal detector and H.F. and L.F. valves.*

"*H.A.G.*" (*Norwich*) **asks (1) if a 0·0003 μF tuning condenser might be used instead of the 0.0002 μF condenser specified to tune the anode circuit of an H.F. valve. (2) For what reason a resistance is connected across the secondary winding of an intervalve transformer.**

(1) A 0·0003 μF condenser could certainly be used, but it will be found that the amplification obtained when the condenser is set at its maximum reading would not be so great as that obtained for a smaller reading. (2) A resistance is often connected across the secondary winding of the transformer to improve the quality of the telephony received. The secondary winding has an appreciable self-capacity, which, in conjunction with its inductance, gives the winding a natural frequency. The value of this frequency very often comes within the band of frequencies used for speech after amplification by the H.F. valve. When the telephones are plugged into jack 2, the crystal detector will be followed by one stage of L.F. amplification. The filament current to the valves not in use should be switched off by means of the appropriate filament resistances.

"*C.R.P.*" (*Newcastle-on-Tyne*) **asks what H.T. voltages will be required for V.24, Q and QX type valves when used for high and low frequency amplification and for rectification.**

The purposes for which these valves are suitable, together with the anode voltages required, are given in the table below:—

H.F. amplification—	V.24	(H.T. 30 volts).
Rectification—	Q or QX	(H.T. 30 volts).
L.F. amplification.—	V.24	(H.T. 30 volts).
	Q	(H.T. 150-200 volts).
	QX	(H.T. 100 volts).

Contributors to this section are requested to limit the number of calls sent in to those heard in the previous three weeks, these being of greater interest and value to transmitters than earlier records. The repetition of the same call sign in consecutive lists is not recommended. Contributors will also assist by kindly arranging reports in alphabetical order.

Dunstable, Beds.
2 AA, 2 AC, 2 FQ, 2 FU, 2 JF, 2 KF, 2 KS, 2 KW, 2 LH, 2 MM, 2 PC, 2 TA, 2 TO, 2 VW, 2 WD, 2 WE, 2 WR, 2 WY, 2 XG, 2 XY, 2 YQ, 2 ZT, 2 ZU, 5 AW, 5 CC, 5 FS, 5 GX, 5 HW, 5 JX, 5 MO, 5 NN, 5 OT, 5 RY, 5 SI, 5 US, 5 VX, 6 AH, 6 BT, 6 DW, 6 EC, 6 LJ, 6 NF, 6 QB, 6 RY, 6 SO, 6 VP, 6 XG, 6 XP, 6 XX, 6 ZY, 8 AG, 8 AO, 8 AP, 8 AQ, 8 BA, 8 BF, 8 BP, 8 BV, 8 CG, 8 CN, 8 CT, 8 CZ, 8 DA, 8 DC, 8 DN, 8 DU, 8 DX, 8 DY, 8 ÉB, 8 EC, 8 ÉI, 8 KZ, 8 MÉ, 8 MH, 8 ML, 8 OH, 8 PA, 8 SSU, 8 WV, 0 AA, 0 AG, 0 BA, 0 BQ, 0 FL, 0 GX, 0 KX, 0 MR, 0 NY, 0 PB, 0 SA, 0 US, 0 WR, 0 XO, 0 XP, 0 XW, 0 YS, 0 ZN, PCII, PCRR, PCTT, XY, 1 XAR. (o—v—o) P. White.)

West Norwood, S.E.27 (since February 1st).
British: **2 AAD, 2 ABZ, 2 AGT, 2 AIP, 2 AIU, 2 AIX, 2 AMF, 2 AP, 2 CA, 2 DS, 2 FM, 2 KG, 2 MM, 2 MP, 2 PC, 2 QJ, 2 VQ, 2 VY, 2 XG, 5 FD, 5 GA, 5 HN, 5 ID, 5 QX, 5 RW, 5 WM, 5 YI, 6 CV, 6 DA, 6 GT, 6 UD, 6 VP, 6 VR, 6 XG, 6 XX.** French: **8 AE 4, 8 AH, 8 AP, 8 BO, 8 BP, 8 CK, 8EI, 8 EM, 8 FF, 8 LY, 8 MH, 8 OH, 8 RS, 8 SSU, 8 ZA.** Dutch: **0 FN, 0 MR, 0 PB, 0 ST, 0 ZN, 0 ZZ, PCRR, 12,BC.** Luxemburg: **0 AA, 1 JW.** Italy: **ACD, 1 MT.** Denmark: **7 EC, 7 ZM, 7 QF.** Belgium: **P 2.** Switzerland: **XY.** Unknown: **GG, 4 ZZ.** American: **1 ABF, 1 AGH, 1 AJA, 1 AJP, 1 AKL, 1 ALJ, 1 AM, 1 BBO, 1 BCF, 1 BDI, 1 BES, 1 BSD, 1 BTR, 1 CAK, 1 CCX, 1 CMP, 1 DQ, 1 IBF, 1 JV, 1 RD, 1 RGB, 1 RW, 1 X4H, 1 XAK, 1 XAM, 1 XAR, 1 XAT, 1 XJ, 1 XM, 1 XR, 1 XW, 1 XWW, 2 AGB, 2 AWF, 2 AWL, 2 BQH, 2 BT, 2 BY, 2 CDU, 2 CLA, 2 FS, 2 RM, 2 TS, 3 AA, 3 AU, 3 BG, 3 BJY, 3 BV, 3 COJ, 3 EH, 3 MB, 3 OT, 3 PX, 3 PZ, 3 SRY, 3 VW, 3 YO, 4 BY, 4 BZ, 4 EQ, 4 HN, 4 HS, 4 IO, 4 JE, 4 OG, 4 LO, 4 XE, 8 AMR, 8 DKB, 8 QM, 8 SL, 9 BD, 9 XW.** (1 valve.)
Canadian: **1 AF, 1 BQ, 1 DD, 2 BG, 2 BN, 9 BL.**
(L. H. Thomas, **6 QB.**)

Ashford, Middlesex ("Dunavon," Chesterfield Road).
British: **2 ACU, 2 AU, 2 AAD, 2 ACD, 2 AGT, 2 CW, 2 LH, 2 OJ, 2 SL, 2 WY, 5 AT, 5 OA, 5 OP, 6 EN, 6 JX, 2 YT (R 10),** (calling R.M.S. "Cedric"). French: **8 AE, 8 AE 1, 8 AE 2, 8 AU, 8 AML, 8 BP, 8 CC, 8 CH, 8 DU, 8 ÉB, 8 ÉD, 8 ÉM, 8 ÉI, 8 OH, 8 ZZ.** Dutch: **0 AB, 0 AG, 0 BA, 0 BS, 0 FL, 0 KX, 0 PO, PCII, PCUU, PCTT, PCGG, 0 WS, 0 WX, 0 XC.** Italian: **ACD.** Swiss: **XY.** American: **1 AUK, 1 BW, 1 BCF, 1 CMP, 3 VW, 1 XB, 1 XM, 1 XAQ, 1 XW, 1 XAR, 1 XAK, 1 XJ, 4 XE.** Canadian: **1 AR, 1 BQ.** (Geo. Rogers.)

Chelsea, S.W.3 (since December).
2 AC, 2 ACU, 2 AP, 2 AIB, 2 AIU, 2 AJA, 2 BR, 2 ET, 2 EK, 2 JP 2 KC, 2 MN, 2 OZ 2 PC, 2 QR, 2 QL, 2 RB, 2 RH, 2 SG, 2 SP, 2 VF, 2 VN, 2 VQ, 2 WY, 2 XY, 2 ZE, 2 ZU, 5 AW, 5 BT, 5 BN, 5 CC, 5 CS, 5 CZ, 5 IZ, 5 OL, 5 OT, 5 PD, 5 QV, 5 RQ, 5 SI, 5 UL, 5 US, 5 VX, 5 WM, 6 AT, 6 BW, 6 CV, 6 DW, 6 EA, 6 FG, 6 GO, 6 GT, 6 IV, 6 NS, 6 PS, 6 QB, 6 QZ, 6 RH, 6 RJ, 6 TG, 6 TS, 6 UC, 6 UD, 6 VP, 6 VR, 6 XX, 6 ZZ. French: **8 AÉ, 8 AM, 8 AU, 8 AZ, 8 ARA, 8 BÉ, 8 BO, 8 BQ, 8 BP, 8 BS, 8 BW, 8 CM, 8 CQ, 8 CT, 8 DY, 8 DU, 8 ÉB, 8 ÉI, 8 ÉM, 8 FF, 8 JL, 8 LY, 8 MH, 8 OF, 8 OH, 8 RD, 8 RJ, 8 RS, 8 RE 2, 8 SS, 8 SSU, 8 YY, P 2.** Dutch: **0 AB, 0 AAL, 0 BA, 0 GN, 0 KX, 0 MR, 0 XO, 0 PB, 0 RB, 0 TX, 0 XQ, 0 XY, 0 XW, 0 YF 0 ZZ, PA 9, PAR 14.** Italian: **1 MT, ACD.** Others: **1 LD, 4 LZ, 4 ZZ, 9 ZF, NKF.** American: **1 AL, 2 AT, 3 AB, 1 AJA, 1 ALB, 1 AUR, 1 AWR, 2 AGB, 1 BEP, 2 BQH, 1 BCG, 2 BLH, 2 BQR, 2 CE, 1 CMP, 2 CXL, 2 CGB, 2 COA, 2 CNB, 2 LB, 4 LP, 1 RB, 1 RV, 2 XUL, 1 XAM, 1 XAR. 1 XW, 7 XQ.** (o—v—o.) (F. Walker.)

West Norwood, S.E.27.
British: **2 AAD, 2 ABZ, 2 AFQ, 2 AGT, 2 AIU, 2 AIX, 2 AMF, 2 AP, 2 AW, 2 DC, 2 CA, 2 ET, 2 FM, 2 IT, 2 JP, 2 MC, 2 QC, 2 TB, 2 WA, 2 YW, 2 ZC, 2 ZU, 5 AT, 5 AW, 5 EX, 5 GF, 5 ID, 5 GX, 5 HN, 5 RQ, 5 TR, 5 UA, 5 MQ, 5 QM, 6 DA, 6 KI, 6 UD, 6 VP, 6 VR, 6 XG, 6 ZX.** French: **8 AB, 8 AE3, 8 AU, 8 AZ, 8 BP, 8 CZ, 8 DA, 8 DP, 8 DU, 8 EI, 8 EM, 8 FB, 8 FI, 8 JL, 8 LY, 8 MH, 8 OH, 8 SS.** Dutch: **0 AA, 0 AG, 0 BQ, 0 FN, 0 DA, 0 US, PA 9, PCTT.** Italian: **XY.** American: **1 AUR, 1 AGB, 1 BCF, 1 BDI, 1 CCX, 1 CAK, 1 CMP, 1 IBQ, 1 KC, 1 XAH, 1 XAK, 1 XAR, 1 XJ, 1 XW, 2 AWF, 2 BT, 2 BY, 2 CEE, 2 TS, 3 AMM(?), 3 OT, 3 YO, 3 MB, 4 BY, 4 BZ, 4 HN, 4 IO, 4 XC, 5 ZA(?), 8 XBH, NKF.** Canadian: **1 BQ, 9 BL, 9 XW.** (o—v—o.)
(L. F. Aldous.)

Broadcasting.

TIMES OF EUROPEAN TRANSMISSIONS (B.S.T.)

GREAT BRITAIN.

ABERDEEN 2 BD, 495 metres: **BIRMINGHAM 5 IT,** 475 metres; **GLASGOW 5 SC,** 420 metres; **NEWCASTLE 2 NO,** 400 metres; **BOURNEMOUTH 6 BM,** 385 metres; **MANCHESTER 2 ZY,** 375 metres; **LONDON 2 LO,** 365 metres; **CARDIFF 5 WA,** 353 metres; **PLYMOUTH 5 PY** (Relay), 330 metres; **SHEFFIELD** (Relay), 303 metres. Tuesdays, Thursdays and Fridays, 1 p.m. to 2 p.m. (**2 LO** only). Regular daily programmes, 3.30 to 4.30 p.m., 5 to 10.30 p.m. Sundays, 3 to 5 p.m., 8.30 to 10.30 p.m.

FRANCE.

PARIS (Eiffel Tower), FL, 2,600 metres. 7.40 a.m., Weather Forecasts; 11.0 a.m. (Sunday), 11.15 to 11.30 (Weekdays), Time Signal and Weather Forecast; 12.0 noon, Market Report; 3.40 p.m., Financial Reports; 5.30 p.m., Bourse Closing Prices; 6.15 p.m., Concert; 7.20 p.m., Weather Report; 9.0 p.m. (Wednesday and Sunday), concert; 10.10 p.m., Weather Forecast.

PARIS (Compagnie Francaise de Radiophone Emissions "Radiola"), SFR, 1,780 metres. 12.30 p.m., Cotton Prices, News; 12.45 p.m., Concert; 1.45 p.m., Exchange Prices; 4.30 p.m., Financial Report; 8.30 p.m., News and Concert.

ECOLE SUPERIEURE des Postes et Telegraphes, 450 metres. 9 p.m. (Sunday, Wednesday, Thursday, Friday and Saturday), Talk on Literature, Dramatic and Musical Selections. 8.15 p.m. to 9.25 p.m. (Tuesday), Morse Practice, English Lesson, Lecture and Concert

PARIS (Station Du Petit Parisien), 340 metres. 6.30 to 7.30 p.m., Tests.

BELGIUM.

BRUSSELS, BAV, 1,100 metres. At 2 p.m. and 6.50 p.m., Meteorological Forecast.

BRUSSELS ("Radio Electrique"), 410 metres. Daily, 6 p.m. and 9.30 p.m., Concert.

HOLLAND.

THE HAGUE, PCGG, 1,070 metres. 4 to 6 p.m. (Sunday), 9.40 to 11.40 p.m. (Monday and Thursday), Concerts.

THE HAGUE (Heussen Laboratory), PCUU, 1,050 metres. 10.40 to 11.40 a.m. (Sunday), Concert; 9.40 to 10.40 p.m., Concert; 8.45 to 9 p.m. (Thursday), Concert.

THE HAGUE (Velthuisen), PCKK, 1,050 metres, 9.40 to 10.40 p.m. (Friday), Concert.

HILVERSUM, 1,050 metres. 9.10 to 11.10 (Sunday), Concert and News.

IJMUIDEN (Middelraad), PCMM, 1,050 metres. Saturday 9.10 to 10.40 p.m., Concert.

AMSTERDAM, PA 5, 1,050 metres (Irregular), 8.40 to 10.10 p.m., Concert.

AMSTERDAM (Vas Diaz), PCFF, 2,000 metres, 9 a.m. and 5 p.m., Share Market Report, Exchange Rates and News.

DENMARK.

LYNGBY, OXE, 2,400 metres. 8.30 to 9.45 p.m., Concert (Sunday excepted).

SWEDEN.

STOCKHOLM (Telegraverts), 450 metres. Monday, Wednesday, Saturday, 7 to 8 p.m.

STOCKHOLM (Svenska Radiobeglets), 440 to 470 metres. Tuesday, Thursday and Sunday, 8 to 9 p.m.

GOTHENBURG (Nya Varvet), 700 metres. Wednesday, 7 to 8 p.m.

GERMANY.

BERLIN (Koenigswusterhausen), LP, 2,700 metres (Sunday), 11.50 a.m. to 12.50 a.m., Orchestral Concert. 4,000 metres, 7 to 8 a.m., Music and Speech; 12.30 to 1.30 p.m., Music and Speech; 5.0 to 5.30 p.m., News.

EBERSWALDE, 2,930 metres. Daily, 1 to 2 p.m., Address and Concert; 6 to 7.30 p.m., Address and Concert; Thursday and Saturday, 7.20 p.m., Concert.

BERLIN (Vox Haus), 400 metres. 11 a.m., Stock Exchange; 1.55 p.m., Time Signals; 5.40 to 7.0 p.m., Concert; 7.0 to 8.0 (Sunday), Concert.

BERLIN (Telefunken), 425 metres. 7.30 to 8 p.m. and 8.45 to 9.30 p.m., Tests and Concert.

FRANKFURT AM MAIN, 440 metres. 7.30 to 10 p.m. Tests. Gramophone records.

CZECHO-SLOVAKIA.

PRAGUE, PRG, 1,800 metres. 8 a.m., 12 a.m. and 4 p.m., Meteorological Bulletin and News; 4,500 metres, 10 a.m., 3 p.m., and 10 p.m., Concert.

KBELY (near Prague), 1,150 metres. 7.15 p.m. and 10.0 p.m. Concert and News.

SWITZERLAND.

GENEVA, 1,100 metres (Weekdays). At 3.15 and 8 p.m. Concert or Lecture.

LAUSANNE, HB 2, 780 metres. Daily, 9.15 p.m., Concert and Address.

SPAIN.

MADRID, PTT, 400 to 700 metres. 5 to 6 p.m., Tests.

ITALY.

ROME, ICD, 3,200 metres. Weekdays, 12 a.m. 1,800 metres. 4 p.m. and 8.30 p.m., Tests, Gramophone Records.